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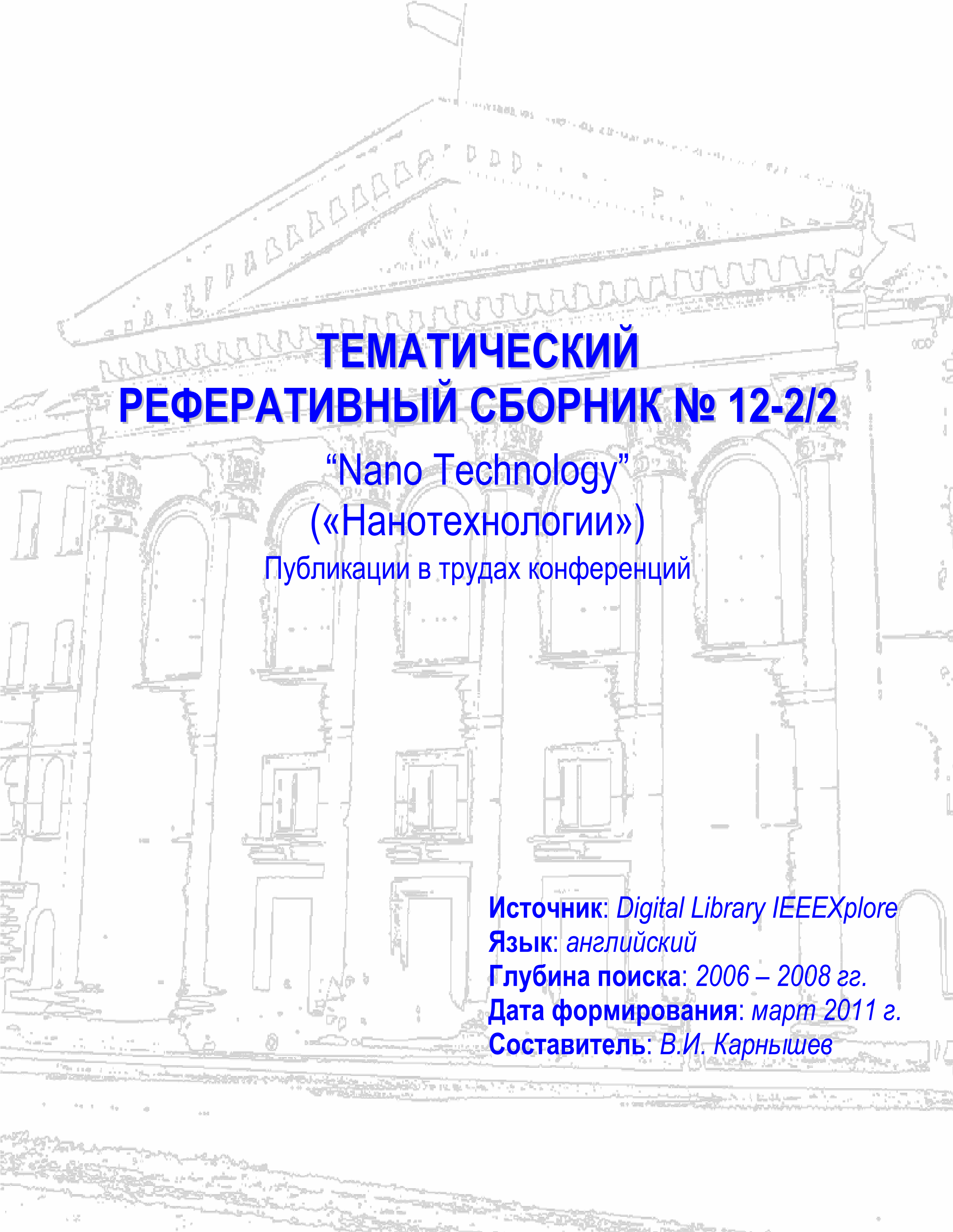

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"Focused Ion Beam Fabrication of Sub-20nm Inter-Electrode Gaps for Room Temperature Operating Single Electron Transistor"

Fabricating nanoelectrodes with a few nanometer inter-electrode gap laterally is a challenge with existing technologies. In this work, we present a simple method to fabricate electrode pairs with a sub-20 nm inter-electrode gaps using Focused Ion Beam (FIB) etching technology. Unlike previously reported methods, no internal or external modification in the Focused Ion Beam system is needed in this technique. An inter-electrode gap of 17 nm in a Cr electrode pair is successfully fabricated by optimizing the thickness of the Cr film. This fabrication technique is further applied to realize the source drain and gate electrodes with a targeted inter-electrode gap of 20 nm, for room temperature operating Single Electron Transistors. [C1021]

"Self-Cleaning Fibers via Nanotechnology-A Virtual Reality"

With the fast-growing demand toward innovative functional and intelligent fibrous materials, the self-cleaning functionalization treatment of fibers via nanotechnology has attracted tremendous technological attention over the past four years. This contribution provides a review of the latest developments of contemporary technologies. [C1022]

"Medical Radiograph of Nano-Magnetic Fluid Used by Spring-8 Synchrotron Radiation X-Ray"

Nano drug delivery system (nano-DDS) is a new medical technology. We studied medical use used by about 7 [nm] ferromagnetic fluids. We searched good energy condition of ferrofluid contrast medium radiograph image used by SPring-8 synchrotron radiation X-ray. As results, in case of low photon energy 15.0 [KeV] (lambda = 0.8 Aring). We showed ferrofluid in Acryl amid gel and taro leaf and mugwort. #1. We found Low photon energy could show vascular tissue and ferrofluid distribution respectively. In case of medium photon energy 20.0 [KeV] (lambda = 0.6 Aring). We observed ferrofluid in rat ear lobe and rat stomach and rat foot. #2. We found medium photon energy could see several organizations by changing exposure. In case of high photon energy 25.0 [KeV] (lambda = 0.5 Aring). We showed ferrofluid in chicken egg and pork. #3. We found high proton energy was suitable for observing ferrofluid distribution in plain organization, but was not suitable for observing ferrofluid distribution in complicate organization. [C1023]

"Nanoscale analysis of ultrasonic wedge bond interface by using high-resolution transmission electron microscopy"

In this paper, the bond interface of Al-1 wt.%Si wire bonded on Au/Ni/Cu pad at atmosphere temperature was analyzed by using high resolution transmission electron microscopy. Nano-scale characteristics at bond interface indicated that elemental aluminum diffusing into gold layer was with the feature of step-level periodicity. Due to exceeding solid solubility limit, intermediate Au8Al3phase penetrated among the Al-Au solid solutions. The diffusion distance was not more than 100 nm analyzed by energy X-ray dispersive spectrum. This process controlled by solid diffusion reaction was realized by the rapid and periodic ultrasonic vibration according to the theoretical calculation based on the Fickpsilas Law and the observation of the deformation twins among the bond wire and within the interfacial diffusion layer. [C1024]

"The effects of Ni nanoparticles addition on shear behavior and microstructure of Sn-Ag Lead-free solder"

In this article, the effects of Ni nanoparticles addition on shear property and microstructure of Sn-3.5Ag Lead-free solder joint was studied. The nickel nano-composite Sn-3.5Ag solder was prepared by adding dispersant to the dry nanoparticles and mechanically stirred Ni nanoparticles into the Sn-3.5Ag Lead-free solder paste. The shear force of the Sn-3.5Ag solder, 0.5 and 1.0 wt% nickel nano-composite solder was tested respectively at reflow 120s and 240s. The result shows that adding nickel nanoparticles can improve the shear performance of the soldered joint; the shear force of the soldered joint is highest when adding 0.5 wt% Ni nanoparticles at reflow 240s. The SEM observations shows that the hexagonal Cu6Sn5IMC (intermetallic compound) in the inside solder is disappears gradually and the morphsa of the IMC that on the interface of the solder joint becomes planar after adding Ni nanoparticles into solder. [C1025]

"Design Methodology for Electron-Trap Memory Cells"

In order to further reduce the feature size of semiconductor devices, the field of single-electronics has come of age. Single electron tunneling (SET) technology uses a single or few electrons to implement various analog and digital applications. Memory design is such a typical example. In this paper, we present a design methodology by discussing the parameter selection and reliability analysis for SET-based electron-trap memory cells. It is shown that the parameter selection is important for correct logic operation of these memory cells as well as their reliability improvement. All the results are verified by the SIMON simulator. [C1026]

"Heating Effects in Dual-Gate Devices"

Heating effects are investigated in dual-gate devices using an in-house thermal particle-based device simulator. Our simulation results demonstrate that the dual-gate structure is advantageous even though there is slightly higher current degradation due to lattice heating compared to conventional single gate structures, since the magnitude of the on-current is 1.5-1.8 times larger in this structure. Thus, one can trade off a slight increase in current degradation due to lattice heating for more current drive. [C1027]

"A Novel Three Dimensional Field Effect Transistor Based on Single-Walled Carbon Nanotubes"

We present the design, fabrication and testing of a novel three dimensional (3D) Field Effect Transistor based on Single-Walled Carbon Nanotubes (SWNTs). Three Dimensional SWNT transistors are realized utilizing low temperature Dielectrophoretic (DEP) assembly. A 1mum thick conformal Parylene-C (poly-para-xylylene) layer is utilized as the gate dielectric with a non-local top gate electrode around the conducting channel. The preliminary results from 3D Carbon NanoTube Field Effect Transistors (CNTFET) display ambipolar behavior with more prominent p-type than n-type behavior. The transistor exhibits an on-to-off current ratio of ~3 x 104, a maximum transconductance of 0.061 mus, and a mobility of 85- 277 cm2/Vs. This 3D-CNTFET technology can be utilized to realize multi layer, compact and high density nanotube transistors for large scale nanoelectronic circuits. [C1028]

"A multi-scale interfacial delamination model of Cu-SAM-epoxy systems"

Interfacial delamination, due to the presence of dissimilar material systems, is one of the primary concerns in electronic package design. The mismatch in coefficient of thermal expansion between the different layers in the packages can generate high interfacial stresses due to thermal loading during fabrication and assembly. More and more functional materials at the nano scale are, such as self-assembly monolayer (SAM) and CNT, used in electronic packaging for the improvement of the interfacial performance, traditional continuum model without considering these nano materials are obviously not suitable to study performance of electronic packages. In this study, a multi-scale model was built to investigate interfacial failure between EMC and SAM coated copper substrate. The interfacial material behavior was derived from the molecular dynamics simulation. The constitutive relation for the EMC-SAM-Cu interface under tensile load was derived from MD simulation. Tapered double cantilever beam tests (TDCB) were conducted on the laminated specimens to quantify the load during delamination propagation along the EMC-Cu interface with SAM and without SAM. Finite element models of the DCB test were built using ANSYS with interfacial element at the Cu-EMC interface. The constitutive relations from MD simulations in the form of a traction-displacement plot were introduced into the cohesive zone model to study the constitutive response of the EMC-Cu interface under the tensile loading, which is traversed across the length scale from nanoscale to macroscale. and assigned to the continuum model. The critical loading forces for the EMC/Cu interface with SAM and without SAM were obtained from the multi-scale model. It was found that interfacial strength between EMC and Cu substrate could be improved by SAM. Based on the proposed method, the predicted results were found to be comparable with those from experimental measurement. [C1029]

"A novel high write speed, low power, read-SNM-free 6T SRAM cell"

In the nano-scaled technologies, increasing sub-threshold leakage, dynamic power and degrading SNM pose major hurdle for future generation circuits, especially in SRAM arrays. In this paper, a novel high write speed, low power, read-SNM-free 6T SRAM cell is presented. Simulation using 128 times 16 SRAM array in 90 nm CMOS technology shows that the cell can achieve 64% faster write operation than the conventional cell. Experimental results show that the write and read energy of the proposed cell are 76.8% and 53% lesser than the conventional cell respectively. Write precharge energy for the proposed cell is almost 81% less than that of conventional cell. During read operation, the proposed cell does not induce any noise at data nodes (dasiaQpsila & dasiaQbarpsila) which makes it a read-SNM-free design. [C1030]

"Fault tolerant adaptive filters based on the Walsh-Hadamard transform"

Previously it has been shown that an FFT-based transform domain adaptive filter (FTAF) operating on real-valued signals can achieve a remarkable degree of fault tolerant performance based on parameter redundancy inherent in the complex arithmetic. In this paper the use of the Walsh-Hadamard transform is considered as a computationally efficient way of achieving fault tolerance. Although the WHT does not provide full fault tolerance it does provide a large degree of fault coverage that may be useful for adaptive filters implemented in highly scaled nano-technology circuits where soft (transient) errors and hard (permanent) faults are of increasing concern. [C1031]

"Plasmonic nano cavity using the cut off property in the metal-insulator-metal waveguide"

We present a novel plasmonic nano cavity formed by two metal-insulator-metal waveguides with different core indices, which utilizes the cut off property of the symmetric mode. [C1032]

"Optical signal processing in silicon nano-waveguides"

All-optical tunable delay, dense wavelength conversion, and non return-to-zero (NRZ) to alternate-mark-inversion (AMI) format conversion are experimentally demonstrated using silicon microrings with a 450 times 250 nm cross-section size. [C1033]

"Reduction of non-orthogonality effect in nanometrology system by modified optics and signal conditioner"

Misalignment and deviation angle in the optical interferometer directly decrease the accuracy of nanometrology system by producing a periodic nonlinearity error. In this paper, the effect of non-orthogonally polarized beams on the displacement measurement error in the advanced nanometrology system is presented. A system for reduction of non-orthogonality effect including linear polarizer, half-wave plate and modified signal conditioner, based on the nonlinearity compensation in a two-mode laser interferometer, is also proposed. The simulations results confirm that the peak error in the nano-displacement measurement is considerably decreased from 0.89 nm to 15 pm by using the modified optics and signal conditioner. [C1034]

"Quantum-Dot Cellular ROM: A nano-scale level approach to digital data storage"

In todaypsilas world of digital communication, high capacity high performance digital data storage is an ultimate solution to preserve sheer volume of data. Nanotechnology emerges to bring new digital media with high capacity and high performance, where digital data is stored at nano-scale. In this paper a quantum dot cellular automata ROM (QDCROM) has been designed and simulated. This ROM has a very simple structure but great specifications enabling us to store 2.5 GBits of digital data per cm2. [C1035]

"Timing implications of fill metal generation methods for system-level nano-scale designs"

In this paper, we investigate the timing implications of dummy fill for large-scale designs implemented in 65 nm process technology. For each design, we employ each of rule-based and model-based metal fill generation techniques and model the incremental path-wise delay increases and the level of interconnect planarization due to the fill metal. The results indicate that fill metal can cause significant increases in the average delay and in the individual path delays. We also find that model-based fill generation methods can provide significantly better incremental delay increases and interconnect planarization than rule-based methods. This study provides the first comprehensive investigation of the delay and interconnect planarization implications of rule-based as well as model-based fill generation for large-scale designs implemented in nano-scale process technology. [C1036]

"Sun glasses for buildings based on micro mirror arrays: Technology, control by networked sensors and scaling potential"

We present different applications of systems including networked sensors and micro- and nano-mirror arrays on large areas for light deflection and control. Mirror arrays are intended for implementation into windows of buildings to provide functionalities like daylight guiding into rooms, heat regulation and glare protection. Placed between the two panes of a window, these mirrors are maintenance-free and not subject to defilement. The use of micro system technology on large areas requires very low-cost processes and materials, as well as a concept with a minimum of process steps and very easy and reliable process control. We present our technological approaches and first technological results. Further applications such as artificial light guiding and light concentration for photovoltaic applications are proposed. [C1037]

"Nano-thermal interface material with CNT nano-particles for heat dissipation application"

Heat dissipation of electronic packages has become one of the limiting factors to miniaturization. The removal of the heat generated is a critical issue in electronic packaging. With the development of thermal management, thermal interface material (TIM) plays a more and more important role in electronics packaging. A new nano-TIM with nanofibers prepared by using electrospinning has been suggested in recent years. In this experiment study, the carbon nanotube (CNT) nano-particles were added into the polymer solution before the electrospinning to improve the thermal conductivity of nano-TIM. The polymer solution of polyurethane was used for present electrospinning. The effects of a number of process parameters in the electrospinning were studied in this work. Different variables such as the distance between needle tip and collector, the voltage applied, and CNT nano-particles content were studied. The scanning electron microscopy (SEM) was used to characterize nano-TIMs with CNT nano-particles. [C1038]

"The role of the molecular simulation approach for IC-backend developments"

Since recent years, the micro-electronic industry changes the material usage, design and structure, in order to satisfy the customer demands of the higher performance and smaller size. One of the examples is the change of the basic materials from Al/SiO2to Cu/low-k in IC interconnect structure. As a consequence, new reliability issues at device/product level have been discovered, and most of the failure modes have the characteristics of multi-scale: the failure of the um or nm induces the malfunction of the device/product. The conventional approach of the failure prediction can be achieved by the well-developed continuum scale theory, e.g., finite element method. Moreover, the nano-meter scaled simulation is demanded in order to link the macro physics to the micro scale. This paper will demonstrate the capability of the molecular simulation of predicting the nano-scaled stiffness and atomic scale failure. [C1039]

"Manufacture, microstructure and microhardness analysis of Sn-Bi lead-free solder reinforced with Sn-Ag-Cu nano-particles"

This paper investigates a composite solders obtained by adding Sn-3.0Ag-0.5Cu (SAC) nano-particles into conventional eutectic Sn-58Bi solder paste. The microstructure analysis and the measurement of the Vickers microhardness have been carried out. Utilizing the self-developed consumable-electrode direct current arc (CDCA) technique, the Sn-3.0Ag-0.5Cu nano-particles with an average particle size between 20 and 80 nm are prepared. The reinforced lead-free Sn-Bi solder was prepared by thoroughly blending the nanometer-sized SAC particles into the eutectic Sn-Bi solder paste. The SAC reinforced Sn-Bi composite solder paste was printed onto ENIG/Cu metalized substrate and reflowed in a conventional reflow oven. After reflow, the morphology of the as-solidified reinforced composite solder was observed by means of SEM and TEM. The Vickers microhardness measurements indicated that the addition of SAC nano-particles enhances the overall strength of the eutectic solder, and the results agree well with the theory of dispersion strengthening. [C1040]

"A comparison study of two different methods to synthesize magnetic slurry for the fabrication of magnetic films"

A new spiral thin-film inductor structure is designed, in which the insulating magnetic thin film takes the places of both the insulating layer and the magnetic layer in the traditional structure. For the fabrication of the insulating magnetic film, a magnetic slurry which is a soft magnetic composite composed of organic polymer and nano Fe3O4particles was synthesized. The magnetic slurry was synthesized by chemical co-precipitation method and microemulsions, respectively. Fe3O4particles with a grain size of 20 nm tends to agglomerate and is constrained by the network of silicon gel in the first slurry prepared via co-precipitation. While in the microemulsions, water-soluble organic material disperses the nanoFe3O4whose size lays in the range of 6-15 nm. The two kinds of magnetic slurries have different magnetic susceptibilities, which is 110 cm3/mol, and 344 cm3/mol, respectively. The surface of the film fabricated with the microemulsions slurry is smooth. In contrast, there are a lot of flaws for the film derived from the co-precipitated slurry. Therefore, the microemulsions method is more suitable to synthesize magnetic slurry for the fabrication of magnetic film. [C1041]

"Ultrahigh sensitivity slot-waveguide biosensor on a highly integrated chip for simultaneous diagnosis of multiple diseases"

SABIO is a multidisciplinary project involving the emerging fields of micro-nano technology, photonics, fluidics and bio-chemistry, targeting a contribution to the development of intelligent diagnostic equipment through the demonstration of a compact polymer based and silicon-based CMOS-compatible micro-nano system. It integrates optical biosensors for label-free biomolecular recognition based on a novel photonic structure named slot-waveguide with immobilised biomolecular receptors on its surface. The slot-waveguides provide high optical intensity in a subwavelength-size low refractive index region (slot-region) sandwiched between two high refractive index strips (rails) [Almeida, V., et al., 2004] leading to an enhanced interaction between the optical probe and biomolecular complexes (antibody-antigen). As such a biosensor is predicted to exhibit a surface concentration detection-limit lower than 1 pg/mm2, state-of-the-art in label-free integrated optical biosensors, as well as the possibility of multiplexed assay, which, together with reduced reaction volumes, leads to the ability to perform rapid multi-analyte sensing and comprehensive tests. This offers the further advantageous possibility of assaying several parameters simultaneously and consequently, statistical analysis of these results can potentially increase the reliability and reduce the measurement uncertainty of a diagnostic over single-parameter assays. In addition, the SABIO micro-nano system device applied to its novel protein-based diagnostic technology has the potential to be fast and easy to use, making routine screening or monitoring of diseases more cost-effective. [C1042]

"Nano pattering by double expose hologram lithography and ZnO nanoscale photonic crystal"

We present spot and mesh patterns formed with same photo-resist by using ultra-violet laser holographic lithography. The ZnO nano crystal was deposited on patterned Si substrate by hydrothermal method. [C1043]

"Advances in quantum dots and 2D/3D photonic crystal nanocavity based on micro-machining technology"

We discuss recent advances in quantum dots for nanophotonics and quantum information devices, including high-performance quantum dot lasers and single photon emitters. Moreover, controlled light emission from quantum dots embedded in 2D/3D photonic crystal nanocavity is demonstrated. [C1044]

"A novel etching-oxidation fabrication method for 3D nano structures on silicon and its application to SOI symmetric waveguide and 3D taper spot size converter"

A novel etching and oxidation method utilizing space effect of dry etching for three dimensional silicon structure is presented. Testing devices of SOI symmetric waveguide with ultra thick SiO2cladding and silicon waveguide structure integrated with 3D taper spot size converter are fabricated using this method. [C1045]

"A management concept of competencies improvement for students with prior vocational, advanced education, and work experience in technical fields"

To overcome a severe shortage of university graduates working in the German industry, the universities plan to tap into the reservoir of skilled vocational workers for recruiting them as students. To shorten the time required for finishing an academic degree, but also as an incentive, the candidates shall receive credit for matching vocational knowledge. One of the preconditions for establishing such a new access route is to implement clear criteria for acknowledging vocational talents. This paper presents the approach taken by the Leibniz Universitaet Hannoverpsilas Institute for Microtechnology (IMT) for accrediting vocational knowledge in the areas of Micro and Nano Technology (MNT) and Mechatronics and compares it to alternatives pursued taken by Information Technologies as well as Health and Life Sciences and Economics. The approach taken by the IMT uses the system of Moon, comparing vocational knowledge and required learning outcomes on six levels. Information technology plans to apply the European Qualification Framework that depends on external experts for establishing competencies classified into formal, non-formal, and informal ones. The approach taken by Economics is based on the concept of Anderson and Krathwohl following the taxonomy of Bloom. It compares formal competences within a six level system. [C1046]

"Technology diffusion planning for ERP in aircraft manufacturing industry"

The Enterprise resource planning (ERP) and material requirement planning (MRP/ MRP-II) are few of the key considerations in any complex manufacturing industry. The requirement of ERP and MRP for aircraft industry is growing at a phenomenal rate. The advancement in material and manufacturing management systems has changed the dynamics of shop-floor scene. The induction of smart materials and nano-technology, ultra-high speed machining technologies and psychometric testing of highly skilled labor in a target focused team environment has tremendously enhanced the performance expectation from Man, Machine and Resources. The resource-management and supply-chain-management is becoming extremely complex and require dedicated ERP modules for better management and effective control over the industrial and financial activities through integrated business intelligence (BI) software. The implementation of ERP in industry is a cumbersome process and takes years before it yields and reveals its effectiveness. Research in all these areas is making a phenomenal addition to the volume of knowledge in limited time. The concept of competitiveness demands that the integrated framework for ERP adoption be planned for aircraft industry prior to its deployment. So as to minimize its deployment-span in terms of time and to curtail financial overheads. A number of working principles and guidelines have already been developed in other industries and can be employed in a variety of ways in aircraft industry for optimum performance and to earn competitiveness through ERP suites. This paper provides guidelines for planning ERP and detailed mapping of all activities for ERP in aerospace-industry for effective production planning and control. [C1047]

"Engineering the soul of management in the nano era"

A goal-driven engineering process-an engine of invention, innovation, and growth-is described to be the soul of management. As this synergy is implemented and lessons learned in the management training, the outcomes are expected to be higher than the individual aspirations of people comprising an organization. In the nano era, the integration of the artificial (human-initiated engineering) and natural (divine engineering) is shown to be of paramount importance in enhancing productivity and in improving the standard of life. Biomedical engineering, nanotechnology, megacomputing and nano-robots will dominate the future of human race and hence an anticipated need for effective management of emerging technologies and related human resources. In support of the synthesis of management and engineering, outcome-based education (OBE) in the Washington Accord criteria are shown to integrate development of management and entrepreneurial skills as part of the engineering training in desiging a product and marketing it. An algorithm of these deliverable attributes by considering the university as an organization dedicating to enhancing the industrial competitiveness is given. [C1048]

"Effect of annealing temperature on dark current density of silicon nanocrystals embedded in a nitride matrix for photovoltaic application"

The purpose of using high density nano-crystalline silicon embedded in insulator matrices is the energy confinement of Si based quantum dot nanostructures. This approach aims to engineer wide band gap Si materials to be used as upper cell elements in Si based tandem cells in order to increased efficiency and low cost thin film processes. One of the main challenges is to obtain sufficient carrier mobility and hence a reasonably conductivity for photovoltaic application. The results of current density as a function of thermal annealing show the evolution of SiQD formation in Si3N4matrix. As deposited film fabricated by using dual-mode PECVD has composition of ordered Si rich nitride (Si3+xN4) arrays. [C1049]

"Single event upset modeling with nuclear reactions in nanoscale electronics"

In modern nano-scale technologies, circuits are increasingly sensitive to various kinds of perturbations. Soft errors, a concern for space applications in the past, are now a top reliability issue at ground level. Alpha particles and atmospheric neutrons induce single-event upsets (SEU), affecting memory cells, latches, and flip-flops, and single-event transients (SET), initiated in the combinational logic and captured by the latches and flip-flops associated with the outputs of this logic. Realistic treatment of the materials and geometries in the back-end-of-line (BEOL), including metallization layers, is essential for accurate modeling of particle-induced single event effects (SEEs). This paper describes new capabilities of CFDRC NanoTCAD mixed-mode simulator, which include interface and adaptive meshing to allow simulations of single event radiation effects with nuclear reactions and secondary particles computed by MRED (Monte Carlo Radiative Energy Deposition), a Geant4 based tool developed at Vanderbilt University. Neglecting the nuclear interaction processes may results in serious underestimation of the SEU error rate for modern technologies. [C1050]

"Compact modeling and characterization of Nano CMOS technologies"

{no data available} [C1051]

"An effect of TiO2 morphology on performance of ITO/TiO2 /MEH-PPV/Au solar cells"

ITO/TiO2/MEH-PPV/Au solar cells were fabricated using nano-porous titanium dioxide (TiO2) infiltrated with poly(2-methoxy-5-(2'-ethylhexyloxy)-p-phenylene vinylene) (MEH-PPV). The TiO2films were prepared using poly(ethylene glycol) (PEG) having different molecular weights and spin coated onto indium tin oxide (ITO) coated glass substrates. Transmission electron microscopy (TEM) showed that the dip-coated TiO2films had uniform thickness of around 70 nm. Surface morphologies of the TiO2films were investigated using scanning electron microscopy (SEM). It was found that the low molecular weight PEG resulted in small pits in the TiO2film and increase contact area between TiO2and MEH-PPV improving the device efficiency of this solar cell. [C1052]

"Computational design of FIB-milled nanostructures for use in biosensing"

This research describes theoretical and experimental evaluations of electromagnetic fields around ordered arrangements of gold and silver nano-pillars. Finite difference time domain method is employed in simulating the periodic arrangements of nano-pillars having different geometries. Metallic nanostructures are developed using the focused ion beam (FIB) milling process. These structures are also fabricated on gold-coated tips of four mode and multimode silica optical fibers. Enhancements in surface enhanced Raman scattering signals are monitored in the experimental evaluation of nanopillars. These FIB-milled nanostructures show practical use for biosensing applications. [C1053]

"Statistical modeling of via redundancy effects on interconnect reliability"

Electromigration is an important failure mechanism in the nano-interconnects of modern IC technology. Various approaches have been investigated to prolong the lifetime of an interconnect. One such approach is to have an in-built redundancy in the via structures of the interconnect. The presence of redundant via in a parallel topology helps improve the overall reliability of the via structure. Although reliability improvement due to via redundancy is qualitatively understood, it is necessary to quantify the improvement in reliability through statistical models so that the improvement in lifetime as a result of redundancy can be quantified. A statistical model that incorporates the effects of redundancy is developed in this study and it is used to estimate the reliability of redundant via structures. The Cumulative Damage Model (CDM) is used in conjunction with the Maximum Likelihood Estimate (MLE) method to assess the reliability of load sharing via redundant structures in this study. [C1054]

"Dynamical approach to manipulation of single atoms/molecules at material surface"

Nano-technology is a bottom-up technology and shows the possibility of spatial arrangement of atoms and molecules by using sensing probes, for example, SEM, AFM, and so on. The demonstrative experiments have been reported since 1990s. In this paper, we will discuss a model of single particles manipulation from material surface. The model is based on a van der Waals molecule vibrational predissociation of T-shaped model. The probability of the manipulation is also considered with relation to chaotic dynamics. The theoretical discussion is confirmed by numerical simulation. Through the results, the method for manipulation of nano-particles is discussed. [C1055]

"Near-field Scanning Optical Microscopy-Breaking the diffraction limit using nano light emitting probe tip"

We describe optical and topographic imaging using a light emitting diode (LED) monolithically integrated on a silicon probe tip for Near-field Scanning Optical Microscopy (NSOM). The light emission resulted from a silicon dioxide layer buried between a phosphorus-doped N+ silicon layer and a gallium-doped P+ silicon region created locally at the tip by a focused ion beam (FIB). The tip was employed in a standard NSOM excitation setup. The probe successfully measured optical as well as topographic images of a chromium test pattern with imaging resolutions of 400 nm and 50 nm, respectively. The directional resolution dependence of the acquired images directly corresponds to the shape, size and polarity of the light source on the probe tip. To our knowledge, this report is the first successful near-field imaging result directly measured by such tip-embedded light sources. [C1056]

"Transimpedance amplifier for very high sensitivity current detection over 5MHz bandwidth"

The paper presents a transimpedance amplifier made on standard 0.35 mum CMOS technology specifically conceived to measure the impedance of low-conductivity nano-bio devices. The circuit combines a bandwidth of 5 MHz with an extremely low noise of 3 fA/sqrt (Hz) by using an integrator-differentiator scheme. An innovative feedback network continuously discharges the integrator capacitance to ensure an unlimited measuring time irrespective of the do input current up to 20 nA. An highly linear 300 GOmega active resistance, used in the feedback network to extend the lower limit of the bandwidth down to 100 Hz, will be also described. [C1057]

"Numerical simulation of pulsed wire discharge for nano-powder production"

Pulsed wire discharge in embedded-gas is a simple and efficient method for producing nanosize powder of metal, alloy, or metal compound. The powder size and size distribution are strongly related to the deposition energy into the wire load by joule heating. This paper established a numerical model to analyze and predict the behavior of electrical circuits containing pulsed current source and exploding wire load. In the model, the entire process of wire explosion is subdivided into five stages: solid heating, melting, liquid heating, evaporation, and plasma growth. Voltage waveform, current waveform and deposition energy on the wire can be numerically simulated by the model. Based on a number of simulations, an actual exploding wire device for nano-powder production was constructed. The test voltage and current waveforms are in good agreement with the calculated results. [C1058]

"Selective plasma etching of micro and nano polymer-matrix composites"

Summary form only given. Selective etching technology has been developed for selective removal of surface layer of polymer on micro and nano polymer matrix composites, leaving fillings virtually intact. This technology is useful for the coatings and composite industry for quality control of the product or in electronic industry for developing new nano-based sensor devices, and also elseware. The two methods for selective etching were developed, compared and evaluated; selective oxygen plasma etching and laser ablation selective removal. In order to avoid neutral gas heating, plasmas are often created in high frequency discharges. Characteristics of plasmas used in different technologies depend on the nature of the material treated. Many applications require plasma with a high degree of ionization, while some prove better if weakly ionized plasma is used. Modern reactors for cold plasma ashing, for instance, use post-glows for sample treatment rather than plasmas themselves. A modern technique based on application of weakly ionized plasma is selective etching of composite materials. It is based on preferential etching of different composite ingredients. High etching selectivity is obtained due to different probability for oxidation with O atoms for different materials. Many materials are not etched at all-grains of ceramics, glasses and some metals, for instance. Carbon of other fillings including nanowires are etched according to the material binding energy-the etching efficiency increases in the range from diamond, graphite, crystalline and amorphous polymer. Even different types of polymers are etched also at different rates. Similarly, limited selective removal can be achieved on the surface of polymer matrix composite with laser ablation, due to selective interaction of light quanta with material, depending on pulse energy and wavelength selection. [C1059]

"Hand-written character recognition using MEMS motion sensing technology"

In this paper, a micro inertial measurement unit (muIMU) based on micro electro mechanical systems (MEMS) sensors is applied to sense the motion information produced by characters written by human subjects. The muIMU is built to record the three-dimensional accelerations and angular velocities of the motions during hand-writing. (Here we write the characters in a plane, so only two accelerations and one angular velocity are taken from muIMU in processing the data discussed in this paper). Then, we compared the effectiveness of data processing methods such as FFT (fast Fourier transform) and DCT (discrete cosine transform) by showing their corresponding experimental results. Subsequently, we gave an analysis of these two methods, and chose DCT as the preferred data processing method. For character recognition (26 English alphabets and 10 numerical digits), unsupervised network self-organizing map (SOM) is applied to classify the characters and comparatively good results are obtained. Our goal is to show the feasibility of character recognition based on selected sensor motion information, and provide a potential technology for human-gesture recognition based on MEMS motion sensors. [C1060]

"Low temperature deposited nano-structured vanadium oxide thin films for uncooled infrared detectors"

A novel process of room temperature ion beam sputtering deposition of vanadium oxide films and low temperature post annealing for uncooled infrared detectors was proposed in this work. VOxthin films with relatively low square resistance (70 K Omega / square) and large temperature coefficient of resistance (more than 3%/K) at room temperature were fabricated using this low temperature process which was very compatible with the process of uncooled infrared detectors based on micromachined technology. Furthermore, chemical composition and film surface have been characterized using X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM) respectively. The results showed that the main composition of the processed thin films was V2O5and the thin films were in the process of crystallization. [C1061]

"Nano phototubes-A new approach towards electronics"

A new electronic device, the ldquoNovatronrdquo, is presented. The Novatron is a nano-scale triode vacuum tube in which electrons are liberated from the cathode via photo-emission instead of thermo-emission. The new technology enables the production of very high frequency devices approaching terahertz frequencies and opens new venues for integration of electronic elements. [C1062]

"Novel nanowire integration schemes for massively parallel and manufacturable nanoscale electronics and photonics"

In the last decade, the nanotechnology has made significant progress in the synthesis and demonstration of novel devices with semiconductor nanowires. However, interfacing and integrating nanowires in devices and circuits has remained a formidable challenge since they were first envisioned as building blocks of future electronics, photonics and sensing systems. We demonstrated an epitaxial bridging technique for interfacing nanowires that allows individual electrical access to a large number of nanowire devices without recourse to nanoprobes or tedious and expensive serial interfacing procedures. Two opposing electrically isolated semiconductor surfaces are fabricated using coarse optical lithography, along with wet and dry etching. Lateral nanowires are then grown from one surface and epitaxially connected to the other, forming electrically continuous and robust ldquonano-bridgesrdquo. By forming the structure on a silicon-on-insulator (SOI) substrate, electrical isolation is achieved. The nanowire devices fabricated using the bridging interfacing technique exhibit more than two orders of magnitude lower contact resistance and three orders of magnitude lower noise level than any other reported works. We extended our nano-bridging method and demonstrated heterogeneous bridged InP nanowires between Si surfaces. Interesting properties such as space charge limited current and a discernable level of persistent photocurrent were observed. The nano-bridging technique was expanded to fabricate high performance nanowire device on any type of substrates such as amorphous materials or even metals. Based on this new approach, a semiconductor nano-bridge based photodetector was designed and fabricated on a quartz substrate and an impressive bandwidth >30 GHz was measured. These results demonstrate that it is now possible to design and manufacture nanowire based semiconductor devices without using expensive single crystal substrates. Exciting opportunities for novel high per--formance electronics and photonics on ultra-low cost surfaces such as quartz, plastic, FR4, metal etc. are likely to becoming a commercial realty. [C1063]

"Fabrication of the Si2 Sb2 Te5 phase change cell structure for PCRAM by using UV nanoimprint lithography"

Phase-change random access memory (PCRAM) is emerging as one of the most promising non-volatile memories for the next generation media due to its fast write/read speed, wide dynamic range, high degree of cycling endurance, excellent data retention, simple structure, low operating voltage, good compatibility with CMOS technologies, and easy applicability. The PCRAM utilizes a reversible phase change phenomena between crystalline and amorphous states of chalcogenide materials by electrical resistive joule heating. A resistance of the crystalline phase (set) is much lower than that of the amorphous phase (reset).Being able to pattern and etch phase change memory in nanometer scale is essential for low power consuming operation of PCRAM device. In particular, high-density electronic memory, uniform, consistent and smooth sidewall storage unit structure for the electrical properties of memory is essential.UV nanoimprinting lithography (UV-NIL) is a new emerging lithographic technique in which patterns as small as sub-100 nm can be easily replicated onto a resin layer from surface protrusions of a stamp with a potential for high throughput at low cost, and a promising as one of the next generation lithography. This study uses the UV-NIL for patterning the PCRAM device. Si wafers coated with SiO2were used as. substrates. Titanium bottom electrode, TiN contact layer, and Si2Sb2Te5(SST) were deposited by sputtering method. The thicknesses of Titanium, TiN and SST layer is about 100, 40, and 200 nm, respectively. Patterns of UV imprinting resin were formed using UV-NIL on the surface of SST films, and that were etched using SF6/O2plasma in a RoTH&RAU MS-350 reactive ion etching (RIE) etcher. The experimental results show that by using UV-NIL processing uniformly consistent, high-quality edge smooth sidewall structure for PCRAM devices is obtained. The operation behaviors of the fabricated devices were c--haracterized by using electrical measurement system, SST material possesses lower threshold current with a resistance ratio of 65 has been achieved. [C1064]

"Synthesis of nano-sized ZnO structure in ionic liquid"

ZnO nanorods were successfully synthesized by thermal decomposition of Zn (OH)2in the ionic liquid 1-butyl-3-ethylimidazolium tetrafluoroborate. Their structure and morphology were characterized by means of infrared spectroscopy (IR), X-ray powder diffraction (XRD), and transmission electron microscopy (TEM). The TEM results indicate that the diameter of the ZnO nanorods was 10 nm, and the length was 200 nm. The XRD pattern reveals that the ZnO nanorods belong to the hexagonal crystal system. The results show that ionic liquid can not only act as a reaction medium but also modify ZnO nanorods in the reaction. In this paper the growth mechanics of ZnO nano-structure was also preliminary studied. [C1065]

"Design For Manufacturing (DFM) in Nano-CMOS era"

This paper overviews DFM for IC design in nano-CMOS technologies. Process/device issues relevant to the manufacturability of ICs in advanced CMOS technologies will be presented first before an exploration on process/device modeling for DFM is done. The discussion also covers a brief introduction of DFM-aware of design flow and EDA efforts to better handle the design-manufacturing interface in very large scale IC design environment. [C1066]

"Luminous performance of YAG:Ce powder synthesized via self-propagating synthesis process"

White LED offers a useful technology for appropriate utilization of energy, relieving energy crisis and giving green lighting. In this paper, by using Y2O3, Al(NO3)3,Ce(NO3)3.6H2O, EDTA, etc. as raw materials, nano-YAG:Ce powder was obtained by self-propagating synthesis method. Samples were checked by X-ray diffractometer and flexstation II spectrophotometer. The self-propagating synthesis method lowed the calcining temperature and single-phase YAG:Ce powder was obtained at 900degC. The highest emission intensity and excitation intensity of as-calcined YAG:Ce powder reached 800 Mcd. Luminescence intensity of YAG:Ce powder decreased with the increasing of Ce content. Putting the gel in the drying oven can effectively restrain the agglomeration between the particles and thus improved the luminescence property, although the resulting particles became large. [C1067]

"Nano: Quo vadis?"

It is evident that a four-letter prefix of Greek origin "nano" is one of the most frequently used in scientific publications as well as in the mass media in recent years. The present review is purported to show that at nanoscale almost all branches of natural sciences effectively merge and so the natural philosophy is coming back. Moreover, the immense potential of nanotechnology sits exactly in synergetic inter-disciplinary effect. Some examples are provided from semiconductor physics and technology, as well as from biophysics, biochemistry and metallurgy to illustrate the main idea of the present work. [C1068]

"Mechanical properties of in-situ doped polycrystalline 3C-SiC thin films"

3C-SiC thin film is widely used extreme environment, RF and Bio-material in micro/nano electronic mechanical systems (M/NEMS). Mechanical properties of 3C-SiC thin films are required in the designing stage, because it is needed to accurately measuring Youngpsilas Modulus and hardness. The Youngpsilas Modulus and hardness is influenced by N-doping. In this paper, it was showed that the mechanical properties of polycrystalline (poly) 3C-SiC thin film was influenced by N-doping concentration, and 3C-SiC thin filmpsilas mechanical properties according to the N-doping concentration 1%, 3%, 5%, respectively was measured by Nano Indentation. In the case of 1% N-doping concentration, Youngldquos Modulus and Hardness were obtained as 270 GPa and 30 GPa, respectively. When the surface roughness according to N-doping concentrations was investigated by AFM (atomic force microscope), the roughness of 3C-SiC thin film doped by 5% concentration was 15 nm, which is also the best of them. [C1069]

"Computer aided design of polymeric composite materials based on UHMW-PE modified by ultrafine powders and nanofibers"

The aim of the research is developing physical-mechanical and information basis for designing protective and functional polymeric materials and coatings based on ultrahigh molecular weight polyethylene (UHMW-PE) with ultrafine and nano-powders and fibers. The method suggested is bases on combination of structural (multi-scale) analysis of materials by advanced methods of computer mechanics and design of numerical experiments as well. It allows establishing a relationship between macro-characteristics of material and control parameters. For the latter the parameters of material structure and manufacturing technology were taken. Within the state space a surface is constructed which characterize the links. A level line on the surface is responsible for a certain level of the macro-characteristics. When an interval of values of the macro-characteristic is appointed it is associated with a region of corresponding values of the control parameters. Reliability of manufactured composite products is evaluated by allowable deviation of control parameters from nominal values that is governed by shape and size of the area of allowable values of the control parameters. The advantage of the method suggested is determined by explicit account of structural state and multilevel character of heterogeneous material behavior under external loading of different nature. [C1070]

"Synthesis of metal nanopowders by reduction in organic liquids"

Possibilities of the method of obtaining metal powders by means of thermal decomposition (or reduction) of their compounds during heating in a medium of a high-boiling organic liquid were investigated. A distinguishing feature of the approach proposed is the use of benzyl alcohol as the liquid medium, while the initial metal carboxylates with different lengths of the methylene chain were formates, caprylates and stearates. It was demonstrated in the present work that the proposed method can be successfully used to synthesize various metals including nickel, copper, silver, bismuth, and it provides the possibility to obtain the powders either in the micron state or in the submicron (nano-sized) ones. The possibility to synthesize powdered alloys of these metals was also demonstrated. [C1071]

"Locality aware redundancy allocation in nanoelectronic systems"

A high level of redundancy is required to deal with the challenge of high defect and fault rates in nano environments. The reconfigurability of nano devices and the regular structure of nano fabrics make reconfiguration based repair an essential approach for both defect and fault tolerance. Ideally, repair based approaches have the best hardware efficiency when full sharing of redundancy is achievable. However, nanoelectronic systems are subject to strict constraints on localized interconnections, which limit the sharing of redundant resources to within a small neighborhood. To more fully understand this challenge, we provide a model for the issue of redundant resource sharing under locality constraint. Our model captures the redundancy sharing essence of a system, and is applicable to any specific topology or layout of a nanoelectronic system. Based on this model, defect tolerance can be well defined, and can be addressed by existing algorithms. In addition, we provide discussion and algorithms for online fault tolerance for various system models. Overall, this paper provides a new framework and novel solutions to a the problem of reliability in nanoelectronic environments, where locality constraint for redundancy sharing plays an important role in developing defect / fault tolerance schemes. [C1072]

"Using the trajectory analysis for measuring nano-objects by the interference phase-shifting systems"

Therefore, the balance of random and systematic variations of brightness field in interferograms and calibration of phase shifts is required for practical realization of the extreme precision characteristics. Trajectory method of analysing the inteferogams is developed, it allows to avoid the influence of determined destabilizing factors and does not require a priori value of inserted phase shifts. The developed trajectory method of analysing the interferograms has no analog in Russia and abroad and allows to increase the exactness of interferential measurements considerably to lambda/10000 and more. [C1073]

"Titanium CO2 -laser welding"

Results of CO2-laser butt and scarf welding of titanium alloy VT20 plates, 2 mm thick, with use of nano-powdered inoculators and without inoculating agents are presented. Satisfactory mechanical properties of weld joint without powders as well as with use of powdered inoculators are obtained. However, introduction of nano-powders of refractory compounds TiN, Y2O3and their compositions allowed us to improve substantially the weld seam characteristics. [C1074]

"Modulation of Coulomb Blockade Behavior of Room Temperature Operational Single Electron Transistors by Tunnel Junction"

The effect of tunneling oxide thickness on the Coulomb blockade behavior of a room temperature operating multi dot Single Electron Transistors (SET) was investigated. Our room temperature operational SETs, fabricated from focused ion beam deposited tungsten nano-islands, clearly show the modulation of Coulomb Blockade voltage with the change in the tunnel oxide thickness. The Coulomb blockade voltage of the device was increased from 2.0 V to 5.0 V by the reduction of tunnel junction thickness from 9 nm to 3 nm. In the present experiment, a decrease in the thickness of the tunneling oxide resulted in an increase in the conductance and tunnel current of the device by two orders of magnitude. The total capacitance of the SET device was reduced from 0.7 atto F to 0.5 atto F with the reduction in the thickness of the tunnel junction thickness of the SET. The charging energy of the SET device was increased from 110 meV to 146 meV with the reduction of the tunnel junction thickness from 9 nm to 3 nm, the modulation of the Coulomb blockade voltage was achieved with the variation in the tunnel junction thickness of the SET device. [C1075]

"Radiation Hard Silicon Nanowire Field Effect Transistors"

Silicon nanowire-based transistors were fabricated and tested for their radiation hardness by exposure to Co60 X-ray radiation at doses ranging from 50-250 kRad. Minor degradation of the transistor characteristics was observed at 250 kRad. Our results show the inherent radiation hardness of nanowire devices. [C1076]

"Optimal Control over the InAs Nanowire Growth for System Integration and their Structural and Transport Properties"

We present new fundamental insights into the nucleation and evolution of InAs nanowires (NWs) grown using organo-metallic vapor-phase epitaxy (OMVPE), the correlation of their room temperature transport behavior with their structural properties, and a novel scheme for their integration to Si substrates. We experimentally distinguish, for the first time, two NW growth regimes defined by the direction of In adatom exchange between the NW (InAs) and the substrate (InAs (III)B). This understanding leads to optimal control over the NW morphology over length scales of the order of the In adatom surface diffusion length on the NW sidewalls. Transmission electron microscopy (TEM) analysis of the NW crystal structure of wurtzite (WZ) and zincblende (ZB) NWs is used to explain striking differences in their transport behavior. We find that the presence of small ZB sections in the WZ NWs can create spontaneous polarization sheet charges at each section interface along the NW channel, leading to improved subthreshold characteristics over those of pure ZB NWs, as observed in our electrical device measurements. Finally, we successfully demonstrate the vertical integration of electrically isolated InAs NWs on SiO2on Si suitable for implementing 3D NW circuits using the bottom-up synthesis approach for practical integration of III-V functional devices to Si technology. [C1077]

"Sequential Circuit Design in Quantum-Dot Cellular Automata"

In this work we present a novel probabilistic modeling scheme for sequential circuit design in quantum-dot cellular automata(QCA) technology. Clocked QCA circuits possess an inherent direction for flow of information which can be effectively modeled using Bayesian networks (BN). In sequential circuit design this presents a problem due to the presence of feedback cycles since BN are direct acyclic graphs (DAG). The model presented in this work can be constructed from a logic design layout in QCA and is shown to be a dynamic Bayesian Network (DBN). DBN are very powerful in modeling higher order spatial and temporal correlations that are present in most of the sequential circuits. The attractive feature of this graphical probabilistic model is that that it not only makes the dependency relationships amongst node explicit, but it also serves as a computational mechanism for probabilistic inference. We analyze our work by modeling clocked QCA circuits for SR F/F, JK F/F and RAM designs. [C1078]

"Heat Assisted Magnetic Recording on High Anisotropy Nanocomposite Media"

The tremendous increase in magnetic areal density has been largely responsible for the proliferation of hard disk drive recording into new applications and markets. The superparamagnetic limit imposes a signal-to-noise ratio, thermal stability, and writability tradeoff that limits the ability to continue to scale traditional magnetic recording technology to higher storage densities. Heat assisted magnetic recording (HAMR) offers a new degree of freedom with elevated writing temperature that holds the promise of extending the areal density of magnetic data storage. By temporarily heating the media during the recording process, the media coercivity can be lowered below the available applied magnetic write field, allowing higher media anisotropy and therefore smaller thermally stable grains. The heated region is then rapidly cooled in the presence of the applied head field where transition is recorded. With a tightly focused laser beam heating the media, the write process is similar to magneto- optical recording, but in a HAMR system the readout is performed with a magneto-resistive element. [C1079]

"Microarray-Based Hybridization Technology for Biosensors"

Current DNA-microarray technologies for detecting specific mutations are challenged in discriminating multiple base-pair (bp) changes in DNA sequences that are more than 50 base pairs in length. To overcome this limitation we will develop a novel microarray-based hybridization technology that exploits the homologous pairing of DNA strands driven by the RecA strand-exchange protein of E. coli. Using magnetic torque-induced dissociation of surface- immobilized RecA-DNA complexes conjugated to magnetic nanoparticles, we will establish the use of magnetic-field- dependent strand-association isotherms as a sensitive method for discriminating hybridization of motifs an order of magnitude longer than those accessible using current technology. These studies have significant potential impact on problems related to biological sensors and their applications in molecular genomics and pathogen characterization. [C1080]

"Magnetic Logic Based on Coupled Nanomagnets: Clocking Structures and Power Analysis"

Summary form only given. At present, there are a number of research efforts that have focused on different devices that might either replace or augment CMOS technology such that the performance scaling trends that we have seen for the last 30 years-and expect for the next 10-15 years-might continue beyond the year 2020. This work represents one such effort and focuses on computing with nanoscale magnets. Our goals are two-fold: First, we extend our previous work to develop more accurate and detailed designs of the structures required to perform a computationally interesting task with nanomagnets. Second, we analyze the performance of said systems and compare the results to what one might expect from end-of-the-roadmap CMOS, as well as other emerging device technologies and their requisite architectures-namely, nano wire-based PLA's. Magnetic logic based on ferrite cores was pursued in the 1950's, but due to disadvantages such as size, was replaced by semiconductor technology. We are studying systems made from nanomagnets that (i) are scalable, (ii) do not possess the disadvantages of the early, bulky, ferrite core magnets, and (iii) can be arranged to form circuits within the quantum-dot cellular automata (QCA) architecture scheme (A. Imre, January 2006). For nanomagnet-based QCA (MQCA), wires, gates, and inverters have all been experimentally realized and verified, they operate at room temperature, and we estimate that if 1010 magnets switch 108 times/second, they would dissipate only about 0.1 W (G. Gsaba, et al., 2005). That said, more than just magnets are required for computation. A lithographically-defined clock structure is used to generate a magnetic field that polarizes groups of nanomagnets along their hard axes and removes the remanent magnetizations associated with a previous computation. When the field is removed, magnets relax to their new preferred state in response to new inputs. While the power loss from nanomagnet switching events should be--quite low, the power loss from the clock is anticipated to be more significant, and constitutes the bulk of the energy required to perform a computation with MQCA. We extend our previous work to consider a more thorough and detailed analysis of an MQCA system (i.e. components such as the clock generation circuitry will also be considered.) On the surface, this technology has many attractive features that could bolster the performance of systems-level applications. Devices should be low power, non-volatile,radiation hard, and should have a natural interface with MRAM. However, again, the aggregate system must better the projected state-of-the-art for at least some tasks of interest. To provide some initial insight into MQCA's potential in this regard, we will compare MQCA circuit designs to functionally equivalent designs in CMOS and other emerging technologies. Our metric of choice will be energy-delay product (EDP) as this provides some insight into both performance (i.e. latency) as well as energy. [C1081]

"CMOS Integrated Single Electron Transistor Electrometry (CMOS-SET) Circuit Design for Nanosecond Quantum-Bit Read-out"

Novel single electron transistor (SET) read-out circuit designs are described. The circuits use a silicon SET interfaced to a CMOS voltage mode or current mode comparator to obtain a digital read-out of the state of the qubit. The design assumes standard submicron (0.35 um) CMOS SOI technology using room temperature SPICE models. Implications and uncertainties related to the temperature scaling of these models to 100mK operation are discussed. Using this technology, the simulations predict a read-out operation speed of approximately Ins and a power dissipation per cell as low as 2nW for single-shot read-out, which is a significant advantage over currently used radio frequency SET (RF-SET) approaches. [C1082]

"Qubit Control-Pulse Generator Circuits for Operation at Cryogenic Temperatures"

Solid-state quantum bits (qubits) generally require cryogenic operating temperatures together with rapid voltage (or current) pulse generation for qubit control and readout. Conventionally this is achieved by generating the signals at 300 K, transmitting them along very long coaxial cables that span ges 4 m from 300 K to sub-K (30-500 mK) into a dilution refrigerator, and reading-out the final qubit states via similar lengths of cable. Here we fabricate the control-pulse generator circuits using a foundry-processed SOS-CMOS technology that is capable of operation down to sub-K temperatures so that control signals can be generated at cryogenic temperatures in the near vicinity of the qubits. We present two full-custom large-scale integrated (LSI) control-pulse generator circuits: (a) a mixed-mode; and (b) a digital design each comprising hundreds of devices, and show pulse characteristics at 4.2 K, demonstrating LSI circuit operation at low temperatures. The mixed-mode design showed lower power dissipation but had increasing jitter at longer dwell times. The digital design eliminated jitter but at the expense of increased power dissipation. Although power dissipation is higher in the digital design, it should be possible to thermally anchor such control circuits at the 1 K stage of a dilution refrigerator thereby minimizing heat propagation to the qubits. [C1083]

"Design and Performance Comparison of Single- and Double-Hot Arm Polysilicon Surface Micromachined Electrothermal Actuators and Arrays Applied to Realize a Microengine"

Several microactuator technologies have been investigated for positioning individual elements in large-scale microelectromechanical systems (MEMS). Electrostatic, magnetostatic, piezoelectric and thermal expansion represent the most common modes of microactuator operation. This research focuses on the design and comparative performance evaluation of asymmetrical electrothermal actuators. The motivation is to present a unified description of the behavior of the electrothermal actuator so that it can be adapted to a variety of microsensor and microactuator applications. This research compares the tip deflection performance of the asymmetrical single- and double-hot arm electrothermal actuator designs. Deflection measurements of both actuator designs as a function of arm length and applied electrical power are presented. As a practical application of the electrothermal actuator, the recent realization of a MEMS microengine is described, and evidence of its bi-directional motion is presented. The electrothermal actuator and microengine designs were accomplished with the MEMSProregCAD software program, and they were fabricated using the MEMSCAP Integrated Microsystems Multi-User Microelectromechanical Systems (MEMS) Processreg(MUMPs) foundry. [C1084]

"Interaction in the Concurrently Running Replication and Self-Assembly Processes"

In the paper the interaction of the concurrently running objects replication processes, and concurrently running replication and self-assembly processes observed in the multi-stage molecular product synthesis, has been analyzed and discussed. Analysis of the interdependent replication processes and also, the mutual replication and self-assembly processes based on the growth functions, provides facilities for determination of the control of these processes in the sense of stabilization, process extinguishing, and avalanche proliferation. In the paper, the numerical examples have been presented. [C1085]

"Integration of Single-Walled Carbon Nanotubes on to CMOS Circuitry with Parylene-C Encapsulation"

This paper presents heterogeneous integration of single-walled carbon nanotubes (SWNTs) with CMOS integrated circuits using die-level post processing. The chip was fabricated using the AMI 0.5 mum CMOS Technology. An electroless zincation process was performed over the Aluminum assembly electrodes (Metal 3 of CMOS technology) to clean and to coat the electrodes with a thin Zinc layer. Low temperature dielectrophoretic assembly was utilized for the placement of the SWNTs on to these electrodes. Encapsulating the CMOS chip with a thin (1 mum) parylene-C layer stabilized the SWNT-electrode contact resistance and also provided environmental protection. Electrical measurements from the assembled SWNTs yield ohmic behavior with a two-terminal resistance of ~44K Omega. The SWNTs were incorporated on to the CMOS chip as a feedback element of a two-stage Miller compensated high gain operational amplifier. The measured small signal ac gain (~1.95) from the inverting amplifier confirmed the successful integration of carbon nanotubes with the CMOS circuitry. This paper lays the foundation for the realization of next generation integrated nanosystems with active nanostructures on CMOS integrated circuits. [C1086]

"Error-Power Tradeoffs in QCA Design"

In this work we present an error-power tradeoff study in a Quantum-dot Cellular Automata (QCA) circuit design. Device parameter variation to optimize performance is a very crucial step in the development of a technology. In this work we vary the maximum kink energy of a QCA circuit to perform an error-power tradeoff study in QCA design. We make use of graphical probabilistic models to estimate polarization errors and non-adiabatic energy dissipated in a clocked QCA circuit and demonstrate the tradeoff studies on the basic QCA circuits such as majority gate and inverter. We also show how this study can be used by comparing two single bit adder designs. The study will be of great use to designers and fabrication scientists to choose the most optimum size and spacing of QCA cells to fabricate QCA logic designs. [C1087]

"The Integration of Molecular Electronic Devices with Traditional CMOS Technologies"

This work describes the development of hybrid circuits composed of silicon-based molecular electronic devices and traditional CMOS technology. In the development of these circuits, we first fabricated individual CMOS-compatible molecular electronic devices and established their effectiveness. We then designed and used traditional VLSI tools to layout a hybrid circuit that includes CMOS for the on-chip characterization of the molecular devices, as well as a platform composed of the contacts and interconnects for the molecular electronic devices. Finally, we developed the procedures for the post-processing fabrication of the molecular electronic devices based on CMOS-compatible techniques. This work is an important step towards the realization of hybrid molecular/traditional circuits. It both advances novel "beyond CMOS" molecular electronic technology, and enables hybrid circuits for the on-chip characterization of the molecular electronic devices via CMOS instrumentation. [C1088]

"Electron Transport in Boron Fullerenes"

The electron transport properties of B80fullerene is studied using first-principles density functional theory in conjunction with the Landauer-Biittiker quantum transport formalism. The electron transmission in B80fullerene is calculated to be much higher than that in C60fullerene in the Fermi-level region. The enhanced transmission in the B80fullerene is attributed to its spatially extended charge distribution in delocalized bonds. [C1089]

"Design and Manufacturing of a Fourier Transform Microspectrometer"

Spectrometry has long been used for measuring chemical compositions and purity of materials in industrial, medical and environmental applications by detecting material dependent absorption of wavelength. Traditional spectrometers, however, are table-top instruments, and they are generally too large, and too costly to be ported outside of lab environments. Micro-electro-mechanical-systems (MEMS) technology offers promising possibilities to build compact and cost-effective miniature instruments, including spectrometers. In this paper, we present a fiber-coupled Fourier-transform microspectrometer of a nominal size of 3 cm times 3 cm times 3 cm, constructed using 3D hybrid microassembly. The microspectrometer targets wavelengths in the Visible and NIR spectra. We use modular microscale parts, including minimum energy compliant MEMS fasteners, in order to configure a die-sized microoptical bench. A scanning micromirror is snapped into a MEMS thermal actuator, and we measure interference fringes from a Michelson interferometer. Light coupling, miniature electronics and power are included in the spectrometer package. We discuss the design, robotic assembly, packaging and experimental characterization of this MEMS-based instrument. [C1090]

"Relation between Structure and Magnetic Property of Ti1-xNixO2 Nano-Particles"

Ti1-xNixO2(x =0.00-0.12) nano-particle samples were prepared by sol-gel method. We investigated the effect of Ni doping on the structural and Raman scattering properties of the Ti1-xNixO2system. SEM and XRD measurements show that the particle size of the powder is in nano-scale, and that the magnetic Ni impurities substitute for the Ti sites in the anatase TiO2phase. Raman spectra also clearly support that the Ni atoms go into the Ti-site in TiO2. Some of the samples, which are found to be weakly ferromagnetic, show additional Raman peaks at around 420 and 620 cm-1. Other samples that do not show the additional Raman peaks are superparamagnetic. The ferromagnetic behavior seems to be due to the existence of Ni or Ni oxide clusters in the Ti1-xNixO2system. [C1091]

"In Situ Mechanical Characterization of One Dimensional Nanoscale Building Blocks Using Novel Microfabricated Devices"

We report the development of simple micro-devices that can be used to perform in situ quantitative nanomechanical characterization of one-dimensional nanoscale building blocks, such as metallic nanowires and carbon nanotubes, within a scanning electron microscope (SEM) or a transmission electron microscope (TEM) chamber equipped with a quantitative nanoindenter. The unique design of these devices makes it possible to convert compression from nanoindentation to uni-axial tension at the sample stages. Fabrication of the micro-devices was carried out on both standard p doped wafers and on silicon on insulator (SOI) wafers using established micro-fabrication processes. Finite element analysis was employed to model the device behavior under mechanical loading in order to ascertain loading parameters. Nanoscratch and in situ nanoindentation experiments were performed in order to obtain the applied force vs. top shuttle displacement curves for the devices. Finally, individual Ni nanowires were picked up, placed and clamped onto the sample stages to act as tensile specimens. [C1092]

"CONTACT-Nanotechnology Research for Air Force Applications"

The CONTACT program (consortium for nanomaterials for aerospace commerce and technology) is a cooperative nanotechnology research program in Texas. The partners include the US Air Force Research Laboratory, five campuses of the University of Texas (Brownsville, Pan American, Arlington, Austin, and Dallas), the University of Houston, and Rice University. The program aims to develop and commercialize new nanotechnology materials and processes for the Air Force and the aerospace industry through the collaborative efforts of the intellectual centers of the consortium. Research is focused on four areas of aerospace research demand: adaptive coatings and surface engineering, nano energetics, electromagnetic sensors, and power generation and storage. This paper provides insight into the projects including work on novel sensors, energetic materials and composites. [C1093]

"Strategies for Closing the ITRS Funding Gap"

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"Molecular-Based Magnet: A Prussian-Blue Analogue NaxMny[CFe(CN)6]"

In this report, we investigate the effect of size of the particles on the properties of the Prussian blue analog NaxMny[Fe(CN)6]. We present a novel synthesis method of the NaxMny[Fe(CN)6] nano-particles. The results of the X- ray diffraction (XRD), scanning electron microscopy (SEM), magnetization measurements, and absorption spectroscopy studies of the compounds are presented. [C1095]

"Intermediate Phases in Synthesis of AlPO4-5 Molecular Sieve: A Study of XRD and Raman Spectroscopy"

We study the intermediate phases and their evolution during crystallization of Aluminophosphate molecular sieves. In this work, the behaviors of the initial gel and the evolution of the intermediate phases during crystallization of AlPO4-5 molecular sieve using triethylamine as a template have been investigated. It has been shown that in the amorphous aluminophosphate gel phases, template triethylamine does exist in protonated form; and there appear a significant change, formation of 12-member rings of AlPO4-5 structure, during the early stage of crystallization of AlPO4-5. In addition, a proposition to explain the crystallization of AlPO4-5 is also suggested. [C1096]

"Neuronal Processing, Reconfigurable Neural Networks and Stochastic Computing"

-This paper proposes and studies the premise of three-dimensional (3D) reconfigurable vector neural networks (3DVNNs). We research a neurocomputing paradigm to accomplish efficient computing. Our overall objective is to advance engineered (human-devised) processing and computing by developing and applying a theory of massive vector processing in a three-dimensional space. Our neurocomputing paradigm and theoretical advancements contribute to natural computing by enhancing the knowledge on processing in living systems. The proposed developments in the fundamental areas of theoretical computer engineering/science and neuroscience are inspired by natural processing and emerging molecular engineering. Our specific objectives are to: (1) Develop enabling design methods thereby advancing the theory of computing and neuroscience; (2) Establish sound and practical CAD-supported tools to design engineered molecular processing platforms (MPPs); (3) Foster preeminent technology-centric design algorithms. This will allow one to synthesize computing hardware (circuits, processing platforms, etc.) guarantying efficient computing and processing. Our goals are to advance models and principles of computation and to devise-develop-and-demonstrate a sound neurocomputing paradigm supported by a set of highly effective methods, algorithms and tools. [C1097]

"The Effect of Device Parameter Variations on Programmable Majority Logic Arrays"

Molecular scale electronics has become an attractive alternative and even extension to existing microscale technologies as they migrate to the nanoscale. With recent research in the field of molecular and nano electronics, devices such as switches and resonant tunneling diodes (RTD) have been developed which exhibit properties such as rectification, hysteresis and negative differential resistance (NDR). These devices have been utilized to realize circuits that can implement both memory and logic structures. This work revolves around the robustness of these nanoscale devices when employed in nanoelectronic programmable majority logic arrays (PMLA), programmable logic circuits based on majority logic resulting from NDR. We also show the results of corner analysis of the circuit's performance under parameter variations, and describe the behavior requirements of the aforementioned molecular devices, especially those of molecular switches, for the system to function efficiently. [C1098]

"Implementation of a New Functional Digital IC for Multiplexing Operation Based on RTDs"

A new functional digital IC for multiplexing operation is proposed by using resonant tunneling diodes. The new proposed circuit topology is mainly based on the CML- MOBILE topology which has the features of self-latching and edge-triggering with reduced device count. The operation of the new functional digital IC is confirmed by implementing the circuit using an InP MMIC technology. The fabricated IC has operated with a low DC-power consumption of 42 mW while achieving a high-speed multiplexing data rate of 25 Gb/s for the first time based on quantum-effect devices. [C1099]

"Quantum Mechanics and Electromagnetics of Weak Magnetic Field Sensing, Storage and Retrieval in Biosystems and Engineered Systems"

We study phenomena and effects which can be utilized to sense weak magnetic fields by engineered systems. Possible mechanisms and phenomena utilized by living systems are outlined and discussed. Assuming the macroscopic device physics, it is found that only fluidic engineered devices can typify a magnetoreception premise believed be utilized by some living systems. It is found that the mechanical properties of silicon-technology solid devices may not coherently utilize possible behavioral transitions and functionality exhibited by natural systems. Hybrid microdevices is an alternative solution which we examine in details. Fundamental, applied, experimental and technological findings are reported. [C1100]

"Fabrication of Bio-Inspired Elastomer Nanofiber Arrays with Spatulate Tips using Notching Effect"

In this paper, a fabrication method for nanoscale elastomer fiber arrays with spatulate tip endings as gecko foot-hairs inspired nanoscale fibrillar dry adhesives is proposed. A master mold is fabricated with silicon-on-insulator (SOI) wafer using the interference lithography and the notching effect during deep reactive ion etch process. Liquid polymer is poured over the mold in vacuum chamber and cured. Final nanoscale elastomer fiber arrays are released after etching the SOI master mold. Fabricated polyurethane nanofiber arrays with 410 nm fiber diameter and 2 mum height demonstrated macroscale adhesion pressures up to 14.1 N/cm2on a 1 mm diameter silicon flat disk for a preload pressure of 6.7 N/cm2. [C1101]

"CMOL-Based Cellular Neural Networks and Parallel Processor for Future Image Processing"

Hybrid CMOS/molecular (CMOL) circuits are promising for future high-performance VLSIs. Recently, digital and mixed-signal CMOL-based image-processing circuits were proposed. Although these circuits have ultra-high performances, several problems exist. In this paper, CMOL-based analog cellular neural network (CNN) and digital parallel image processor is proposed. The CMOL-based CNN has high speed and good fabrication tolerance. The parallel processor has high peak performance with easy configurability. [C1102]

"Licensing Nanotechnology"

Money being invested in nanotechnology has to date produced few returns. Much of this is due to the novelty of the technology and the few commercial applications currently available. In order to improve commercial returns, companies will need to license nanotechnology. This papers deals with the basics of licensing and suggest strategies for improving the commercial returns through effective licensing. [C1103]

"nanoHUB.org-Online Simulation and More Materials for Semiconductors and Nanoelectronics in Education and Research"

NanoHUB.org provides a community service to over 65,000 users in over 172 countries annually with "online simulations and and more". Over 85 interactive simulation tools supported by tutorials and general nanotechnology information material are available free of charge to anybody. In all there are over 1,000 resources on nanoHUB. Usage in over 30 classes in the last year and over 270 citations in the literature demonstrate dual usage of nanoHUB in education and research. The content is contributed by members of the Network for Computational Nanotechnology (NCN) which hosts nanoHUB and an increasing number of users. nanoHUB.org is supported by a state-of-the-art content management system and embraces Web 2.0 technologies, that engage the user community through automated contribution processes, tagging, and user ratings. User ratings, usage patterns, and scientific citations of nanoHUB content flow into the content ranking which influences the ranking in nanoHUB searches and category listings. Despite these advanced capabilities, some users still benefit from "personal collections" or "topic pages" by domain experts that aggregate nanoHUB content for specific audiences. Here we highlight the topic pages on "Nanoelectronics", "Non-Equilibrium Green Functions", and "Semiconductor Device Education Materials" as examples relevant to the IEEE nano community. [C1104]

"Mass Production of Room Temperature Single Electron Transistors using Step & Flash Imprint Lithography and Lift-Off Technique"

We report the use of step & flash imprint lithography reverse tone (SFIL-RTM) and liftoff technique to fabricate sub-100 nm metal nano-wires as the electrodes for room temperature single electron transistors (RT-SET). The optimized process flow was performed on approximately 300 imprints, for a total of 714,000 devices. Each imprinted device contains drain/source/gate electrodes. Multiple electrode geometries were designed to explore the impact of device parameters. Following electrode formation, Tungsten quantum dots (QD) were formed using a novel focus ion beam (FIB) deposition technique, resulting in room temperature single electron transistor (RT-SET) devices. The RT-SET devices are tested using a Keithley 4200-SCS semiconductor parametric analyzer. [C1105]

"Realization of Nano-Wires in Quartz using Focused Ion Beam and ICP/RIE Etching Process for Single Electron Transistor Fabrication"

The fabrication of sub-50 nm features with existing lithographic techniques is a technological challenge. Here we present the results for a fabricated nano-structure in quartz which can be potentially used for the large scale fabrication of single electron transistor (SET) devices using ultra-violet nano-imprint lithography (UV-NIL). The fabrication process was developed using focused ion beam (FIB) etching and inductively coupled plasma reactive ion etching (ICP/RIE). The results demonstrate the realization of quartz stamp with required nano-structures for the mass production of SET devices. SET devices could be integrated into nano-scaled systems incorporating vital functions like nano-sensing, data storage and communication will provide revolutionary capabilities. [C1106]

"Metallated Porphyrin Self Assembled Monolayers as Cu Diffusion Barriers for the Nano-Scale CMOS Technologies"

In this paper we have studied the application of metallated porphyrin self assembled monolayers (SAMs) as Cu diffusion barriers for ultra-large scale integration (ULSI) CMOS applications. The results for Cu/SiO2/Si and Cu/SAM/SiO2/Si MOS CAP structures are compared through a detailed electrical characterization of threshold voltage shift using bias-temperature studies. Material characterization and surface morphology is studied using UV absorption spectra and AFM. Our results show that metallated porphyrin SAMs can be effectively used as Cu diffusion barriers for ULSI applications. [C1107]

"The Behaviors of Direct-Written Nanofibers on Patterned Substrate"

The Direct-Write (DW) technology based on Near-Field Electrospinning (NFES) is utilized to study the deposition behaviors of nanofibers on silicon substrate patterned with thin film of silicon dioxide (SiO2). The deposition behaviors of nanofibers on patterned substrate, such as width of distribution area and deposition morphology of direct-written nanofibers on patterned substrate are investigated in this article to accelerate the industrial application of DW technology based on NFES. Due to the repulsion force of charges on nanofibers and the elastic force of nanofibers stem from surface tension force and viscous force, the width of nanofibers distribution area on is bigger than that on Si surface. There is more spacing among nanofibers that deposited on SiO2surface, while nanofibers prefer to aggregate together on Si surface. Nanofibers may aggregate to form cluster like twisted structure periodically on the Si surface and two adjacent nanofiber clusters are connected by one single nanofiber. Under the repulsion force and elastic force of charged nanofibers, denser nanofibers would be collected at the junction of Si and SiO2surface or on the middle Si area between SiO2teeth in comb structure. The effect of CMS on deposition morphology of nanofibers was also investigated. When CMS ranges from 8 to 20 cm/s, wave-shaped nanofibers would be direct-written on both Si and SiO2surface. When CMS is in the range of 20~35 cm/s, straight-line nanofibers would be drawn on Si layer but nanofibers on SiO2surface of wave-shape. Straight nanofibers can be direct-written on both Si and SiO2surface, when CMS is higher than 35 cm/s. These results show that higher CMS is needed to direct-write straight nanofibers on SiO2surface than that needed on Si surface. [C1108]

"A New Method for Microwave Characterization of Metallic Single-Walled Carbon Nanotubes"

On-chip subtraction of capacitive parasitic effects is proposed for microwave characterization of individual metallic single-walled carbon nanotube (mSWNT) that yields low intensity signals. The method dramatically reduces capacitive parasitic effects to uncover the otherwise buried signals. Both computer simulations and experimental measurements of small capacitance demonstrated the efficacy of the approach. [C1109]

"Micromachined Nanoporous Membranes for Blood Oxygenation Systems"

Nanostructured membranes with precisely engineered nanopores were fabricated on a thin silicon nitride membrane, using a combination of bulk micromachining and focused-ion-beam drilling. These membranes are designed to preserve microscale blood channel dimensions, thereby permitting the red cell shape change that enhances gas exchange in the pulmonary capillary. The membranes were tested for their mechanical stability and the results were verified with finite element analysis. Initial studies have proven the membranes to be robust, and capable of withstanding pressures typically experienced in blood oxygenator channels. A novel MEMS-based blood oxygenation system employing the nanoporous membranes is also presented. The oxygenation system is designed to have controlled blood and gas volumes for efficient blood oxygenation. [C1110]

"Charge-Transport Properties of para-Hexaphenylene Nanofibers"

Organic semiconductors have a range of applications in electronics and optoelectronics. para-hexaphenylene molecules are of particular interest due to their ability to self-assemble into a special type of elongated, crystalline nanostructures: nanofibers. Here, we report the results of a theoretical investigation of the charge-transport properties of such nanofibers and compare the results to experimental data. [C1111]

"Near-Field Scanning Optical Imaging with Monolithic Silicon Light Emitting Diode on Probe Tip"

We describe optical and topographic imaging using a light emitting diode (LED) monolithically integrated on a silicon probe tip for near-field scanning optical microscopy (NSOM). The light emission resulted from a silicon dioxide layer buried between a phosphorus-doped N+ silicon layer and a gallium-doped P+ silicon region created locally at the tip by a focused ion beam (FIB). The tip was employed in a standard NSOM excitation setup. The probe successfully measured optical as well as topographic images of a chromium test pattern with imaging resolutions of 400 nm and 50 nm, respectively. The directional resolution dependence of the acquired images directly corresponds to the shape, size and polarity of the light source on the probe tip. To our knowledge, this report is the first successful near-field imaging result directly measured by such tip-embedded light sources. [C1112]

"Field Emission Dependence on Nanogap Separation in Surface Conduction Electron-Emitter Display"

Nanogap nowadays is fascinating in surface conduction electron-emitters (SCEs) for electron sources of the flat panel displays (FPDs). Surface conduction electron-emitter display (SED) is one of new type FPDs based on the SCEs. The nanogap fabricated by focused ion beam was studied, but the extremely narrow fissure complicated its fabrication. Palladium hydrogenation nanogaps have thus been proposed as a novel surface conduction electron-emitters for it low turn-on voltage, high emission current, high focused capability, and high emission efficiency. In this work, we investigate effects of nanogap separation width of the palladium hydrogenation nanogaps on the field emission efficiency using a finite-difference time domain particle-in-cell simulation method. The result of this study shows as the gap width increases, the field emission efficiency grows due to the larger space allows the particles attracted to the anode plate instead of attracting by the opposite electrode. Moreover, the study shows the better emission efficiency can be achieved under wider gap width, which reduces the difficulty of the fabrication. [C1113]

"Mid Infrared Focal Plane Arrays with Nanoscale Quantum Dots and Superlattices"

Presently, the state of the art photon detectors for the mid wave infrared (MWIR, 3-5 mum) and long wave infrared (LWIR, 8-12 mum) are based on interband transitions in bulk indium antimonide (InSb) and HgCdTe alloys respectively. Two emerging technologies for next generation sensors that offer enhanced functionality include (i) intersubband detectors based on nanoscale quantum dots and (ii) interband transitions in the Type II InAs/GaSb strain layer superlattice system. Infrared detectors based on InAs/GaSb strain layer superlattices (SLSs) appear as a promising alternative to the present-day infrared detection technologies. SLSs offer numerous advantages over existing detector technologies, including better uniformity, reduced tunneling currents, normal incidence absorption and suppressed Auger recombination. SLSs are characterized by the broken-gap type-II alignment. Presently all SLSs detectors are based on a photodiode (p-i-n or n-i-p) design. During the conventional fabrication process of photodiodes, the deep etch through the absorbing region is utilized in order to define the optical area of the detector. Electronic surface states within the energy band gap of SLS are generated, resulting in large surface leakage currents. The suppression of these currents is the most demanding challenge for the SLS technology. We have recently fabricated a high performance InAs/GaSb SLS detector with a P on N polarity and a 320 times 256 MWIR FPA with a noise equivalent temperature difference of 24 mK at 77K. In the quantum dots in a well (DWELL) heterostructure, InAs quantum dots are placed in a thin InGaAs quantum well that is in turn placed in a GaAs matrix. Three-color DWELL detectors, operating at 78K, with spectral response in the MWIR (lambdap1~ 4 mum), LWIR (lambdap2~ 8 mum) and VLWIR (lambdap3~ 23 mum) regime have been fabricated in our group. Recently, we have fabricated the first long wave infrared and two-color quantum dot foc--al plane array (320times256 pixels). [C1114]

"High Operating Temperature InAs Quantum Dot Infrared Photodetector via Selective Capping Techniques"

We report on the improvement in a quantum dot-in-a-well (DWELL)-based infrared photodetector's operating temperature with spectral response observable till 150 K. This improvement was achieved through addressing issues related with the growth conditions and subsequent capping of the quantum dots (QDs) by various overlying materials. The influence of these conditions was determined by examining the size and optical properties of the QDs as well as how it affected their function as the absorbing region in a DWELL IR photodetector. Photoluminescence of InAs QDs embedded in asymmetric InGaAs/GaAs quantum well or AlGaAs/InAlGaAs quantum well with different capping materials and different growth temperatures have been characterized as a function of the intermixing energies between the interface of the QDs and the capping materials. Through the improvement in QD confinement, the dark current can be decreased and the overall temperature of operation can be increased to 150 K. [C1115]

"Objects Self-Replication in the Nanosystems of Informatics"

In the paper, the characterization of the nanosystems of informatics used as a host for the molecular objects self-replication processes has been discussed in terms of informatics. Presented analysis shows that the application of nanotechnologies in the nanosystems of informatics enables realization of processes for formation of objects with self-replication feature, similarly to the existing processes in biological informatic systems. Migration from bit-coding represented by the microcircuits states to nano-bit encoding in which the nanobit in the text is the presence of chosen single molecule, and fabrication of the self-replicating objects with internally in its structure encoded program according to which the objects realization have been performed, provides facilities for the construction of structure of the algorithms and a technical completion of the technical nanosystems of informatics of the direct objects and products nanofabrication. [C1116]

"Uncooled IR Nanobolometers Fabricated by Electron Beam Lithography and a MEMS/CMOS Process"

We combine electron beam lithography (EBL) with conventional microscale metal deposition and etch process technologies, to fabricate bolometer devices with nanoscale feature critical dimensions (CDs). We report the creation of titanium (Ti) bolometer devices with 70 nm minimum feature CDs, and total bolometer film thicknesses ranging between 40 nm and 120 nm. Our new nanobolometer devices integrate with conventional CMOS and MEMS fabrication processing, to create thermally isolated sensors with nanoscale feature sizes on a 0.5 mum CMOS base process. We present temperature coefficient of resistance (TCR) data for our new devices, and report a nanobolometer TCR performance of 0.22%/K at 70 nm CDs, a TCR value comparable to figures reported for Ti-based uncooled microbolometer devices. [C1117]

"Performance Evaluation on Light Efficiency of Anti-Reflection Films by a DC Ion Source Sputter System in LCD Applications"

In this paper, the structural and optical properties of these prepared films are sputtered by direct current (dc) powers without/with the ion-assisted deposition (IAD) technique. The optimal four-layer structure with anti-reflection (AR) coating films, which grown at 80degC temperature, 15-cm distance between target and substrate, 55-sccm oxygen flow and 1250-W magnetron sputtering power with the IAD technique, is used to study the optical performance. By using atomic force microscope (AFM) to identify the surface of the sputtered Nb2O5films, we found that films' roughness is 0.185 nm. In the glass substrate with SiO2/Nb2O5multilayer, the peak transmittances measured at visible range are 95.89% and 93.40%, respectively coating with/without the IAD-sputtering technology. These results are better than those that is measured with a bare hardness poly-carbonate (HPC) (91.25%) and improved well above the flexible liquid crystal display (LCD) application standard. [C1118]

"Computer Integrated Plasma Nano Manufacturing Workcell"

As a very important material processing technology, plasma processing is able to modify sample surface through etching, deposition, activation, functionalization, polymerization, etc. However, the general plasma processing reacts on a large area of sample surface. Hence a mask is needed for selectively treating the sample surface. In this paper, a computer integrated plasma nano manufacturing workcell is developed, which consists of a micro plasma source and an integrated Atomic Force Microscopy (AFM) nanomanipulation system. The miniature microwave plasma discharge applicator is able to create a miniature plasma stream with a diameter ranges from 2 millimeters down to micrometers. Hence the micro plasma will be able to locally treat a sample surface and has the potential to eliminate the requirement of masks. With the integrated AFM system, the sample surface is able to be inspected and further modified at nanoscale in the same chamber after machined by the micro plasma. The system design and implementation are presented in the paper. Experiments have been carried out to demonstrate the effectiveness of the system by locally etching a silicon substrate surface using the micro plasma source. [C1119]

"Developing New Nanotechnology Products"

Summary form only given. Many new products are designed, developed and commercialized that never sell. The most critical factor for new product success is the existence of a competitive opening. A competitive advantage, such as patent protection, is a necessary component for maximizing profits but it is not sufficient. A successful product solves a real problem at a price the market will bear. This paper will describe the difference between innovation and invention. It will explain terms such as opportunity analysis, concept definition, influencing factors and describe the difference between a product feature and a customer benefit. Several decision making tools useful for the inventor will be introduced. This paper provides insights to how nanotechnologies are the same and different from other technologies with respect to requirements for new product success. [C1120]

"Rhodopsin Photon Receptor Energetics: Studies of Biomolecular Sensing and Processing"

This paper researches rhodopsin photon receptor functionality and energetics by applying quantum mechanics. It is important to examine the fundamentals of bioenergetics in order to coherently study mechanisms, processes and transitions in biomolecules. This will allow one to apply and utilize biophysics to the engineered devices and systems. Our goal is to study qualitatively and quantitatively study transitions exhibited by biomolecules to and assess their functionality. The solution of the aforementioned problems will advance knowledge and technological abilities. We outline the typifying prospect by devising sound advanced-performance sensing and processing devices. [C1121]

"Automatic Tool Changer for SPMs"

Our research encompasses improvements in SPM instrumentation needed for rapid automated change of nano-working tools like cantilever chips or grippers in the immediate region of SEM or FIB field of view. The major challenges are utmost precision working-tool positioning, repeatable clamping of the tool and placing the working-part in the same point after tool's change, and devising a design which will not incapacitate SEM or FIB for work. The communication presents an entirely new approach with the promise to meet these demands. [C1122]

"Compact Model of a Dual Gate CNTFET: Description and Circuit Application"

We present a physical compact model of a dual gate carbon nanotube field effect transistor (DG CNTFET). To obtain an accurate and predictive model, the expression of the drain current is based on the description of the local channel potentials as well as the injected charge. The comparison between the simulation results and experiments highlights the influence of the parasitic Schottky barrier at high injection level. Hence, assuming a higher DG-CNTFET technology maturity, this predictive model allows to evaluate the performance of logic circuits in terms of reconfigurable architecture. [C1123]

"Building Blocks for Fluctuation Based Calculation in Single Electron Tunneling Technology"

Fluctuations and noise are important factors interfering with the operation of devices and circuits, and this effect will become stronger as feature sizes decrease. This paper presents two building blocks for single electron tunneling (SET) circuits that are designed with signal fluctuations in mind. One of these blocks, a so-called Hub, outputs its signals to other building blocks by repeatedly offering its signals at its output terminals, and taking them back when they cannot be delivered. Based on a random scheme of signaling, the Hub requires fluctuations to drive its operation. The other building block, a ConservativeJoin, is designed to work in cooperation with the Hub, though it does not require fluctuations. We propose SET circuit topologies for both blocks, and analyze their behavior at a temperature of IK by computer simulations with SIMON 2.0. The two very different modes of operation in the blocks-fluctuation vs. non-fluctuating-can be accommodated by appropriately tuning circuit parameters, as we show. Utilizing these proposed topologies we then present an example of a network constructed using the two building blocks. [C1124]

"OMEN an Atomistic and Full-Band Quantum Transport Simulator for post-CMOS Nanodevices"

The technology computer aided design of nanometer-scaled semiconductor devices requires appropriate quantum-mechanical models that capture the atomic granularity of the simulation domain. The recently developed nanodevice simulator OMEN fulfills this condition. It is able to treat two- and three-dimensional transistor structures in a full-band framework using the semi-empirical sp3d5s* tight-binding model. In this formalism each atom of the device is represented by a set of ten orbitals leading to multi-band and open-boundary Schrodinger equations that have to be solved thousands of times. To improve its computational efficiency OMEN has four levels of parallelism that make it run on the largest available supercomputers. [C1125]

"Control of Charge Carriers in Molecular Devices"

This paper focuses on control of electron transports and switching of molecular devices (Mdevices). To accomplish these objectives one should control motion of charge carriers. Various phenomena and transitions, exhibited by Mdevices (microscopic systems) and microscopic particles, can be utilized only if specific effects, evolutions and events are controlled ensuring device functionality and required capabilities. Concentrating on molecular electronics, our objective is to develop sound and practical solutions. Molecular (nano) electronics is fundamentally distinct and cannot be compared to solid-state microelectroncs due to: (1) Distinct phenomena exhibited and utilized; (2) Device physics and functionality differences; (3) Distinct device-physics centered control principles and mechanisms; etc. We examine dynamics and control of microscopic charge carriers in Mdevices. In particular, for solid and fluidic Mdevices, the controlled motion of electrons, ions and molecules is studied. Applying sound device physics, we report theoretical and applied developments in analysis and control of Mdevice transitions with a primary focusing on: (i) Device physics and analysis consistency; (ii) Device physics and control coherency; (iii) Device physics and technology soundness. It is possible to control the transitions and motion of microscopic particles (charge carriers) thereby control tunneling, transport, characteristics and other evolutions exhibited by Mdevice variables (quantities of interest). The processing and memory transitions at the device level are defined by the device physics, control principles, behavior of microscopic system (device) and particles, etc. The ability to control microscopic particles means guarantying the overall device functionality. We examine the device physics and demonstrate that the device functionality, performance requirements and specified capabilities can be achieved by c--ontrolling principles. The results are validated by examining device transitions by applying quantum mechanics. We perform high-fidelity modeling and carry out heterogeneous simulations. The quantifying and qualifying studies are reported. [C1126]

"On the Design of Low Dimensional Devices Using Atomistic Computational Approaches"

Summary form only given. Nanoscale electronic devices are considered as a new frontier beyond conventional microelectronics. In this article, the author shows how it is possible to couple large-scale quantum electronic structure calculations with non-equilibrium Green function formulation to design new paradigms for nano devices. In particular, the author presents recent findings on a nano-switch based on the encapsulation of a donor/acceptor molecule within a carbon nanotube. The switching behavior is analyzed in detail and a novel model for nanoscale non-volatile memory element is presented. [C1127]

"A Thin, Vertical, Parallel Plate Capacitor with Multi-Wall Carbon Nanotube Electrodes"

We propose a new capacitor structure which uses carbon nanotube electrodes and is suitable for use in advanced integrated circuit technologies. Metallic carbon nanotubes have characteristics which make them well suited for capacitor electrodes (low resistance and large surface area per unit volume). We demonstrate that our thin vertical plate carbon nanotube capacitor can exhibit a capacitance per unit area of 175 fF/mum2. [C1128]

"Reliability of a QCA Array Multiplier"

Defects and faults of the future circuit technologies have to be taken into account early in the design of digital systems. To form practical design guidelines, we study the relationship between system reliability and component failure rates, in the case of a binary multiplier unit on quantum- dot cellular automata nanotechnology. The analysis is based on a decomposition of probabilistic transfer matrices, a versatile framework for computing the conditional probability of system failure. Our results indicate that passive wiring dominates the reliability of arithmetic designs on the nanotechnology. [C1129]

"Photoactive Compound-Triplex-Forming Oligonucleotide Linked Gold Nanoparticle as an Artificial Gene Specific DNA Cleaver Assembly"

We previously demonstrated the first DNA-nicking agent using PEG linked photoactive compound with gold nanoparticles (3 nm). The DNA cleavage was greatly improved (104 times) by nanoparticle conjugation compared to photoactive compound alone. However, the compound failed to recognize gene sequence and thus greatly limit their biomedical applications. In this study, we demonstrated the use of gold nanoparticles (13 nm) conjugated triplex forming oligonucleotide (TFO) to selectively target gene(s) of interest. Gold particle enabled multiplexed targeting of selected genes while terminally conjugated photoactive compound exert the cleavage in response to light exposure. The targeting DNA cleaver was synthesized by self-assemble of 5'-end thiol modified TFOs on 13 nm gold particles followed by coupling to photo-inducible DNA cleaver to the amino-group modified 3'-end of TFO. The Electrophoretic Mobility Shift Assays (EMSA) revealed sequence specific DNA binding of both TFO and TFO-nanoparticle probes. A successful double strand DNA cleavage at pre-designed site of the target sequence but not the control scrambled sequence was observed upon photo illumination. In conclusion, this study reported, the first time, an artificially assembled photo-inducible sequence specific double strand DNA cleaver. The double strand DNA cleavage was greatly enhanced by the use of gold particles as the carrier. A great potential for the development of improved gene manipulation strategy, recombinant DNA technology, treatment of infectious disease and gene therapy is anticipated. [C1130]

"Structure Effect of Cylindrical-Shaped GeSbTe Alloy on Phase Transition in Phase Change Memory"

Novel chalcogenide-based phase change memories (PCMs) are known as one of next-generation non-volatile memory technologies for its high resistance contrast, better endurance and high writing speed. PCM cell stores data by a thermally induced phase transition between crystalline to amorphous states, and thus understanding of temperature distributes within a cell and determining the programming current of phase transition are crucial in design and technology of PCM. In this study, a three-dimensional electro-thermal time-domain simulation is conducted for dynamic analysis of the cylindrical-shaped PCMs. The structure GST is a cone with different cone angle, ranging from 90deg to 45deg. The relation between contact size of nanoscale GeSbTe (GST) alloy and the required programming current for phase transition is advanced. The preliminary result shows that the GST structure with a 90deg angle exhibits the smallest required programming current, the fastest phase transition characteristic, the highest resistance contrast, and the best heat utilization efficiency. This study quantitatively estimates the structure effect on phase transition of PCM and physically provides an insight into design and technology of PCMs. [C1131]

"Quantum Mechanical Simulation of QCA with a Reduced Hamiltonian Model"

Molecular quantum-dot cellular automata (QCA) is an emerging computing paradigm which utilizes electrostatic coupling between electronic configurations in neighboring molecules to perform information processing. A simulation tool for this technology, QCADesigner, exists and allows designers to quickly layout and simulate QCA circuits constructed with up to thousands of QCA cells. However, in general, large quantum mechanical systems are not suitable for efficient simulation on a classical computer, and as a result, QCADesigner uses the Hartree-Fock approximation to reduce the computational complexity of the simulation. Under certain circumstances, this approximation can lead to the incorrect ground state and hence, produce logically incorrect results at the outputs. In this work, we provide examples of problem circuits and propose a method to identify areas that must be simulated using the full Hamiltonian. [C1132]

"A microstructure fibre doped with nano-material particles"

The core property of optical devices is its high nonlinearity, which will play an important role in the future optical communications. The advent of nano-technology, have paved a way for researchers to invent a novel optical fibre by combining the technologies of optical fibre and nano-technologies. In this paper, we present a manufactural method of this novel optical fibre. In addition, we conduct the propagation constant simulation of this fibre using Femlab. An average effective refractive index neffap 1.400 is obtained. This result is a step-stone bridge for future research of nonlinear parameter on this novel optical fibre. [C1133]

"Assigning statistical significance to tumor changes in patient monitoring using FDG pet"

In PET-based patient monitoring, tumor changes can be assessed using standardized uptake values (SUV), tumor volume (V), or total lesion glycolysis (TLG). We studied the impact of the SUV, V and TLG estimation methods on the interpretation of tumor changes between 2 PET scans. We also propose a bootstrap approach to assign statistical significance to the observed tumor changes. In 17 tumor changes, the SUV variations were the least dependent on the estimation method compared to the V or TLG changes. In 16/17 cases, SUV changes were significant. In 2 out of these 16 significant cases, at least one SUV index suggested non significant change. Testing the significance of tumor feature changes might reduce errors in interpreting tumor changes. [C1134]

"Automated MAP-MRF EM labelling for volume determination in PET"

An automated, unsupervised Maximum a Posterior-Markov Random Field Expectation Maximisation (MAP- MRF EM) Labelling technique, based upon a Bayesian framework, for volume of interest (VOI) determination in Positron Emission Tomography (PET) imagery is proposed. The segmentation technique incorporates MAP-MRF modelling into a mixture modelling approach using the EM algorithm, to consider both the structural and statistical nature of the data. The performance of the algorithm has been assessed on a set of PET phantom data. Investigations revealed improvements over a simple statistical approach using the EM algorithm, and improvements over a MAP- MRF approach, using the output from the EM algorithm as an initial estimate. Improvement is also shown over a standard semi-automated thresholding method, and an automated Fuzzy Hidden Markov Chain (FHMC) approach; particularly for smaller object volume determination, as the FHMC method loses some spatial correlation. A deblurring pre-processing stage was also found to provide improved results. [C1135]

"Light confinement in low contrast slot waveguide structures investigated"

The advent of slot waveguide structure has led the field of nano-photonics into an era, where maximum light can be confined inside low index slot guarded by high index slabs. Already in use slot waveguides (contrast ratio is 2.42) have two distinct properties over the conventional waveguides, i.e. high E-field amplitude, optical power, optical intensity in low index materials and a strong E-field confinement is localized to nanometer-size low index regions. We hereby propose a low contrast double slot waveguide structure (contrast ratio is 1.65); where low index slots comprising of air surrounded with high index glass slabs. The whole structure is based on substrate comprising of glass whereas cladding is of air. Novelty lies in showing high E-field amplitude, optical power, optical intensity and a strong E-field confinement in low index slot regions. Low contrast double slot structure usage in forming passive nano-devices had been verified by simulating a Y-branch coupler. [C1136]

"Backprojection-based reconstruction and correction for distance-dependent defocus in cryoelectron microscopy"

We study two methods of micrograph processing in cryo- electron microscopy: the defocus-gradient corrected back- projection algorithm and the correction of micrographs for the contrast transfer function based on the frequency-distance relation. Analyzing integral images produced by the methods we conclude that they are asymptotically equivalent within the framework of stationary phase approximation. [C1137]

"Monte Carlo assessment of time-of-flight benefits on the LYSO-based discovery RX PET/CT scanner"

Time-of-flight (TOF) positron emission tomography (PET) was studied and preliminarily developed in the 80s, but the lack of a scintillator able to deliver proper time resolution and stopping power at the same time had prevented it becoming viable technique. Today newly discovered scintillators with greater light yield and/or stopping power, along with advances in photomultiplier tubes and electronics, are rekindling interest in TOF. In this study we performed Monte Carlo simulation using GATE to explore what gains in PET performance could be achieved if the timing resolution in the LYSO-based PET component of Discovery RX PET/CT scanner were improved. For this investigation, count rate performance in different activity concentrations was simulated for different coincidence timing windows and temporal resolutions. Strong evidence of the simulation accuracy was found in the good agreement between measured and simulated data. The results show that the random event rate can be reduced by using a narrower coincidence timing window with increasing the peak NECR by 50%. However, utilization of TOF information improves NECR proportionally with the dramatical reduction of random coincidences as a function of timing resolution. As the TOF performance potential improvements are substantial and the fast electronics and newly scintillators gives us the means to obtain them without other sacrifices, efforts to improve PET timing should resume after their long dormancy. [C1138]

"Automated calcium measurements in live cardiomyocytes"

Heart failure due to hypertension, infarction, or other factors, is a leading killer of men and women in modern society and involves, at its base, a debilitating loss of cardiomyocytes. Recent studies indicate the feasibility of regenerating lost cardiomyocytes by transplanting embryonic stem cell-derived cardiomyocytes (ESCMs) or mobilizing resident stem cells. To realize the potential of stem-cell based therapies, we hypothesize that it will be extremely beneficial to develop technology and instruments for high throughput, high content screening (HCS) of drugs and genes for their ability to stimulate the formation of functional, contractile cardiomyocytes. Contractile activity is the primary physiological function of cardiomyocytes and abnormal contractility is potentially lethal. We discuss the first phase of the development of an instrument dedicated to distinguishing differentiated ESCMs from undifferentiated non-cardiac background cells using automated cell-by-cell quantification of contractile-calcium transients as the primary assay. [C1139]

"Wires segmentation in fluoroscopic images during cerebral aneurysm endovascular intervention"

Endovascular intervention is currently considered the treatment of choice for cerebral aneurysms. Nowadays imaging technology for real-time endovascular tool navigation consists of digital fluoroscopy detectors mounted on C-shaped arms with multiple orientations capability. In theory, a 3D representation of interventional devices (guide wire, coils) can be done using biplane fluoroscopic acquisitions. This approach opens the door to a real 3D road-map guidance of endovascular procedure. However, it is important that the tool be precisely identified during an intervention on the low contrast and low resolution fluoroscopic images. Therefore, a new method for segmenting guide wires and coils on fluoroscopic images is presented. A line enhancement algorithm based on Hessian matrix is applied and line candidates are marked by simple thresholding. Line artifacts are suppressed according to geometric criterion. The remaining line segments are linked when appropriately aligned to assemble continuous tools regardless of crossing from the projection of a planar view. This identifying method is evaluated on in vivo fluoroscopic sequences acquired during endovascular interventions on patients with cerebral aneurysm. [C1140]

"2008 international workshop on junction technology extended abstracts"

The following topics are dealt: semiconductor junction technology; doping technology; nano-CMOS technology; ion implant technology; junction for CMOS devices; annealing technology; silicide and Schottky S/D MOSFET. [C1141]

"Effect Extraction Methods on Micro/Nano Particles Leaching from E. Camaldulensis Wood"

Now Eucalyptus wood begins to be used to pulp. However, water, adhesives and other assistants are severely wasted because the extractive of Eucalyptus wood is enriched. What is worst, water pollution becomes more serious because of the polluting extractives of Eucalyptus wood. Therefore, based on the single-factor method, the fresh E. camaldulensis shavings were treated in the sorbitic extractor and supersonic wave extractor. The extractives were analyzed by ZETA and SIZER to find out the leaching rule of nano particles from E. camaldulensis wood, hence to obtain the way to lower the negative effect of the extractives. The results were following as: (1) the regression curve showed that the extraction mass increases when the extracting time extends in the sorbitic extractor; (2) diameters of leached nano particles distribute from 37.8 to 106 nm by volume evaluating indicator, and 28.2 to 91.3 nm by number evaluating indicator in the sorbitic extractor. The particles with diameters of 4150~5560 nm, 1110~6440 nm and 4150~5560 nm are too few to test, and their volume are only 0.3%, 2.6% and 0.3% respectively, however, they can bring barrier of wood extractives on wood permeability and obstructive action of wood turpentine on pulping; (3) the volume of the particles with diameter of 28.2~78.8 nm was 80.1%, the number of the particles with diameter of 24.4-50.7 nm was 89.0%, and the volume of 190-396 nm particles is 15.2%, but its number was very less. Therefore, not only extraction mass is increased but also the grouping number of leached nano particles from E. camaldulensis is lowered in supersonic wave extractor. [C1142]

"Study on Leaching Rule of Nano Particles from Cunninghamia Lanceolata Wood"

The resin in Chinese-fir (Cunninghamia lanceolata), which has been widely planted in south China is very liable to bring about the occurance of both holes and spots in paper, to aggravate the pollution of waste water, to shroten the fixed number of service year of equipment, to increase the consumption of chemicals, to relieve the rate of delignification, and to reduce the the permeability of flows in the process of pulping and paper-making. In order to overcome the above-mentioned negative effects, the extractives of the fresh Cunninghamia lanceolata shavings, which were obtained by using both the sorbitic- and supersonic-extracting approaches, were analyzed by ZETA and SIZER to find out the leaching rule of nano particles in Chinese-fir wood. The results are as follows: (1) During the the sorbitic-extracting process, the extracted quantity of nano particles rapidly increases firstly, then slightly increases with the extracting time. Based on the evaluating indicator of the volume fraction and the mass fraction, 63.63% and 66.87% of the particles are mainly distributed in the range of 37.8-91.3 nm and 28.2-68.1 nm in diameter, respectively, despite volume fraction 0.7%, 20.5% and 20.5% of the particles with the diameter of 4150-6440 nm, 459-825 nm and 825-4800 nm, respectively, it is enough for these particles to be able to result in the obstructive effects on the permeability and the pulping. (2) During the the supersonic-extracting process, the particles with the diameter of 32.7-78.8 nm and 32.7-58.8 nm occupy 88.8% and 90.5%, respectively, while there is no particles in the diameter of more than 190 nm. Therefore, it can be drawn a conclusion that not only the extraction mass of the particles is enhanced, but also the agglomeration degree of the leached nano particles is lowered on Cunninghamia lanceolata wood for the supersonic-extracting approach. [C1143]

"New device architectures for nano-CMOS technology "walking" to end of the roadmap and the impact on RF/analog applications"

The paper will focus on the double gate devices and gate-all-round devices, as well as the related impact on RF/analog scaling. Three kinds of double gate devices with different gate positions and different junction profiles will be generally estimated, including one extension of FINFET, named as BOI FINFETs which can combine the advantages of both SOI FinFETs and bulk FinFETs.The paper will discuss the device fabrication with compatible process integration scheme and related issues for further improvement, as well as the unique quasi-one-dimensional transport property, analog/RF performance and reliability behavior of this potential device. [C1144]

"Mixed analog-digital design of a learning nano-circuit for neuronal architectures"

The association of CNTFET and adjustable resistive devices is investigated to implement programmable logic using neural networks. A learning cell, based on switched capacitors principle, is designed in order to apply a simplified learning rule to program the resistances associated to each synaptic weight of the network. Electrical simulations validate the relevance of such approach. [C1145]

"Interconnect sizing and spacing with consideration of buffer insertion for simultaneous crosstalk-delay optimization"

As integrated circuits (ICs) are scaled into nanometre dimensions and operate in gigahertz frequencies, interconnects have become critical in determining system performance and reliability. In this paper we propose a new approach to investigate crosstalk reduction techniques which helps to have simultaneous optimization of interconnect delay and crosstalk noise in deep submicron VLSI circuits. The optimization problem is modelled by solving a new cost function to find a minimum cost for both crosstalk noise and delay which are conflicting in nature. Through MATLAB software, a system of three coupled wires is modelled as a RC distributed network. The results indicate the number of optimum available solutions including wire sizing, wire spacing and buffer insertion in which crosstalk reduction techniques can be useful for both crosstalk noise and delay. [C1146]

"Thermal stability improvement of Ni germanide utilizing Ni-Pd alloy for nano-scale Ge MOSFETs"

The thermal stability of Ni germanide utilizing pure Ni and Ni-Pd alloy on Ge-on-Si substrate was studied. The proposed Ni-Pd alloy shows the highly thermal immune Ni germanide due to reduced oxidation and retarded Ni and Ge diffusion. Therefore, the Ni-Pd alloy could be promising for the high mobility Ge MOSFET applications. [C1147]

"Meshfree framework for image-derived modelling"

Disorder of electrical propagation pattern might lead to serious heart attacks, so a variety of efforts have been developed to identify pathological patterns. Among those works, the most promising attempt is 3D model-based imaging of cardiac electrical activities. However, current models are computationally expensive and often too complicated to be adopted into clinical data. In this paper, we propose a meshfree framework, which can build a computational model from the image-derived geometry straightforwardly, without burden mesh generation. This image-derived framework opens great possibilities, including the ability to be directly integrated into our previous cardiac information recovery framework or explore cardiac electrical activities with clinical data. Experiments have been conducted on synthetic data to show the ability of the framework, and on real human data to show its practical potential. [C1148]

"Beyond ClearPET: Next aims"

The CRYSTAL CLEAR collaboration, in short CCC, is a consortium of 12 academic institutions, mainly from Europe, joining efforts in the area of developing instrumentation for nuclear medicine and medical imaging. In the framework of the CCC a high performance small animal PET system, called ClearPET, was developed by using new technologies in electronics and crystals in a phoswich arrangement combining two types of lutetium- based scintillator materials: LSO:Ce and LuYAP:Ce. Our next aim will be the development of hybrid image systems. Hybrid MR-PET imaging has many unique advantages for brain research. This has sparked a new research line within CCC for the development of novel MR-PET compatible technologies. MRI is not as sensitive as PET but PET has poorer spatial resolution than MRI. Two major advantages of PET are sensitivity and its ability to acquire metabolic information. To assess these innovations, the development of a 9.4T hybrid animal MR-PET scanner is proposed based on an existing 9.4T MR scanner that will be adapted to enable simultaneous acquisition of MR and PET data using cutting- edge technology for both MR and PET. [C1149]

"System sensitivity in preclinical small animal imaging"

Preclinical small animal imaging is an important tool at the disposition of biological researchers. While the range of studies performed by non-invasive preclinical imaging is greatly varied, high sensitivity is of key importance in any biological experiment with molecular imaging probes. The technologies that are used to achieve high system sensitivity mostly focus on the use of large solid angles and dense scintillator materials. In this work, we investigate and discuss different preclinical Positron Emission Tomography system designs and the effects of these designs on the overall sensitivity. We focus our investigations in hypothetical system geometries and scintillator materials and perform Monte Carlo simulations. The results indicate that preclinical PET systems based on detector materials that have minimal intrinsic background and higher effective atomic number, might offer performance advantages for situations where the weakest signal possible needs to be detected. [C1150]

"Branching medial models for cardiac shape representation"

The cm-rep (continuous medial representation) is a powerful shape representation method that models a 3D object by describing its medial axis (skeleton) and boundary as continuous parametric manifolds. It provides parametrization of the entire interior of the object, which can be used for combined statistical analysis of shape and appearance. This paper extends the cm-rep to more complex shapes with multi-figures, i.e., shapes whose skeletons have branches. Along the branching curves, the equality constraints enforced by the medial geometry are implemented as soft penalties in the deformable model. The remaining small violations are corrected by local adjustments. As a proof of concept, the branching continuous medial representation is applied to a 2-chamber heart model data set consisting of 428 cardiac shapes from 90 subjects. The results show that our model can capture the heart shape accurately. [C1151]

"Special Fault Tolerant properties of FFT-based transform domain Adaptive Filters"

Transform domain fault tolerant adaptive filters (FTAFs) rely on inherent learning capabilities of the adaptive process to compensate for transient (soft) or permanent (hard) errors in the hardware implementation. In this paper it is shown that an FFT-based transform domain FTAF operating on real valued signals can provide a considerable degree of fault tolerance without introducing redundant hardware. When the filter operates on real valued signals the added complexity of complex arithmetic provides additional fault tolerant capabilities that may be useful for adaptive filters implemented in highly scaled nano-technology circuits where soft and hard errors are of increasing concern. [C1152]

"Interconnect design and limitations in nanoscale technologies"

In this paper, the limitations posed by metallic interconnect in nano-scale technologies are discussed as well as design methodologies to deal with non-ideal interconnect. It is shown that there is a limit on how ideal an on-chip interconnect can be made independent of the how wide the wire is made. This limit is a function of the height of the interconnect, its length, and some other physical and material constants. It is also shown that it is possible to design a repeater system that results in close to speed of light propagation on narrow nanoscale wires. In addition, wider wires can be used to effectively eliminate the need for repeaters in current technologies. [C1153]

"Does the brain really outperform Rent's rule?"

This paper presents a thorough analysis of brain's connectivity from the perspective of the latest interpretation of Rent's rule, and using neurological data. While at first sight the brain might seem to outperform most of the known network topologies, a closer look will reveal that in fact it does not. From another perspective, the brain will seem to be just on the border of the latest range of Rent's rule values, while neurological data will show that it is almost right on the average. We conclude that, among quite a few network topologies, the crossbar (for very small sizes) and the cube connected cycles are highly competitive contenders for future brain-inspired nanoarchitectures. [C1154]

"Autocalibrated regularized parallel mri reconstruction in the wavelet domain"

To reduce the scanning time in some MRI applications, parallel acquisition techniques with multiple coils have been developed. Then, the full Field of View (FOV) image is reconstructed from the resulting registered subsampled k-space data. To this end, several reconstruction techniques have been proposed such as the widely-used SENSE method. However, the reconstructed image generally presents artifacts especially when perturbations occur in both the measured data and in the estimated coil sensitivity maps. In order to alleviate such shortcomings by limiting the distortions, Tikhonov regularization in the image domain has also been investigated. In this paper, we present a novel algorithm for SENSE reconstruction which proceeds with regularization in the wavelet domain, the hyperparameters being estimated from the data. Experiments carried out on real T1-weighted MRI data at 1.5 T indicate that the proposed algorithm generates reconstructed images with reduced artifacts in comparison with conventional reconstruction techniques. [C1155]

"Detection of the dermis/epidermis boundary in reflectance confocal images using multi-scale classifier with adaptive texture features"

Reflectance confocal microscopy is an emerging modality for dermatology applications, especially in-situ and bedside detection of skin cancers. Work to date has concentrated on hardware development and validation by clinicians in comparison with standard histological staining. As this technology gains acceptance, the development of automated processing methods becomes more important. We concentrate here on detection of the dominant internal feature of the skin, the epidermis/dermis boundary, a complex corrugated 3-dimensional layer marked by optically subtle changes and features. We adopt a machine learning approach to this segmentation problem, using a hierarchical multi-scale classifier with sophisticated on-line feature selection, to minimize the required expert labeling and maximize the range of potential features in the face of high inter- and intra-subject variability and low optical contrast. Initial results indicate the ability of our approach to recover the complex 3-D boundary surface. [C1156]

"Classification of dementia from FDG-PET parametric images using data mining"

It remains a challenge to identify the different types of dementia and separate these from various subtypes from the normal effects of ageing. In this paper the potential of parametric images from FDG-PET studies to aid the classification of dementia using data mining techniques was investigated. Scalar, joint, histogram and voxel-level features were used in the investigation with principal component analysis (PCA) for dimensionality reduction. The logistic regression model and the additive logistic regression model were applied in the classification. The results show that cerebral metabolic rate of glucose consumption (CMRGlc) was efficient in the classification of dementia and data mining using voxel-level features with PCA and the logistic regression model method achieving the best classification. [C1157]

"Automated lateral sectioning for Knife-Edge Scanning Microscopy"

Recent advances in high-throughput microscopy are used to acquire large-scale anatomical information at the microscopic level. One of these methods, known as knife-edge scanning microscopy (KESM), allows large volumes of tissue to be imaged using physical sectioning. This method has been limited, however, by constraints on the field of view of the objective and the need to prevent damage to tissue before it is imaged. In this paper, we describe a simple sectioning algorithm we use to overcome these constraints on tissue size. By maintaining a height field of the tissue surface, we are able to cut lateral sections while minimizing damage to un-imaged tissue. Although lateral sectioning introduces some deformation and tissue damage at the interface of the sections, the damage is minimal and the deformations can be compensated for using affine transformations. [C1158]

"Imaging dynamics of organs and drugs at sub-half-mm and sub-minute resolution using focusing pinhole SPECT"

We demonstrate new technologies for SPECT imaging with unsurpassed resolution in mice and rats. Results of the imaging of living animals will be shown. In addition development of detectors for next generation systems with an even higher resolution will be shown. [C1159]

"Real-time intra-operative 3D tissue deformation recovery"

Since the advent of laparoscopy, surgical technology has advanced on an exponential scale that has broadened the accessibility of the surgeon to the operative field with minimal incisions. Minimally Invasive Surgery (MIS) is carried out through natural body openings or small artificial incisions. It achieves its clinical goals with minimal inconvenience to patients, which results in reduced patient trauma, shortened hospitalisation, improved diagnostic accuracy and therapeutic outcome. With the introduction of robotic assisted MIS, the use of image guided surgical navigation is becoming increasingly popular, but it needs to handle non-rigid tissue deformation over the course of the procedure. In this paper, a probabilistic framework is presented that combines the strengths of different depth cues for tissue deformation recovery. The practicality of the technique is demonstrated using in vivo stereo laparoscopy data. Real-time intra-operative application of this technique has benefits for image based adaptive navigation and motion stabilisation in robotic assisted surgery. [C1160]

"Computer-assisted and image-guided abdominal interventions"

This paper gives an overview of computer-assisted and image-guided systems for abdominal interventions. Computer-assisted means that the power of the computer is used to provide the physician a virtual reality view of the anatomy. Image-guided means that the intervention is carried out based on imaging modalities such as CT, MM, and ultrasound. These minimally invasive procedures are rapidly increasing in popularity as they cause less trauma to the patient and the technology to carry them out continues to improve. [C1161]

"Investigation of the stress-strain curves of lead-free solder alloy"

In this paper, a new methodology to extract the elasto-plastic properties of lead-free solder materials from an instrumented sharp indentation loading curve has been proposed using dimensional analysis and finite element computation. The nano indenter XP technology is used to test samples of lead-free eutectic SnAgCu solder alloys to obtain a load-displacement curve, which can be used to calculate its hardness, elastic modulus and contact stiffness using the Oliver's method. Then, a group of dimensionless functions Pi (proposed by Dao et al.), that relate the characteristic parameters of indentation load- unloading curves to the mechanical properties obtained from the stress-strain curves, is used to predict the representative strain, the representative stress, strain hardening exponent and yield stress. Finally, according to the obtained parameters of materials, the 2D axial symmetrical element model was adopted to simulate the nanoindentation process by using the ANSYS finite element code. The validity of the new methodology is checked using the agreement of comparing the load-displacement curves of nanoindentation impressions in the experiments with FEM results. Eutectic SnPb solder was also examined for comparative purpose. [C1162]

"A 0.6V 32.5mW Highly Integrated Receiver for 2.4GHz ISM-Band Applications"

We explore the challenges of designing RF transceivers for an ultra-low-voltage (ULV) supply with performance that is compatible to commercial standards. The ITRS roadmap projects that the aggressive device size scaling will result in supply voltage reductions to well below IV, in particular for low-power technologies. The use of alternative energy sources also requires ULV operation in some applications. Achieving sufficient linearity with low power consumption is very challenging for the ULV mixer and baseband circuits. The on-chip LO generation and distribution is difficult due to the low-voltage device bias. We present optimized mixer and filter topologies, and a polyphase LO buffer, used in a low-power ULV receiver for 2.4GHz applications like Bluetooth or Zigbee. The use of spiral inductors is kept to a minimum to avoid their excessive area. The design techniques demonstrated here can enable the continued integration of RF front-ends onto SoC devices in nano CMOS technologies without requiring dedicated supply voltages or thick oxide devices. [C1163]

"Measurement of Nano-Displacement Based on In-Plane Suspended-Gate MOSFET Detection Compatible with a Front-End CMOS Process"

The first front-end CMOS co-integration based on the lateral SGMOSFET presented in this paper demonstrates the benefit of a co-integration approach for NEMS devices. Performance using this device is compared to that obtained with a standalone ASIC. The next step will consist of replacing equivalently the input transistor of the ASIC cascode structure by the SGMOSFET. [C1164]

"Modelling the Nano-Imprint Forming process for the production of miniaturised 3D structures"

Nano-imprint forming (NIF) as manufacturing technology is ideally placed to enable high resolution, low-cost and high-throughput fabrication of three- dimensional fine structures and the packaging of heterogeneous micro-systems (S.Y. Chou and P.R. Krauss, 1997). This paper details a thermo-mechanical modelling methodology for optimising this process for different materials used in components such as mini-fluidics and bio-chemical systems, optoelectronics, photonics and health usage monitoring systems (HUMS). This work is part of a major UK Grand Challenge project-3D-Mintegration-which is aiming to develop modelling and design technologies for the next generation of fabrication, assembly and test processes for 3D-miniaturised systems. [C1165]

"Wafer Scale Integration Enabling Space Science"

Wafer scale integration enables the ability to miniaturize space craft instrument builds. We use the term wafer scale to indicate a packaging concept where the wafer is the substrate eliminating the use of individually packaged microstructures. The key here is the combination of advanced integration and miniaturization. The Johns Hopkins University Applied Physics Laboratory (JHUAPL) in collaboration with the US Air Force Academy is building a wafer integrated plasma spectrometer (WISPER) for mapping missions. The fabrication of the WISPER instrument suite uses a number of Micro Electro Mechanical Systems (MEMS) and micro electronics fabrication technologies. JHUAPL has successfully demonstrated these approaches in the fabrication of the single instrument currently in orbit on the FalconSat-3 mission. This instrument is a Flat Plasma Spectrometer (FlaPS) which includes a sensor-head array, printed circuit board with amplifier array electronics, power supply, and chassis which occupies a volume of approximately 400 cm3in a 0.5 kg, 700 mW package. The sensor head array is fabricated and assembled at the wafer-level and stacked in a planar geometry. Together with common electronics to control the array, our design takes advantage of emerging micro- fabrication techniques including deep reactive ion etching, laser machining, and wire electrical discharge machining, as well as advanced electronic die assembly and packaging methods. Innovations in packaging combined with etch process steps from the micro-fabrication industry allow for novel instrument builds which will open up the realm of nano sats and cubesat in mapping missions. This paper reviews the combination of manufacturing methods, material combinations and packaging techniques that can be applied to miniaturizing space instrumentation. This work is representative of the next generation of space instruments that will be enablers for smaller and more cost effective missions. [C1166]

"Precision Spacecraft Tracking Using In-Beam Phase Referencing"

The deep space network (DSN) Array of the future provides an intriguing possibility of using the techniques of in-beam phase referencing to determine the angular position of spacecraft with accuracy at the level of 0.1 nano-radian (nrad). In this paper, we discuss the prospects for carrying out such measurements at both 8.4 GHz (X-band) and 32 GHz (Ka-band). Our study suggests that at X-band in-beam calibration may be available as an astrometric tool over 20-30 percent of the sky. The prospects at Ka-band, on the other hand, are not very hopeful. We point out that these estimates depend strongly on the number density of compact sources at the 1-mJy level. We also present the results from our recent VLBA (very long baseline array) observations at X-band, which has determined the compact source density at the 10-mJy level and discuss future observations to probe weaker source population. Finally, we discuss issues related to phase cycle ambiguity resolution and potential techniques to resolve them. [C1167]

"The CubeSat Approach to Space Access"

As advances in technology make payloads and instruments for space missions smaller, lighter, and more power efficient, a niche market is emerging from the university community to perform rapidly developed, low-cost missions on very small spacecraft-micro, nano, and picosatellites. Among this class of spacecraft, are CubeSats, with a basic form of 10 times 10 times 10 cm, weighing a maximum of 1kg. In order to serve as viable alternative to larger spacecraft, small satellite platforms must provide the end user with access to space and similar functionality to mainstream missions. However, despite recent advances, small satellites have not been able to reach their full potential. Without launch vehicles dedicated to launching small satellites as primary payloads, launch opportunities only exist in the form of co-manifest or secondary payload missions, with launches often subsidized by the government. In addition, power, size, and mass constraints create additional hurdles for small satellites. To date, the primary method of increasing a small satellite's capability has been focused on miniaturization of technology. The CubeSat Program embraces this approach, but has also focused on developing an infrastructure to offset unavoidable limitations caused by the constraints of small satellite missions. The main components of this infrastructure are: an extensive developer community, standards for spacecraft and launch vehicle interfaces, and a network of ground stations. This paper will focus on the CubeSat Program, its history, and the philosophy behind the various elements that make it a practical an enabling alternative for access to space. [C1168]

"Low Power and Reliable Interconnection with Self-Corrected Green Coding Scheme for Network-on-Chip"

In this paper, a low power joint bus and error correction coding is proposed to provide reliable and energy-efficient interconnection for network-on-chip (NoC) in nano- scale technology. The proposed self-corrected ";green"; (low power) coding scheme is constructed by two stages, which are triplication error correction coding (ECC) stage and green bus coding stage. Triplication ECC provides a more reliable mechanism to advanced technologies. Moreover, in view of lower latency of decoder, it has rapid correction ability to reduce the physical transfer unit size of switch fabrics by self- corrected technique in bit level. The green bus coding employs more energy reduction by a joint triplication bus power model for crosstalk avoidance. In addition, the circuitry of green bus coding is more simple and effective. Based on UMC 90 nm CMOS technology, the simulation results show self-corrected green coding can achieve 34.4% energy reduction with small codec overhead. This approach not only makes the NoC applications tolerant against transient malfunctions, but also realizes energy efficiency. [C1169]

"A Self-Scheduling Model for NASA Swarm-Based Exploration Missions Using ASSL"

This article presents our research towards a self-scheduling mechanism for the NASA swarm-based exploration missions. By its virtue, ANTS (Autonomous Nano Technology Swarm) is considered to be an autonomic system with autonomic behavior that constitutes a self-scheduling mechanism, thus allowing task distribution on the fly with no human intervention. The goal of this work is to investigate a possible self-scheduling mechanism for ANTS, in accordance with the system and environmental conditions. In this paper, a formal task-scheduling approach is presented, and the ANTS self-scheduling behavior is modeled and specified with ASSL (Autonomic System Specification Language), where the group and individual tasks are structured in the fashion of TAFT (Time Aware Fault-Tolerant). TAFT is a recently devised approach that applies tolerance to timing violations. [C1170]

"Simultaneous FU and Register Binding Based on Network Flow Method"

With the rapid increase of design complexity and the decrease of device features in nano-scale technologies, interconnection optimization in digital systems becomes more and more important. In this paper we develop a simultaneous FU and register (SFR) binding algorithm for multiplexer optimization based on min-cost network flow. Unlike most of the prior approaches in which functional unit binding and register binding are performed sequentially, our approach performs these two highly correlated tasks gradually and concurrently. We also present an ILP formulation of the combined functional unit and register binding problem for the optimality study of heuristics. Experimental results show that when compared to traditional binding algorithms, our simultaneous resource binding algorithm is close to optimal solutions for small-size designs (only 5% more MUX) and achieves significant reduction for MUX area (12%) and timing (10%) for a set of real-life benchmark designs. [C1171]

"A Development of the Nano OS Kernel based on System State-Monitor for Ubiquitous Sensor Network"

In this paper, the problems that MCU stopping and the auto-reset in sensor nodes, and the dead end transition in nano OS kernel are analyzed and confirmed. In addition to this, the solutions to tolerate the confirmed problems are also suggested and the performance of the suggested solutions was evaluated by variable experimentation. The 1stmechanism is the stack-safe nano OS kernel suitable for USN using the nano QPlus 1.6 version that is released at present time for application program to run safely even though the stack overflow problem during program execution is occurred in sensor module. The 2ndmechanism is the system state-monitor mechanism that recoveries the modules to normal state even though the main modules of kernel are transited to dead end or deadlock state in the nano OS. [C1172]

"Commentary: Trends, Challenges and Opportunities in Semiconductor Memory Technology Scaling"

As IC dimensions continue to shrink into the nanometer realm, conventional CMOS scaling appears to be running up against thermal and physical scaling wall. Technology innovations that can circumvent these scaling limits are required in order to achieve the performance gains needed to support the market demands. These performance requirements are driving the introduction of new materials and devices architectures in the process flow. In addition, the aspect ratio of nanostructures is increasing since the vertical dimension of the nano scale device structures in many instances, does not shrink. These high aspect ratio nanostructures pose a variety of new challenges related to patterning, deposition, and cleaning processes, and for the mechanical stability during and after fabrication. Nanotechnology is driving developments of materials with unique physical and chemical characteristics. These materials can potentially help extend the scaling of CMOS based semiconductor devices for logic and memory applications. For memory, conventional charge based concepts may be reaching fundamental limits and new concepts need to be explored. [C1173]

"New Y-function-based methodology for accurate extraction of electrical parameters on nano-scaled MOSFETs"

We developed a new Y-function-based extraction methodology to overcome the difficulties encountered by applying the conventional techniques. Our method relies on a robust recursive algorithm which requires a limited number of input parameters on which the results have a weak dependence, and so an increased reliability. The obtained results are in line with the previous methods, but show an improved accuracy. Finally, parameter extraction performed through this technique has provided accurate and reliable results over a large range of MOSFET architectures. [C1174]

"FIB-Sputtering Characteristic of Mold Material and Nano Grid Pattern Fabrication"

Recently, FIB-Sputtering process has been applied to many micro-manufacturing fields such as semi-conductor industries, display industries and IT industries etc. because it is available to fabricate the micro 3D shape structure directly and more effectively than other machining processes. However, currently FIB is not applied in the fabrication of this micro mold because of some problems such as redeposition and charging effect relating to shape accuracy and productivity. Furthermore, the prediction of the material removal rate is difficult for micro structure fabrication. In this paper, we studied the FIB-Sputtering rate according to mold materials. As well, surface roughness characteristics were analyzed for micro and nano mold fabrication. Si wafer, G.C (glassy carbon), STAVAX, and DLC that have been normally considered as good micro or nano mold materials were used in this study. And also we have known the pattern by pattern procedure has more good fib-sputtering shape than layer by layer procedure. [C1175]

"Advanced Nano CMOS Platform using Carrier-Transport-Enhanced Channels"

It has been well recognized that, under sub-100 nm regime, conventional device scaling concept has confronted with several physical and essential limitations. Therefore, any new device engineering to realize advanced CMOS by overcoming these difficulties is strongly needed. A group of theses new device technologies called the technology boosters can be classified mainly into three categories, gate stack engineering, source engineering and channel engineering. Particularly, the channel engineering includes carrier-transport-enhanced channels aiming at high current drive and multi-gate channels aiming at high immunity for short channel effects. Among them, the carrier-transport-enhanced channels, typically seen in strained-Si channels, are recently becoming more important. [C1176]

"A Study of Slow Erasing Speed at Edge Cell in Nano-Scale NAND Flash Memory"

In this paper, we present our study of a method to improve nonuniform erasing speeds caused by slow edge cells (cell 0 and cell 31). Simulation and measurement results showed that the slow erasing speed at edge cells is resulted from the coupling effect of select gate (SG) transistors. Moreover, several extra bias voltages were forced on the pass wordlines to evaluate the electrostatic potential difference and to improve erase uniformity. Simulation result and measurement data demonstrated that 0.4 V of the extra bias voltage can improve the uniformity of the erasing speed in nano-scale NAND flash memory. [C1177]

"Progress and Future of Carbon-Based Electronics"

In the last few decades, the semiconductor industry has been able to maintain steady improvements of device performance by the scaling of silicon-based devices. However, this approach will soon meet both scientific and technical limits, and there have been tremendous efforts to seek alternative device technologies. Some approaches involve moving away from traditional charge-based electronics, such as spin-based transport or nano-mechanical switches. Another approach maintains the operating principle of current technology with the emphasis on new materials that provide superior performance. In this respect, carbon-based nanomaterials, including one-dimensional carbon nanotubes and two-dimensional graphene, are probably the most promising candidate[Ph. Avouris et al. (2007)]. [C1178]

"Statistical Compact Modeling of Variations in Nano MOSFETs"

We present a methodology to generate performance-aware corner models--PAM. Accuracy is improved by emphasizing electrical variation data and reconciling the process and electrical variation data. PAM supports corner (plusmnsigma and plusmn2sigma) simulation and MC simulation. Furthermore, PAM supports application-specific corner cards, for example, for gain sensitive applications. [C1179]

"Nano-Sized Spherical Polyelectrolyte Brushes: Potential Protein Carriers and Diagnostic Tools"

By using a novel method of thermo-controlled emulsion polymerization, we prepared biocompatible nano-sized spherical polyelectrolyte brushes which consist of a solid polymer core and a poly(acrylic acid) (PAA) shell covalently attached on the core surface densely by one end. Dynamic light scattering (DLS) was employed to determine the size of the brushes and to monitor the brush growing during the preparation. The size of the brush is tunable by controlling pH and salt concentration in the solution while the pH and salt concentration inside the brush keep constant due to the polyelectrolyte Donnan effect. These nano-sized spherical polyelectrolyte brushes should be ideal candidates for protein carriers and diagnostic tools after attaching diagnostic groups inside the brushes. [C1180]

"Photocatalytic Oxidation Kinetics of Thiophene with Nano-TiO2 as Photocatalyst"

Photocatalytic oxidative kinetics of thiophene in n-octane/water extraction system was studied with nano-TiO2powders as photocatalyst and O2in air as oxidant. Influence of initial concentration of thiophene and addition of TiO2on reaction rate constant and half time were investigated. Kinetics equation was founded. The results showed that the approviate addition of TiO2was 0.1 g in 100 mL reaction system and the photooxidation kinetics of thiophene with TiO2was first-order with rate constant of 0.6405 h-1and half-time of 1.0822 h under the conditions with initial concentration of thiophene at 800 muLldrL-1and addition of TiO2at 0.1 g. The reaction rate constant increased with the decrease of initial concentration of thiophene. [C1181]

"Oxidative and Binding Effect of Nano-TiO2 on Plasmid DNA and Pepsin"

With the development of nano material industry, more and more attention has been paid on the biological effect of nano materials. However, little research focused on the effect of nano TiO2on protein level. In this study, we detected the toxic effect of nano TiO2(50~60 nm) on DNA and functional proteinase. The oxidative damage of nano TiO2on DNA was detected by gel electrophoresis and HPLC. Anson method was used to study the inhibition of nano TiO2on pepsin, and the mechanism of the reaction was further researched by the method of UV-Vis scan and TEM. The results showed that the ratio of super-coiled DNA decreased significantly both under UV radiation and visible light. Levels of 8-OHdG generated from DNA increased from 27.66 8- OHdG/104 dG to 296.69 8-OHdG/104 dG after treated with nano TiO2. After water incubated with nano TiO2at 37degC, the activity of pepsin decreased with the increase of the concentration of particels, UV-Vis scan and TEM detection proved the binding effect of nano TiO2on pepsin, which indicated potential usage for oral drug delivery of nano TiO2. [C1182]

"Pre-silicon SPICE modeling of nano-scaled SOI MOSFETs"

Problems of pre-silicon compact modeling of nano-scaled silicon-on-insulator MOSFETs are addressed using the extraction of SPICE model parameters directly from numerical TCAD simulations. Although there are difficulties in the parameter extraction for the standard SPICE compact models we show by a direct comparison with the results of the numerical mixed-mode TCAD simulations that with some trade-offs in accuracy of static device characteristics reasonably accurate transient SPICE simulations are possible for such transistors. [C1183]

"2008 9th international conference on ULtimate Integration on Silicon"

The following topics are dealt: ultimate integration on silicon; advanced semiconductor device technology; innovative nano-electronic devices; pMOSFET and FinFET modelling; strained silicon devices; gate dielectrics; semiconductor device modeling and characterization. [C1184]

"Copper Nanotubes for Packaging Applications"

In this paper, we present a process for fabricating Copper (Cu) nanotubes, which can be utilized for novel electrical interconnect materials. Because of superior properties in electromigration and thermal management to aluminum, Cu technology has been attractive to the semiconductor industry. Cu nanotubes can be fabricated by electrodeposition using alumina nanopore templates. Nanotubes can provide high surface-to-volume ratio in nanostructures compared to nanorods. In addition, nanotubes provide lower resistively and high thermal conductivity. Cu nanotube arrays were electrodeposited into alumina nanopore membranes with pore diameters of approximately 30 nm and 50 nm, with estimated porosity of 43%, by nano template-based electrodeposition. [C1185]

"Modeling and Characterization of Capacitively Coupled Interdigital-Gated HEMT Plasma Device for Terahertz Wave Amplification"

A capacitively coupled interdigital-gated HEMT structure was used to investigate the occurrence of uniformity of electric field distribution along the structure. The structure was designed and simulated using Commercial Electromagnetic Sonnet Suites software. The return loss characteristics were analyzed and evaluated. The comparison of the admittance characteristics from simulation between dc connected structure and capacitively coupled structure is carried out in order to evaluate electromagnetic wave propagation. This structure kept uniform electric field in the channel when the dc biased is applied to the interdigital gate, which modulates the potential in the channel. [C1186]

"New functionality and ultra low power: key opportunities for post-CMOS era"

This paper addresses the challenges and opportunities offered by post-CMOS devices in terms of new functionality and ultra low power. It focuses on the illustration of: (i) the quest for the new electronic abrupt switches (tunnel-FET and IMOS/PIMOS) and (ii) the quest for new functionality that can be offered by some non-pure electronic functions (as nano-mechanical integrated functions offered by suspended gate-FET). It is shown that beneficial interactions between the beyond CMOS and More-than-Moore domains should be considered in the post-CMOS era. A system design perspective with particular attention to the true benefits at circuit and system levels and the need for accompanying the technology and device effort by adapted design and/or new system architectures, is discussed and illustrated with some examples concerning power management, digital and analog applications. [C1187]

"Landscape of Combinatorial Materials Exploration and High Throughput Characterizations for the Post-CMOS Devices"

A combinatorial synthesis and high throughput characterization was employed to accelerate the new materials exploration. Also tow basic guide lines were shown to design the future nano CMOS. They are amorphous structure and defect control. As examples, we examined a HfO2-Y2O3-Al2O3ternary oxide for gate oxide and Pt-W, Ru-Mo amorphous metals for metal gate. Moreover, C-incorporation is effective to obtain metal electrodes with a smaller grain size, which would be required for ultimate short-channel MIS-FET devices in 32-22 nm node and beyond to suppress variability of electric properties as well. [C1188]

"P-Channel I-MOS Transistor featuring Silicon Nano-Wire with Multiple-Gates, Strained Si1-y Cy I-region, in situ doped Si1-y Cy Source, and Sub-5 mV/decade Subthreshold Swing"

We realized Impact Ionization Nanowire Multiple-gate Field- Effect Transistors (I-MuGFETs or I-FinFETs) having a multiple- gate/nanowire-channel architecture to exploit the superior gate-to- channel coupling for reduced breakdown voltage VBD and enhanced device performance. The first p-channel Impact Ionization MOS transistor (I-MOS) having in situ doped source was also demonstrated. An in situ phosphorus-doped Si source with improved dopant activation and very abrupt junction profile reduces VBDand enhances the on-state current Ion. A further improvement was also made by incorporating strained Si1-yCyimpact-ionization region (I-region) and in situ doped Si1-yCysource, leading to further reduction in VBD and enhancement in Ion. This is due to strain-induced reduction of the impact-ionization threshold energy Eth. In addition, excellent subthreshold swing of below 5 mV/decade at room temperature was achieved for all devices. [C1189]

"The Feed-Back from a Biodevices and Cellular Nano-Electronics Course Learned in an Electrical Engineering Faculty"

This paper reports the feed-back from a pilot new course, proposed in 2005 and accepted in 2006 for next years at the Polytechnic University of Bucharest, Romania, Faculty of Electronics, Microsystems Specialization at master studies. The BioNEC course entitled Biodevices and Cellular Nano-Electronics is dedicated to the Biosensors, Biosignals and Biomodeling, accordingly with the European curricular area. Placed at the cross-point of Biology and Electronics Engineering, this course intends to familiarize the future engineers with the new trends, products and applications in bio-engineering. [C1190]

"A rapid interference detector for ultra wideband radio systems in 0.13µm CMOS"

A broadband low-power down-converter that can rapidly scan the UWB spectrum within several tens of nano-seconds to detect large interferers, is presented. The detector employs cascaded image-reject stages, each consisting of harmonic-rejection mixers, and decomposes the spectrum into 16 equal sub-bands. The LO path uses a single HF input with integer dividers. The IC is in 0.13 mum CMOS. It requires 17 mA in the signal path and 24 mA for the LO path from a 1.2 V VDD, while spanning 1.75 to 8.75 GHz. [C1191]

"Top down nano technologies in production of integrated circuits and surface modification of materials"

As microelectronic devices continue to shrink and process requirements become ever more stringent, plasma modeling and simulation becomes increasingly more attractive as a tool for design, control and optimization of plasma reactors. Nowadays, plasma- etching processes are expected to produce patterns from the nanometer to the micrometer range. Charging effects in the etching of dielectrics due to ions accumulation in the shallow trenches or contact hole cause damage such as notching and earlier etching stop. In this article, a brief overview of the plasma etch process with emphasis on charging induced damage has been made. In addition, a level set method was applied to the 3D simulation of the etching profile of high aspect ratio trenches into silicon. Calculations were performed in the case of simplified model of Ar^+/CF_4non-equilibrium plasma etching of SiO_2. The time dependence of the profile charging as well as charging on profile during SiO_2etching in plasma are presented. We shall also illustrate the properties of etching of organic low-k dielectrics. [C1192]

"An Integrated Clinico-Proteomics Information Management and Analysis Platform"

Detecting proteins in human blood holds the promise of a revolution in cancer diagnosis. Also, the ability to perform laboratory operations on small scales using miniaturized (lab-on-a-chip) devices has many benefits. Designing and fabricating such systems is extremely challenging, but physicists and engineers are beginning to construct such highly integrated and compact labs on chips with exciting functionality. This paper focuses on the presentation of the information technology layer in such an integrated platform that has been developed in the LOCCANDIA project. LOCCANDIA ultimate objective is to develop an innovative nano-technology based (lab-on-a-chip) platform for the medical-proteomics field. The paper presents the main engineering aspects and the architecture of the integrated Clinico-Proteomic environment. [C1193]

"Growing Interest of Advanced Commercial CMOS Technologies for Space and Medical Applications. Illustration with a New Nano-Power and Radiation-Hardened SRAM in 130nm CMOS"

This paper reviews recent experimental confirmations that the intrinsic radiation robustness of commercial CMOS technologies naturally improves with the down-scaling. When additionally using innovative design techniques, it becomes now possible to assure that performance and radiation-hardness are both met. An illustration is given with an original nano-power and radiation-hardened 8 Mb SRAM designed in 130 nm CMOS. [C1194]

"Nanotube and other interconnects for nanotechnology circuits"

Interconnects will play a crucial role in the development of the nanoscale integrated circuits. In addition to the development of the nano devices, interconnects that will be used to connect these devices in nanotechnology circuits deserve a very special attention. In this paper, potential technologies for nanoscale circuit interconnects (metallic, nanowires, nanotubes and quantum wires) have been reviewed with emphasis on the carbon nanotube based interconnects which have shown the greatest promise so far. [C1195]

"Novel paper-based inkjet-printed antennas and wireless sensor modules"

In this paper, inkjet-printed flexible antennas fabricated on paper substrates are introduced as a system-level solution for ultra-low-cost mass production of UHF radio frequency identification (RFID) tags and wireless sensor nodes (WSN) in an approach that could be easily extended to other microwave and wireless applications. The presented material is a review of our grouppsilas major reported milestones in this area. First, we discuss the benefits of using paper as a substrate for high-frequency applications, reporting its very good electrical/dielectric performance up to at least 1 GHz. The RF characteristics of the paper-based substrate are studied by using the microstrip ring resonator in order to characterize the dielectric properties (dielectric constant and loss tangent). Then, we give details about the inkjet printing technology, including the characterization of the conductive ink, which consists of nano-silver-particles, while highlighting the importance of this technology as a fast and simple fabrication technique especially on flexible organic (e.g. LCP) or paper-based substrates. A compact inkjet-printed UHF ldquopassive-RFIDrdquo antenna using the classic T-match approach and designed to match ICpsilas complex impedance, is presented as a demonstrating prototype for this technology. In addition, the author briefly touches up the state-of-the-art area of fully-integrated wireless sensor modules on paper and show the first ever 2D sensor integration with an RFID tag module on paper, as well as the possibility of a 3D multilayer paper-based RF/microwave structures. The presented approach could potentially set the foundation for the development of low-cost light-weight autonomous nodes for cognitive intelligence applications and for wearable communication and biomonitoring systems. [C1196]

"Statistical Device Variability and Its Impact on Design"

It is widely recognized that the uncontrollable statistical variability in device characteristics represent major challenges to scaling and integration for present and next generation nano-CMOS transistors and circuits. This will in turn demands revolutionary changes in the way in which future integrated circuits and systems are designed. Strong links must be established between circuit design, system design and fundamental device technology to allow circuits and systems to accommodate the increasing statistical variability. This will add significant complexity to the design process, requiring orchestration of a broad spectrum of design tools by geographically distributed teams of device experts, circuit and system designers. In this talk we review the major sources of variability in CMOS devices focusing at and beyond 45 nm technology generation and beyond. The focus is on intrinsic parameter fluctuations introduced by discreteness of charge and matter, which play an increasingly important role in the present and future CMOS devices and cannot be controlled or reduced by tightening the process tolerances. [C1197]

"Adaptive Reliable Chips-Reconfigurable Computing in the Nano Era"

The field of embedded electronic systems is still emerging, e.g. in attractive products from wide-spreaded industry as well as in corresponding academic and industrial research activities. Here, multipurpose adaptivity and reliability features are playing more and more central roles, especially while scaling silicon technologies down according to Moore's goals. This keynote will discuss the challenges arising out of this situation and will try to outline some promising perspectives for future adaptive, reliable and complex systems-on-chip. [C1198]

"The Role of Test in Circuits Built with Unreliable Components"

The talk will reconsider the role of the test in new emerging device circuits for CMOS Terascale and further technologies where a high level of redundancy will be present. As far as we are getting close to ultimate CMOS and ulterior new emerging nano-devices technologies the indication made by J. von Neumann in 1950 that errors had to be viewed not as an extraneous accident but as an essential part of the process under consideration caused by natural phenomena is becoming a real fact. It is well accepted that at the same time electronic technology is going into the deep nanoscale the device reliability decreases rapidly. For such future technologies internal electromagnetic coupling or just thermal noise as well as permanent manufacturing defects will cause a loss of reliability and introduce an inherent error probabilistic factor to every component of the system. These deviations motivate new design paradigms. Many of these deviations will be transient in nature, at the same time current computer architecture approaches are reaching their practical limits. In order to build reliable electronics it will be necessary to include fault and defect tolerant schemes through the introduction of massive redundancy. Within this change of scenario, in comparison to conventional deterministic logic circuits these emerging technologies have to face new design and test strategies in order to give support to this probabilistic behavior logic. [C1199]

"Plasmonic, Carbon Nanotube and Conventional nano-interconnects: a comparison of propagation properties"

The scaling of the integrated circuits foreseen by the technology roadmap imposes tight requirements to the interconnects, in terms of latency, energy density and bandwidth. Innovative solutions are proposed to replace the traditional copper technology at nanometric scale. In this paper we investigate the behavior of some of these innovative interconnects, namely carbon nanotube interconnects, arrays of plasmonic nanoparticles and surface plasmon-polariton waveguides. Starting from the electrodynamic models describing such structures, the performances in terms of latency and decay lengths are compared. [C1200]

"3D device modeling of damage due to filamentation under an ESD event in nanometer scale drain extended NMOS (DE-NMOS)"

We present a detailed understanding of filamentation, through rigorous mixed-mode 3D simulation in a nano-meter scale drain-extended NMOS (DE-NMOS). Localization is first triggered in the 2D plane due to regenerative turn-on of the parasitic bipolar. 3D Simulations performed by adding width along the Z-axis (i.e., W) show a very prominent localization effect, which leads to electro-thermal runaway in the DE-NMOS and causes an irreversible damage. [C1201]

"Survey of characterization and metrology for nanoelectronics"

Advances in process technology enable high volume manufacture of integrated circuits with nano-scale transistor and interconnect technology. This fabrication capability results in the availability of a great range of nano-scale materials and structures such as nano-tubes, thin films, nano-dots, and nanowires. Many of these materials are under consideration as the material for beyond CMOS switches. There are two themes emphasized in this paper. First, materials exhibit new phenomena such as quantum confinement at nano-scale dimensions. Measurements not only observe these phenomena, determination of the dimensions of nanoscale materials requires understanding of these phenomena. Second, simulation and modeling at nano-scale dimensions is critical to both device operation and metrology. This extended abstract reviews the materials characterization and metrology methods necessary for measuring materials properties. This abstract covers several of the many measurement methods necessary for nanoscale characterization and metrology. [C1202]

"Significance of Conductivity and Thickness of Thin Inkjet Printed Microstrip Lines"

The effect of conductor loss of very thin lossy printed silver nano-particle traces manufactured using the printable electronics technology is studied up to 10 GHz by simulations and measurements. First, microstrip resonators are used as test structures with measurements and simulations. In addition to this, the behavior of the attenuation of microstrip lines with different conductivity value and layer thickness pairs have been studied with simulations to achieve basic guidelines for the effects of parameter variation. [C1203]

"New nano-devices for cancer diagnosis and therapeutic treatment"

Cancerous cells and tumours may occur in any part of the body any time and hence proper diagnosis and treatment of such diseases would need immediate attention. Presently, conventional radiological diagnostic and therapeutic techniques are in use but more reliable and quick techniques are required to be developed to tackle the problem of cancer and tumours, in an effective manner. The current diagnosis techniques are usually in tissue level, and have limitation of low efficiency to detect specially invisible cancer cells. The treatment technique for cancer has been surgery, with or without radiotherapy, for years, while chemotherapy, is also used extensively these days, but this has its limitation of efficacy and the patients suffer from severe side effects. [C1204]

"Session 1 Abstract: Ubiquitous, Pervasive and Nano-technology"

{no data available} [C1205]

"Statistical leakage modeling in CMOS logic gates considering process variations"

The dramatic increase in leakage current, coupled with the swell in process variability in nano-scaled CMOS technologies, has become a major issue for future IC design. Moreover, due to the spread of leakage power values, leakage variability cannot be neglected anymore. In this work an accurate analytic estimation and modeling methodology has been developed for logic gates leakage under statistical process variations. The developed methodology is completely based on BSIM4 equations, implemented in Verilog-A, and applicable to any different CMOS technologies (90 nm, 65 nm, etc), electrical simulators and models. For the first time subthreshold, gate, BTBT, and GIDL leakage variations are considered. Comparisons to Monte-Carlo simulation on 90 and 65 nm STMicroelectronics CMOS technologies fully validate the accuracy of the proposed method and demonstrate the efficiency of the proposed analysis method. [C1206]

"An Interuniversity Research, Development, and Training Center in Nano: National Nano Device Laboratories, Taiwan, Republic of China"

Taiwan has been one of the centers of chip manufacturing, known as Silicon Island. In order to keep technical advances, it demands a mechanism to strengthen research and development of new technologies as well as train more high-tech personnel. The National Nano Device Laboratories (NDL) has been playing an important role to fulfill aforementioned objectives in Taiwan since 1992. To establish the competence in the mainstream of globalization, internationalization of NDL is a must for the development of this silicon island. Therefore, the purpose of this presentation is to introduce NDL as well as promote the information exchange and stimulate the interactions between the author and the participating scientists for potential research collaborations. [C1207]

"Digital design using quantum-dot cellular automata (A nanotechnology method)"

This paper presents the design, layout, and successful simulation of a QCA multiplexor. Quantum-Dot Cellular Automata (QCA) is one of several proposed computational nanotechnology paradigms that are being investigated as alternatives to CMOS at the nano-scale. QCA has been reported to offer relatively low power consumption and very high device density. Unlike conventional computers in which information is transferred from one place to another by means of electrical current, QCA transfers information by propagating a polarization state. In recent years, several researchers have started investigating relatively complex circuit architectures using QCA. [C1208]

"Low Leakage High Speed Carbon-Nano Tube Field Effect Transistor Based Look Up Table"

This paper proposes an energy efficient Carbon Nanotube Field Effect Transistor (CNFET) based architecture of 4-input Look-up Table (LUT), a building block of Field programmable gate arrays. HSPICE simulation based on Berkeley Predictive Technology Model (BPTM) for 32 nm channel length device shows that for Iso-area, the CNFET based LUT is 98% more leakage power efficient than the LUT implemented in the bulk CMOS. Similarly, at operating frequency of 250 MHz and at supply voltage of 0.9 V compared to bulk CMOS LUT, the proposed Hybrid LUT and CNFET LUT provides 36% and 53% improvement in power delay product respectively. [C1209]

"Nanopores for the study of single biomolecules"

Nanoscale containers and devices fabrication and application are recently attracted much attention. The surface profiles of nanoscale patterns are very important for nanotechnology and nano-devices integration. Nanopits and nanopores arrays are fabricated with focused ion beam tool. The morphologies of these small containers were explored by atomic force microscopy. The topography of every nanopattern looks like a volcano; and each nanopit has a V-shaped cross section with a pronounced ring-shaped structure that surrounds the crater. The main reason of this protruded ring structure is the swelling of the substrate due to amorphization and it is the inherent shape obtained by single-pass FIB milling. In this fabricating case, the redeposition effect is minor. The atomic force microscopy results of the nanopits rim morphologies are helpful to the micro- and nanoscale devices integration. [C1210]

"Exploiting Parametric Power Supply and/or Temperature Variations to Improve Fault Tolerance in Digital Circuits"

The implementation of complex functionality in low-power nano-CMOS technologies leads to enhance susceptibility to parametric disturbances (environmental, and operation-dependent). The purpose of this paper is to present recent improvements on a methodology to exploit power-supply voltage and temperature variations in order to produce fault-tolerant structural solutions. First, the proposed methodology is reviewed, highlighting its characteristics and limitations. The underlying principle is to introduce on-line additional tolerance, by dynamically controlling the time of the clock edge trigger driving specific memory cells. Second, it is shown that the proposed methodology is still useful in the presence of process variations. Third, discussion and preliminary results on the automatic selection (at gate level) of critical FF for which DDB insertion should take place are presented. Finally, it is shown that parametric delay tolerance insertion does not necessarily reduce delay fault detection, as multi-vdd or multi-frequency self-test can be used to recover detection capability. [C1211]

"Reliability in Application Specific Mesh-Based NoC Architectures"

Networks on chips (NoCs) provide a mechanism for handling complex communications in the next generation of integrated circuits. At the same time, lower yield in nano-technology, makes self repair communication channels a necessity in design of digital systems. This paper proposes a reliable NoC architecture based on specific application mapped onto an NoC. This architecture is capable of recovering from permanent switch failures via replacing them by neighboring switches. This method has hardware and power consumption overhead, but significantly improves reliability and has a very little effect on the performance of the system. We suggest a reliability analysis method based on the combinatorial reliability models and use it to evaluate our proposed fault-tolerant NoC architecture. [C1212]

"Yield Improvement, Fault-Tolerance to the Rescue?"

With the technology entering the nano dimension, manufacturing processes are less and less reliable, thus drastically impacting the yield. A possible solution to alleviate this problem in the future could consist in using fault tolerant architectures to tolerate manufacturing defects. In this paper, we analyze the conditions that make the use of a classical triple modular redundancy (TMR) architecture interesting for a yield improvement purpose. [C1213]

"Silicon-On-Nothing (SON) applications for Low Power technologies"

The power consumption and the matching will be the principal issues at the 32 nm node and below. In this context, Ultra-Thin Body devices are extensively studied for the end-of-roadmap CMOS. In this paper we present the SON technology, leading to the simple fabrication of sustained mono-Si nano-membranes over an empty tunnel, and discuss on the application of this process to build-up electronic devices. This technology opens a wide range of applications, in particular for the realization of localized single-gate fully depleted transistors on bulk substrates and of double-gate planar devices, co-integrable with conventional bulk devices. [C1214]

"Probabilistic modeling of nanoscale adder"

This paper presents the probabilistic logic model to compute the probability distribution of the nano gate states. The characterization is based on the Markov random field and statistic physics. The primary logic gates are probabilistically characterized. The effectiveness of the method is demonstrated by a full adder and an 8-bit adder. The analysis shows that the device probability distribution highly depends on the system structures and other performance parameters. [C1215]

"Low-voltage limitations and challenges of nano-scale CMOS LSIs-A personal view of memory designer -"

The minimum operating voltage (Vmin) of nano-scale LSIs is investigated, focusing on logic gates, SRAM cells, and DRAM sense amplifiers in LSIs. The Vminthat is governed by SRAM cells rapidly increases as devices are miniaturized due to the ever-larger variation of the threshold voltage (VT) of MOSFETs. The Vmin, however, is reduced to the sub-one-volt region by using repair techniques and new MOSFETs (e.g., FD-SOIs and/or high-k metal gates) that can reduce VTvariations. [C1216]

"Reliability issues for nano-scale CMOS dielectrics:-From transistors to product reliability-- From SiON to high-k dielectrics -"

Continuous scaling, necessary for enhanced performance and cost reduction, has pushed existing CMOS materials much closer to their intrinsic reliability limits, forcing reliability engineers to get a better understanding of circuit failure. This requires that designers will have to be very careful with phenomena such as high current densities or voltage overshoots. In addition to the reliability issues, new materials as metal gates and high-k gate dielectrics have been integrated. These new materials require that we gain understanding of the reliability physics related to these new materials and that we develop high confidence-level design rules. These new materials require a high understanding level of their reliability issues, as well as the development of high confidence level design rules. [C1217]

"SALAMANDER: A Distributed Sensor System for Aquatic Environmental Measurements"

This report details a new distributed measurement system, "SALAMANDER, " which stands for serial amphibious linear arrays of micro and nano devices for environmental research. The SALAMANDER platform is designed for a wide range of users, from students to environmental researchers. Modular construction allows users to customize a high spatial density sensor array for fundamental and applied studies of sediment transport. We demonstrate integration of temperature, pressure, flow rate and optical turbidity sensors into a data collection system designed for a two-week battery life. Specifications are given for integrating new sensor types such as sample collectors and chemical sensors for determining the composition of sediment in this multi-year project. [C1218]

"Low-noise Instrumentation for the Measurement of Piezoresistive AFM Cantilever Deflection in Robotic Nanobiocharacterization Applications"

Characterization of biological samples with nano-resolution is an extremely growing research area due to the evolution of the technology for developing nanosensors for biological measurements. One of the most important nanobiosensors is the AFM tip used in scanning probe microscopes. The AFM tip interacts with the biological sample and gets topographic, mechanical, electrical and chemical information with extremely high resolution. Advances in piezoelectric actuators allow robots to position with nm resolution. If they are equipped with AFM tips, these nanorobots overcome some limitations of the classical AFM microscopes: nanorobots can cooperate between them and with microscopes to perform more complex nanobiocharacterization experiments. The main technological limitation of AFM-tip equipped robots is the need of use an alternative to the classical laser-photodiode cantilever deflection detection system. Piezoresistive cantilevers seem to be the adequate solution but they are noisier than laser-photodiode and then the robots' force sensitivity is limited. In this work we present the design of low-noise instrumentation for accurate sensing of piezoresistive cantilevers and the test-bench to characterize and compare the resolution in force of the robot equipped with a commercial AFM tip as nanosensor. Results show a noise of 5 nN in the measured force and a resolution of 6 nN in the force applied by the robot, which is good enough for cell studies but it's still high for interacting with biomolecules. [C1219]

"Low-Temperature Plasma-Oxidation Process for Reliable Tantalum-Oxide (TaO) Decoupling Capacitors"

Low-temperature plasma-oxidation process of ultra-thin PVD-Ta is developed to fabricate MIM capacitors with high-k TaO dielectric through the current Cu-BEOL process. We found that controlling both the oxidation process and micro-structure of the initial Ta to be oxidized is a key to achieve high-quality TaO dielectrics. Laminated TiN/Ta/TiN bottom electrode with a flat surface in nano-scale contributes to high reliability. The integrated TaO-MIM capacitor in the Cu-BEOL achieves high breakdown voltage of 10 V with high capacitance of 13 fF/Г,Вïm2, and the TDDB lifetime at 85 Г,В°С exceeds 10 years at less than 4 V (2 MV/cm). [C1220]

"A Floorprint-based Defect Tolerance for Nano-scale Application-Specific IC"

A floorprint-based yield modeling, assurance and optimization method for the defect tolerant NASIC system under broken NW defects is proposed and validated through extensive parametric simulations in this paper. Ultimately, intelligent exploitation of the proposed yield modeling and simulation methods will make possible to realize a reliable NASIC-based computing system. According to the simulation results given in this paper, the defect tolerant NASIC system with 15 row and column NWs, respectively, each with length = 0.000034 on horizontal and vertical core nanoarray in a nanotile can achieve a yield higher than 99.8%. [C1221]

"Using novel materials to enhance the efficiency of conductive polymer"

Conductive polymers have a vast market in integrated circuits (IC) and microsystems packaging to enhance mechanical, thermal, electrical performance, and cost effectiveness[1]. Isotropically conductive adhesives (ICAs) have been explored for attaching encapsulated surface mount components on rigid and flexible printed circuits [2]. However, the practical use of conductive adhesives in surface mount applications is limited because of the weak electric conductivity. Jiang et al [3] used nano-sized silver particles as a candidate for conducting filers in order to reduce the sintering temperature, but the contact resistance is still high. Some groups [4, 5] studied a series of methods such as using carboxylic acid group containing chemicals as surfactants to enhance the conductivity of ICAs in a variety of conditions, but because the micron-sized silver fillers have a high sintering temperature, the enhancement in conductivity is still limited. In order to further improve the conductivity of ICAs and minimize the cost, we experimented on a series of materials for silver surface pretreatment. We noticed an about 20 times improvement in conductivity of the modified ICA than the control sample (75% silver content in all samples). The volume resistivity of the optimum formulation reached the level of 10-6Omegaldrcm. We also analyzed the adhesion strength and thermal property of the modified ICA material. The study indicated that both the electrical properties and the mechanical property were improved without negatively affecting the other physical properties, and they are both remain stable after subjecting to the 85degC and 85% relative humidity conditioning test. [C1222]

"Nano-particle enhanced encapsulants for improved humidity resistance"

Polymer materials-mainly epoxy resins-are widely used in microelectronics packaging. They are established in printed circuit board manufacturing, for adhesives as die attach glues or for encapsulants as molding compounds, glob tops or underfill materials. Low cost and mass production capabilities are the main advantages of these materials. But like all polymers they can not provide a hermetical sealing due to their permeability properties. The susceptibility to water diffusion through the polymer and along the interfaces is a drawback for polymer materials in general. Water inside a microelectronic package might lead to softening of the material and to a decreasing adhesive strength and resulting delaminations close to solder bumps or wire bonds reducing package reliability by decreasing the package structural integrity. During package reflow, the incorporated humidity might lead to popcorning, i.e. abrupt evaporation of humidity during reflow soldering, is one major problem during plastic package assembly. The introduction of high temperature lead- free soldering processes has even increased this issue. Therefore, plastic packaging materials with enhanced humidity resistance would increase package reliability during assembly and lifetime without cost increase and with no changes in processing. The incorporation of nano-particles into plastic packaging materials is discussed as one potential solution for improved humidity resistance as it is a rather low effort approach to material modification opposed to chemical modification of the matrix. To evaluate the potential of such additives concerning moisture resistance the effect of nano-particles mixed with a microelectronic grade epoxy resin is studied. From the large variety of fillers available this work mainly focuses on three different types: nano-sized silica, modified bentonite and zeolites. Working principles of these particles range from large surface impact of nano-particles, barrier functionality due to-stacked layer formation and molecular catcher function. Formulations with different particle concentrations and surface modifications are characterized regarding their influence on humidity diffusion, absorption and desorption behavior as well as their influence on other material properties as reaction kinetics, viscosity and thermo- mechanical properties. Additionally the combination of nano- and standard micro-particles needed for thermo-mechanical adjustment of the polymer properties is studied. Experimental work is accompanied by simulations, in order to provide further qualitative understanding on effects of particle form, size and surface properties. In summary this paper describes the potential of different nano-particles as additives for plastic packaging materials for enhanced humidity resistance/barrier enhancement within microelectronic packages. This topic is gaining increased importance when considering the trend towards system in package, where a multitude of components is encapsulated to form one SiP that incorporates a large number of different material interfaces and interconnects. All these interfaces and interconnects need to be protected from degradation caused by moisture ingress, without allowing much increased package volume or package cost. Polymers with improved moisture resistance can be one building block of future moisture resistant packages-the results of this study show their large potential for this field of application. [C1223]

"Computer-Generated Holograms and 3-D Visual Communication"

Summary form only given. 3D visual communication is one of the most topical issues in the development of the modern information society. There are no doubts that the ultimate solution for 3-D visualization is holographic imaging. This is the only method that is capable of reproducing, in the most natural viewing conditions, 3-D images that have all visual properties of the original objects including full parallax, and are visually separated from the display device. 3-D visual communication and display can be achieved through generating, at the viewer side, of holograms out of data that contain all relevant information regarding the scene to be viewed. Digital computers are ideal means for converting data on 3-D scenes into optical holograms for visual perception. Basic ideas of using computer generated holograms for 3D visualization date back to 1960-th .1970-th. However, at that time there was no an appropriate technological base for the implementation of these ideas. Recent advances in computer engineering, electro optics and nano-photonics allow making a decisive breakthrough in this respect. The goal of the tutorial is to assist new generation of researches in the adaptation of these ideas to the new emerging technical means and their implementation in 3D displays, 3D television and 3D video communication. It covers all main relevant issues, from basics of holography to principles of synthesis and encoding of computer generated holograms and methods of 3D visualization using computer generated holograms. [C1224]

"A nano-CMOS process variation induced read failure tolerant SRAM cell"

In a nanoscale technology, memory bits are highly susceptible to process variation induced read/write failures. To address the above problem, in this paper a new memory cell is proposed which is highly stable against nanoscale process variations as well as power efficient. The effectiveness of the proposed cell is exhaustively evaluated through detailed Monte Carlo simulations. It is observed that the 16% variation in threshold voltage results in negligible effects on static noise margin (SNM) during read operation. Experiments under different loading conditions indicate that there is reduction 2X (approximately) in power dissipation and 2X (approximately) in leakage. [C1225]

"3-D thermal simulation with dynamic power profiles"

On-chip temperature and temperature gradient have been emerging as important design criteria as technology is scaled down to nano-meter regime. There have been several approaches to analyze or simulate the thermal behavior of chips, but all the approaches assume constant average power consumption of each block, which is reasonable when the change in power is localized and transient. However, as the aggressive power management techniques are employed in block level of granularity, power consumption of blocks become fluctuating a lot, which yields a large error with the conventional thermal analysis. A 3-D thermal simulation, with time-varying power consumption of blocks, is proposed in this paper. The partial differential heat conduction equation is solved with finite difference method, and we also employ alternating direction implicit method to decrease the computational complexity. The prototype simulator was designed and tested on several examples. [C1226]

"High linear voltage references for on-chip CMOS smart temperature sensor from −60°C to 140°C"

A low-cost and high linear voltage reference circuitry is designed and implemented in TSMC 0.18 mum CMOS technology. Previous research has proposed the use of MOS transistors operated in the weak inversion region to replace the bipolar devices with conventional PTAT (proportional to absolute temperature) circuits. However, such solutions often cause linearity problem in high temperature region because of the current leaking devices in modern deep sub micron and nano-scale CMOS technology. The proposed circuit utilized temperature complementation technique on two voltage references, PTAT and IOAT (independent of absolute temperature) references, to enhance the linearity and produce a stable IOAT voltage reference. Based on the measurement results, the R-square of PTAT reference is better than 0.9 and the temperature coefficient of IOAT reference is 14 ppm/degC in a considerable wider temperature range from -60degC to 140degC. The occupied chip area is 0.00126 mm . Thus, a fully integrated temperature sensor with wider temperature range is designed and easily to integrate to modern system-on-chip designs with minimal efforts. [C1227]

"Fabrication of biodegradable scaffolds by use of self-assembled magnetic sugar particles as a casting template"

Technologies to develop scaffolds with controlled pore layout and porosity have great significance in tissue engineering. As one method of scaffold fabrication, porogen leaching has been commonly used to control pore size, pore structure and porosity in the scaffold. In this paper, we describe a novel approach to fabricate 2D and 3D porous biodegradable scaffolds made of poly(L-lactide-co-epsiv-caprolactone) by using magnetic sugar particles as porogens. First, ferrite micro/nano particles were encapsulated in sugar microspheres to make them magnetized. After sieving magnetic sugar particles, those diameter-controlled particles were attracted by a magnetic force to form an assembled template for polymer casting. A magnetic field with polka-dot pattern was also utilized to align particles on desired positions. After polymer casting and removal of the sugar template, spherical pores were generated inside scaffold. For future application in vascular tissue engineering, we extended the scaffold fabrication to straight tubular scaffolds by winding 2D porous sheets on sacrificial molds. The biocompatibility of the developed scaffold was confirmed by viable cells after 4-day culture. [C1228]

"Estimating Kapitza resistance between Si-SiO2 interface using molecular dynamics simulations"

The interface between nano-scale films is of relevance in many critical applications. Specifically, recent technological advances in semiconductor industry that utilize Silicon-on-Insulator (SOI) devices have given urgency to understanding thermal transport across Si-SiO2interface. Estimates of interfacial (Kapitza) resistance to thermal transport across Si-SiO2films do not appear to exist at the present time. In this paper, we develop and carryout reverse non-equilibrium molecular dynamics (NEMD) simulations by imposing known heat flux to determine the Kapitza resistance between Si-SiO2thin films. For the Si-SiO2interface, the average Kapitza resistance for a ~8 Aring thick oxide layer system was 0.503 times 10-9m K/W and for a ~11.5 Aring thick oxide layer system was 0.518 times 10-9m K/W. These values were of the same order of magnitude as the Kapitza resistance values determined from the acoustic mismatch model (AMM) and the diffuse mismatch model (DMM) for the Si-SiO2interface. [C1229]

"Nano-scaled SRAM thermal stability analysis using hierarchical compact thermal models"

Non-uniform temperature profile generated by hot- spots affect the nearby units in a chip. Different sections of a large sized cache memory would experience different failure statistics due to their proximity to the hot-spots. The nano-scaled SRAM (Static Random Access Memory) cell stability is analyzed systematically under such 'spatial' temperature variations for different technologies. The bitcell level compact thermal models are generated for 65 nm, 45 nm, 32 nm and 22 nm bulk CMOS technology nodes based on the 6 T 'thin-cell' structure. Next, the block level and system level 'macro' thermal models are generated hierarchically for each technology node. A prominent effect 'leakage induced stability degradation' is observed at 22 nm node. This work demonstrates that leakage reduction techniques should consider temperature/stability aspects in nano-scaled SRAM cells. [C1230]

"Detection and real-time correction of faulty visual feedback in atomic force microscopy based nanorobotic manipulation"

One of the main roadblocks to Atomic Force Microscope (AFM) based nanomanipulation is lack of real time visual feedback. Although the model based visual feedback can partly solve this problem, its unguaranteed reliability due to the inaccurate models in nano-environment still limits the efficiency of AFM based nanomanipulation. This paper introduce a Realtime Fault Detection and Correction (RFDC) method to improve the reliability of the visual feedback. By utilizing Kalman filter and local scan technologies, the RFDC method not only can realtime detect the fault display caused by the modeling error, but also can on-line correct it without interrupting manipulation. In this way, the visual feedback keeps consistent with the true environment changes during manipulation, which makes several operations being finished without a image scanning in between. The theoretical study and the implementation of the RFDC method are elaborated in this paper. Experiments of manipulating nano-particles have been carried out to demonstrate the effectiveness and efficiency of the proposed method. [C1231]

"Nano-micro filled conductive adhesive based 3D micro arrays for Z-axis interconnections"

This paper discusses nano-micro filled electrically conductive adhesive (ECA) based 3D micro array interconnects to connect multiple electronic layers. Adhesives formulated using controlled-sized particles, ranging from nanometer scale to micrometer scale, were used to form micro arrays of contact pads having diameters ranging from 5 mum to 300 mum for internal and external interconnect applications. SEM and optical microscopy were used to investigate the micro-structure, and conducting and sintering mechanisms. This work also discusses micro-filled epoxy-based conducting adhesives modified with nanoparticles for low temperature sintering. A variety of nanoparticles ranging from 10-15 nm was used to modify micro adhesive composites. Addition of in-situ nanoparticles reduces sintering temperature without compromising electrical conductivity. Adhesives exhibited volume resistivity ranging from 10-4ohm-cm to 10-6ohm-cm, depending on composition, particle size, and loading of the adhesives. It was found that with increasing curing temperature of the adhesive, the volume resistivity decreased due to sintering of metal particles. Adhesives modified with nanoparticles or in-situ nanoparticles showed 30-90% resistance drop when cured at 240-265 degC instead of 200 degC. A few optimized metal-epoxy adhesives were used for hole fill applications to fabricate Z-axis interconnections in laminates. Conductive joints were formed during composite lamination using the ECA. Around 5,000 to 200,000 through holes in the joining cores, formed by laser or mechanical drilling, and having diameters ranging from 50 mum to 300 mum, were filled with an optimized conducting adhesive. The adhesive-filled joining cores were laminated with circuitized subcomposites to produce a composite structure. High temperature/pressure lamination was used to cure the adhesive in the composite and provide Z-interconnection among the circuitized subcomposites. A variety of joining core- and subcomposite structures such as OS/IP, 0S/2P, 2S/1P, 2S/2P were used for hole fill applications. As a case study, an example of nano-micro filled conductive adhesives used in a z-axis interconnect construction of a 26 metal layer package with a 300 mum pad pitch is given. The present work describes processing of conductive adhesives used to achieve smaller feature dimensions, satisfy stringent registration requirements, and achieve robust electrical interconnections. [C1232]

"Low stress and high thermal conductive underfill for cu/low-k application"

SiC particles and epoxy resin were applied to prepare a potential high thermal conductivity underfill material. SiC particles are thermally coated with a nano layer silica by oxidation at high temperature. Then silane was used as the surface treatment of the silica coated SiC particles to improve the interaction between filler and polymer matrix. TEM and TGA measurements were used to characterize the treated SiC particles. Mechanical properties of the epoxy composite with the treated SiC filler were measured by DMA, TMA and die shear adhesion test. This study also focused on optimizing the thermal conductivity of the polymer composites by filler surface pretreatment to increase interfacial bonding and decrease the thermal resistance. [C1233]

"A 10 Gbps x 12 channel pluggable optical transceiver for high-speed interconnections"

We developed a 10 Gbps x 12 channel pluggable optical transceiver. It consists of three photoelectric devices, an FR4 substrate with a microcontroller, a 12 x 2 multimode fiber with three optical connectors for the three photoelectric devices, an electrical connector, and a heat sink. This transceiver can be vertically plugged to the motherboard by using electrical connector. A vertical plug enables the photoelectric conversion devices in the optical transceiver to be located close to the logic LSI on the motherboard at high density to prevent the waveform degrading. Moreover, it is possible to do prompt repairs if the transceiver breaks down because the module is pluggable. We demonstrated error-free operation after 50 m transmission over a GI/50 multimode fiber (MMF). These performance characteristics indicated that this optical transceiver is feasible for implementation in high- throughput interconnections. [C1234]

"Wearable RFID-enabled sensor nodes for biomedical applications"

A wearable RFID-enabled sensor node for continuous biomedical monitoring is investigated in this paper. Dielectric characterization of fabric substrates, inkjet-printing of conductive nano-particle silver ink, design of RFID antennas and integration of sensor active and passive devices were discussed in this paper. Preliminary experiments show that the RFID-enabled sensor node could be effective for biomedical applications. [C1235]

"Full-chip leakage analysis in nano-scale technologies: Mechanisms, variation sources, and verification"

In this paper, a methodology for full-chip leakage analysis based on accurate modeling of different leakage currents in nano-scaled MOSFETs has been developed. Novel process effects have been covered in our statistical model, and a systematic characterization method of leakage-related parameter variations has been proposed. With these two contributions, we present an effective algorithm to address the growing issue of full-chip leakage verification for actual-fabrication circuits. Unlike many traditional approaches that rely on log-Normal approximations, the proposed algorithm applies a quadratic model of the logarithm for the full-chip leakage current and is able to include both Gaussian and non-Gaussian parameter distributions. Our simulation examples in a 65 nm CMOS process demonstrate that the proposed methodology provides more accurate results compared with the previous methods, while achieving orders of magnitude more efficiency than a Monte Carlo analysis. [C1236]

"Process variation tolerant SRAM array for ultra low voltage applications"

In this work, we propose a Schmitt Trigger (ST) based differential sensing SRAM bitcell that can operate at ultra-low supply voltage. The proposed Schmitt Trigger SRAM cell addresses the fundamental conflicting design requirement of read versus write operation of a conventional 6T cell. Schmitt Trigger operation gives better read-stability and as well as better write- ability compared to the standard 6T cell. The proposed ST bitcell incorporates a built-in feedback mechanism, achieving process variation tolerance -- a must for future nano-scaled technology nodes. Measurements on 10 test-chips fabricated in 130 nm technology show that the proposed Schmitt Trigger bitcell gives 58% higher read Static Noise Margin (SNM), 2X higher write- trip-point and 120 mV lower read Vmincompared to the conventional 6T cell. The ST SRAM array is operational at 150mV of supply voltage. [C1237]

"Photocurrent enhancement of nanocrystalline zinc oxide films using low cost dyes"

Improvement of dye sensitized solar cell was investigated using methyl-violet dye and nanocrystalline ZnO thin film electrodes. A low cost fabrication method and low cost materials were used to prepare this photocell. The X-ray diffraction (XRD) and scanning electron microscopy (SEM) were used to characterize the microstructure and surface properties of dye coated ZnO electrodes. According to the XRD and SEM measurements, nanosize particles were found in ZnO film. Smaller nano-particles enhance the effective surface area; therefore the photo-current. ZnO film coated with methyl-violet dye was measured in electrolyte of KI/I2with secondary electrode of platinum. Cell thickness and dye coating time were varied in order to obtain optimum photo-current and photovoltage. Photo-current density around 1.33 mA/cm2was obtained for the ZnO films sensitized with methyl-violet dye. [C1238]

"3D silicon integration"

Three-dimensional (3D) chip integration may provide a path to miniaturization, high bandwidth, low power, high performance and system scaling. Integration options can leverage stacked die and/or silicon packages depending on applications. The enabling technology elements include: (i) through-silicon-vias (TSV) with thinned silicon wafers, (ii) fine pitch wiring, (iii) fine pitch interconnection between stacked die, (iv) fine pitch test for known-good die, and (v) power delivery, distribution and thermal cooling technology. Applications may range from miniaturization of portable electronics like image sensors and cell phones to power efficient, high performance computing solutions such as servers and super computers. Silicon based packaging and 3D stacked die technologies have been in research studies for more than a decade at IBM and in industry, universities & consortia. IBM research experiments have included test vehicle design, build, characterization and modeling. Robust structures and processes have been developed based on (i) process learning for silicon based structures, (ii) assembly process comparisons for fine pitch chip interconnection, (iii) electrical, mechanical and thermal characterization and (iv) reliability & accelerated stress characterization. TSV technology investigations have included composite, copper and tungsten metallurgies. Wiring demonstrations ranged from sub-micron fine pitch wiring line widths & spaces to larger dimensions. I/O interconnections investigated feature sizes such as 100 I/O / mm2, 400 I/O/mm2, and interconnection features sizes which support 2500 I/O / mm2. In addition, integrated decoupling capacitors of one hundred ten nano-farads per mm2per layer and assembly of module structures on silicon packages with ceramic or organic base packages were demonstrated. Examples of robust TSV structures and characterization, single die with silicon interposers, multiple die o- n a silicon package and stacked die assemblies are given along with highlights of characterization including aspects of electrical, mechanical and reliability results. This research paper describes recent advances in industry and reports advancements from IBM in the design, technical challenges and progress toward 3D chip integration structures. In addition, examples of potential applications that may take advantage of 3D integration are discussed. [C1239]

"Temperature dependence of mechanical properties of individual phases in Sn-3.0Ag-0.5Cu lead-free solder alloy"

The commercial Sn-3.0Ag-0.5Cu (SAC) lead-free solder alloy consists of Sn-rich and eutectic phases. The mechanical properties of these individual phases were demonstrated to be a function of the temperature. The nano-indentation equipment assembled with advanced-controlled hot-stage was utilized to examine the mechanical characteristics. The experiments were performed at 60degC, 80degC, 110degC, 130degC and 150degC, respectively. It was found that for both Sn-rich phase and eutectic phase, the mechanical properties, such as hardness and elastic modulus, exhibited the dependence on the temperature. In particular, the creep deformation at the dwell time of constant target load exhibited high sensitivity to the temperature. Generally, the higher temperature resulted in a larger creep deformation, which in turn impacted the strain rate sensitivity of the individual phases. The Sn-rich phase showed larger creep deformation than that of eutectic phase. However, the much larger strain rate sensitivity index value was obtained for eutectic phase at the lower temperature than 150degC. The activity energy of Sn-rich phase was derived based on the relation of strain rates versus temperature. [C1240]

"Dendritic palladium-silver nano-structure grown by electrochemical migration method for hydrogen sensing device"

We have developed a new method to fabricate Pd-Ag nanowire for hydrogen sensor application. Pd-Ag nanowire with 50~200 nm diameter is grown by electrochemical migration method in a few minutes. This is simpler, faster and lower-cost nanowire fabrication method than other processes such as templated nanowire growth. The response time of Pd-Ag nanowire is much shorter than pure Pd. The response time is about 5 seconds and the recovery time was equally short. [C1241]

"Microwave design & characterization of a novel Nano-Cu based ultra-fine pitch chip-to-package interconnect"

This paper presents design and characterization of nano-Cu based ultra-fine pitch chip-to-package interconnects for microwave frequencies. Transitions are designed with this new interconnect and characterized up to 40 GHz in packaging configurations such as chip-on-chip and chip-on-package. [C1242]

"A numerical analysis of crack growth and morphology evolution in chip-to-packages nano-interconnections"

The International Technology Roadmap for semiconductors (ITRS) has predicted that by the year 2007, integrated chip (IC) packages will contain feature sizes of 65 nm and an I/O pitch for the die-to-package interconnects approaching 80 mum. These will reduce even further in the next five years. The current approach of using surface mount technology and flip chip are mainly solder based and the lead and lead-free solder interconnects are known to fail mechanically as the pitch is reduced from 200 mum down to lower levels due to the thermal mismatch between the substrate and the chip. Although compliant interconnection could solve some of the mechanical issues, it is done at the expense of the electric performance. The PRC at Georgia Institute of Technology is proposing re-workable copper based nano-interconnections as a new interconnection paradigm as the next step beyond lead-free solders for future low-cost, high performance and high reliability packages. However, very limited data is published about the fatigue life of nano-crystalline materials and specifically those of nano-crystalline copper. It is important to predict crack growth as it can aid the understanding of the useful life of the IC-packages' interconnections. Multiple mechanisms may be responsible for crack initiation, but eventually most dominant fatigue cracks form a surface crack, which often have a semi-elliptical shape. Hence, the fatigue crack growth life predictions in this study are based on the assumption of elliptical and semi-elliptical cracks being initiated in the nano-interconnections. In this study, numerical analysis using the J-integral stress intensity parameter, in conjunction with experimental fatigue crack growth data, has been employed to study semi-elliptical crack growth and morphology evolution in nano-interconnection subject to uniaxial fatigue loading in linear-elastic conditions. The results indicate that a J-integral finite element analysis, using the loading portion of th- e fatigue cycle, in conjunction with known rates of fatigue crack growth can approximate surface crack morphology evolution. This study also predicts that the long crack growth is a relatively small portion of the total fatigue life of the material for the experimental LCF conditions. Hence, initiation of the cracks in the interconnection is the main criterion used to predict its fatigue life. [C1243]

"Interfacial adhesion of nano-particle silver interconnects for electronics packaging application"

Rapid package prototyping (RPP) technology based on a data-driven chip-first approach using nano-particle silver (NPS) interconnects has been developed to promptly assess novel package designs, new packaging materials, and performance of new devices. A potential limitation of rapid package prototyping with NPS interconnects is the adhesion between NPS and polymer substrates such as LCP, Polyimide, and BCB. Improving the adhesion strength of NPS is a key issue for reliable package prototypes with NPS interconnect. Qualitative measurement of the adhesion strength of NPS is necessary to investigate the adhesion improvements of NPS. A new adhesion test method is developed to estimate the interfacial fracture energy of NPS films. It has been found that most of the existing adhesion test methods are not directly applicable to NPS films. The newly developed adhesion test method is called Modified Button Shear Test (MBST) because it modifies the conventional button shear test and integrates the generally known die shear test. The MBST is used for measuring the interfacial fracture energy of NPS interconnect material. The interfacial fracture energy varies depending on physical, mechanical, and chemical states of the interface between NPS and polymer substrates. A mechanical interlocking adhesion model will be validated using MBST to demonstrate that the contribution of surface roughness to the interfacial fracture energy can be identified. It will show that the Yao's model is an applicable mechanical interlocking model for NPS film adhesion model. [C1244]

"Tin/silver/copper alloy nanoparticle pastes for low temperature lead-free interconnect applications"

Chemical reduction methods were used to synthesize tin/silver/copper (SnAgCu) alloy nanoparticles with various sizes. The thermal properties of the SnAgCu alloy nanoparticles were studied by differential scanning calorimetry. Both the particle size dependent melting temperature and latent heat of fusion have been observed. The as-synthesized SnAgCu alloy nanoparticles were dispersed into an acidic type flux to form the nano solder pastes. Their wetting properties on the cleaned copper surface were studied. It was found that the nanoparticle pastes completely melted and wetted on the copper surface and the tin and copper intermetallic compounds formed. These low melting point SnAgCu alloy nanoparticles could be used for low temperature lead-free interconnect applications. [C1245]

"NEMS based on top-down technologies: from stand-alone NEMS to VLSI NEMS & NEMS-CMOS integration"

This paper reviews some recent advances related to NEMS based on top-down technologies: from stand-alone NEMS to VLSI NEMS and NEMS-CMOS integration. [C1246]

"Improved effective index method for designing devices based on silicon nano-waveguides"

A new effective index method for designing devices including directional couplers based on silicon nano-waveguides is proposed in this paper. The optimal value of the refractive index of the device in two dimensional model is determined and optimized. The results are checked with 3D numerical methods. [C1247]

"Deposition of SiO2/polymer nanoporous thin films on long-period grating (LPG) optical fibres and dramatic enhancement of the resonance bands"

A nano-assembled porous thin film, deposited using the layer-by-layer method and infused with a functional compound, is used for the development of a highly sensitive fibre-optic ammonia sensor. Sensor fabrication involves a 2-stage process: firstly the deposition of the basic porous thin film (poly(diallyldimethylammonium chloride)/SiO_2) over a long period grating written in optical fibre, followed by infusion of a porphyrin compound (tetrakis-(4-sulfophenyl)porphine, TSPP), into the porous film. The device shows high sensitivity to ammonia (ca. 1 ppm) when immersed into an aqueous solution. [C1248]

"3D image analysis for evaluating internal deformation/fracture characteristics of materials"

In the past, D/F characteristics, load-deformation relationships until the materials are fractured, have been analyzed on the surface. The D/F characteristics are affected by more than ten thousand micro-scale internal structures like air bubbles (pores), cracks and particles; therefore, it is required to analyze nano-scale D/F characteristics inside materials. In this paper, we propose a method that automatically obtains the corresponding relations of the particles from nano-order 3DCT images at each deformation stage. The particles are deformation-proof and may have different geometries. First of all, some big particles are considered as landmarks and matched between pre- and post-deformation. The results of landmark matching make it easy to match many remaining particles and pores. [C1249]

"Recent Development of Nano-solder Paste for Electronics Interconnect Applications"

Conventional lead-free solders, with a solder alloy particle size in the micrometer range, present some major disadvantages, such as relatively high melting temperatures, which can result in defects and build up stresses during reflow processing, and limited application for high density, ultra- small pitch electronic applications. By decreasing the size of the solder alloy particles to the nanometer range, one can both decrease the melting temperature of the solder alloy and use such solders in very fine pitch applications. Besides lower melting temperature, particles in the nanometer size range present many other extraordinary properties, such as, large surface area per unit volume, large surface energy, supermagnetism, extraordinary optical properties, self-purification properties and quantum size effects. It is all these extraordinary properties that have attracted the attention of both scientific and technological communities all over the world. The main focus of this paper is the recent development of both composite solders and pure nano-solder pastes and their application as electronic interconnect materials. The paper starts by giving and introduction to the subject of nanoparticles, including definitions, advantages and general applications. This is followed by a section dealing with the main manufacturing processes presently being used to manufacture solder alloy nanoparticles. The two main sections of this article deal with composite solders and pure nanosolder pastes. The first part, regarding composite solders, deals with the issues related to adding nanoreinforcements into conventional micrometer-sized solders and the effect of such reinforcements on both the mechanical and physical properties of solder alloys. The second part deals with pure nano-solder pastes and their application in electronic interconnect applications. [C1250]

"Conference information-registration, publications, presentations & events"

The following topics are discussed: biologically inspired systems; biomechatronic systems; prostheses; human-machine interaction; exoskeletons and augmenting devices; neuro-robotics; rehabilitation and assistive robotics; modelling interactions; microrobotic systems; robot locomotion; surgery and diagnosis; micro-nano technology in medicine and biology. [C1251]

"A study of material properties for package flatness in 3D package"

Mold compound, substrate core, solder resist, underfill and die attach materials have been used for semiconductor packages for a long time. Recently, 3D packages (such as package-on-packages, stacked-die-packages) were introduced in the electronics industry. Moreover, pursing ultimate performance requires package body downsizing more and more. 3D packages are achieved by stacking laminate substrate packages in vertical direction and interconnecting them with solder balls. However, Package on Package (POP) usually shows large warpage for the complex structural mismatch, and also this makes more difficult to do surface mount. Especially, heavy package warpage for POP leads to solder joint failures between two packages. Package warpage is one of the important factors for the surface mount yield. To improve package flatness, a laminate-based substrate package structure and material property were evaluated with a Shadow Moire equipment, DMA (dynamic mechanical analysis), Nano-indentation equipment and finite element-based modeling. Finite-element modeling was utilized to improve package flatness after observing the correlation between models and measured data. For building up high accuracy warpage modeling, we studied viscoelastic parameter for mold compound, substrate core, solder resist, underfill and die attach materials, and created material database. However, die attach materials and solder resists are very thin material compared to other materials. Therefore, it is very difficult to measure viscoelastic material using DMA. To solve the problem, we studied the measurement method using a Nano-indentation. This paper describes material property effects on package flatness at the peak temperature during the reflow process. In addition, we verified experimental result and finite element-based modeling result. [C1252]

"Gas sensing performance of pure and modified SrTiO3 thick film resistors"

Strontium titanate (SrTiO3(ST)) was prepared mechanochemically from Sr(OH)2and TiO2. XRD confirms the pervoskite phase of material. Thick films of ST were prepared by screen-printing technique. The gas sensing performance of thick films were tested for various gases. It showed maximum sensitivity to CO gas at 350degC for 100 ppm gas concentration. To improve the sensitivity and selectivity of the film towards a particular gas, ST thick films were surface modified by dipping them in a solution of nano copper for different intervals of time. These surface modified ST films showed larger sensitivity to H2S gas (100 ppm) than pure ST film. A systematic study, of sensing performance of the sensor, indicates the key role-played by the nano copper species on the surface .The sensitivity, selectivity, response and recovery time of the sensor were measured and presented. [C1253]

"Multi-mode compliant digital enhanced transmitter architectures in nano-scale CMOS"

This paper treats two different transmitter concepts both enhanced by highly flexible and generic digital architectures. The first investigated transmitter is based on a state-of-the-art direct up-conversion transmitter extended with a digital front end and the second concept is a polar transmitter (PT). Crucial part is to mitigate radio frequency (RF) impairments by the means of digital compensation techniques, e.g. direct current (DC) and I/Q gain imbalance and digital predistortion. Both transmitter architectures are multi-mode compliant and shall support LTE, UMTS, CDMA2000, and GSM. Each transmitter concept utilizes a highly reconfigurable all digital phase locked loop (ADPLL). In the case of the direct up-conversion transmitter the ADPLL is used for RF synthesis and in the case of the PT it is used as phase modulator. Furthermore, measurement results for RF synthesis, realized by an ADPLL in a 130 nm complementary metal oxide semiconductor (CMOS) process technology, will be presented. [C1254]

"Invited talk 1: Integrative MEMS/NEMS technology for micro and nano systems"

Materials technology and process integration are the key enabling tools for novel advances in MEMS/NEMS for future biological and chemical micro and nano systems applications. The talk presents an overview of various building block materials and process technologies. [C1255]

"Fabrication of highly efficient fibre-optic gas sensors using SiO2 /polymer nanoporous thin films"

A highly porous nano-thin film has been deposited on the optical fibre with the aim to develop a fibre-optic gas sensor. The film was composed of alternate layers of poly(diallyldimethyl ammonium chloride) (PDDA) and silica nanoparticles of 40-50 nm in diameter deposited using the electrostatic self assembly process. As a final step of preparation, the coating was infused with the functional compound of tetrakis-(4-sulfophenyl) porphine (TSPP). Exposure of this material to ammonia induces a change in the absorption spectrum, which can be observed in the transmission spectrum of the coated optical fibre. The ammonia sensor shows a linear sensitivity in the concentration range of 0.1-50 ppm and the sensor response and recovery were within 5 min. The sensor was exposed to different chemical compounds in order to study the sensors selectivity. [C1256]

"Study of cross- sensitivity of porous alumina based trace moisture sensor in dry gases"

Present work deals with the development of capacitive porous alumina based trace moisture sensor in the range of 50 to 500 ppm(V) fabricated by low cost sol-gel technique. For its commercial usefulness, the cross-sensitivities due to the presence of organic vapours like ethanol, methanol, acetone and benzene are studied. The effects of ambient temperature have also been studied. Experimental results show that moisture sensor is responsive to the polar organic vapours but has almost negligible response to the nonpolar molecules like benzene. However compared to the moisture sensitivity, the sensor response to the organic vapours is very small. [C1257]

"Porosity modification for the adjustment of the dynamic range of ceramic humidity sensors"

The effect of the change of porosity and pore-size distribution on the sensitivity and the dynamic range of the rutile-based resistive humidity sensors is reported. Bead-type resistive humidity sensors were fabricated by the sintering of the rutile powder aggregates on the two adjacent platinum wires at 800degC. Porosity modifications were carried out in two different directions: Sol-gel impregnation of the titanium dioxide into the porous structure of the ceramic bead followed by an annealing at 500degC decreased the micron-sized pores and increased the proportion of the nano-sized pores, while re-sintering of the pallets at 1000degC eliminated the fine pores and increased the population of the micron-sized pores. Sensitivity measurements showed a shift of the useful dynamic range of the sensor towards lower relative humidity (RH) range (0-20 %) in the first group, while the second group demonstrated better performance at the higher RH range (60-100 %). It was shown that the ceramic sensors of desired RH dynamic range can be fabrication based on the pallets of predetermined pore-size distribution. [C1258]

"Effect of nano Ag on gas sensing performance of ZnOThick films"

Thick films of AR grade ZnO were prepared by screen-printing technique. The gas sensing performance of thick films were tested for various gases. It showed maximum sensitivity to CO gas at 100degC for 100 ppm gas concentration. To improve the sensitivity and selectivity of the film towards a particular gas, ZnO thick films were surface modified by dipping them in a solution of nano silver for different intervals of time. These surface modified ZnO films showed larger sensitivity to H2S gas (100 ppm) than pure ZnO film at 300degC. Nano silver on the surface of the film shifts the reactivity of film from CO to H2S gas. A systematic study, of sensing performance of the sensor, indicates the key role-played by the nano silver species on the surface. The sensitivity, selectivity, response and recovery time of the sensor were measured and presented. [C1259]

"Investigation of stack as a low power design technique for 6-T SRAM cell"

Low power large scale integration of memory technology is an increasing important and growing area of electronics. In nano-scaled devices, standby power needs to be reduced effectively for high performance System on Chip designs. As per the dasiaInternational Technology of Roadmap for Semiconductors-2007psila, high leakage current in nanometer regime is becoming a significant portion of power dissipation in cmos circuits as threshold voltage, channel length and gate oxide thickness are scaled. This paper explores the possibility of reduction in the energy dissipation in 6T-SRAM cell. This paper evaluates SRAM cell with and without introducing stacking in nanometer regime. Overall leakage in a stack of transistors reduces due to modification of gate to source voltage, threshold voltage and drain induced barrier lowering. T-spice and L-Edit simulation results shows that compared to the conventional high performance SRAM cells, stacked cells offer significant reduction of power consumption. Some of the issue like static noise margin, increase in level of stack and variation in length are discussed in the paper. [C1260]

"Study on Board Level Drop Reliability of Wafer Level Chip Scale Package with Leadfree Solder"

Wafer level chip scale package (WLCSP) is a promising packaging technology to accommodate the demand for small, portable handheld electronic. This bare-die bumped package is able to offer significant area savings, improve package electrical parasitics and power dissipation performance over substrate-based BGA packages. However, its board level reliability especially mechanical performance under shock impact is a great concern for handheld electronics. In this paper, daisy chained WLCSP packages with leadfree solder bumps have been assembled on customer boards, and board level drop test has been carried out on a JEDEC compatible drop tester. First failure is found at 42 drops among 36 samples. All the electrical failure found is caused by the breakage of Cu trace under critical corner ball at PCB side. To understand the failure mechanism and built up the life prediction model for WLCSP, finite element simulation has been carried out by explicit dynamic software ANSYS/LS-Dyna. Strain-rate dependent elastoplastic model for solder is developed vi nano-indentation test and implemented to the simulation. highest interface peeling stress is found at one of the corner and between solder and PCB Cu pad, which is exactly correlated with failure location from the test results. This failure mode is different from those results for WLCSP open publications, where failure mostly happened at component side. From simulation analysis, it is understood that the maximum stress located at PCB side is mainly due to the Cu trace connected to the Cu pad along board length direction. Recommendation on Cu trace alignment has been proposed to improve PCB design accordingly. Bump structure effect has also been simulated, and it is shown that RDL design with soft dielectric passivation layer is very helpful for the drop reliability performance improvement of WLCSP. [C1261]

"Patterned Metallic Nanowire Arrays Based Flip Chip Interconnects"

Chip to substrate interconnect density is continuously being scaled down to support the rapidly decreasing minimum feature size of IC components. At very fine interconnect pitches not many chip to substrate interconnects can meet the requirements of reliability and performance. One potential solution to improve the interconnect reliability is the use of compliant structures as interconnects. In this article a novel and flexible chip to substrate interconnect scheme that comprises of multiple metallic nanowires as nano interconnects is proposed. In the proposed scheme an individual flip chip interconnect pad on the chip comprises of multiple metallic nanowires, which bond to the substrate solder pad. Patterned micropads made of metallic nanowires (MMN) are fabricated on silicon substrate by electrodeposition in patterned nanoporous alumina (PNA) templates. High aspect ratio PNA templates are fabricated by selective anodization of an aluminum thin film patterned with SiO2. The PNA templates are then filled by copper metal electrodeposition. The aluminum that is underneath SiO2is protected from anodization. I-V characteristics of MMN, Sn solder coated and reflowed MMN display ohmic behavior with extremely low resistance values of few m Г,Вї. Eutectic Sn-Pb solder and multiple copper nanowires based interconnect joint displays shear strength of 42 MPa which is comparable to conventional flip chip package joints. [C1262]

"Variation-aware gate sizing and clustering for post-silicon optimized circuits"

As technology is aggressively scaled, nano-regime VLSI designs are becoming increasingly susceptible to process variations. Unlike pre-silicon optimization, post-silicon techniques can tune the individual die to better meet the power-delay constraints. This paper proposes a variation-aware methodology for the simultaneous gate sizing and clustering for post-silicon tuning with adaptive body biasing. The proposed methodology uses an accurate table look-up model and fully explores the interaction between gate sizing and optimal body bias based clustering. In addition, it is suitable for industrial test cases with tens of thousands gates. Our optimization methodology includes a body bias distribution alignment strategy to mitigate the impact of critical gates. In this way, the cluster's body bias voltage is not simply determined by only a few critical gates. We also prove the linear dependence between the mean of the body bias probability distribution and the gate size. Based on this, we further investigate a simultaneous sizing and re-clustering algorithm for better leakage savings. A circuit re-balancing and gate snapping scheme is then suggested to map the solution to a standard cell library. Compared with arecently-reported method, the proposed methodology can obtain on average 25.5% leakage saving at nearly the same run time. [C1263]

"20 GHz Power Amplifier Design in 130 nm CMOS"

Five different 20 GHz power amplifiers in 130 nm CMOS technology have been designed and characterized. The power amplifiers explore single versus cascode configuration, smaller versus larger transistor sizes, as well as the combination of two amplifiers using power splitters/combiners. A maximum output power of 63 mW at 20 GHz was achieved. Transistor level characterization using load pull measurements on 1 mm gate width transistors yielded 148 mW output power. These numbers are, to the authors' knowledge, the highest reported for CMOS above 10 GHz. Transistor modeling and layout for power amplifiers are also discussed. [C1264]

"NBTI tolerant microarchitecture design in the presence of process variation"

Negative bias temperature instability (NBTI), which reduces the lifetime of PMOS transistors, is becoming a growing reliability concern for sub-micrometer CMOS technologies. Parametric variation introduced by nano-scale device fabrication inaccuracy can exacerbate the PMOS transistor wear-out problem and further reduce the reliable lifetime of microprocessors. In this work, we propose microarchitecture design techniques to combat the combined effect of NBTI and process variation (PV) on the reliability of high-performance microprocessors. Experimental evaluation shows our proposed process variation aware (PV-aware) NBTI tolerant microarchitecture design techniques can considerably improve the lifetime of reliability operation while achieving an attractive trade-off with performance and power. [C1265]

"Thermal analysis of 8-T SRAM for nano-scaled technologies"

Different sections of a cache memory may experience different temperature profiles depending on their proximity to other active logic units such as the execution unit. In this paper, we perform thermal analysis of cache memories under the influence of hot-spots. In particular, 8-T SRAM bit cell is chosen because of its robust functionality at nano-scaled technologies. Thermal map of entire 8-T SRAM cache is generated using hierarchical compact thermal models while solving the leakage and temperature self consistently. The impact of spatial temperature variations on 8T-SRAM parameters such as local bitline (LBL) sensing delay, noise robustness and bitcell stability are evaluated for 45nm/32nm/22nm bulk CMOS technology nodes. The effectiveness of variable keeper sizing on LBL sensing delay is analyzed. It is predicted that at 22 nm node, the leakage induced temperature rise has severe effects on the 8-T SRAM characteristics. [C1266]

"Low Cost Printed Flexible Multilayer Substrates"

For high-volume products, such as mobile terminals, low-cost techniques for multilayer polymer-based thick film wiring board manufacturing are needed. Screen-printing is a cost-efficient technology candidate to build up approximately 6 conductor layers on both sides of a flexible substrate, for example. In order to experimentally evaluate the feasibility of screen-printing technique, the printing resolution was tested on different substrate materials, such as, polycarbonate (PC), polyethylene terephtalate (PET), polyimide (PI) and liquid crystal polymer (LCP). Conventional screen printed polymer thick film pastes were characterized on polymer substrates to form multilayer fine-line patterning and through-hole vias. The final demonstrator was a double-sided PI substrate having two conductor layers separated by dielectric layers on both sides of the substrate and through substrate vias. The screen-printed conductor material was an Ag-based nano particle ink and the dielectric layer was a polyimide-based material. Several challenges were identified that might hinder the applicability of the technology for mass-production. The stability of the polyimide substrate is a problem if the curing temperature of the printed materials is above 200degC. Layer-to-layer alignment tolerances are feasible if the printed area is small, 5"times5", in our case. The flatness of the substrate, however, is not very good after printing several layers on each other. The tested nano particle ink is a promising conductor system; however, lowering of the curing temperature from 230degC below 200degC would have a major impact on production friendliness. Another way to realise multilayer structures is to utilise lamination methods. In this study PET and PC sheets were also used. The focus in the processing development was on the deposition of adhesive layer over the PET sheet and the lamination process. Vias and conductors needed in multilayer structures were realised by utilising conventional th- ick-film processes. Vias were punched and then filled by stencil- printing and conductors were screen-printed. The lamination parameters were optimised for each material system. Good adhesion was achieved and the alignment accuracy between the layers was <plusmn15 mum. [C1267]

"Effect of Dispersed SiC Nano-particles in Eutectic Sn58Bi Solder Micro-Bumps of Wafer Level

Package by Electroplating"

In this paper, the effect of SiC nano-particles in micro-solder bump was investigated. SiC nano-particles were dispersed by using ultrasonic homogenizer in plating solution of eutectic Sn58Bi solder and codeposited in eutectic Sn58Bi solder bumps. Solder bumps were fabricated on patterned wafer. Prepared samples were aged for 100, 256 and 400 hrs at 100Г,В°C respectively, and then the observation of microstructure and shear test were carried out to examine SiC particles effects. There was little effect on the growth of intermetallic compound (IMC) between solder bumps and Cu pad; however, microstructure became fine and the value of shear strength increase as much value as 13% due to the suppression of grain coarsening by SiC particles. [C1268]

"Contactless Component Handling on PCB Using EWOD Principles"

As the development of microelectronics is still driving towards further miniaturization, new materials, processes and technologies are crucial for the realization of future cost effective microsystems and components. Futures ICs and passives will also decrease in size, e.g. for RF-ID applications forecast die sizes are smaller than 250 ?m, thicknesses less than 50 ?m and pitches way below 100 ?m. Passives, if not directly integrated into the system carrier, will be even smaller. Touchless and self-assembly based procedures seem to be a promising method for handling miniaturized components not directly fabricated at the very place where they are needed. Based on the "electrowetting on dielectrics" effect (EWOD)-a contactless handling technology well known from lab-on-chip applications for liquid transport, sorting, mixing and splitting-is used as a basis for microelectronics assembly purposes on standard printed circuit boards. Handling shall be feasible for miniaturized components as duplets, smallest SMDs as well as for nano-scaled building blocks. The physical principle is a change in the droplet contact angle of a droplet when immersed into an electrical field, an effect that can be used for droplet movement and potentially for component transport. The process flow under evaluation starts with positioning of a droplet, containing a component, on a hydrophobic surface of the carrier substrate with rough accuracy. Using the mentioned electro wetting effect the droplet will be moved quickly until the desired position is reached. The precise placement of the droplet in ?m range takes place by means of field gradients and local manipulation of the carrier surface. The assembly is finished with the evaporation of the component containing droplets and the transfer of all components to the final substrate. The experimental work on EWOD described in this paper includes electrical layout, substrate manufacturing, hydrophobic surface modification and droplet handling in-combination with a process simulation. The electrowetting conveying system is simulated using the Multi Body Dissipative Particle Dynamics method (MDPD), where clusters of fluid molecules are represented by coarse grained particles. Wetting behavior is introduced by position-fixed wall particles: the force between a wall and a fluid particle is adapted such that the required contact angle emerges. The electrowetting model uses the Lippmann equation to find the influence of the applied voltage on the wetting behavior, i.e., the attractive forces between wall and fluid particles are modified to simulate the electrostatic forces on the contact line. The micro parts are also simulated by connected particles with special interaction forces for (almost) rigid body motion. [C1269]

"Challenges for Multi-Scale Modeling of Multiple Failure Modes in Microelectronics Packaging"

Design for thermo-mechanical reliability of electronics components on the basis of parameterized Finite Element Models and DoE/RSM-approaches (Design of Experiments/Response Surface Methods) are more and more performed for optimizations at early phases of the product development process. This is especially the case for electronic components in the fields of RF (Radio Frequency), optoelectronics, high temperature, and power applications, which are often exposed to extreme thermal environmental conditions, mechanical shock and vibrations. Additionally, a continuous industry drive for miniaturization and function integration forces the development of feature sizes down to the nanometer range and the introduction of new high-tech, nano-particle filled or nano-porous materials. These developments cause new challenges for reliability analysis and prediction, i.e. the development of multiple failure criteria for combined loadings including residual stresses, interface delamination, cracking and fatigue of interconnects simultaneously. That's why, the authors face up to multiscale modeling approaches, damage and fracture mechanics approaches on the basis of continuum mechanics, and measurement techniques of material properties in the miniaturized range addressed. Evaluations of residual stresses, especially of thin films, resulting from several manufacturing steps are an important precondition for high-quality FEA-based RSM/DOE-simulations towards robust designs, too. [C1270]

"Nano Packaging-A challenge for Non-destructive Testing"

The challenge of nano packaging requires new non-destructive evaluation (NDE) techniques to detect and characterize very small defects like transportation phenomenon, Kirkendall voids or micro cracks. Imaging technologies with resolutions in the sub-micron range are the desire. Possible evaluation methods are for example x-ray microscopy, x-ray tomography, ultrasonic microscopy and thermal microscopy. However, techniques with the necessary resolution can not be found on the market. The Center for Non-Destructieve

Nano Evaluation of Electronic Packaging (nanoevaГ,В®) is taken up to develop this equipment in cooperation with the electronics industry and to transfer the knowledge to colleagues in industries and research institutions. The new center is a common organization of Fraunhofer IZFP-D and the Electronics Packaging Lab with its Centre of Microtechnical Manufacturing (ZГ,ВїP) of the Technische Universitat Dresden. This paper will focus on the new possibilities of nano x-ray CT and shows first results. [C1271]

"TEM Microstructural Analysis of As-bonded Copper Ball Bonds on Aluminum Metallization"

In this study, the nano-scale interfacial details of ultrasonic copper ball bonding to an aluminum metallization in the as-bonded states were investigated using high resolution scanning/transmission electron microscopy with energy dispersive spectroscopy. Our results showed that ultrasonic vibration swept aluminum oxide and copper oxide in some regions of contacting surface, where an approximate 20 nm Cu-Al intermetallics (i.e. CuAl2) formed. In the regions where oxide remained, aluminum oxide layer connected with copper oxides layer. No nano-level voids or gaps were observed at the central area of the interface, including the regions with oxide. Calculation of interfacial temperature showed that the ultrasonic vibration increased the flash temperature up to 465Г,В°C which was believed to improve the interdiffusion for the formation of Cu-Al intermetallics. [C1272]

"Effect of Type of Reinforcement at Nanolength Scale on the Tensile Properties of Sn-0.7Cu Solder Alloy"

In this study, Sn-0.7Cu solder alloy was reinforced with Al2O3(50 nm) and ZrO2(45 nm) nano particulates to form Sn-0.7Cu/Al2O3and Sn-0.7Cu/ZrO2composites. The volume percentge of the Al2O3and ZrO2nanoparticulate reinforcement was kept at 1.5%. The composites were synthesized using powder metallurgy technique assisted with microwave sintering and incorporating hot extrusion as secondary processing technique. The extruded materials were characterized in terms of microstructural, physical and mechanical properties. The density values of composite solder materials were found to be lower when compared to monolithic alloy. Microstructure characterization revealed bigger pores in Sn-0.7Cu/ZrO2composite samples compared to Sn-0.7Cu/Al2O3composite samples. The results of room temperature tensile testing revealed that 0.2% yield strength and ultimate tensile strength of composite solder materials increased when compared to monolithic solder. Among the composite solders, the 0.2% yield strength and ultimate tensile strength of Sn-0.7Cu/Al2O3composite was found to be distinctly superior to Sn-0.7Cu/ZrO2composite. [C1273]

"Nuclear microbatteries for micro and nano Devices"

Radioisotopes have many applications. Among the various technologies for micro power generation being investigated, nuclear microbatteries that convert the kinetic energy of charged particles emitted from the radioisotopes into electricity are very attractive for many applications. In this paper, the previous work on developing nuclear microbatteries for micro and nano devices, including two types of microbatteries, betavoltaic microbatteries and direct charge collector batteries, has been reviewed, and new progress for energy conversion, betavoltaic microbatteries using Pm-147 and porous silicon, have been proposed and developed as well. [C1274]

"Low-voltage limitations and challenges of memory-rich nano-scale CMOS LSIs"

The minimum operating voltage (Vmin) of nano-scale LSIs is investigated, focusing on logic gates, SRAM cells, and DRAM sense amplifiers in LSIs. The Vminthat is governed by SRAM cells rapidly increases as devices are miniaturized due to the ever-larger variation of the threshold voltage (VT) of MOSFETs. The Vmin, however, is reduced to the sub-one-volt region by using repair techniques and new MOSFETs (e.g., FD-SOIs and/or high-k bulk) that can reduce VTvariations. [C1275]

"A multi-core/multi-chip scalable architecture of associative processors employing bell-shaped analog matching cells"

A methodology for building a low-power high-capacity associative system has been developed. In the system, matching cells having bell-shaped I-V characteristics play the role of similarity-evaluation elements and can be replaced by nanoscale quantum-effect devices. The study is aiming to extend the current CMOS designs to the coming era of nano-devices. A multi-core/multi-chip architecture has been developed in a 0.18 Г,Вїm standard CMOS technology. The system is scalable to adapt to the vast-scale integration capacity provided by nanoscale devices. Solutions to the problems of device characteristics variability and signal propagation delay in inter-chip interconnects have been developed in the study. [C1276]

"Co-integration of silicon nanodevices and NEMS for advanced information processing"

In this paper we present our recent attempts at developing the advanced information processing devices by integrating nano-electro-mechanical (NEM) structures into conventional silicon nanodevices. Firstly, we show high-speed and nonvolatile NEM memory which features a mechanically-bistable floating gate is integrated onto MOSFETs. Secondly we discuss hybrid systems of single-electron transistors and NEM structures for exploring new switching principles. [C1277]

"Application oriented MEMS by open collaboration"

Silicon MEMS as electrostatically levitated rotational gyroscope and 2D optical scanner, and wafer level packaged devices as integrated capacitive pressure sensor and MEMS swatch are described. MEMS which use non-silicon materials as diamond, CNT (carbon nano tube), LTCC with electrical feedthrough, SiC (silicon carbide) and LiNbO3for multi-probe data storage, multi-column electron beam lithography system, probe card for wafer-level burn-in test, mold for glass press molding and SAW wireless passive sensor respectively are also described. [C1278]

"A CMOS active-pixel sensor based DNA micro-array with nano-metallic particles detection protocol"

A DNA micro-array based on integrated CMOS active pixel sensor utilizing the opacity of self-assembled nano-metallic particles is demonstrated. Due to the complementary nature of DNA hybridization process, the DNA fragments attached to the nano-particle precipitate them only at locations where complementary DNA strands exist. The opacity of the chip surface change due to accumulation of nano-metallic particles can be used to detect the existence of some targeted DNA fragments. Ordinary light sources can be used in this approach rather than special UV light sources in the most popular fluorescence based detection method. The chip has been fabricated with a 0.5 Г‚Вµm CMOS process and contains on-chip timing control, dynamic range enhancement by pulse-width modulation and correlated double sampling. The system can detect DNA sample with extremely low concentration down to 10 pM under. [C1279]

"Contact printing of metallic pattern and its applications on fabricating high-frequency surface acoustic wave (SAW) devices"

In this paper, two types of contact-printing methods for micro/nano-lithography are developed and their application on fabricating high-frequency surface acoustic wave (SAW) devices are investigated. First of all, a light-assisted metal film patterning (LAMP) method which transfers a patterned metal film directly from a silicon mold to a substrate is discussed. The pattern transformation relies on both mechanical contact pressure and optical heating at the interface. Metal patterns with 100 nm feature size can be easily transferred in laboratory using simple equipments. Secondly, a contact-transfer and mask-embedded lithography (CMEL) is proposed which cleverly arranges pure mechanical forces and surface energy difference to achieve the patterning of nano-structures on various kinds of substrates. Applications of these two developed methods are demonstrated on the fabrication of high-frequency (~2 GHz) surface acoustic wave (SAW) filters and resonators. Future developments and potential applications of these nanoimprinting and nano-patterning methods will be addressed. [C1280]

"Electrical properties of multilayer silicon nano-crystal nonvolatile memory"

Nonvolatile memories with triple layers silicon nanocrystals have been fabricated with conventional CMOS technology. In this paper, the program and erase performance and reliability of nanocrystal nonvolatile memories (NCNVMs) with triple layers of nanocrystals are investigated. Experiment result indicates that the nanocrystals in the triple layers NCNVMs are difficult to be fully charged during program process for the second and third layers nanocrystals at low applied gate voltage. The program and erase transient characteristics for the triple NCNVMs is also measured at various programming times. The charges mainly trapped at the first layer nanocrystal below 1 ms, and then transferred to the second and third layer silicon nanocrystal as increasing program time further more. The reliability performance is analyzed by endurance measurement. The memory window has little degradation after 104cycling. [C1281]

"Piezoresistive linearity analysis of polysilicon nanofilms deposited at different temperatures based on interstitial-vacancy model"

From our previous investigations, polysilicon nano-films (PSNFs) shows large gauge factor (>30) and lower temperature coefficients of resistance and gauge factor at high doping concentration, comparing with the common polysilicon films. The films are suitable for high temperature piezoresistive sensors. In this paper, the PSNFs doped highly (2ГѓВ—1020cm-3) were prepared by LPCVD at different deposition temperatures, and the following measurements of resistivity, gauge factor and linearity of the films were performed. Based on as-established interstitial-vacancy model of grain boundaries, the structure, piezoresistive properties and linearity of

PSNFs were analyzed. The influence of residual hydrogen atoms in films was also taken into consideration. The model is proved to have good agreement with experiment results. Finally, it can be obtained that using the optimized deposition temperature (620Г,В°C) and high temperature annealing, the PSNFs containing fewer amorphous phases and residual hydrogen atoms had better piezoresistive linearity. [C1282]

"High temperature synthesis of In-doped ZnO nano-structures on InP (001) substrate by pulsed laser deposition"

ZnO nanostructures were grown on InP (001) substrate to achieve the In-doped ZnO nanostructure by pulsed laser deposition technique at high temperature. The FE-SEM images showed that the nanostructures grown at different temperatures have distinct dissimilar structures, and the morphology became better with increasing substrate temperature. The results of XRD showed that In element from InP substrates diffused into the ZnO layer to form In-doped ZnO nanostructures at the high temperature above 500Г,В°C. Energy dispersive chemical analysis (EDAX) is taken to ascertain the component of the nanostructure grown. [C1283]

"A simple nano-scale patterning technology for FinFET fabrication"

In this paper, a simple low-cost sub-50 nm silicon fin patterning technology is proposed and experimentally demonstrated. The technology is based on a micro-meter level lithography equipment, that is, it does not need any critical photolithographic step. The masking layer for fin formation is the nitride caped oxide layer which is reduced in width from sub-micrometer scale to nano-meter scale through a lateral etching in BOE. The etching rate is shown to slow down as the etching process goes on. A nano-scale oxide hard mask can be achieved after the nitride is removal. Both the cross-sectional view and top view of the etching process are shown by SEM photographs. Results indicate the simple patterning way is of low cost and under good control, and applicable to FinFET technology. [C1284]

"A fully integrated CMOS bio-chip aiming at selective assembly of charged nano-particles"

A fully integrated bio-chip targeting at electrical selective assembly of charged nano-particles is proposed and designed in SMIC 0.18 Г,Вїm CMOS mixed signal process. The proposed circuit integrates the electrode array, potentiostat circuit, and logics on a single chip, and provides a rail-to-rail range of assembly voltage, a potential resolution of 9 bit, and a maximal assembly current up to 0.46 mA, biased at a current of 1 Г,ВїA. Meanwhile, a novel electrode-reuse scheme is also proposed to further simplify the architecture and save chip area as well, without degrading the functionalities. Experimental results from on-chip selective assembly of 50 nm poly-styrene nano-particles (PS) are included and discussed to verify the feasibility of the proposed circuits. [C1285]

"Process variation tolerant LC-VCO dedicated to ultra-low power biomedical RF circuits"

In this paper, a technique to mitigate the effect of process variations on the performances of a 1.830 GHz nano-scale CMOS LC-VCO is presented. The proposed complementary cross coupled LC-VCO, dedicated to low-power implantable RF microsystems, uses a linear voltage regulator to allow adaptive scaling of the VCO supply as a function of process parameters. The proposed VCO implementation has improved immunity to variations in phase noise and supply current caused by process variations, and hence avoids worst-case design. The LC-VCO was implemented using STMicroelectronics 1-V 90-nm CMOS process and simulated using SpectreRF to validate its performance. Compared with a identical LC-VCO powered using a fixed supply voltage, the average close-in phase noise is reduced by about 3.6-dB at 10 kHz offset, and the 3-Г,Вї deviation is reduced from 3.53 dB to 0.48 dB at the same frequency offset. Furthermore, the average power consumption is reduced by about 40%, as is the 3-Г,Вї deviation in current drawn. [C1286]

"Ultimate top-down etching processes for future nanoscale devices"

For the past 30 years, plasma etching technology has led in the efforts to shrink the pattern size of ultra-large-scale integrated (ULSI) devices. However, inherent problems in the plasma processes, such as charge buildup and UV photon radiation, limit the etching performance for nanoscale devices. To overcome these problems and fabricate sub-10-nm devices in practice, neutral-beam etching has been proposed. In this paper, we introduce the ultimate etching processes using neutral-beam sources and discuss the fusion of top-down and bottom-up processing for future nanoscale devices. Neutral beams can perform atomically damage-free etching and surface modification of inorganic and organic materials. This technique is a promising candidate for the practical fabrication technology for future nano-devices. [C1287]

"Society Related Materials"

The following topics are dealt with: miniaturization technology; micromechatronics; microrobotics; microsensors and microactuators; microfabrication; micro integrated devices and systems; micro power source and supply; data transmissionand communication; micromachining and microfabrication technology; micro and nano assembly technology; nanotechnology; nano material; intelligent control; human centered robotics and mechatronics; human care and assisting systems; human interface; human science; artificial life; virtual reality; multi media; software aspects; human-ware network systems; applications (consumer electronic products, security system and others in bio, medical and industrial fields). [C1288]

"Configurable rectilinear Steiner tree construction for SoC and nano technologies"

The rectilinear Steiner minimal tree (RSMT) problem is essential in physical design. Moreover, the variant constraints for fabrication issues, including obstacle avoidance, multiple routing layers, layer-specific routing directions, cannot be ignored during RSMT construction for modern SoC and nano technologies. This paper proposes a construction-by-correction approach for obstacle-avoiding preferred direction rectilinear Steiner tree construction. Experimental results show that our algorithm is promising and outperforms the state-of-the-art works. [C1289]

"Power-state-aware buffered tree construction"

Interconnect delay and low power are two of the main issues in nano technology. Buffer insertion during routing effectively reduces interconnect delay; power state management and multiple supply voltage significantly lower power consumption. However, buffering without considering power states in multiple supply voltage designs may cause the signal integrity problem. This paper first considers power states into buffered tree construction. Based on a hierarchical approach combined with dynamic programming, we can simultaneously minimize power, satisfy timing constraints and maintain signal integrity. [C1290]

"Micromachined Sealed Cavities by Silicon Wafer Bonding for the Formation of Microstructures of Desired Thickness Using TMAH Etching"

The present research report a fabrication process of suspended silicon microstructures of desired thickness over controlled depth micromachined cavities. The process is developed using direct wafer bonding to seal the micromachined cavities and wet anisotropic etching in pure and surfactant added tetramethyl ammonium hydroxide (TMAH) solutions. Wet anisotropic etching is used for the formation of cavities, thinning down the wafer for structural layer and releasing the structures. Non-ionic surfactant Triton-X-100 [$C_{14}H_{22}O(C_2H_4O)_n$] added TMAH is used to realize the microstructures with rounded concave and sharp convex corners. [C1291]

"High Precise Positioning Control for Block Spring Motor"

Nanotechnology is based on a combination of many technologies such as high precise positioning and force control, especially magnetic recording, biotechnology and semiconductor industry require the utilization of nanotechnology. To date, various actuator systems have been proposed, but their structural models show working distances of either less than a millimeter or over ten millimeters. Structural models with working distances of several millimeters are rare. Therefore, we propose a new structural design of an actuator that would enable construction of actuator systems with such working distances. This new actuator consists of a voice coil motor (VCM) and a new guide with an elastic support mechanism (ESM). The ESM consists of a special spring which is restricted to moving in only one direction. This new ESM engenders no lost motion, mechanical play, or friction with motion. Because, characteristically, the VCM thrusts and displaces the ESM linearly, highly precise positioning and force control can be realized using a simple controller. This paper presents basic data for developing future nano-actuator systems. [C1292]

"Biochemical Sample Divider Fabricated by SU-8 Mold Process"

We developed novel type of a sample divider, which can easily divide the sample solution into multiple small amount of it on a chip, for single molecule analysis by MEMS technologies. We used the composite of a PDMS and an expancelRas a material, and fabricated the sample divider structure by applying the mold process. The SU-8 mold was fabricated by using laminated bi-layer films on a Si substrate. We investigated the channels closing performance, and they were successfully closed when the volume ratio between the expancel and PDMS solution was 1:2 and the heating time was 5 minutes. [C1293]

"Fabrication of Microcoils with Narrow and High Aspect Ratio Lines for Electromagnetic Actuators"

Recently, actuators are finding the various fields and many applications. It is one of the most important components in various machines because its performance determines to operate a machine. The demand of micro- and nano- fabrications such as microactuators, microcoils, sensors, etc is increasing. To realize this demand, the key technology is processing of micro-fabrication. We are forcing on the electromagnetic actuators that could be driven at a low voltage and high efficiency. However, this type actuator is known to be unsuitable for miniaturization because current paths of coil lines are small in size. And, it is very difficult to make the microscopic coil lines with three dimensional structures. Therefore, we have fabricated and measured a solenoid type electromagnetic actuator with narrow pitch and high aspect ratio coil lines using X-ray lithography technique. Using this technique, we have obtained the coil lines with a width of 30 mum and an aspect ratio of about 3. It is very expected a high performance microcoil with high aspect ratio could be manufactured in spite of miniature size electromagnetic actuators. [C1294]

"Zero-Hardened SRAM Cells to Improve Soft Error Tolerance in FPGA"

Soft errors due to charged particle strikes at the sensitive cell nodes could modify the functionality of the design by changing the configuration bits of an SRAM based FPGA. However, with the development of very-deep-sub-micron (VDSM) or even the nano-technologies, aggressive device size has impacted severely the soft error rate of integrated circuits. In this paper, three new SRAM cell designs are proposed which mainly aim at reducing the soft error rate in FPGA. We verify the soft error tolerance and the power dissipation of these three designs using HSPICE simulation with Berkeley Predictive Technology Model (PTM) of the 65 nm, 1.0 V technology. The simulation results of our three designs are compared with that of standard 6-transistor SRAM cell and an existing increased soft error tolerance cell-ASRAM0. Comparison result shows that our new cells, especially the 0-hardened SRAM cell, have triple the critical charge of the standard 6-transistor SRAM cell, when the cell is storing 0. [C1295]

"Study of Coherence Resonance in Carbon Nanotube Gas-Ionization Sensor System Using Leaky Integrate-and-Fire Model"

Coherence resonance in carbon nanotube gas-ionization sensor system was focused in this article. Firstly, experimental step was held: Gaussian white noise was added to the system. With the increase of noise intensity, electrical breakdown density became more and more intensive. The sensor system reached its electrical breakdown state at a lower interelectrode potential. Secondly, Based on the former study of coherence resonance in single leaky integrate-and-fire (LIF) neuron model, a nano-neuron array was proposed to give an explanation to the experimental results. Potential of each nano-neuron in the nano-neuron array varied according to noise intensity shift. With proper noise intensity, the amount of excitatory nano-neurons was enough to generate spike trains, which is the corresponding period of compact electrical breakdown. [C1296]

"Power Management in Wireless Sensor Networks by Enhancing the Thermo-Electric Properties of Their Circuitries"

With the proliferation of portable computing platforms and devices, wireless networks have received more and more attention as a means of data communication among portable devices. It has long been recognized that energy conservation usually comes at the cost of degraded performance such as longer delay and lower throughput in stand-alone systems and communication networks. Power conservation and power management must be taken into account at all levels of the sensor networks system hierarchy. Even though various power management schemes such as Dynamic Power Management systems (DPMs), application aware power management systems have been implemented, the results are not yet satisfactory. Its due to the reason that the technologies adopted till now does not concentrate on the hardware electrical parameters such as Power and thermo-electric properties of the materials in the network which are at the forefront of concerns facing modern computing systems. Here it is proposed to improve the thermoelectric properties of the electrical components by introducing nanostructures into Bi2Te3thin films from which the sensorГ‚Вїs hardware components can be designed. Good thermoelectric materials require an unusual combination of electrical and thermal properties, i.e. high See beck coefficient (S), low electrical resistivity (Г‚Вї) and low total thermal conductivity (Г‚Вї), which defines dimensionless figure of merit (ZT). Recently, with developing nanofabrication technology, further improvement of S has been actualized by using a quantum effect. [C1297]

"Nano-Enabled Metal Oxide Varistors for Surge Protection"

Commercial metal oxide varistor (MOV) devices provide a combination of high voltage, peak current, pulse energy absorption, and fast response speed. The non-uniformity and defects, however, may lead to relatively low voltage and energy dissipation, high leakage, low reliability and mechanical cracking. GE global research has been studying NanoMOV technology, and has been developing new formulations and processes. New compositions were invented to enable sintering at much lower temperatures, which exhibits improved I-V characteristics and microstructure uniformity. These compositions not only show high resistance at low fields and breakdown voltage (1-5 kV/mm), but also a large alpha at high fields (50-140). The higher breakdown strength (>

10x) compared to commercially available MOVs will enable MOV miniaturization, high voltage surge protection, and open up new areas of usage. [C1298]

"Nanotechnology:The power of small"

Summary form only given. Like no other technology, integrated electronics has changed our daily life during the past 50 years. Integrated circuits have become the indispensable resource of the modern knowledge based society: For example, without ICs, the rich multimedia experience we enjoy when using the Internet, mobile phones or digital video and audio would not have been possible. This revolutionary progress is based primarily on one major development: The continuous miniaturization-The power of small! At the beginning, structures in integrated circuits were approximately 10 mum large in lateral size, which corresponds to the size of a human blood cell. Present state-of-the-art technologies are utilizing a feature size of 100 nm and below. Today, micro-electronics is in the transition to nano-electronics and device structures are smaller as a virus. Due to the continuous downscaling, integrated circuits with steadily increasing functionality and complexity have been realized. System performance has greatly enhanced, but at the same time the cost-per-function has dropped substantially.-The power of small! Also, integrated electronics has become a major driver of the economic progress worldwide: With an average annual growth rate of 15 % per year for the past three decades, the worldwide annual market of electronics with euro800 billion exceeded the global automotive market in 2004.-The power of small! The end of the silicon roadmap has been announced already many times. However, conventional semiconductor-based transistors have been continuously shrinking at a pace which has brought us today's cheap and powerful electronic products. Nevertheless, it is obvious that the traditional top-down technologies are becoming more and more impractical with the nanoscale. Beyond the Moore's law era of silicon, new bottom-up methods will be mandatory to implement e.g. low-dimensional semiconductor nanostructures, like carbon nanotubes (CNTs), which offer unique possibi--lities such as extremely low power dissipation, high surface sensitivity and low fabrication cost. It is generally expected, that nanotechnology as an interdisciplinary area of research which cuts across many fields-electronics, chemistry, physics, biology and engineering is capable to fill this technology-gap. This contribution will emphasize on nanotechnology for electronic applications. An attempt is made to briefly summarize the past development of macro-/micro-electronics and discuss promising technological developments and future challenges towards nanoelectronics as well. [C1299]

"Design and test of integrated circuits in nano era: What is next?"

The talk addresses the technology scaling, its impact on design, test and reliability. Both the near term and long term trends will be covered. It will be shown that below 32 nm technology node, the design of reliable systems has to be done based on ldquounreliablerdquo components. Therefore, new design and test styles are required to maintain further technology scaling. [C1300]

"Timing driven force-directed floorplanning with incremental static timing analyzer"

As nano-scale technology is widely adopted, minimizing the interconnection delay has become one of the most critical issues in designing high performance systems. To achieve fast timing closure, it is very important to estimate the interconnection delay accurately at an early design stage. In this paper, we propose a novel timing driven force-directed floorplanning technique using an efficient incremental static timing analyzer. Our proposed floorplan framework contains a fast and accurate interconnection delay estimator which is very important to obtain an excellent floorplan. The proposed timing methodology has been implemented as a part of a commercial floorplanning tool called Pillar-DP from Entasys Design Inc. We carried out experiments on several benchmarks to show the effectiveness of our approach. The experiment results show that our tool is valuable in generating a near optimal floorplan within a reasonable amount of time. [C1301]

"The microstrip coupled line Bandpass filter using LTCC technology for 5GHz wireless LAN application"

This paper presents a top-down design of the microstrip coupled line Band pass filter (BPF) embedded in low temperature co-fired ceramic (LTCC) for 5 GHz wireless LAN applications. It includes the design, simulation, fabrication and measurements. The filter circuit was designed and simulated based on Agilent Advanced Automation (ADS2005A) software. Then, the physical dimensions of components and the filter itself is subsequently determined and the physical design is later performed in the layout window of Empire XcCEL. All measured simulations are analyzed and compared to design specifications and characteristics (curve fitting). Any inaccuracy is taken into account where corrected design is further recovered. [C1302]

"Pad characterization for CMOS technology using time domain reflectometry"

The pad structure of CMOS technology is characterized by way of time domain reflectometry measurement.

Using the on-wafer TDR measurement system, the capacitance of the pad in the CMOS process was extracted and estimated. Measured and simulated TDR data are also presented in this study. The capacitance is estimated when the curve is fitted by mathematical tool. This method is simple to use, and furthermore the results agree with data extracted from vector network analyzer. [C1303]

"A low power 8T SRAM cell design technique for CNFET"

In this paper, a new SRAM cell design based on carbon nanotube field-effect transistor (CNFET) technology is proposed. Carbon nanotube with their superior transport properties, excellent thermal conductivities, and high current handling capacities has proved to be a promising alternative device to the conventional CMOS. The proposed SRAM cell design on CNFET is compared with SRAM cell designs implemented with the conventional CMOS and FinFET in terms of speed, power consumption, stability, and leakage current in this paper. The HSPICE simulation and analysis show that the dynamic power consumption of the proposed 8T CNFET SRAM cell's is reduced about 48% and the SNM is widened up to 56% compared to the conventional 6T CMOS SRAM structure at the expense of 2% leakage power and 3% write delay increase. [C1304]

"Zero and one dmentional quantum- and nano- structures for advanced photovoltaics"

In this work we present technology and characterization of nanostructures for advanced photovoltaics (PV). Fabrication, dimensional control, and surface passivation of silicon (Si) nanopillars and nanowires, as well as their detachment and further manipulation are first described. Nest, we present the polymeric layer embedment of cadmium selenide (CdSe) quantum dots. Scanning electron microscope, high resolution transmission electron microscope, and X-ray photoelectron spectroscopy are used for the structural analysis. Absorption and photoluminescent properties have been measured in the nanostructures for use in PV. Process parameter effects on the optical properties are established and discussed. [C1305]

"Impact of body bias on the high frequency performance of partially depleted SOI MOSFETs"

SOI MOS technology has been slated as the future ULSI technology because of its advantages in terms of speed, isolation, density, yield and performance. The superior speed advantage of the SOI devices has attracted much attention in both digital and radio frequency applications. In recent years, a number of direct current analysis based on the body-tied configurations of SOI devices have been reported. It has been confirmed that the body-tied configuration is one of the most effective and practical methods of suppressing the floating body effect and realizing the stable operation in SOI circuits, because the body potential of an SOI MOSFET's is fixed. Body-tied configuration SOI MOSFET has therefore been employed for some crucial parts in circuits that require high stability such as dynamic circuits. However, to this date, high frequency performance of body-tied configuration SOI devices is mainly focused on the dynamic-threshold MOSFET in which the body of the device is tied to the gate. This particular device configuration makes the analysis of small-signal model complicated and does not reveal much insight into the body bias effect on the device high frequency performance. In this study, we investigated the impacts of body bias on the high frequency performance of PD SOI MOSFET and showed, for that both fTand fmaxare dependent on the body bias. [C1306]

"Single-nanowire Si solar cells"

Solar cells based on arrays of CVD-grown Si nano- or micro-wires are being considered as a potentially low-cost route to implementing a vertical multijunction cell design via radial p-n junctions. This geometry has been predicted to enable efficiencies competitive with planar multicrystalline Si designs, while reducing the materials and processing costs of solar cell fabrication [1]. To further assess the potential efficiency of cells based on this design, we present here experimental measurements of minority carrier diffusion lengths and surface recombination rates within nanowires via fabrication and characterization of single-wire solar cell devices. Furthermore, we consider a potential Si wire array-based solar cell design, and present device physics modeling of single-wire photovoltaic efficiency. Based on experimentally observed diffusion lengths within our wires, we model a radial junction wire solar cell capable of 17% photovoltaic energy conversion efficiency. [C1307]

"Zero and one dmentional quantum- and nano- structures for advanced photovoltaics"

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"Session 33: Memory technology-DRAM and NOR"

This session presents recent advances in 1T DRAM, standard DRAM and NOR flash memory. The 1st Paper by Ki-Whan Song et al., from Samsung demonstrates aggressively scaled 55 nm capacitor-less 1T DRAM cell transistor with non-overlap source and drain. The next paper by T. Ohsawa et al., from Toshiba Corporation proposes autonomous refresh of floating body cell for 1Gb 32nm FBRAM. Hyun Jun Bae at al., from Samsung explore the evaluation of 1T RAM using various operation methods with SOONO device and show the longest retention time ever reported for 1T RAM. T. Schloesser et al., from Qimonda present a 46nm 6F2buried word line DRAM enabling the smallest cell size of 0.013μm2published to date. The invited paper by S.Q. Gu et al., from Qualcomm reviews stackable memory of 3D chip integration for mobile application which provides unique opportunity for high BW and low power. The next paper by Wen-Jer Tsai et al., from Macronix reports on highly punchthrough-immune operation for ultra-short-channel hot-carrier injection type non-volatile memory. Finally, C. Gerardi et al., from STMicroelectronics and CEA-LETI demonstrate excellent performance and reliability of Si nano-crystal 4Mb NOR flash in 90nm. [C1309]

"Novel Si-based nanowire devices: Will they serve ultimate MOSFETs scaling or ultimate hybrid integration?"

Both CMOS scaling and NEMS sensor devices scaling converge to the same type of sub 100 nm objects. This opens new fields of application for IC chips integrating both complex signal treatment and very highly sensitive sensing functionalities. [C1310]

"22 nm technology compatible fully functional 0.1 μm2 6T-SRAM cell"

We demonstrate 22 nm node technology compatible, fully functional 0.1 mum26T-SRAM cell using high-NA immersion lithography and state-of-the-art 300 mm tooling. The cell exhibits a static noise margin (SNM) of 220 mV at Vdd=0.9 V. We also present a 0.09 mum2cell with SNM of 160 mV at Vdd=0.9 V demonstrating the scalability of the design with the same layout. This is the world's smallest 6T-SRAM cell. Key enablers include band edge high-kappa metal gate stacks, transistors with 25 nm gate lengths, thin spacers, novel co-implants, advanced activation techniques, extremely thin silicide, and damascene copper contacts. [C1311]

"Hierarchical modeling of carbon nanoribbon devices for CNR-FETs engineering"

Most of the attractive electrical properties of carbon nano-tubes (CNT), such as 1D transport and very large mobilities, are also shared by carbon nanoribbons (CNR), which can potentially overcome the growth control problems of CNTs. Since experimental demonstration of CNR field effect transistors (FET) is at an early stage, simulation studies are important to investigate their theoretical limits. In the literature one can find simplified semiclassical models and full atomistic tight binding (TB) models. Both have limitations: in the former case, direct and band-to-band tunneling effects are ignored, in the latter deep physical insight is achieved at the price of very long computational times. Here we present a hierarchical approach to the modelling of CNR-FETs, which blends together first-principle density functional theory (DFT) for subband calculations, full 2D atomistic TB modelling, and effective mass (EM) ID quantum transport modelling, improved with nonparabolic (NP) corrections. The approach is applicable to armchair semiconductor CNRs. Moving along the hierarchy of models from the most physically in-depth (DFT) to the most details-free (EM) approach, more accurate models are used to calibrate the parameters of less accurate ones. In-depth models are suitable for the simulation of very small FETs (both narrow and short ribbons), but are impractical for devices of large sizes, which however are the ones that can be fabricated with the state-of-the-art technology. For such devices, where quantum effects already play a major role, the NPEM approach is quite effective. [C1312]

"A new SRAM cell design using CNTFETs"

As CMOS devices scales to the nano ranges, increased short channel effects and process variations considerably affect device and circuit designs. Novel devices are been proposed to address these problems. As a promising new transistor, the carbon nanotube field effect transistor (CNTFET) avoids most of the fundamental limitations of the traditional CMOS devices. In this paper, the MOSFET-like CNTFET is reviewed and shown as a promising device for high-performance and low-power memory designs. A 6T SRAM cell based on CNTFET is designed and simulated to show the improvements in stability, performance, and sensitivity on process variations compared to the CMOS 6T SRAM design. [C1313]

"High Precession Measurement Setup for the Spectral Gain of EDWA in a Low Signal Regime"

A high precision measurement setup has been realized especially for the spectral gain of erbium doped waveguide amplifier (EDWA) in a low signal regime. Each part of the set-up is shown in detail from laser light sources, objectives and tapered fibers for performing the coupling task to the light collection system and analyzing the transmitted signal from optical waveguide devices. The main individuality of this setup is that it can be aligned up to 1 nm displacement accuracy with the help of nano-positioner. Also this setup can be used for structural analysis, mode profile, and loss measurements by using different techniques of various Si-based waveguides in different geometries. [C1314]

"Correction of Nonlinearity in High-Resolution Nano-Displacement Measurements"

In this paper, a simple method to reduce the nonlinearity in the high-resolution nano-displacement measuring system using a modified laser interferometer is presented. By using a retarder plate and improved optical head, in additional to the nonlinearity compensation, the resolution of the displacement measurement is doubled and quadrupled compared to the conventional three- and two-mode laser interferometers, respectively. In the particular case, the nonlinearity of 18.4 nm is reduced to a value of 140 pm. [C1315]

"Nanocomposites for turn insulation for inverter fed motors"

In the paper nanocomposites for turn insulation of inverter fed motors have been proposed. The results of the modifying both enamelled winding wires and impregnating varnishes with nanoparticles is shown. The presented nanocomposites offer a much longer lifetime then conventional insulation under pulse voltage generated by inverter due to barrier effect to partial discharges. Thermal and mechanical properties of nano filled varnishes have been also improved because the nanoparticles behave as a physical crosslinker in the interface layer. [C1316]

"Optimal design of silicon-on-insulator nano-wire waveguides for broadband wavelength conversion"

The size of a silicon-on-insulator nano-wire waveguide is optimized for broadband wavelength conversion. A 3-dB conversion bandwidth of over 250 nm is achieved through four-wave mixing in a 2.5-mm-long waveguide of size 425 nm times 258 nm. [C1317]

"Consideration of heat transfer enhancement mechanism using nano- and micro-scale porous layer"

A convective heat transfer enhancement using nano- and micro-scale porous layer surface was discovered by Kunugi et al. The heat transfer experiments, analytical considerations, flow visualization near the porous layer, and the porous layer surface observation were performed to grasp the heat transfer characteristics and the heat transfer enhancement mechanism. The heat transfer experiments revealed the porous layers were capable to enhance heat transfer by 20-25% in net energy compared to the bare plate, independently of substrate materials. The heat transfer experiment changing the Reynolds number showed the Reynolds number dependency of heat transfer performance. One-dimensional unsteady heat conduction analysis showed the temperature recovery of the porous layer was incapable to catch up with the very fast temperature fluctuation, so that the porous layer might be a thermal-resistance when the main flow was strongly turbulent. The vestige visualized by the tracer-particles of around 0.85 mum in diameter showed a fluid behavior like "squirt" from the porous layer. From observation of the porous-layer surface, the porous layer has some micron-scale bubbles inside its own pore-connecting structure in spite of the good wetting feature. The expansion and contraction of the bubble-foam in the layer was observed and these behaviors may be considered as the main contribution to the mechanism of the heat transport. [C1318]

"Simulation analysis of the Fe40 Ni38 B18 Mo4 nano-crystalline thin films, in the 0.3-9.6 GHz domain"

A simulation analysis of the nano-crystalline thin films of Fe40Ni38B18Mo4was performed in this paper, in order to obtain the frequency evolution of the material parameters: electric permittivity, conductivity and magnetic permeability, in microwave domain. Material behaves like a soft magnetic alloy, with positive magnetostriction character. With help of the 3D Full-wave Electromagnetic Field Simulation HFSS from Ansoft the thin film structure was developed and the exposure field parameters were controlled for material parameters determination. Resonant frequency evolutions were obtained for the electric permittivity and magnetic permeability, determined by different aspects of the exposure field interacting with the internal structure (macro and micro domains). Electric conductivity presents an increasing evolution with frequency, describing the fact that currents appears easier inside the structure when frequency increases. Conclusions were polarized on frequency evolution interpretation for the material parameters and applications. [C1319]

"Minimising the risk of defects in nano-imprint forming"

Nano-imprint forming (NIF) is among the most attractive manufacturing technologies offering high yield and low-cost fabrication of three-dimensional fine structures and patterns with resolution of few nanometres. Optimising NIF process is critical for achieving high quality products and minimising the risk of commonly observed defects. Using finite element analysis, the effect of various process parameters is evaluated and design rules for safe and reliable NIF fabrication formulated. This work is part of a major UK Grand Challenge project-3D-Mintegration-for design, simulation, fabrication, assembly and test of next generation 3D-miniaturised systems. [C1320]

"Nanomaterials and technology for conductive microstructures"

Production of modern microelectronic devices needs printing technologies with the highest level of resolution and repeatability. Ink-jet technology makes it possible to dispense small volumes of a material in the range of tens picolitres. As the results the printed matrix of dots, lines and more complicated shapes have tens to hundreds micrometers scale. The printing of electrically conductive microstructures requires dispensed materials containing conductive particles as a filler. In the paper the systems for printing, possible results as well as background of nano silver production and its properties are presented. Just after ink-jet printing process the structures have the form of molecular fluid without any electrical conductivity hence special technologies for obtaining the printed microstructures with very high conductance have to be applied. As the result it is possible to make lines and complicated shapes with resitivity in range 10-6Ohm cm. [C1321]

"Electrical connection network within an electrically conductive adhesive"

This paper deals with the connection network in isotropically conductive adhesives (ICAs). The reader will learn about conductive network creation, tunneling effect, possible ways of modeling the conductive network and differences between failures within soldered joints and electrically conductive adhesive joints. This article compares theoretical models with real measurement and properties of the electrically conductive adhesive. The inner structure of the adhesive that is either formed by micro-sized particles, or micro-sized particles mixed with nano-sized particles, is described. [C1322]

"Effect of unintentional charges, on the performance of nanoscale DGMOSFETs"

A model of the nano DGMOSFET employing Non-Equilibrium Green's Function (NEGF) formalism is used to analyse the influence of the presence of ac stray negative charge in the channel on the perfomance of the device. As done preciously, the MOSFET is considered as essentially a 2D charge sheet, since the width of the device is very large, and the eigen vectors in that direction are effectively taken as plane waves. We then use the uncoupled mode space approach to reduce the problem to ID, enabling one to use two-dimensional electrostatics to model transport through the device. The NEGF equations and the Poisson equation are solved self-consistently to obtain subband energy and current in the device. Taking the position of the trapped charge as random, we compute its effect on the threshold voltage, sub-threshold swing, and drive current, and compare these results with that of a device having a pure channel, devoid of any such trapped charges. [C1323]

"A novel design of nano layered optical, filter using photonic band gap materials"

Much interest has been drawn in Photonic crystal, which are novel nanostructure of light. In the present paper, we present how the emerging technology of Photonic crystal can be suitably exploited to design and make a nano sized tunable optical falter. A novel theory to design tunable optical filter using one dimensional nano photonic structure is proposed in this present paper far ultraviolet and visible region of wavelength. A periodic structure of different dielectric and semiconductor materials (i.e. air and GaAs, air and Ge) are used. This idea is based on the Kronig -Penny model in the band theory of solids. [C1324]

"Fault tolerant adaptive filters based on number theoretic transforms"

Previously it was shown that FFT-based transform domain adaptive filters operating on real-valued signals can achieve adaptive fault tolerant performance based on parameter redundancy inherent in the complex arithmetic. In this paper the Fermat number transform (FNT) is combined with transform domain block processing as an alternate way of achieving computationally efficient fault tolerance. It is shown that a hybrid combination of Fermat transform domain block processing and polynomial ring theory provides computationally efficient fault tolerance for adaptive filters implemented in highly scaled nano-technology circuits. [C1325]

"Asymptotic performance analysis and optimization of resource-constrained multi-core architectures"

Multi-core processor architectures are gaining huge interests from academia and industry. The multi-core architectures have been proposed and designed for overcoming diminishing return and for efficiently utilizing the exponentially increasing number of transistors available in nano-meter semiconductor technology. Though the multi-core architecture has been proposed as a promising alternative to a traditional monolithic core architecture, performance characteristics and benefits of the multi-core architecture are not well studied. In this paper, we develop an asymptotic analysis model for better understanding the performance characteristics of multi-core processor architectures using Amdahl's law in order to foresee their performance impact for a given workload characteristics (e.g. available parallelism). Through the asymptotic analysis based on the models proposed in this paper, we can make the architectural design decisions such as Г,Вїthe number of coresГ,Вї and Г,Вїcore sizeГ,Вї, and further we can probe the possible research direction of optimizing the performance of multi-core architectures. [C1326]

"Electrochemical aspects of DC diaphragm discharge in water solutions of textile dyes"

Decomposition of two textile dyes (Direct Blue 106 and Direct Red 79) in water solutions containing supported electrolyte (NaCl, NaNO3or Na3PO4) by DC diaphragm discharge and by pure electrolysis was observed in both electrode spaces of the reactor. The removal was much intensive in the anode space, up to 60 % after 40 minutes of the treatment. Higher contribution of electrochemical processes was observed in DB106 solution. Further, NaCl was determined as the most effective electrolyte for the dye removal. Significant stimulation effect of acidic pH value for the dye decomposition was proposed as well. [C1327]

"Characterization of two dimensional photonics structures using optical sccaterometry"

The technology of photonics structures has being still developed. The main problem, which this technology copy with, is characterization of geometrical parameters in a nano regime. The best method should be quick, easy to use, cheep and precise. Two popular methods such as microscopy AFM or SEM are expansive to maintain and use. Moreover the time of a measurement is long and the inspected area are relatively small. Majority photonic structures are periodic due to optical methods look quite promising. One of them is optical scatterometry which is the angle-resolved measurement and characterization of light scattered from a structure. This technique is able to precisely measure geometrical parameters of structures in the sub-micron size. Additionally scatterometry is quick and non-invasive method. In previous paper has been presented results of using this method to obtain profile one dimensional photonic crystal. In this paper is described the method to measure two dimensional nano-structures and results characterization of two dimensional photonic crystal PhC in photoresist obtained by holographic lithography. [C1328]

"Investigating issues of on-chip voltage regulator in nanoscale integrated circuits"

Voltage regulation in system-on-chip has turned into a very critical challenge for nanoscale IC designers. It is imperative that for multi-core implementation on-chip voltage regulator offers enormous benefits. This paper discusses the advantages and disadvantages of using on-chip regulators as well as their functional operation. Furthermore, it introduces the technique of using a hot swap controller along with an N-channel MOSFET to monitor and control the inrush current in the circuit, and reduce the voltage droop. Simulations show how the controller reduces the voltage droop in the circuit. Here, an overview of current technology and different types of regulators used in the design of micro- and nano-electronic systems is presented. Specific emphasis is given to switching regulators since they are the preferred topology for on-chip integration. The primary goal of this work is to identify the issues associated with on-chip regulators. [C1329]

"Nano-Structured and Micro-Structured Semiconductors for Higher Efficiency Solar Cells"

Hybrid thin-film solar cells are fabricated on the glass substrate using ZnO nanorods, well-aligned single-crystalline Si nanowires (SiNWs), and poly(3-hexylthiophene):[6,6]-phenyl-C61-butyric acid methyl ester (P3HT:PCBM) as well as micro-structured III-V semiconductors . The effect of introducing a solution-processed fullerene as an electron transport layer on the polymer/ZnO nanorod array composite solar cells is investigated . Devices with the fullerene layer exhibit a larger short circuit current density (10.16 mA/cm2) than those without this layer (9.37 mA/cm2). For the Si NWs with P3HT:PCBM, the well-aligned SiNWs are fabricated from Si wafer and transferred onto the glass substrate with the P3HT:PCBM. Such SiNWs provide uninterrupted conduction paths for electron transport, enhancing the optical absorption to serve as an absorber, and increase the surface area for exciton dissociation . Our investigations show that Si NWs are promising for hybrid organic photovoltaic cells with improved performance by increasing the short-circuit current density from 7.17 to 11.61 mA/cm2. III-V semiconductors are also used for thin-film solar cells. InGaP/GaAs two-junction square-based (25 mum times25 mum) cuboid arrays with a height of 6.52 mum were released from GaAs substrates by the epitaxial lift-off process. These InGaP/GaAs cuboid arrays were transplanted to the P3HT film spun on ITO glass substrate. In addition to the significant cost reduction, our method shows the rapid transplantation and the potential for high-efficiency large-area devices fabrication. [C1330]

"Adaptivity and reliability in future chips. Multi-core and reconfigurable architectures in the Nano Era"

The field of embedded electronic systems is still emerging. Multipurpose adaptivity and reliability features are playing more and more of a central role, especially while scaling silicon technologies down according to Moore's benchmarks. Leading processor and mainframe companies are gaining more awareness of reconfigurable computing technologies due to increasing energy and cost constraints. My view is of an "all-win-symbiosis" of future silicon-based processor technologies and reconfigurable circuits/architectures. [C1331]

"Space Altimetry from Nano-Satellites: Payload Feasibility, Missions and System Performances"

Thale graves Alenia Space is an industry world leader in high performance altimeters for ocean topography from space (Poseidon1 on TOPEX-Poseidon, Poseidon2 on Jason1, Poseidon3 on Jason2 and AltiKa on AltiKa/SARAL), and for ice topography from space (SIRAL1 and SIRAL2 on Cryosat). Thale graves Alenia Space is also involved on advanced altimeter concepts such as wide swath and high resolution altimetry (SWOT) for hydrology. CLS is dedicated to satellite environmental monitoring and security services. In this framework, CLS is involved in algorithms and products definition, data processing and CalVal for the altimetry missions developed in cooperation between US and France (TOPEX-Poseidon, Jason1/2), in US (GFO) and in Europe (ERS1-2, Envisat, Cryosat) and is currently involved in the definition and development of future missions (AltiKa, Sentinel3) and future wide swath altimetry concepts (SWOT). Altimetry satellites for space oceanography have seen continuous and tremendous reduction in size, mass, and program cost: TOPEX-Poseidon satellite mass is 2500 kg. Jason1/2 satellites mass is 500 kg. AltiKa microsatellite mass shall be around 150 kg. Is a further step in reduction of satellite mass (and cost) achievable? What kind of altimetry payload? Which (system) performances? Which payload and satellite technologies? For which (new) mission(s)? This paper addresses these points and shows the way of an additional step in innovative solutions opening to low cost constellation of altimetry satellites with new applications and services. [C1332]

"Fabrication of Tunable Duty Cycle Metal Wire Nanograting by Oblique Sputtering"

A method to fabricate metal wire nanogratings of tunable duty cycle (0.5~0.9 and even larger) without using e-beam lithography (EBL) is demonstrated. This provides a low cost technology to realize subwavelength metal slit arrays. The fabrication processes and the details of accurately controlling the grating shape are disclosed. The transmission properties of the metal wire nanograting with different duty cycles are discussed. The technique to make multiple layer metal wire grating using oblique deposition is also proposed. [C1333]

"Innovations to extend CMOS nano-transistors to the limit"

Summary form only given. The scaling of CMOS technology has led to phenomenal growth in transistor density and performance during the last three decades. However, starting at 90nm CMOS node, the industry started to experience significant barriers in achieving historical transistor performance gains through traditional dimensional scaling. Fortunately, the industry has responded positively to this challenge by implementing many innovations in device structure and materials to overcome traditional scaling barriers. Intel has been at the forefront in addressing these challenges by successfully driving transistor innovations from research phase to mainstream CMOS manufacturing. Implementation of uniaxial strained-silicon transistors at the 90nm node and the recently announced "HiK+Metal Gate" transistors for the 45nm node are two excellent examples of major innovations which have demonstrated dramatic performance enhancement. After a brief review highlighting the dramatic performance benefits demonstrated with uniaxial strained silicon technology, I will describe process details and present significant performance gains achieved with "HiK+Metal Gate" transistor technology for 45nm CMOS node. Finally, I will discuss the role of increasing power density and transistor parasitics in limiting future CMOS transistor scaling and describe potential new transistor structure and material innovations required to meet performance/power/density improvements beyond 45nm CMOS node. The convergence of new transistor structure and materials will be critical for successfully scaling CMOS transistors through next decade. [C1334]

"Parallel detection of nucleic acids using an electronic chip"

Prostate cancer is the most commonly diagnosed cancer among North American men. The recent discovery of altered genes that play an underlying role in prostate cancer development has made the sequence-specific detection of nucleic acids especially important. Multiplexed detection using electronic readout would permit sensitive, reliable, fast and inexpensive identification of molecular biomarkers in clinical settings. This would improve early diagnosis, and would provide a route towards prognosis and new therapeutic possibilities. Here we report for the first time the development of a novel chip-based, addressable array of nano-textured microelectrodes (NMEs) that can be used in automated detection of a panel of prostate cancer-related gene fusions in clinical samples. The attomolar sensitivity along with the unique multiplexing capability of this system make it superior to the previously reported electrochemical nucleic acids sensors. [C1335]

"A Bayesian based EDA tool for accurate VLSI reliability evaluations"

As the sizes of (nano) device are aggressively scaled deep towards the nanometer regime, the design and manufacturing of future nano-circuits will become extremely complex and inevitably introduce more defects and their functioning will be adversely affected by transient faults. Therefore, accurately calculating the reliability of future designs will become a very important factor for nano-circuit designers as they investigate several design alternatives to optimize the trade-offs between the conflicting metrics of area-power-energy-delay versus reliability. This paper introduces a novel EDA tool for accurate calculation of future nano-circuits reliabilities. Our aim is to provide both educational and research institutions (as well as the semiconductor industry at a later stage) with an accurate and easy to use tool for comparing the reliability of different design alternatives, and for selecting the design that best fits a set of given (design) constraints. [C1336]

"Nonlinear optical properties of some Au nanostructures"

The investigation of the nonlinear optical response of various Au nanostructures has been recently accomplished in our laboratory and some selected results concerning the nonlinear optical properties of these nanostructures will be presented and discussed. In particular, the third-order nonlinear optical response of nanometer thick Au films and Au nano-island films, both deposited on transparent dielectric substrates, are going to be presented and discussed. In addition, the nonlinear optical response of Au nano-clusters encapsulated in block copolymer micelles will be also presented and compared with the other nanostructures. In all cases, the influence of the morphological characteristics of these structures on the nonlinear optical response will be discussed. [C1337]

"Effects of Surface Modification of Nano-silica on Combustion Behaviors of LLDPE/ATH/silica composites"

In this paper, nano-silica with and without surface modification was added into linear low density polyethylene (LLDPE) to prepare LLDPE/silica or LLDPE/Aluminun trihydrate (ATH)/silica composites. Effects of surface modification of nano-silica on the dispersibility of silica in LLDPE and combustion behaviors of composites were investigated by Transmission electron microscopy (TEM) and cone calorimeter (CONE). The results showed silica without surface modification was not well dispersed in LLDPE owing to the severe aggregation of silica particles and its poor compatibility with LLDPE. Improved dispersibility of surface modified silica was found because of its improved compatibility with LLDPE. Obvious decrease of peak-HRR value was observed. Well dispersed silica after surface modification, as proved by TEM, should be contributed to the decreased peak-HRR. Because the shapes of two curves were similar, it was concluded that the mechanistic reason for the decreased HRR come mainly from the physical effects of silica on the surface. [C1338]

"Space Charge Formation in Epoxy Resin Including Various Nanofillers"

It has been widely anticipated that the combination of recent advances in nanocomposites technology with traditional and novel resin systems may create materials with enhanced electrical, thermal and mechanical properties. It has been recognised that charge dynamics under an electric field play an important role in determining the electrical performance of a material. In this research, the pulsed electroacoustic (PEA) technique has been used to measure space charge in epoxy anhydrite samples loaded with various nano-fillers. Space charge characteristics in both dried and wet samples have been measured at ~27 kV/mm. In addition to different charge dynamics, it has also been noticed that the electrical performance of nanocomposites has been affected in the presence of moisture. Further tests have been carried out at a lower field to reveal if different mechanisms take place. [C1339]

"Optical ceramic scintillator for gamma-ray detection"

Transparent lutetium oxyorthosilicate (LSO) ceramic was obtained with its scintillation properties rivaling those of single crystalline LSO. The transparent LSO ceramic was prepared by a nano-technology approach. Hot-isostatic-pressing (HIPing) was employed to densify the ceramic and eliminate porosity after sintering. Transparent polycrystalline LSO ceramics were obtained after the final HIPing. XRD examination confirms single monoclinic LSO phase. A light output as high as 30,100 ph/MeV was achieved under a 22Na excitation source. LSO ceramic showed an energy resolution of 15% (FWHM) at 662 keV (137Cs source) as well as a fast scintillation decay of 40 ns due to the 5d → 4f transition of Ce3+. The time resolution of the LSO ceramic (215 ps, FWHM) was found comparable to that of LSO single crystal (203 ps, FWHM). [C1340]

"Impact of nano particles on semiconductor manufacturing"

Semiconductor industry faces a continuous challenge to decrease the transistor size as well as to increase the yield by eliminating defect sources. One of the sources of particle defects is ultra pure water used in different production tools at different stages of processing. In this paper, particle count data measured in ultra pure water is related to the yield of two large size products. An impact of nanoparticle present in ultra pure water on yield of up to 4-6 % has been found in two different products. [C1341]

"Investigation of the piezoelectric properties of semiconducting nanostructures"

In this paper, the piezoelectric properties of semiconducting nano structures have been investigated. The piezoelectric effect can be characterized via a nano-scale material testing system that utilizing microelectromechanical systems technology. The coefficients were measured by applying a voltage (field) and measuring the induced elongation (strain). It can be readily seen that the piezoelectric effects in nanostructures are generally non-linear and the coefficient is much higher than that for bulk. [C1342]

"The simulation of acoustic field in the design of ultrasound driving device for site nano-drug delivery"

Particle manipulation plays a very important role in many fields, such as ultrasound drug delivery, cell manipulation and trapping molecules. Ultrasonic manipulation, which uses acoustic radiation forces, is a contactless manipulation technique. When the particles suspended in a fluid, the ultrasound radiation forces made the particles concentrate in a designated location. Here it is reported on a simulation for two-dimensional arraying based on the superposition of two in-plane orthogonally oriented standing pressure waves. First, we do the simulation of one-dimensional acoustic field with the FEA software of ANSYS. Then, we got the two-dimensional acoustic field by modify the PZT model. We make the particles concentration when the model was excited with a 14 V amplitude signal at 1.5 MHz. [C1343]

"Designing 5GHz microstrip coupled line bandpass filter using LTCC technology"

A top-down detail design of a 5 GHz micro strip coupled line band pass filter in LTCC is presented in this paper. LTCC, which stands for low temperature co-fired ceramic is especially used for wireless and high-frequency applications. Now, the importance of LTCC is becoming more prominent in views of the fact a lot organizations has been funding R&D-projects regarding this new technology that focuses on larger implementation of functionality in LTCC substrates. Although Malaysia is new to this technology, its industry has certainly high hopes on the LTCC innovation to make a breakthrough and contribute significant benefits to the technology, industry, market and also, the country itself. The filter circuit was designed and simulated by using ADS2005A. Then, the physical dimensions of components and the filter itself is subsequently determined and the physical design is later performed in the layout window of Empire XcCEL. All measured simulations are analyzed and compared to design specifications and characteristics (curve fitting). Any inaccuracy is taken into account where corrected design is further recovered. [C1344]

"Conception of integrated hybrid technology: CMOS-molecular electronic"

Numerical simulations have been performed to study the influences of the geometric and coupling-strength parameters such as the intermolecular distance d and pi-orbital on the current-voltage (I-V) characteristics. The model involves 1,4-dithiolbenzene (DTB) molecules stacked in one dimension (1D) ordered structure. It is found that the conductance gap (CG) depends on the highest occupied molecular orbital (HOMO) and the lowest unoccupied molecular orbital (LUMO) gap (HLG). The number of molecules N associated with their intermolecular distance d can significantly modify the HLG which has a strong effect on the conductance gap of the I-V characteristics. The HLG is reduced when decreasing the intermolecular distance d and increasing the number of DTB molecular units N. These studies could be useful to introduce a new concept of design rules for molecular wire. Based on the numerical simulation results, two parameters could be defined as geometrical specification for future molecular layout design rules (DRs), the minimum spacing d between two adjacent molecular units and the number of molecular units N packed in the parallel arrangement. The objective is to implement molecular scale electronic devices based on thiophenyl to extend CMOS technology. This implies the development of electronic hybrid technology in which the components nano and micro come close to each other. [C1345]

"A Novel on chip LDO voltage regulator in 180nm"

An on chip low drop out voltage regulator that employs a simple fast path and an elegant compensation scheme is presented in this paper. The novelty in this design is that the device parasitic capacitances are exploited for compensation at different loads. The proposed LDO is designed to provide a constant voltage of 1.2 V and is implemented in UMC 180 nano meter CMOS technology. The voltage regulator presented improves stability even at lighter loads and enhances line and load regulation while providing reasonably good transient response. [C1346]

"Micro- and nano-electro mechanical (MEMS and NEMS)-based technologies for implanted biomedical devices"

The next generation of implantable biomedical devices based on micro- and nano-electro-mechanical systems (MEMS and NEMS) technology is presented for diagnostics and treatment of chronic and non-chronic illnesses. These passive and active implantable devices allow for early diagnostics as well as timely and precisely controlled therapeutic drug delivery. The implantable devices are also applicable to a number of medical applications, including the next generation of early cancer diagnostics and treatments. [C1347]

"Session 21: Solid-state and nanoelectronic devices carbon-based devices"

This session is devoted to carbon-based devices. The first three papers cover various aspects of graphene field-effect transistors. First, the paper by Z. Chen of IBM and J. Appenzeller of Purdue University reports the measurement of quantum capacitance and suggests a different method for extracting field-effect mobility. Next, the paper by I. Meric et al., of Columbia University presents the first RF measurements of graphene field-effect transistors. Finally, the paper by Y. Ouyang et al., of the University of Florida provides a theoretical assessment of the performance limits of graphene nanoribbon (GNR) FETs with different edge-termination species. The last three papers describe the benefits of carbon for various other applications. First, F. Kreupl et al., of Qimonda propose a carbon-based resistive memory. Next, H. Li and K. Banerjee of University of California Santa Barbara discuss single-walled and multi-walled carbon nanotube (CNT) bundles for RF inductor applications. Finally, H. Dadgour et al., of The University of California Santa Barbara present a scaling and variability analysis of carbon nanotube-based nano-electro-mechanical (NEM) devices. [C1348]

"Session 18: Characterization, reliability, and yield-Strain optimization and performance"

In this session the first paper proposes a new strain mapping technique with sub-nano meter spatial resolutions using TEM. The strain maps obtained by this technique have been shown to contribute to the understanding of mobility enhancement mechanism in nano-scale MOSFETs. The second paper, which is an invited paper from UMC, provides guidelines for developing high-end strained CMOS technologies with acceptable reliability for 65 nm node and beyond. The third paper in this session shows results of IC timing and delay optimization by backside FIB processing and a comparison of the same with conventional and strained technologies. The next paper deals with defect reduction by proper plasma process optimization in order to achieve high mobility and performance improvements. The final paper in the session then addresses the variability issues in circuits by providing an understanding of high drain bias effects on threshold voltage fluctuations by an optimization of halo and drain-induced-barrier-lowering. [C1349]

"Advanced simulation of statistical variability and reliability in nano CMOS transistors"

Increasing CMOS device variability has become one of the most acute problems facing the semiconductor manufacturing and design industries at, and beyond, the 45 nm technology generation. Most problematic of all is the statistical variability introduced by the discreteness of charge and granularity of matter in transistors with features already of molecular dimensions [i]. Two transistors next to each other on the chip with exactly the same geometries and strain distributions may have characteristics from each end of a wide statistical distribution. In conjunction with statistical variability [ii], negative bias temperature instability (NBTI) and/or hot carrier degradation can result in acute statistical reliability problems. It already profoundly affects SRAM design, and in logic circuits causes statistical timing problems and is increasingly leading to hard digital faults. In both cases, statistical variability restricts supply voltage scaling, adding to power dissipation problems [iii]. In this invited paper we describe recent advances in predictive physical simulation of statistical variability using drift diffusion (DD), Monte Carlo (MC) and quantum transport (QT) simulation techniques. [C1350]

"Nanowire conductance biosensor by spacer patterning lithography technique for DNA hybridization detection: Design and fabrication method"

The use of Silicon nanowires has allowed the introduction of many new signal transduction technologies in biosensors. The sensitivity and performance of biosensors is being improved by using doping process for their construction. This research presents the design and fabrication of a Silicon nanowire for deoxyribonucleic acid (DNA) hybridization detection using electrodes made of nanowires whose width is comparable to the size of a DNA molecule. During hybridization, DNA change from single stranded DNA (ssDNA) to double stranded DNA (dsDNA) cause the change of charge density of molecules structure. Fabrication of a Silicon nanowire (NW) using spacer patterning lithography (SPL) techniques is addressed and characterization of its conductivity altogether with capacitance effect is discussed in this research. [C1351]

"Latest developments in bumping technologies for flip chip and WLCSP packaging"

Stencil printing of solder paste remains the technology route of choice for flip chip bumping because of its economical advantages over traditionally costly evaporation and electroplating processes. Fraunhofer IZM printing group has developed stencil printing processes to meet the current trends in wafer bumping roadmaps with continuous increase of I/O's and reduced bumping pitch. Mainstream wafer bumping has been performed by using innovative Type 5 (15-25µm) and Type 6 (5-15µm) pastes with both Sn-Pb and Pb-free compositions from 300 µm up to 100 µm pitches for peripheral pad configurations and up to 120 µm for area array configurations. At R&D level, IZM has advanced stencil printing very close to its technological limits at pitches even down to 50 µm. Innovative electroformed and laser-cut with nano-treatment stencils have been manufactured with an extreme thinness of 20 µm for bumping wafers at Ultra fine pitches (UFP) of 100 µm, 80 µm and 60 µm. Specifically, for 100 µm pitch bumping, both type 7 (2-11µm) and type 6 (5-15µm) pastes of eutectic composition Sn63/Pb37 have been successfully employed. Bumping using 25 µm electroformed stencil thickness has yielded bump heights of 42.3±3.8µm and 43.6±3.5µm for type 7 and type 6 pastes, respectively. A newly prototype developed type 8 paste (2-8µm) has been used for the first time to bump chips with peripheral contacts at 80 µm and 60 µm pitch. Bumping at 80 µm pitch with nano-treated laser-cut stencil has yielded bumps of 28 µm in height. For bumping at 60 µm pitch, a 20 µm thick electroformed stencil was used with 35 µmx80 µm oblong apertures. Printing at 60 µm pitch has yielded very promising results and has proved the capability of electroformed technology to manufacture accurate and ro--bust thin stencils. The bump height at 60 µm pitch was measured to be 28 ±3 µm. Paste-in-Resist technology lias been developed as an alternative to stencils in order to overcome the manufacturing difficulties of making extremely small apertures. Paste is printed in resist apertures which have been opened by photolithographic processes. In this way, bumping has been demonstrated up to 50 µm pitches. Complimentary to stencil printing processes, IZM has developed balling technologies up to 400 µm pitch up to 8" wafers with a thickness of 150 µm. Solder balling can be achieved either by "perform ball print" using conventional stencil printers with specially designed stencils or by "ball drop" techniques. Balling technologies have demonstrated the application of 300 µm and 250 µm Sn-Pb and Pb-free balls at respective area array pitches of 500 µm and 400 µm, the main I/O pitches for WL-CSP bumping. [C1352]

"Fabrication of nanoporous polyimide of low dielectric constant"

Polyimide is a choice of material widely used in electronic packaging due to its high thermal and mechanical stability and low thermal expansion coefficient and dielectric constant. Two porous polyimides of structure shown in the following figure were successfully synthesised. The reaction scheme involve polycondensation of 3,3',4,4'-biphenyltetracarboxylic dianhydride with 4",4"'-(hexafluoroisopropyllidene)-bis(4-phenoxyaniline) and 4,4'-(4,4'-isopropylidenediphenyl-1,1'-diyldioxy) dianiline followed by thermal curing of the intermediate polyamic acid. This treatment afforded a high molecular mass polyimide of tough and thermally stable polymer. Nanofoam polyimide films were fabricated by means of sol-gel technique to give a homogeneously dispersed nano-sized voids in range 100-400 nm. Both materials showed an ultra-low dielectric constant of 2.76 and 2.84 respectively. Comparison of the treated and non-treated polyimide films showed that the gain in low dielectric constant is achieved at a considerable expanse of mechanical properties. [C1353]

"Nano silica dispersion in epoxy: the investigation of heat, milling speed and duration effect"

Nano composites are a promising development but the challenge of homogenous and discrete dispersion of the nano fillers are barriers that must be overcome before they can be effectively implemented. Although the common dispersion methods such as particle surface modification, comprehensive milling metrologies and the usage of solvents bear results, these are time consuming and not cost effective. In this paper, we explore the efficiency of coupling the usage of ball-media and heat on the dispersion of nano silica in epoxy. No solvents are involved. The effects of milling speed and duration are also studied albeit under a fixed ball media: silica-epoxy volume ratio of 3:5. The experiment set-up involves a simple 3-blade mixer, round bottom flask and 60 ? m zirconia ball. At nano silica loading of 10 wt % the nano silica clusters are systematically reduced from 1.5-2 ? m to 100-200 nm with the usage of ball media and application of heat. At the optimum milling speed and duration of 500 rpm for 5 hours, the aggregate sizes were further reduced to 30-70 nm, which is almost a discrete dispersion. [C1354]

"Space complexity optimization for nano electronic devices based on evolutionary computation"

Recent studies show quantum-dot cellular automata (QCA) as one of the promising alternatives to CMOS technology. Optimization plays an important role in circuit design despite the used technology. One possibility is the minimization of the number of basic building blocks usually resulting in less energy consumption and fewer delays in processing. The principles of evolutionary computation have already been successfully used for logic optimization of majority gate-based nano electronic circuits. The realm was to reduce the number of the basic building blocks (majority gates) required for computing Boolean functions. Our study is focused on the space complexity optimization of simple and also more complex QCA devices by means of the minimization of the number of employed QCA cells. [C1355]

"Finger number and width variation effect of nano-scale strained NMOS device with and without protection diode"

The enhancement of carrier mobility by strain is necessary to improve transistor performance with scaling down. Especially the technique of inducing strain by using a tensile or compressive nitride capping layer is more attractive because of its relative process simplicity and its extendibility from bulk-Si to silicon-on-insulator (SOI) MOSFETS. Also to improve the packing density of integrated circuits, scaling down of isolation region is necessary. Shallow Trench Isolation (STI) is usually used in order to avoid the subthreshold hump, bird's beak and field oxide thinning effect in LOCOS. Compared with LOCOS isolation, STI has various additional advantages such as perfect surface planarity, scalability and latchup immunity, However the reliability of strained NMOS device with narrow width and gate finger number variation at 60nm gate length has not been investigated yet in detail and also protection diode effect. In this work, we have shown various STI stress and protection diode effects in narrow width device, finger number variation of the gate with 60nm gate length technology by HCE (Hot Carrier Effect), 1/f noise. [C1356]

"Characterization of nickel plated copper heat spreaders with different catalytic activation processes for flip-chip ball grid array package"

This paper presents the effects of two different catalytic activation techniques on the thermal performance of flip chip heat spreaders. The two activation techniques investigated are i) thin nickel-copper strike and ii) galvanic initiation. Thermal diffusivity of these heat spreaders was studied using the Nano-flash Apparatus [1]. High temperature storage tests were run to investigate the extent of intermetallic diffusion between the nickel and copper layers. The results obtained showed that heat spreaders processed with thin nickel-copper strike catalytic activation technique formed thick nickel-copper intermetallic layers compared to those processed with galvanic initiation. Nickel-copper intermetallic layers have lower thermal conductivity compared to pure copper [2]. As a result, heat spreaders processed with thin nickel copper strike have lower thermal diffusivity values averaged at 35-65W/mK XX compared to 60-85W/mK YY measured for those processed with galvanic-initiation. It is also discovered that the nickel-copper intermetallic layers of these heat spreaders grew thicker from 0.2μm at initial time until around 0.55μm after high temperature storage of 168 hours, further degrading the thermal diffusivity of these heat spreaders. As a conclusion, the galvanic initiation technique provides better thermal performance for heat spreaders used in semiconductor packages. [C1357]

"Theoretical and experimental results of a fully ballistic nano-FET with high gain"

We report on the experimental evidence of a fully ballistic nano-FET with a voltage gain higher than 1 which is based on a 1D quantum ballistic conductor. In such a FET, the transconductance and the output conductance are basically modulated by the 1D subbands and the experimental results can theoretically be explained based on the Landauer-Buttiker formalism and the Buttiker model of the saddle-point constriction. [C1358]

"Waveguide-integrated Si nano-photodiode with surface-plasmon antenna and its application to on-chip optical clock signal distribution"

We developed a waveguide-integrated Si nano-photodiode (PD) with a surface plasmon (SP) antenna for on-chip optical clock distribution. The interfacial periodic nano-scale metal-semiconductor-metal Schottky electrodes were shown to function as an SP optical antenna and also as an optical coupler between a SiON waveguide and a very thin Si-absorption layer. Furthermore, a very high speed response of 17 ps as well as enhanced photoresponsivity was achieved for a 10-mum coupling length. By using this technology, we fabricated a prototype of a large-scale-integration (LSI) on-chip optical clock system and demonstrated 5 GHz of optical clock circuit operation connected with a 4-branching H-tree structure. [C1359]

"Aberration reduction in composite photonic crystal negative refractive lens"

We propose a composite photonic crystal for compensating an aberration in negative refractive lens. We experimentally observed that the focal spot size was clearly narrowed, compared with the case of single photonic crystal. [C1360]

"Sub-THz RTD oscillators integrated with planar horn antennas for horizontal radiation"

Fabrication and oscillation characteristics of sub-THz RTD oscillators integrated with planar horn antennas for horizontal radiation are reported. Oscillation frequency of 455 GHz and horizontal output power of ~0.6 muW were observed. [C1361]

"Ultra compact photonic crystal modulator based on silicon nano-pillar array filled with functional polymer"

We present the optical design of the photonic crystal modulator based on silicon nano-pillar array filled with functional polymer. The device will achieve an ultra compact size and sub-volt driving voltage with the slow-photon effect. [C1362]

"New SRAM Cell Design for Low Power and High Reliability Using 32nm Independent Gate FinFET Technology"

This paper proposes new methods for SRAM cell design in FinFET technology. One of the most important features of FinFET is that the independent front and back gates can be biased differently to control the current and the device threshold voltage. By controlling the back gate voltage of a FinFET, a SRAM cell can be designed for low power consumption. This paper proposes a new 8T (8 transistors) SRAM structure that reduces dynamic power for the write operation and achieves a wider SNM (static noise margin). Using the new FinFET based 8T SRAM cell, dynamic power consumption is reduced by nearly 48% and the SNM is widened up to 56% compared to the conventional 6T SRAM at the expense of 2% leakage power and 3% write delay increase. [C1363]

"Resistive Crossbar Switching Networks for Inherently Fault Tolerant Nano LUTs"

We present a detailed treatment of crossbar switching networks (R-CSNs) made of resistive elements for memory utilization (as look-up table) in a nano FPGA. Initially, a technology assessment of this technology compared with a VLSI CMOS based memory is pursued considering area and support circuitry. Then, a graph model is utilized for characterizing the effects of a single fault on the fault tolerant capabilities of a R-CSN. This is used to establish the exact analytical expression for the fault tolerance of a R-CSN in the presence of a single stuck-open/closed fault. The presented analysis confirms that small-sized R-CSNs are well suited as LUTs for FPGAs at nano scales. [C1364]

"Electromigration Feedback Controlled Nanogaps Fabrication Based on MPTMS Adhesion Layer"

Nanogap devices are useful in several applications and together with other novel solutions represent interesting approaches to find new technologies to solve the limitation of CMOS processes. They can be used in molecular electronics, but also in sensor devices, exploiting nano-structures to detect molecules having comparable dimensions. Present work is devoted to fabrication of nanogaps using gold probes and Electromigration Induced Break Junction (EIBJ) technique. To produce the two terminal probes where to build the nanogap on silicon surface, a self assembly adhesion molecule (3-Mercaptopropyl)trimethoxysilane is used. This molecule solves the problem of using metallic adhesion layers for gold deposition, like titanium or chromium. Analysis on produced nanogaps has been carried out, while studying in particular the combined effects of temperature and electromigration. [C1365]

"Optical equalization for bandwidth enhancement of directly modulated DFB Lasers"

We demonstrated the bandwidth enhancement of a directly-modulated DFB laser using an optical equalizer, which increases a 3 dB modulation bandwidth of a 10 Gbps DFB LD module to be over doubled. [C1366]

"Enhancement of terahertz optical activity with photo-excitation in metal chiral gratings"

We demonstrate the enhancement of optical activity in the terahertz frequency region with metal chiral gratings by photo-excitation of the semiconductor substrate. This result indicates the possibility of the active control of the terahertz polarization. [C1367]

"Refractive index sensing utilizing a CW photonic crystal nanolaser and its array configuration"

We achieved a record high index sensitivity in a cw photonic crystal nanolaser with a potential index resolution of < 10-6. We also demonstrated spectrometer-free index sensing utilizing nanolaser array. [C1368]

"Coherent power combination in multi-element sub-THz RTD oscillators coupled with MIM stub structure"

We observed coherent power combination in 3-element oscillator array using resonant tunneling diodes coupled through planar circuits. In the array, a single peak at 293 GHz with the output power of 13 muW was observed. [C1369]

"Unidirectional emission of a single-cell photonic-crystal deformed hexapole mode laser"

We experimentally demonstrate linearly polarized vertical emission from the hexapole mode of a single-cell photonic-crystal cavity with simple deformation. 68% of the photons of the resonant mode is funnelled within a divergence angle of plusmn45deg. [C1370]

"Comparison of wafer bonding methods of membrane GaInAsP wired waveguides on Si substrate"

SiO2/SiO2direct wafer bonding and BCB bonding have been compared to realize membrane GaInAsP wired waveguides on Si Substrate. Bonding environment and pressure were essential for BCB bonding and SiO2direct bonding, respectively. [C1371]

"Fabrication and millimeter-wave characterization of semiconductor Klystron amplifier device"

As a possible terahertz amplifier device, Semiconductor Klystron Device was proposed. Theoretical analysis shows that the transconductance has a peak in the THz range. The frequency characteristics is measured in the millimeter wave range. Measured transconductance increases with frequency in agreement with theory. [C1372]

"Progress in biosensor and bioelectronics simulations: New applications for TCAD"

Scaling of devices in the semiconductor industry has reached an extremely impressive level; electronic device dimensions are approaching atomic scales and can also have dimensions comparable to many biological microstructures. In this paper, we present an overview of the new challenges in modeling electronics that interface with and bridge into the domains of biotechnology. In particular, we will discuss the applications of conventional integrated circuits technology computer-aided design (TCAD) in these new and emerging areas. Furthermore, we will examine the unique modeling requirements of biosensors in molecular identification and quantification applications. As we will discuss in this paper, there are exciting research challenges for the electronics community-new opportunities to leverage lessons learned from scaling. [C1373]

"Unification of obstacle-avoiding rectilinear Steiner tree construction"

Multi-layer obstacle-avoiding rectilinear Steiner tree construction is an essential problem in physical design for advanced SoC and nano technologies. This paper unifies obstacle-avoiding rectilinear Steiner tree construction either for single or for multiple routing layers. Experimental results show that our algorithm outperforms the state-of-the-art works for both cases. [C1374]

"Module Grouping for Defect Tolerance in Nanoscale Memory"

Designing a nanoscale memory system with defect rate as high as 10% poses a significant challenge. Redundancies at various levels have been employed to tolerate the high defect rates. Multiple crossbar modules that share the same address space can be used to build a simple and robust memory architecture to overcome the defects in the crossbar. In this paper, we presents a module grouping scheme for tolerating defects in a nanoscale memory composed of nano-modules. Redundancy at nano-module level with some degree of flexibility in assigning nano-modules is used to achieve defect tolerance. Computer simulation shows that the proposed scheme can construct a functioning memory with up to 45% reduction in the required number of nano-modules as compared to the existing simple redundancy scheme. [C1375]

"Effect of random impurities on transport characteristics of nano-scale MOSFET"

Recently, we have proposed a new method for device simulations which allows for splitting the device area into a set of independent elements and computing all the physical observables in the form of local spectral representation. The shape of the device elements and their internal coordinate representation are arbitrary which offers a natural way to treat singular dopant charge distribution by choosing appropriate device fragmentation scheme. We have applied our method to study the impact of an attractive ion in intrinsic Si channel to the MOSFET transport characteristics. We have observed an intrinsic bistability in biased MOSFETs related with two possible ion charge screening mechanisms. [C1376]

"High-throughput in vivo genetic and drug screening using femtosecond laser nano-surgery, and microfluidics"

We demonstrate microfluidic devices and imaging technologies for high-speed immobilization, cellular resolution imaging, and femtosecond laser micro-surgery of awake small-animals (C. elegans) for high-throughput in vivo genetic and drug screens on neural degeneration and regeneration. [C1377]

"Converging micro-nano-bio technologies towards integrated biomedical systems: State of the art and future perspectives under the EU-information & communication technologies program"

Research and development at the convergence of microelectronics, nano-materials, biochemistry, measurement technology and information technology is leading to a new class of biomedical systems and applications e.g. molecular imaging, point of care testing, gene therapy and bionics (including on and inside the body sensors and other miniaturised smart systems) which are expected to revolutionise the healthcare provision and quality of life. In particular they are expected to identify diseases at the earliest possible stage, intervene before symptomatic disease becomes apparent and monitor both the progress of the diseases and the effect of intervention and therapeutic procedures. The group of EC-funded projects on Micro-Nano-Bio Convergence Systems, "so-called" MNBS, is made by projects developing systems that use a vast array of technologies to integrate across traditional boundaries between the micro-nano- bio, and info worlds, enabling a wide range of applications from health care to food quality monitoring. It includes mainly two sub-groups, one dealing with systems for in vitro molecular diagnosis and biological/biochemical analysis and the other is dealing with systems for in vivo interaction with the human body. Current status of development and future challenges, technological and socioeconomic, are briefly presented in this paper as background introductory information to the mini-symposium on MNBS. Relevant examples of R&D within the group will be presented in the mini-symposium. [C1378]

"Structured piezo-ceramic mechatronic handling devices for micro and nano manipulations"

This paper presents the development of a methodology and technology for the appropriate selection and creation of mechatronic handling devices (MHD) able to accomplish certain micro- and/or nano-operation task. As basis actuator, piezo ceramic structures integrated into the mechatronic device are utilized and developed here. Two applications, in bioscience and electrochemistry are foreseen for a demonstration phase. Specific multilayer design approach of piezo-actuated mechatronic handling devices for micro- and nano-operations was proposed based on the method for piezo structures synthesis. Comparison study of the developed mechatronic handling device prototypes is performed based on the obtained simulation and experimental results. Teleoperated control approach is developed based on the impedance scaling technique. [C1379]

"Catalyst-free solvothermal synthesis of carbon nanotubes"

Conventional methods of producing carbon nanotubes are generally limited by the length and quality of the tubes and maybe more importantly, cost. This paper presents the development of solvothermal techniques designed to produce a highly scalable and cost effective method for producing carbon nanotubes in long and highly aligned bundles, without the use of transition metal catalysts. In addition, the nanotubes are prepared from feedstock materials that are otherwise persistent chemical pollutants, making the process of potential interest in environmental remediation. [C1380]

"Xilinx Virtex V Field Programmable Gate Array Dose Rate Upset Investigations"

The results of ionizing dose rate experiments on XC5VLX50T FPGAs demonstrate the most susceptible upset mechanism of commercial devices and provide insight into the effectiveness of dose rate hardening of nano-scale technology by using epi substrates. [C1381]

"Combinatorial Optimization Problem in Designing DNA Self-Assembly Tile Sets"

DNA self-assembly has been advocated as a bottom-up manufacturing technology (as applicable in the nano scales) and for algorithmic computation. However, previous research did not address the issue of designing a tile set for an arbitrary target pattern (as to ensure periodic repetition in its assembly) of finite size. This paper considers the synthesis of tile sets for DNA self-assembly and analyzes it as a combinatorial optimization problem. This problem is referred to as PATS (pattern assembling tile-set synthesis). A brief proof is provided for the NP-completeness of PATS. [C1382]

"Targeted epidermal delivery of vaccines from coated micro-nanoprojection patches"

Transcutaneous vaccine delivery has the potential to greatly improve immunization effectiveness and safety. This work characterizes our novel micro-nanoneedles and their payload release profile in vitro and in vivo. We found that these dry-coated micro-nanoneedles quickly deliver the payload to the epidermis. [C1383]

"Using TMR Architectures for Yield Improvement"

With the technology entering the nano dimension, manufacturing processes are less and less reliable, thus drastically impacting the yield. A possible solution to alleviate this problem in the future could consist in using fault tolerant architectures to tolerate manufacturing defects. In this paper, we use the classical triple modular redundancy (TMR) fault tolerant architecture as a case study. Firstly we analyze the conditions that make the use of TMR architectures interesting for yield improvement purpose. In the second part of the paper, we investigate the test requirements for the TMR architecture and we propose a solution for generating test patterns for this type of architecture. Finally, we propose a new manner to implement the TMR architecture that makes it very effective for yield improvement purpose. Experimental results are provided on ISCAS and ITC benchmark circuits to prove the efficiency of the proposed approach in terms of yield improvement with a low area overhead. [C1384]

"Determination of the eigenstates and wavefunctions of a single gated As donor"

Current semiconductor devices have been scaled to such dimensions that we need take atomistic approach to understand their operation for nano-electronics. From a bottoms-up perspective, the smallest functional element within a nanodevice would be a single (dopant) atom itself. Control and understanding over the eigenenergies and wavefunctions of a single dopant could prove a key ingredient for device technology beyond-CMOS. Here, we will discuss the eigenlevels of a single As donor in a three terminal configuration. The donor is incorporated in the channel of prototype transistors called FinFETs. The measured eigenlevels are shown to consist of levels associated with the donors Coulomb potential, levels associated with a triangular well at the gate interface and hybridized combinations of the two. The theoretical framework in which we describe this system (NEMO-3D) is based on a tight-binding approximation. [C1385]

"QCA implementation of a MUX-Based FPGA CLB"

Quantum cellular automata (QCA) represents an emerging technology at the nano technology level. Nowadays, many applications of QCA technology are introduced while programmability can increase the flexibility of QCA implementations. Using the structure of FPGAs can lead to flexible QCA implementations. So, we have implemented a MUX-Based FPGA CLB. This CLB has 3 multiplexers and each multiplexer is composed of 34 QCA cells. [C1386]

"Silicon photonic devices and their integration"

Optical communication is accepted as practical when the cost of introducing it is less than that of the conventional electronics. Silicon photonics is the prime candidates for low-cost highly integrated photonic devices because silicon semiconductor industry gives the most cost-effective and highly-integrated devices today. In addition to that, silicon as an optical material offers high-index contrast waveguides and hence it gives micro-meter scale passive optical devices. Those advantages could lead silicon photonics as a key technology for shorter interconnects such as on-chip networks as well as for long-haul telecommunication devices. Low cost integration of photonics with LSI using 3D-integration and surface-plasmon devices will be discussed briefly. [C1387]

"Photonic integration: Technologies and applications"

Advances in telecommunication and information technologies are fueled by innovations resulting from strategic research. Strategic research may be defined as that mission-oriented research which pursues specific and realistic goals leading to practical applications. Photonic integration, a research activity since the beginnings of optical communication over 35 years ago, with the goal to reduce packaging cost and component foot-print while enhancing subsystem functionality, reliability, performance and cost-effectiveness, is a compelling example of strategic research for optical communications. Photonic integrated circuits (PICs) consisting of a few integrated devices on InP or silica substrates have found commercial application in WDM lightwave transmission systems since the late 1990s. Recently, multi-wavelength (WDM) transmitter and receiver PICs consisting of several tens of arrayed devices integrated on InP substrates have emerged as cost-effective subsystems deployed in commercial systems. In the meantime, research on photonic integration advances to include divers material platforms, novel physical effects, different fabrication techniques, and nanotechnologies. This rump session will present some of the on-going research in the field of photonic integration, address specific technological strengths and challenges, discuss costeffectiveness if possible, and consider potential applications and impact. [C1388]

"Role of nucleation in the nanowire growth and properties"

Nucleation of two-dimensional islands from a liquid alloy is generally considered as one of the most important processes driving the ldquovapour-liquid-solidrdquo catalyst-assisted growth of semiconductor nanowires. This talk presents an overview of theoretical and experimental results concerning the influence of nucleation on the morphology and structure of different III-V nanowires. In particular, it will be shown that nucleation at the triple line leads to the formation of hexagonal wurtzite crystal phase in nanowires of zinc blende III-V materials. [C1389]

"Photonic crystals and silicon photonics"

Photonic crystals and silicon photonics have dramatically reduced the size of photonic devices to a micron scale and added unique functionalities such as slow light and negative refraction. They will increase the feasibility of large scale photonic integration if III-V devices are smartly combined with Si platform. This presentation discusses their current status and effective choice of photonic nanostructures in each photonic device. [C1390]

"Basic technologies for all-optical packet switching"

Trials of basic technologies for all-optical packet switching are described, among which include start bit extraction, label-payload separation, serial-parallel conversion, label information recognition, and packet routing. These functions are realized by using SOA-MZI all-optical switches. [C1391]

"Applications for 100 ethernet and beyond"

Internet protocol (IP) data traffic is explosively increasing with the diffusion or broadband access environments such as fiber to the home (FTTH) and asynchronous digital subscriber line (ADSL) which enables video on demand services, video chat, large data downloads, and so on. In Japan, the IP data traffic is roughly doubling each per year, and the number of FTTH users exceeded 12 million in 2008 Q1. To support these huge traffic, the IEEE 802.3ba working group recently started standardization activity on 40/100 GoE LAN interfaces and will finalize it by 2010. In addition, regarding the long-haul transmission, very high speed, large capacity optical transport network (OTN) architectures have been discussed and will be standardized in ITU-T such as Recommendation G.872 and G-700. Corresponding to these situations, physical layer components for 400/100 GE LAN interfaces have been extensively developed. Especially, parallel transmission techniques such as 25 Gb/s times 4 can be adapted for 100 GE, and optical integration should be a key technologies to reduce the cost. Research and development for 100 Gb/s-based serial transport technologies, which are based on coherent detection and wireless technologies are promising for the long-distance transmission, as well as optical integration technologies are important for spreading the 100 Gb/s-based transmission widely. In the presentation. I will review the R&D activities regarding 40/100 GE and 100 Gb/s-based long-distance transmission technologies. [C1392]

"Applications of PICs for computer architecture and interconnects"

High-speed and high port-count optical switches are very attractive for optical interconnecting applications in high-performance computing systems. To make such optical switches practical, however, the reduction of both switch-size and power consumption is essential. This presentation discusses the optical interconnect architecture with monolithically-integrated SOA gate switch devices and compact packaging technology by novel module assembly. [C1393]

"Inkjet printing of passive microwave circuitry"

Inkjet printing technology was utilized to fabricate transmission lines on a glass substrate. 50 micron resolution was realized using 10 pL drop volumes on a Corning 7740 glass substrate. This can be further improved by applying other methods as described in this paper. The conductivity of the sintered silver structures were 1/6 that of bulk silver after sintering at a temperature much lower than the melting point of bulk silver. A comparison of the DC resistance of the sintered silver shows that it can be a match for electroplated and etched copper. Printed coplanar lines demonstrated losses of 1.62 dB/cm at 10 GHz and 2.65 dB/cm at 20 GHz. [C1394]

"Potential of carbon nanotubes for sensor applications"

Due to their unique electrical and mechanical properties carbon nanotubes (CNTs) are the most studied material in the nanotechnology. These material properties involve interesting advantages for sensors, such as a short reaction time, a higher sensitivity and novel sensing principles. In this paper we evaluate the potential of CNTs for different sensor applications. Although nanotechnology is still under development, several sensors can be already realized showing decisive advantages compared with nowadays sensors for several measured quantities.Three different categories of CNT based sensors are reported: analytical sensors which are based on the interaction of CNTs with ions and molecules, mechanical sensors which are based on the piezoresistivity of CNTs and optical sensors which profit from the high absorption rates of CNT and their unique optical properties. [C1395]

"A Quantitative Approach for Analysis of Defect Tolerance in QCA"

Quantum dot cellular automata (QCA) is one of the emerging nanotechnologies for the design of next generation nanocomputing systems. However, excessive defects at the device level are expected to become a fundamental obstacle for achieving reliable computation in QCA-based integrated systems. In this paper, we present an information-theoretic approach to investigate the relationship between defect tolerance and the redundancy inherent in QCA systems. The proposed method allows us to evaluate the effectiveness of redundancy-based defect tolerance in a quantitative manner. [C1396]

"Design, integration and characterization of a novel paper-based wireless sensor module"

In this paper, the first ever wireless "System On Paper" is introduced. A paper based wireless sensor module verifies the feasibility of this technology. Inkjet printing of conductive nano-particle silver ink, as well as the efficient integration of sensor active and passive devices and power source, reported in this paper, set the foundation for the development of low-cost light-weight autonomous nodes for cognitive intelligence applications. [C1397]

"Nanowires, nanoneedles and sub-wavelength structures: Enabling a new era of optoelectronic technologies"

We review the progress of synthesis, characterization and properties of III-V compound semiconductor nanowires and nanoneedles grown on lattice-mismatched substrates and a new family of optoelectronic devices based on high-contrast grating. There are intense interests in semiconductor structures with dimensions at the two ends of the nanometer regime. Materials with size on the order of a few nanometers, close to the de Broglie wavelength, are critical because their physical properties may be altered by its dimensions. In particular, they offer a tremendous opportunity to engineer properties of active materials. On the other hand, materials with dimensions on the order of one hundred nanometer scale are of enormous interests because they open up a new window to re-examine the wave guiding properties in sub-wavelength structures. In this talk, I will discuss recent progress in these two areas. We will discuss the synthesis and characteristics of III-V compound nanowires and nanoneedles that are monolithically grown on Si and sapphire despite of a very large lattice mismatches (over 50% for the latter) [1-4]. The structures show excellent crystalline and optical quality. The nanowires are promising for ultra low threshold lasers and high efficiency solar cells. The nanoneedles, on the other hand, have an extremely sharp tip of a few atoms in diameter. They are shaped in hexagonal pyramid and have a sharp 6-9deg angles. Core-shell GaAs/AlGaAs and GaAs/InGaAs/GaAs layered nanoneedles are demonstrated with bright photoluminescence. They will find applications for field emission tips, atomic force microscopic probe tips and atto-liter liquid delivery. For the hundred-nm regime structures, we recently discovered a novel high index contrast subwavelength grating (HCG) structure, which showed an unprecedented effects on optical wave guiding and reflection properties [5-9]. We showed a single grating with an exceedingly large bandwidth (Deltalambda/lambda=35%) at high reflect--ivity (99.5%) for surfacenormal incident light. The broad bandwidth was accompanied by a very large tolerance where key grating parameters can vary by 50% to still yield VCSEL with similar light-current characteristics. By varying the grating parameters, we show a single layer of uniform grating exhibits high-Q (14,000) resonator characteristics-again for surface-normal emission. The HCG grating brings guided-wave optics to a totally untrespassed regime and will find many useful applications in lasers, filters, waveguides, sensors and detectors. [C1398]

"Towards a tunable nanoscopic light source"

Semiconductor nanowires have witnessed an explosion of interest in the last several years due to advances in synthesis and the unique thermal, optoelectronic, chemical, and mechanical properties of these materials. The potential applications of single-crystalline nanowires are truly impressive, including computational technology, communications, spectroscopic sensing, alternative energy, and the biological sciences. While lithographic silicon processes are rapidly approaching their physical size limits, optical information processing promises to be a low-power, high-bandwidth alternative for the continuation of Moorepsilas Law. Semiconductor systems with photon, phonon and/or electron confinement in two dimensions offer a distinct way to study electrical, thermal, mechanical, and optical phenomena as a function of dimensionality and size reduction. These structures have cross-sectional dimensions that can be tuned from 5 to 500 nm, with lengths spanning hundreds of nanometers to millimeters. The vapor-liquid-solid crystal growth mechanism has been utilized for the general synthesis of nanowires of different compositions, sizes, and orientation. Precise size control of the nanowires can be readily achieved using metal nanocrystals as the catalysts. Epitaxial growth plays a significant role in making such nanowire heterostructures and their arrays. Achieving such high level of synthetic control over nanowire growth allows us to explore some of their very unique physical properties. For example, semiconductor nanowires can function as self-contained nanoscale lasers, LEDs, sub-wavelength optical waveguides, photodetector. We have also recently developed an electrode-free, continuously tunable coherent visible light source compatible with physiological environments, from individual potassium niobate (KNbO3) nanowires. These wires exhibit efficient second harmonic generation, and act as frequency converters, allowing the local synthesis of a wide range of colo--urs via sum and difference frequency generation. We use this tunable nanometric light source to implement a novel form of subwavelength microscopy, in which an infrared laser is used to optically trap and scan a nanowire over a sample, suggesting a wide range of potential applications in physics, chemistry, materials science and biology. [C1399]

"Nanophotonics; walking beyond the classical limits of light"

Nanophotonics has recently achieved new dimensions in several aspects of nanoscience, such as nano-imaging, nano-analysis or even nano-manipulation of several kinds of samples ranging from semiconductors to biomolecules. The interaction volume between light and sample is classically restricted by so-called diffraction limit of light, which is about half of the wavelength of the probing light. We have jumped aver this classical limit in several nanophotonics technologies, such as in fabrication, in analysis and in imaging of samples at nanoscale, and have shown how light can interact with materials in a volume much smaller than the diffraction limits. [C1400]

"Research activities in photonic devices for BBA systems"

The number of Internet users is increasing very rapidly, and data traffic is growing dramatically. A large and dramatic transition has occurred in relation to the information network. In Japan, a 100 Mbit/s class broadband service is now available through fiber to the home (FTTH) at the lowest price in the world and the number of FTTH users exceeded 12.1 million in March, 2008. Broadband traffic roughly doubles each year. This makes it necessary to reconstruct the NW to meet the requirement for a huge transmission capacity. We are changing the network from a legacy telephony network to a new network, which is a broadband network based on Internet Protocol (IP). The photonic technology is the key to create the broadband network system. This talk will describe the innovation of photonic device technologies. [C1401]

"Expectations for photonic broad-band access"

Broad-band services such as Video-on-Demand(VoD), Internet TV(IP-TV) and P2P traffic with movies demand much higher broad-band optical access system as well as core network. Current status of optical technologies for optical broad-band network will be reviewed including research at NICT. [C1402]

"Broadband access systems: Networks, applications and devices"

Internet access is ubiquitous throughout the developed and much of the developing world. Many users, especially youthful ones, regard broadband video applications, such as social networks, games and IP movies, as necessities. Innovative developments in broadband access technologies hold the key to enhancing these services and realizing futuristic applications. For example, the need for much higher network data rates, such as 100 Gb-Ethernet, have been widely predicted. Rump session #3 is designed to explore the nano- components and network strategies needed to realize a new age of information and communications in society. [C1403]

"Evolution of photonic networks and their devices"

This talk summarizes the evolution of photonic technologies and related devices. FTTH and metro-network sustaining its broadband capacity become media as well as a part of social infrastructure. [C1404]

"Highly collimated and ultra-high-intensity near-field lasers by wavefront engineering"

Nanophotonics, i.e. the science and technology of manipulating light at sub-wavelength scales, is emerging as one the most exciting and potentially useful areas of physical optics. I will highlight recent research in my group aimed at inventing and investigating a new class of light-sources with unique near field and far-field properties. Using surface plasmons (i.e. surface electromagnetic waves) interacting with metallic nanostructures built on the facets of semiconductor lasers. We have demonstrated new infrared light sources that can create extremely intense (~ 1 GW/cm2) nanoscale size light-spots of dimensions much smaller than the wavelength. These sources have revolutionary applications in areas such high density DVDpsilas (1 Tb disks) and high resolution chem/bio imaging for example to peer into the interior of cells. [C1405]

"Physics and technology of spin-based quantum computing with quantum dots"

Recent progress in single spin rotation in quantum dots and manipulation of inter-dot exchange coupling, both QT which are necessary for implementing universal set of quantum gates, is reviewed. [C1406]

"Photonic devices for 100Gb ethernet"

We present high-speed 16 quadrature-amplitude-modulation (QAM) and differential quadrature-phase-shift keying (DQPSK) for over 100 Gb/s transmission. 12.5 Gbaud 16-QAM was demonstrated by an integrated LN modulator. This technology is scalable to 25 Gbaud. Polarization-division-muptiplexing (PDM) can be applied to QAM-based modulation by using digital coherent detection scheme. [C1407]

"Nanophotonics in integrated photonics: A view on metamaterials and devices"

We discuss from a theoretical viewpoint the required advances in material technology and device structures needed to continue the rapid development of photonic circuit spatial integration density. [C1408]

"Sub-terahertz and terahertz oscillators at room temperature using electron devices"

Compact and coherent sources are key devices for wide applications of the terahertz (THz) frequency range. In this paper, we report on our recent results of RTD oscillators in the THz and sub-THz range. [C1409]

"New optoelectronic materials"

Optoelectronics is a very materials dependent technology. The metastable growth of new alloy materials and strain have significantly increased the performance and addressable wavelength regions due to these materials technology enhancements. The growth technologies, new materials and resulting devices are described. [C1410]

"The nano-bio-info-cogno revolution"

Electronics, Photonics, MEMS and Biology will impact our life style in the 21st Century in an unprecedented way. Using nanotechnology, Biotechnology, Information Technology and the interaction with Cognitive Sciences will be described. [C1411]

"GaN-based nanocolumn emitters and related technology"

Self-assembled InGaN nanocolumn LEDs emitting from ultraviolet to red were fabricated on n-type (111) Si substrates by rf-MBE. To achieve homogenization of nanocolumns, Ti-mask selective area growth was developed to fabricate uniform arrays of GaN nanocolumns. [C1412]

"Key technologies based on injection locked lasers for millimeter waveband radio over fiber access networks"

Some enabling technologies based on injection locked lasers for millimetre waveband radio over fiber access networks are discussed, including optical millimeter wave generation, single-band modulation, wavelength reuse, dynamic and frequency response enhancement, and architecture. [C1413]

"LED street lighting technologies with high human-eye comfortability"

For fabrication human-eye comfortable LED street lighting sources, specific optical beam shaping systems with rectangular illumination distribution were designed based on non-imaging optics. Furthermore, thermal dissipation and high efficiency and reliability driving solutions were presented. [C1414]

"Experimental characterization of biosensor based on surface plasmon nano interferometer"

Theoretically, label-free biosensing can be achieved by a surface plasmon interferometer in silicon-on-insulator. We present in this paper measurement results validating this theoretical prediction and show this device to be capable of bulk refractive index sensing. [C1415]

"Nanoscale optical field localization by resonantly focused plasmons"

Nanoscale field confinement enabled by plasmonic phenonena [1] has great potential to revolutionize many applications in nanophotonics, including bio-sensing, imaging, and magnetic recording. Various schemes using propagating surface plasmon polariton (SPP) waves have been suggested [2-4], but they experience power losses due to SPP propagation, restricting their practical applications. Here we experimentally demonstrate use of plasmonic resonant phenomena combined with strong field localization to enhance efficiency of confining optical fields. Our approach utilizes a nano-crescent-moon (NCM) shape plasmonic element integrated with a lossless Si waveguide utilized with silicon-on-insulator (SOI) technology, to achieve a sub-diffraction limited focusing with spot size ~25 nm. The metallic NCM effectively converts an incoming propagating waveguide mode into a localized resonant plasmon mode, which is localized in an ultrasmall volume in all 3 dimensions. The novel NCM geometry for efficient field localization simultaneously uses three physical mechanisms: localized surface surface plasmons (LSPs) [5,6], SPP edge localization [4], and TEM field localization [7]. The near-field optical measurements of the fabricated NCM using heterodyne near-field scanning optical microscope (H-NSOM) validate the theoretical predictions showing strong field localization. [C1416]

"Functional Proteomic Pattern Identification under Low Dose Ionizing Radiation"

The goal of this study is to explore and to understand the dynamic responses of signaling pathways to low dose ionizing radiation (IR). Low dose radiation (10 cGy or lower) affects several signaling pathways including DNA repair, survival, cell cycle, cell growth, and cell death. To detect the possibly regulatory protein/kinase functions, an emerging reverse-phase protein microarray (RPPM) in conjunction with quantum dots nano-crystal technology is used as a quantitative detection system. The dynamic responses are observed under different time points and radiation doses. To quantitatively determine the responsive protein/kinases and to discover the network motifs, we present a Discriminative Network Pattern Identification System (DiNPIS). Instead of simply identifying proteins contributing to the pathways, this methodology takes into consideration of protein dependencies which are represented as Strong Jumping Emerging Patterns (SJEP). Furthermore, infrequent patterns though occurred will be considered irrelevant. The whole framework consists of three steps: protein selection, protein pattern identification, and pattern annotation. Computational results of analyzing ATM (ataxia-telangiectasia mutated) cells treated with six different IR doses up to 72 hours are presented. [C1417]

"Advanced Plasmonic Biosensing Devices and Automation Systems for Disease Diagnostic and Drug Screening Applications"

Bio-plasmonics is proposed for the research and development of novel devices, which use biomolecules as a part of the plasmon oscillation system to actively interact with nano/micro structure. We have reported a novel design of surface plasmon resonance (SPR) device and system, which uses alternative dielectric layers to enhance the SPR signal quality and modulate its resonant position. The use of biomolecular thin film, such as DNAs or proteins, in this design can result in resonant condition of wavelength changes and thus can be detected by using nano-grating in the scattering mode with enhanced feature due to resonance. According to our calculation, it can provide ultra sensitivity system (dLx/dn) of 108for biosensor applications. The fundamental SPR principle and extended application of these fundamental principles and novel devices, including screening and diagnosis, will be discussed SPR-system to control is the ability. SPR-system has the ability to detect, in near real-time, the concentration of a target analyte and biosensing is viewed as a key application domain for this new technology. [C1418]

"An auto-switched mode CMOS image sensor for high dynamic range scientific imaging applications"

This paper presents a CMOS image sensor with auto-switched mode readout architecture for high throughput and high dynamic range scientific imaging applications. The proposed readout circuit compares background illumination with a threshold level and automatically adjusts the pixel array to operate in either linear or logarithmic mode by feeding back a mode switching control signal. This novel readout architecture allows simultaneous linear-logarithmic operation of each pixel, resulting in direct readout of image sequence covering a dynamic range of 121 dB. A chip consisting of 16 times 16 8-T pixel array and the proposed readout circuit has been designed and fabricated using AMI 0.5 mum technology. The chip has been verified for imaging clusters of nano particles (CoFe2O4) illuminated using bright green LED. Experiment results confirm high dynamic range performance due to linear-logarithmic auto-switched mode operation. [C1419]

"Modifying the improved light-output intensity of AlGaInP-based LEDs by nanoporous alimina"

This investigation describes the development of AlGaInP light-emitting diodes (LEDs) with a nanometer diameter of porous anodic alumina (PAA) films which are formed by anodization technique to improve and modify the light extraction efficiency. The pore-widening time was changed for surface modulation to obtain the optimum light extraction efficiency. The diameter of nano-pores varies from 30 nm to 60 nm and the interpore spacing is about 75 nm. The light output intensity of the PAA LEDs with 40 minutes pore-widening is 1.39 times that of conventional LEDs. PAA films can effectively reduce critical angle loss, Fresnel loss and be used as scattering center to improve the light extraction. [C1420]

"Proteomic based identification of cancer biomarkers: The LOCCANDIA integrated platform"

Pancreatic cancer is the fourth leading cause of cancer death in the United States. Consequently, identification of clinically relevant biomarkers for the early detection of this cancer type is urgently needed. In recent years, proteomics profiling techniques combined with various data analysis methods have been successfully used to gain critical insights into processes and mechanisms underlying pathologic conditions, particularly as they relate to cancer. The LOCCANDIA (Lab-On-Chip based protein profiling for CANcer DIAgnosis) project is primarily concerned with validating the application of plasma protein profiling for early pancreatic cancer diagnosis by means of developing an innovative nano-technology based (lab-on-a-chip) platform integrated in a full proteomics analysis chain. This paper describes the integrated clinico-proteomic information management and analysis platform. In particular it focuses on discussing the underlying methodologies and technological aspects of key SW modules, i.e. the data preprocessing and profile reconstruction as well as the classification modules. [C1421]

"Nano Evaluation in Electronics Packaging"

The challenge of nano packaging requires new non-destructive evaluation (NDE) techniques to detect and characterize very small defects like transportation phenomenon, Kirkendall voids or micro cracks. Imaging technologies with resolutions in the submicron range are the desire. Possible evaluation methods are for example x-ray microscopy, x-ray tomography, ultrasonic microscopy and thermal microscopy. However, techniques with this resolution can not be found on the market. The ldquocenter for non-destructive nano evaluation of electronic packagingrdquo (nanoevareg) is taken up to develop this equipment in cooperation with the electronics industry and to transfer the knowledge to colleagues in industries and research institutions. The new center is a common organization of Fraunhofer IZFP-D and the electronics packaging lab with its centre of microtechnical manufacturing (ZmuP) of the Technische Universitat Dresden. [C1422]

"Uncertainty analysis to minimise risk in designing micro-electronics manufacturing processes"

A design methodology based on numerical modelling, integrated with optimisation techniques and statistical methods, to aid the process control of micro and nano-electronics based manufacturing processes is presented in this paper. The design methodology is demonstrated for a micro-machining process called Focused Ion Beam (FIB). This process has been modelled to help understand how a pre-defined geometry of micro- and nano-structures can be achieved using this technology. The process performance is characterised on the basis of developed Reduced Order Models (ROM) and are generated using results from a mathematical model of the Focused Ion Beam and Design of Experiment (DoE) methods. Two ion beam sources, Argon and Gallium ions, have been used to compare and quantify the process variable uncertainties that can be observed during the milling process. The evaluations of the process performance takes into account the uncertainties and variations of the process variables and are used to identify their impact on the reliability and quality of the fabricated structure. An optimisation based design task is to identify the optimal process conditions, by varying the process variables, so that certain quality objectives and requirements are achieved and imposed constraints are satisfied. The software tools used and developed to demonstrate the design methodology are also presented. [C1423]

"Recent advances in the synthesis of lead-free solder nanoparticle"

Particles in the nano-meter size range present extraordinary properties, such as, large surface area per unit volume, large surface energy, low melting point, supermagnetism, self-purification and quantum size effects. These properties have attracted the attention of scientific and technological communities al over the world.In the area of electronics production, one major disadvantage of conventional lead-free solders is their relatively high melting temperatures. Higher melting temperatures result in higher reflow temperatures which in turn result in stress build-up and other defects occurring during reflow. The possibility to lower the melting temperature of solder alloys and to improve the mechanical properties of solder joints by decreasing the particle size to the nanometer range, has therefore, offered a potential solution to these problems. Nanoparticles of different solder alloys have, therefore, been manufactured using both top-down and bottom-up techniques. This paper presents the latest developments in the area of lead-free solder nanoparticle's manufacturing. Both the manufacturing and characterization of solder nanoparticles are covered. This paper does not include, however, applications of such nanoparticles. Both work performed in our group and in other research groups, from all over the world, is included, and the results discussed. [C1424]

"Electromagnetic and circuital modeling of carbon nanotube interconnects"

This paper presents an electromagnetic and a circuit model to describe the propagation of electric signals along interconnects made by carbon nanotubes. The models are both derived from an enhanced fluid description of the carbon nanotube electrodynamics, which takes into account size effects disregarded in the literature. The electromagnetic model is obtained in a surface integral formulation by coupling the fluid equation to the full-wave Maxwell equations and is numerically solved using a null-pinv decomposition technique. The circuit model is derived within the frame of the classical multiconductor transmission line theory. Both the models are used to analyze case-studies of interest where the carbon nanotube technology is used to build electrical nano-interconnects. [C1425]

"Evaluation of printing parameters and substrate treatmet over the quality of printed silver traces"

Printed electronics provide a promising potential pathway towards the design of low cost products. Manufacturing electronic devices by printing techniques using nano-size material particles at low temperatures can revolutionize the electronics industry in coming years. Products based on printable electronics might include ultra cheap radio-frequency identification tags (RFID), inexpensive and disposable displays/electronic paper, interior connections, parts of electronic assemblies (e.g. PWB and phone chassis), sensors, memories, and wearable user interfaces. Moreover, PWBs could be replaced by an inkjet printed substrate. Direct printing of nanoparticle inks could also be used for the electrical interconnection of components (traces). Considering this scenario, the challenge is to provide sufficient quality of interconnecting traces considering the selection of appropriate material, more precise material deposition process and sintering. Adequate process control would lead to suitable electrical conductivity of printed interconnections.In this work the influence of the printing parameters-such as ink temperature, cartridge ink height and the plate temperature (surface over which the substrate that receives the ink is fixed)-in the print quality were evaluated. These parameters are very important in order to obtain conductive traces with good resolution and reproducibility. Another important factor is the treatment of the substrate. It also defines the quality and resolution of the traces since the chemical interaction between the ink and the surface (defined by the surface energy) determine how the ink will spread over the substrate. An optimized surface can be obtained by seeking the best relation between the metal trace adhesion and trace resolution. The surface treatment can be made in different ways aiming at an optimal value for the surface energy. Common surfaces treatments are plasma, corona treatment, and chemical treatment. In this work, polyimide subs--trates were submitted to surface treatment using corona and a chemical solution. The surface energy was evaluated and an optimum surface energy value was determined. [C1426]

"Effect of nano Ni additions on the structure and properties of Sn-9Zn and Sn-8Sn-3Bi solder in ball grid array packages"

The effect of nano Ni additions in Sn-9Zn and Sn-8Zn-3Bi solders on their interfacial microstructures and shear strengths with Au/Ni/Cu pad metallization in ball grid array (BGA) applications were investigated. After addition of nano Ni powder in Sn-based lead-free solders, there was no significant changes in the interfacial microstructure. But, in the solder region a very fine Zn phase was observed. Also, on the fracture surfaces fine Zn-Ni compound was found. After addition of nano Ni powder in Sn-based solders, the shear loads were increased and in addition, ductile fracture surfaces were clearly observed. The shear loads of Sn-9Zn and Sn-8Zn-3Bi solder were about 1798 gm and 2059 gm, respectively. After addition of nano Ni powder, their strengths were about 2172 gm and 2212 gm, respectively. [C1427]

"Electrically conductive adhesive filled with mixture of silver nano and microparticles"

Electrically conductive adhesive with isotropical electrical conductivity modified with addition of silver nanoparticles has been investigated. The electrical resistance, nonlinearity of a current vs. voltage characteristic and the tensile strength of adhesive joints formed of this adhesive have been measured. The specimens have also been aged at the temperature of 125degC and at the combined climate 80degC/80 % relative humidity for 700 hours. It has been found that silver nanoparticles added into the electrically conductive adhesive cause decrease of its conductivity, increase of its nonlinearity and increase of the tensile strength. [C1428]

"Investigations on the physical understanding of mobility in MOSFETs-from drift-diffusion to quasi-

ballistic"

This paper provides scattering matrix method to analyze the transport property in nanoscale MOSFETs. A unified mobility model with analytical expression is presented, which can cover the whole range from drift-diffusion to quasi-ballistic region. The inherent mobility reduction in MOSFETs with the shrinking of the channel length is extensively investigated from the theory and well agrees with the experiments, but the low-field free path is nearly constant. It is found that the reduction of measured mobility in nano-MOSFETs is only an apparent phenomenon. The relationship between the low-field mean free path Г,Вї0and the driving current in nano-MOSFETs is discussed. The results indicate it is the Г,Вї0instead of apparent mobility that determine the transport characteristics in nano-devices. [C1429]

"An analytical model for carrier recombination and generation lifetimes measurement in SOI MOSFET's"

In this paper, an analytical model is proposed to study the carrier recombination-generation (R-G) processes in silicon-on-insulator (SOI) metal-oxide-semiconductor field-effect transistors (MOSFET's). The correlations of the carrier lifetimes and the external perturbation rates have been investigated to examine the applicability and accuracy of techniques for carrier lifetimes measurement in device characterization and modeling. The credibility of the proposed model is supported by the consistent experimental and simulation results. [C1430]

"Noise in nano-scale MOSFETs and flash cells"

In this paper, we present a compact channel thermal noise model for short-channel MOSFETs which takes into account various short channel effects. Then, we compared measured data with shot-like noise level and thermal noise model in sub-40 nm CMOS devices. Also we characterized four level RTN (Random Telegraph Noise) and extracted the characteristics of two independent traps in MOSFETs and flash cells. Their vertical, lateral locations in the oxide as well as the trap energy (ET) were obtained by using accurate equations. [C1431]

"Impact of NBTI on the performance of 35nm CMOS digital circuits"

The negative bias temperature instability (NBTI) of p-MOSFET has the greatest impact on the long term reliability of nano-scale devices and circuits. For several decades, NBTI research has been focused at the device physics level or on the characterization methodology, with little attention paid to the impact of NBTI on the performance of basic digital circuits. This paper discusses the effects of NBTI on 35 nm technology CMOS inverters and SRAM. The delay degradation and power dissipation of the inverters, as well as the static noise margin degradation of the SRAM are analysed. Moreover, the effects of power supply voltage on inverters and the cell ratio on SRAM under NBTI are also discussed. [C1432]

"Nano silicide formation in nano Si wires"

The review reports that the conductance of nanowire of Si is very sensitive to small changes in its surrounding potential and can be affected by the attachment of a small number of charged biological molecules. Using different receptors on the oxidized nano Si wire surface, the detection of the conductance change can be specific to the molecules absorbed on the wire surface. The combination of sensitivity and selectivity makes nanowire-based electronic device to be unique in having a great potential in bio-sensing. It is further reported that in order to have ultra-sensitivity for the detection of a single charged molecule or a virus, the length of the nanowire of Si has to be in the nm range or it requires a nanogapofSi. [C1433]

"The application of carbon nanotubes in CMOS integrated circuits"

With the complementary metal-oxide-semiconductor (CMOS) technology approaching its scaling limit, many novel devices and material are being considered to enable further scaling of CMOS. Carbon nanotubes show unique properties and are currently considered as a potential alternative material for nano-CMOS building blocks. Performance of carbon nanotube field effect transistors (CNFET) can be competitive with Si MOSFET in the sub-20nm regime. With its superior material properties, CNT can also function as quantum wire and a critical material for the integrated circuit interconnection. In this talk, we shall present some of the works we have done on applying carbon nanotubes to the CMOS Integrated Circuits in our research group at the Hong Kong University of Science and Technology. [C1434]

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"Ultra-small one-chip color-less multiplexer/demultiplexer using silicon photonic circuit"

Using silicon waveguides, an arrayed waveguide grating and switches are integrated into one chip. Low-power and fast-speed reconfigurability of optical paths within a 2-mm device is demonstrated. [C1436]

"From RADAR to NODAR"

Photonics and nanotechnologies are emerging revolutionary technologies that will provide a revolution in the sectors of sensors and radar systems. SELEX Sistemi Integrati intends to face this evolution as a leader by proactively supporting and developing its state of the art. One century after the first RADAR ldquoideardquo we registered the NODAR (nanotechnology optical detection and ranging) trademark. Such NODAR, by including both photonic and nano technologies, aims to implement multifunctional, multirole, multidomain sensors, as well as adaptive, flexible, knowledge-based sensors. NODAR requires proactive studies and developments on: I) nanotechnology vacuum tube amplifiers (TX reverse nano triode); II) wide bandwidth Tx-Rx optical beam forming network by means of optical modulator, combiner, analogue optical receive and programmable true time delay; III) broadband photonic analogue to digital converters; IV) thermal management and interconnection by means of carbon nanotubes; V) nanotechnology infrared and chemical state of art sensors. Finally, the insertion of state of the art innovative technologies requires an integrated ldquomultiscalerdquo approach, by combining materials sciences, photonics, nanotechnologies and production technologies with other based technologies. [C1437]

"MEMS-based gas chromatography columns with nano-structured stationary phases"

Gas chromatography columns produced using microelectromechanical systems (MEMS) technology makes it possible to achieve very narrow widths as it improves the separation efficiency. However, coating these columns to obtain a uniform stationary phase is challenging using traditional techniques. This paper presents an important step to address this issue by merging MEMS and nanotechnology and reports, for the first time, MEMS-based columns coated with functionalized gold nanoparticles (FGNPs) by a modified layer-by-layer (LbL) deposition technique. The FGNPs were made stable by coating the etched silicon surface with a thin layer of silicon nitride. These films are of particular interest for GC as they provide a homogeneous phase with nanometer resolution and a fast mass transfer rate. The 1 m-long MEMS column with FGNP stationary phase was successful in separating a mixture of 6 alkanes in less than 6 minutes. [C1438]

"Ultra-compact photonic-crystal-based tuneable Mach-Zehnder interferometer for low-power integrated optical switches"

The ldquoslow lightrdquo property and wide-band 90deg-bends of pillar-photonic-crystal waveguides enables entire-C-band ultra-compact optical devices. We demonstrate tuneable Mach-Zehnder interferometers with an area of only 13.2 times 37.2 mum to densely integrate optical node switches. [C1439]

"Road-blocks to Tera-level nanoelectronics"

The national program for Tera-level Nanodevices (TND) serves as a frontier research resource to a broad range of nanoscale electronics areas. Outstanding nanoscale devices have been achieved and are being further developed using core technologies such as fast nanoscale molecular assembly, damage-free nano-etch process with a neutral beam and nano-rod and particle formation technology. Sub-30 nm scale nonvolatile memory arrays have been demonstrated by changing structures and materials. Using high quality heterojunction epitaxial growth technology, ultra high speed HEMT devices have been demonstrated with cut-off frequencies of approximately 610 GHz corresponding to gate length of 15 nm. Additionally, single electron transistor logic circuits have been extended to multi-valued static random access memory applications. [C1440]

"Prediction of channel thermal noise in twin silicon nanowire MOSFET (TSNWFET)"

In this work, channel thermal noise in the twin silicon nanowire MOSFET (TSNWFET) is predicted using analytic thermal noise model taking into account short channel effects. TSNWFET used in this work has 40 nm gate length, 5 nm radius of silicon wire, and the 3.5 nm of gate oxide. Predicted thermal noise is compared with that of the planar MOSFET using various processes. [C1441]

"Application of modern new materials in product design"

Material technology is one of the most important fields in the development of science technology. With the development of science technology, new materials appear and are widely used all over the world, and they give tremendous impetus to product design. At first, the paper describes how these new materials affect the product design. Then the paper discusses about the development of new materials and their applications in some typical products, these materials include: nano-materials, ceramic materials, green materials, composite materials and functional materials. Finally, the paper concludes some important factors that may affect the widespread application of new materials. [C1442]

"NANOPACK-Nano packaging technology for interconnect and heat dissipation"

NANOPACK is a European large-scale integrating project aiming at the development of new technologies and materials for low thermal resistance interfaces and electrical interconnects, by exploring the capabilities offered by nanotechnologies such as carbon nanotubes, nanoparticles and nano-structured surfaces, and by using different enhancing contact formation mechanisms combined with high volume compatible manufacturing technologies. Several key research areas relative to thermal management, interconnect and packaging will be addressed by European industrial and academic partners: thermal interface materials, assembly, reliability and characterisation, supported by world class modeling and simulations. The benefits of the technologies will be evaluated in different applications to demonstrate improved performance of microprocessors, automotive and aerospace high power electronics and high power radio-frequency switches. [C1443]

"Technology Library Modelling for Information-driven Circuit Synthesis"

Due to weaknesses in circuit synthesis methods used in todaypsilas CAD tools, the opportunities created by modern microelectronic technology cannot effectively be exploited. This paper considers major issues and requirements of circuit synthesis for the nano CMOS technologies, and discusses our new information-driven circuit synthesis technology that satisfies these requirements. It focuses on an adequate technology library modelling for information-driven circuit synthesis. The new circuit synthesis technology considerably differs from all other known synthesis methods and overcomes their main weaknesses. The experimental results demonstrate that it is able to produce very fast, compact and low-power circuits. [C1444]

"On brain-inspired hybrid topologies for nano-architectures-a Rent's rule approach -"

This paper will start by comparing brainpsilas connectivity (based on different analyses of neurological data) versus well-known network topologies (originally used in massively parallel super-computers), in view of the latest interpretation of Rentpsilas rule. These will reveal that the brain is in very good agreement with Rentpsilas rule average growth rate. With respect to classical network topologies, the crossbar (only for quite small sizes) and the cube connected cycles (for a wider range) look like promising contenders (for the brain), while in fact any network topology falls short of properly mimicking brainpsilas connectivity. That is why, we will go on exploring hybrid (hierarchical) combination of two network topologies, allowing us to identify those (hybrid network topologies) which could closely emulate brainpsilas connectivity (as well as the particular ranges where this is happening). [C1445]

"Photonic crystal-/quantum dot-integrated circuit for innovative all-optical digital processor"

Nano-technologies of advanced photonic crystals (PCs) and quantum dots (QDs) for all-optical flip-flop (PC-FF) integrated circuits have been reviewed. Topology optimization design of high-performance PC waveguides and selective-area-growth of optical nonlinear QDs with high-uniformity/density were established for demonstration of the PC-FF. The results will pave the way for implementation of innovative all-optical digital processors. [C1446]

"Session 8-Characterization and test methods for device variability in nanoscale technologies"

With scaling of CMOS towards nano-scale technologies, device variability and reliability is emerging as a major challenge for circuit design in such technologies. Hence, accurate measurement and characterization of sources of device variations and reliability degradations is very critical for coming up with appropriate circuit design techniques to mitigate such device non-idealities, as well as to insure the device manufacturability and yield. This session presents cutting-edge papers on effective measurement methods for characterization of gate dielectric breakdown, threshold voltage variations, delay variations, and an effective testing of multi-core SOC under process variations. [C1447]

"Inductor-based ESD protection under CDM-like ESD stress conditions for RF applications"

Charged device model (CDM) electrostatic discharge (ESD) stress is a major concern for inductor-based ESD protection strategies for RF circuits processed in advanced nano-CMOS technologies. The CDM robustness of such protection methodology is investigated in this paper based on very-fast transmission line pulse (VFTLP) measurements. Its applicability is discussed for future technologies and RF applications. [C1448]

"The development of nanosensors for space applications"

This report concentrates on the enabling capabilities and products that could impact robotic and human exploration of space. The objectives of the report is to review of state of the art, define the major challenges, and develop near-and long-term goals. The main attention concentrates on nanosensors, nanoaccelerometer. This report discusses the basic concepts of, and developments in, the field of optical nanosensors and nanobiosensors. After a brief overview of the techniques for fabricating nanometer-sized optical fibers, we describe the various types of transducer and bioreceptor molecule presently used for nanosensor and nanobiosensor fabrication. eters, micro-energetic devices and nano-robotics. [C1449]

"Fabrication of gold nano-particle based sensors using microspotting and DEP technologies"

We have shown that Au nanoparticles (Au NPs) pearl chain could be formed consistently between microelectrodes by combining microspotting and DEP technologies. Experimental results on varying the Au particle size and dielectrophoretic (DEP) parameters, including voltage and frequency, are reported in this paper to explore the critical parameters in controlling the Pearl Chain Formation (PCF) process between microelectrodes. PCF was observed from 10 kHz to 5 MHz for 100 nm Au NPs, and 100 kHz to 10 MHz for 10 nm Au NPs. Variations in formation rate were detected when the applied voltage and particle size varied. With higher voltage, pearl chain began to form at higher rate and the formation time decreased. The optimum frequency of the Au NPs PCF shifted to higher frequency region when the particle size decreased. Theoretical analysis was carried out by applying the theories of DEP force and AC electrokinetics to explain the observations with the DEP frequency ranging from 10 Hz to 10 MHz. Finally, Au nanoparticle chains formed between the microelectrodes were shown to vary in resistance when environmental temperature was changed, indicating that these Au particle sensors could potentially be used to sense temperature and other thermal-based physical phenomena. [C1450]

"Towards automated handling on the nano-scale"

Automated robot-based nanomanipulation is one of the key challenges of microsystem technology and nano-technology. Controlled, reproducible operation on the nano-scale will enable high-throughput manufacturing of revolutionary products and open up new application fields. The ultimate goal of these research activities is the development of automated nanomanipulation processes to build a bridge between existing precise handling strategies for micro- and nano-scale objects and aspired high-throughput fabrication of micro- and nanosystems. This paper describes our current work on different problems of nanohandling automation, both by nanorobots inside a scanning electron microscope and by an atomic force microscope applied as a nanorobot. [C1451]

"Piezo motor based microdrive for neural signal recording"

The miniature piezo motor based microdrive which is applicable to the neural signal recording in mice is presented. The microdrive is manipulated by the micromotion of the mobile coupled to the piezo motor generating the flexural vibration within the range of 3.8 mm, with the resolution of 60nm. Advancement of electrodes in a mouse brain is monitored by an integrated MR (Magneto-Resistive) sensor. This microdrive has the length of 6.5mm, the width of 6.5 mm, the height of 12 mm and the total weight of 1.63 g only, including PCB for neural signal recording. The displacement of the microelectrode was evaluated and verified as applying the inputs with 5 to 100 pulses, 30 times to the piezo motor according to various driving voltages. The neural signals from the single thalamic neurons in an awake and freely moving mouse were recorded successfully with the presented microdrive. [C1452]

"Current Trends in Field Emission Displays"

Vacuum nanoelectronics has been expected to provide a number of advanced devices such as flat panel displays, high- frequency devices and so on. Especially, field emission displays (FEDs) including Surface-conduction electron-emitter displays (SEDs) have been showing tremendous progress and become attractive nanoelectronic technology for a new generation of flat panel displays. Nowadays, nanomachining and nanomaterials are coming to new targets in the development for new generation devices. However, there are important limitations of their reliability and efficiency in FEDs and SEDs, mainly attributed to the emitters. The Transfer Mold emitters, the carbon nanotube emitters, the Si nano crystalline emitters, and the surface conduction electron emitters (SCEs) have been the candidates for getting and controlling the emitter structures. Also, recently, field emission lamps (FELs) have become new research target as promising mercury-free fluorescent lamps. In this paper, the recent progress and the technical issues on FEDs and FELs are overviewed. [C1453]

"Nanocomposite insulating materials for environmental-conscious heavy electric apparatuses"

This project develops a nanocomposite insulating material with high insulation performance obtained by homogeneous dispersion of nano-fillers to epoxy resin. This project aims to apply solid insulating technology with nanocomposite material to electric power apparatuses for power distribution such as switchgears. [C1454]

"Digest report on investigation committee on nano-interface properties of organic and composite thin films and device/sensor applications"

The committee was established in November 2007, with the term of three years. The investigation has focused attention on the nano-interface properties of organic and composite thin films and device/sensor applications related to: 1. evaluation techniques for nano-interface between different materials, 2. structure control of nano-interface for organic and composite thin films, 3. electrical and optical properties of organic and composite thin film nano-interface, and 4. device/sensor applications of organic and composite thin films. [C1455]

"Pulsed vacuum flashover of Al2 O3 /epoxy nanocomposite"

Research on vacuum surface flashover mechanisms of insulating material under nanosecond pulses is important for the design and manufacture of high power pulse generators. This paper studies the vacuum surface flashover characteristic of Al2O3/epoxy nanocomposite filled with different weight proportion of nano-filler. By using a unipolar pulse generator (20 ns rise time and 800 ns full width at half maximum), the flashover characteristic of Al2O3/epoxy nanocomposite is investigated. In addition, the thermally stimulated depolarization current (TSDC) is measured. The experimental results can be explained in terms of the different effects of shallow and deep traps. [C1456]

"Micro-fabrication on 3-D surface by electrostatic induced lithography"

This paper presents a novel technology to pattern polymer material deposited onto 2D and 3D surfaces at the micro- and mesoscopic scales. Electro-hydrodynamic instability patterning (EHDIP) relies on the formation of features induced by electrostatic pressure. Unlike previous work reported elsewhere in nano-patterning, we focused on the fabrication of structures from the micro- to the meso-scale. The electrostatic induced lithography technique is proven to work with not only DC voltage but also AC voltage at frequency up to 1 KHz. Besides planar substrates, patterning is carried out on 3D surfaces like the inner surface of a half hollow cylinder, which is extremely difficult by traditional photolithography methods. The whole fabrication process is found to be fast, cost-effective and no photosensitive material is needed as in traditional photolithography. Applications of this technology include microfluidics, MEMS and wafer bumping. [C1457]

"Optimized biasing technique for high-speed digital circuits with advanced CMOS nanotechnology"

This paper presents a biasing optimization technique for high-speed digital circuits design with advanced CMOS nanotechnology. Modern CMOS nanotechnology introduces several new problems in high-speed circuits design. As the fastest signal frequency components approach the peak transition frequency of the MOSFET, which depends heavily on the biasing voltage, the optimized biasing techniques become very important in high-speed circuits. Many trade-offs in the high-speed circuits need to be considered, and either power or headroom may be traded for higher speed. The optimized biasing technique is thoroughly analyzed first in this paper, and a typical high-speed CML circuit is designed based on this technique. [C1458]

"A WiMedia UWB receiver with a synthesizer"

This paper describes a direct-conversion receiver for WiMedia UWB applications. The receiver consists of separate BG1 and BG3 LNAs including a 2.4-GHz notch filter, quadrature mixers, a base-band gm-C low-pass filter with variable gain, and a fast-hopping synthesizer. The UWB receiver is targeted for a mobile handset and therefore special emphasis has been placed on the reduction of interferers. The receiver achieves 60-dB gain, noise figure less than 6.2 dB, LO settling time of less than 3 ns and DC current consumption of 137 mA from a 1.2-V supply for BG1 operation mode. The chip was fabricated using 65-nm standard CMOS process. [C1459]

"Nano-scaled functional layers for current and heat transport in electronics packaging"

The amount of information capable of being stored on a computer chip doubles every two years as stated first by Gordon Moore in 1965. Electronics packaging technology has to adopt the resulting requirements of this tremendous development of the microelectronic industry. In view of future applications it is necessary to establish new interconnect materials for high-density electronics packaging because common materials are facing physical barriers and fail to meet the requirements of nano-scale miniaturisation. These requirements will be steady miniaturisation of the electronic devices, higher current density per device, pitches down to 20 mum and higher thermal dissipation loss. Current joining elements cannot meet these requirements. For common joining element materials there are also limitations with regard to their thermomechanical behaviour. Downscaling of traditional solder bump materials to lower pitch cannot satisfy the reliability requirement [1]. For example, lead and lead-free solders typically fail when scaled down to less than 100 micron pitch due to poor fatigue resistance. On the other hand compliant interconnections do not meet the high frequency electrical requirements. Consequently, there is a need for new joining materials in electronics packaging. Carbon nanotubes (CNTs) are promising candidates for functional layers for packaging in the nanometre scale because of their superior mechanical, thermal and electrical properties. The reproducibility and the performance of such structures for thermal and electrical transport on common packaging substrates are not sufficiently known and were investigated by our groups. Latest results concerning the preparation of CNT films and their structural and functional properties are described in the present paper. Using a ldquobottom uprdquo approach the CNTs are grown with a defined wall structure on a catalyst layer by chemical vapour deposition (CVD). The catalyst layer is a nano-structured deposit on a Si wafe--r formed by a self assembly mechanism. The nano-scaled structuring is the most important requirement for manufacturing CNTs with defined properties. Unlike state-of-the-art methods a layer of a conducting material is deposited on the Si surface as finish. This conducting layer could be the basis for the following die bonding process transferring the CNT layer on common packaging substrates. The application potential is exemplarily shown. [C1460]

"Room temperature sintering mechanism of Ag nanoparticle paste"

Recently, the authors have developed a novel room temperature wiring method with Ag nanoparticle paste. In the present work, the sintering mechanism of Ag nanoparticle paste was clarified through analysis of the adsorption stability and the removal of the dispersant from the Ag nanoparticles. The Ag nanoparticles in the paste are protected by dodecylamine as a dispersant. This paste possesses a substantially long shelf life. When a printed line of Ag nanoparticle paste is dipped in a methanol bath, the methanol dissolves the dispersant allowing it to be removed from the nanoparticles, effectively. Ag nanoparticles are sintered within a short period, although the sintering is not uniform. Some Ag nanoparticles grow quickly and form networks by sintering necking. The other nanoparticles remain on the nano-meter scale. Large Ag particles and Ag skeletons continue to grow by absorbing very small nanoparticles. In addition, the effect of ethanol and isopropanol as treatment agents is found. [C1461]

"Strain-rate effects on mechanical properties for SAC387 and SAC105-Y solder"

In this paper, solder alloy of Sn-3.8Ag-0.7Cu (SAC387) and Sn-1.0Ag-0.5Cu-Y (SAC105-Y), where Y is a small addition of a fourth element, were tested at room temperature to study the strain-rate-dependent elastic modulus and yield strength of the solder. Nano-indentation tests were conducted at various strain rates from 10-3to 1011/s by using the continuous stiffness measurement (CSM) technique. Microstructures of the IMC for SAC105-Y on NiAu surface finish and OSP surface finish were investigated prior to the nano-indentation tests. Based on the test results, the higher the strain rate the higher the elastic modulus and yield stress of the solder. The power law relationship is used to curve fit the strain-rate-dependent yield stress with the indentation strain rate. [C1462]

"High frequency characterization and modelling of inkjet printed interconnects on flexible substrate for low-cost RFID applications"

This paper presents the characterization and modeling of inkjet printed interconnects on flexible polyimide substrate using nano-particle silver ink for low-cost RFID applications. Then TDR/TDT and S-parameter measurements are performed at high frequency from 30 kHz to 6 GHz. A lumped equivalent circuit and distributed parameter model of the printed interconnects have been developed for the realization of the full printed RFID tags. Additionally the related electrical properties of the printed interconnects are extracted. [C1463]

"Collection and storage of hydrogen micro- and nanopowders of silicon"

The process of hydrogen transportation into a silicon powder has been investigated. It is also established, that in the process of transition from nano- to microsizes is an accumulation of hydrogen takes place, both in volume, and on the surface of the powder. [C1464]

"A dual-phase charge pump regulator with nano-ampere switched-capacitor CMOS voltage reference for achieving low output ripples"

In this paper, a regulated dual phase charge pump with switched-capacitor voltage reference is presented. This charge pump uses a dual phase technique to reduce the output ripple and combines the switch-capacitor CMOS voltage reference to diminish the chip area and quiescent current. This charge pump provides output voltage 5 V and maximum load current 5 mA with the constant frequency regulation. This design is based on TSMC 0.6 mum 5 V/12 V CMOS technology. The output ripples are reduced from 6.1 mV to 3.7 mV. Besides, the power consumption is minimized because of the integration of the nano-ampere CMOS reference voltage. [C1465]

"Super-resolution: Imaging beyond the pixel size limit"

We have implemented a new high resolution imaging system independent of the image sensorpsilas pixel size. This super-resolution is achieved by integrating a nano-aperture patterned in the first metal layer within the pixel using a standard CMOS process. The image sensorpsilas focal plane is scanned with a sub-micron step to obtain the super-resolution image. To experimentally verify the operation of our technique, we have fabricated a standard 3-Transistors (3T) active pixel sensors with integrated nano-apertures in a 0.13 mum CMOS technology. Here, we describe the concept of our super-resolution imaging and elaborate on our fabricated design and experimental setup. [C1466]

"Computer microwave diagnostic system for measurement of parameters of sandwich-like micro- and nano-structures"

The Computer Diagnostic System for measurement of parameters of sandwich-like metal-dielectric and metal-semiconductor micro- and nano-structures from the reflection and transmission microwave spectra, developed in Saratov State University, is presented. [C1467]

"Nano materials for microelectronic and photonic packaging"

This paper addresses the state of art nano science and technology regarding next generation high density microelectronics and photonics packaging applications, including carbon nanotubes (CNTs) for electrical/thermal devices, nano lead-free alloy, molecular wires for electrical interconnects, etc. [C1468]

"An all-organic technology platform for electronic devices manufacturing"

In this work a complete and dedicated technology platform for all-organic electronic applications with micron and sub-micron feature-size is proposed. Both the organic technology and the design tools have been developed by considering organic materials to be deposited by solution techniques. The complete process flow has been defined in order to realize multilayered functional structures as all-organic active and passive devices. Feature sizes ranging from 50 nm up to 10 mum can be achieved according to the adopted solution processing techniques. The technology platform comprises also the CAD tools required for the design and realization of the all-organic devices. [C1469]

"Synthesis of CNT-SnO2 and CNT-In2 O3 films for micro sensor application using vacuum microelectronics technology"

CNT-SnO2and CNT-In2O3composite materials were prepared for micro sensor application. Micro sensors with CNT-SnO2and CNT-In2O3films were designed and fabricated using microelectronics technology on the silicon substrate prefabricated with Pt electrodes and heater. Gas sensing properties of the sensors were tested against combustible gases, such as H2, CO, CH4, C3H8, and NO2, which are common pollutant in the air. The CNT-SnO2and CNT-In2O3composites showed higher sensitivity and selectivity to H2, NO2and CO respectively. The present gas sensors are low energy consuming portable sensor module that can be mass-produced applying the synthesized nano gas sensing materials using vacuum microelectronics technology. [C1470]

"Embedded Tutorial-ARTEMIS and ENIAC Joint Undertakings: A New Approach to Conduct Research in Europe"

Summary form only given. This special session will present the two first ever Europe-wide public private R&D partnerships ARTEMIS and ENIAC. ARTEMIS will address the invisible computers (embedded systems) that today run all machines from cars, planes and phones, from energy networks and factories to washing machines and televisions. ENIAC will target the very high level of miniaturisation required for the next generations of nanoelectronics components. These joint technology initiatives (JTI's) on embedded computing systems and nano-electronics will pool industry, Member states and Commission resources into targeted research programmes. The session will include global presentations on the initiatives and information on the expected research topics included in the first calls in 2008. [C1471]

"Classical, Quantum and Non-signalling Resources in Bipartite Games"

We study bipartite games that arise in the context of nonlocality with the help of graph theory. Our main results are alternate proofs that deciding whether a no-communication classical winning strategy exists for certain games (called forbidden-edge and covering games) is NP- complete, while the problem of deciding if these games admit a non-signalling winning strategy is in P. We discuss relations between quantum winning strategies and orthogonality graphs. We also show that every pseudo-telepathy game yields both a proof of the Bell-Kochen-Specker theorem and an instance of a two-prover interactive proof system that is classically sound, but that becomes unsound when provers use shared entanglement. [C1472]

"Quantum Merkle Puzzles"

Starting in 1974, Ralph Merkle proposed the first unclassified systems for secure communications over insecure channels. When legitimate communicating parties are willing to spend an amount of computational effort proportional to some parameter N, an eavesdropper cannot break into their communication without spending a time in the order ofN2, which is quadratically more than the legitimate effort. We investigate quantum analogues to this technique. First, we show that Merkle's systems are completely insecure if the legitimate parties are classical but the eavesdropper uses quantum computation. Then, we describe simple modifications on Merkle's proposals, in which the legitimate parties still use classical communication but benefit from local quantum computation to agree on a common key. We show that the optimal quantum eavesdropping strategy against our protocols requires a time in the order o/7V3/2. We conjecture these Quantum Merkle Puzzles to be optimal in the classical communication model, in which case quantum mechanics does more harm than good for the purpose of secure communications over insecure classical channels. This is in sharp contrast with Quantum Key Distribution, which ensures unconditionally secure communications over quantum channels. [C1473]

"Strict Hierarchy of Bell Theorems"

As proved by John Bell, quantum mechanics exhibits correlations in spacelike separated bipartite systems that are impossible to reproduce by classical means. There are three levels of "Bell theorems", depending on which aspects of the quantum correlations can or cannot be reproduced classically. The original "Bell inequalities" (BI) require a perfect classical simulation of all quantum probabilities. With "Bell theorems without inequalities" (BTWI), we ask the classical simulation to be able to produce precisely the outputs that could occur according to quantum mechanics, but we do not worry about their exact probabilities. With "pseudo-telepathy" (PT), we are satisfied if the classical simulation produces only outputs allowed by quantum mechanics, but not necessarily all of them. Bell's original proof of BI involved a maximally entangled 2times2 bipartite state such as the singlet state. Hardy proved that BTWI are possible in dimension 2times2, but his construction used a non-maximally entangled state. Here, we prove that no 2times2 maximally entangled state can serve to produce BTWI. Combining this with the fact that 2times2 entangled states cannot be used at all for the purpose of PT, it follows a strict hierarchy on the quantum resources that are required to exhibit the various levels of Bell theorems. [C1474]

"Multiparty Distributed Compression of Quantum Information"

We study a protocol in which many parties use quantum communication to transfer a shared state to a receiver without communicating with each other. This protocol is a multiparty version of the fully quantum Slepian-Wolf protocol for two senders and arises through the repeated application of the two-sender protocol. We describe bounds on the achievable rate region for the distributed compression problem. The inner bound arises by expressing the achievable rate region for our protocol in terms of its vertices and extreme rays and, equivalently, in terms of facet inequalities. We also prove an outer bound on all possible rates for distributed compression based on multiparty squashed entanglement. [C1475]

"Contextual Probabilistic Analysis of Bell's Inequality: Nonlocality, "Death of Reality" or Non-Kolmogorovness?"

The main aim of this report is to inform the quantum information community about investigations on the problem of probabilistic compatibility of a family of random variables: a possibility to realize such a family on the basis of a single probability measure (to construct a single Kolmogorov probability space). These investigations were started hundred of years ago by J. Boole (who invented Boolean algebras). The complete solution of the problem was obtained by Soviet mathematician Vorobjev in 60th. Surprisingly probabilists and statisticians obtained inequalities for probabilities and correlations among which one can find the famous Bell's inequality and its generalizations. Such inequalities appeared simply as constraints for probabilistic compatibility. In this framework one can not see a priori any link to such problems as nonlocality and "death of reality" which are typically linked to Bell's type inequalities in physical literature. We analyze the difference between positions of mathematicians and quantum physicists. In particular, we found that one of the most reasonable explanations of probabilistic incompatibility is mixing in Bell's type inequalities statistical data from a number of experiments performed under different experimental contexts. [C1476]

"Preparation and Thermal Characterization of Carbon Nanotubes-Based Composites for Applications in Electronics Packaging"

The thermal resistance of nanocomposite layers formed by Single Wall Carbon Nanotubes (SWCNT) dispersed in epoxy resins has been measured under conditions similar to the ones used to dissipate heat in microelectronic devices. The variation of thermal conductivity as a function of concentration of SWCNT is reported and discussed with reference to the dispersion state of SWCNT in the layers. [C1477]

"Quantum Strategies and Bell Inequalities"

A multi-sector probability matrix formalism for games with incomplete information are formulated. Classical and quantum strategies can be treated in the same footing. A multi-sector extension of the game of Battle of Sexes is analyzed to clarify the two distinct roles of nonlocal strategies that break Bell inequalities. [C1478]

"A Survey of Quantum Programming Languages: History, Methods, and Tools"

Quantum computer programming is emerging as a new subject domain from multidisciplinary research in quantum computing, computer science, mathematics (especially quantum logic, lambda calculi, and linear logic), and engineering attempts to build the first non-trivial quantum computer. This paper briefly surveys the history, methods, and proposed tools for programming quantum computers circa late 2007. It is intended to provide an extensive but non-exhaustive look at work leading up to the current state-of-the-art in quantum computer programming. Further, it is an attempt to analyze the needed programming tools for quantum programmers, to use this analysis to predict the direction in which the field is moving, and to make recommendations for further development of quantum programming language tools. [C1479]

"Author Index"

{no data available} [C1480]

"Study on hall effect of SOI MAG-MOSFET formed by nano-polysilicon films"

The hetero-junction source and drain of SOI MAG-MOSFET of n-type nano-polycrystalline silicon films on p-type crystalline silicon were fabricated and the Hall effect was studies. The nano-polycrystalline silicon films was deposited in a plasma enhanced chemical vapor deposition system. Experiments shown, the nano-polycrystalline silicon films-Si hetero-source and hetero-drain are abrupt hetero-junction and shown good temperature stability and good rectifying properties. The SOI MAG-MOSFET is devices made on very thin silicon layers on top of the insulating oxide. The advantages of using SOI structures are that the parasitic capacitance can be significantly reduced as well as some unique properties of SOI that allow low- power and low-voltage operations to be improved. Appeal of a structure like this the possibility of application that would require the flexibility of nano-polycrystalline silicon films. [C1481]

"Application Oriented Intelligence Control; Survey and Future Perspectives"

Intelligence control is the control based on Computational Intelligence Technology that covers fuzzy logic, neural networks, and evolutionary computation. The world first industrial application example can be seen in the cement kiln control developed by F.L.Smith Inc (Denmark) in 1979. After that, many (i.e., more than several hundred) intelligence control applications have been announced in various fields. Such R&D histories are surveyed by showing many photos/illustrations, that will be a good help for application oriented young researchers in the field of intelligence control. The author has also been cooperated with industries in some of those industrial application examples. Such results, especially in the field of robotics applications, are mentioned by showing DVD video images. Lastly several on going projects in the author's laboratory are introduced such as NEDO next generation robotics project and stepping motor nano-drive control by referring their future perspectives. [C1482]

"Simple and sensitive method of microcantilever-based DNA detection using nanoparticles

conjugates"

As the real sample diagnosis using resonance-based microcantilevers, a simple method is strongly suggested that capture probe immobilized on the cantilever directly hybridize with nanoparticles conjugated detection probe. Two different dimensions of microfabricated piezoelectric cantilevers and two different sizes of nanoparticles were used in this experiment. As a result, the most suitable conditions, the 30times90 mum2(width times length) of the cantilever and the 140 nm of the nanoparticles, were chosen for this method. And quantitative analysis was carried out in different concentrations of nanoparticles conjugated detection probe which are 1 mug/mL, 10 mug/mL and 100 mug/mL. In addition, the sensitivity of this method was demonstrated through the SNP (single nucleotide polymorphism) detection by comparing with quantitative data of hybridization in full matched sequence at same concentration. [C1483]

"Research of thick-film capacitive displacement sensors used in nano-meter scaled operation"

On the basis of thick-film technology, a novel gap- variation-type thick-film capacitive micro-displacement sensor have been developed to detect nanometer-scaled displacement, using 96% A12O3ceramic plates and Pd-Ag conducting paste via a print-fire process. This paper describes the principle, structural design and theoretic computation of the capacitive sensor. Factors affecting the sensors' resolution and linearity, and effects of materials and technological parameters are also discussed. Tests results of the preliminary prototype sensors show that the as-prepared prototype sensors possess good linearity (about 2%, without additional compensation or corrections) and resolution (about 0.025/100 nm). The obtained results demonstrate that the sensors have favorable applied prospects. [C1484]

"A Radiation Hardened Nano-Power 8Mb SRAM in 130nm CMOS"

An eight megabit rad hard SRAM, implemented in 130 nm CMOS technology, uses stacked capacitors within the memory cell for robustness, supply power gating and internally developed array power supplies to achieve very low soft error rates and standby current consumption under 600 nA. [C1485]

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{no data available} [C1486]

"The Statistical Failure Analysis for the Design of Robust SRAM in Nano-Scale Era"

Increase of the process variability with aggressive technology scaling causes many productivity issues in VLSI manufacturing. Analysis about the relationship between process variability and failure has been performed to specify guidelines in both technology and design aspects for yield optimization. By applying the proposed methodology, the core scheme and the operating voltage of the 200 MHz SRAM were determined to secure the immunity to operational failures. In DFM point of view, the statistical circuit analysis for failure characteristics is indispensable to guarantee an optimal yield in manufacturing. [C1487]

"High-Quality Circuit Synthesis for Modern Technologies"

Due to weaknesses in circuit synthesis methods used in today's CAD tools, the opportunities created by modern microelectronic technology cannot effectively be exploited. This paper considers the issues and requirements of circuit synthesis for the nano CMOS technologies, and discusses our new circuit synthesis technology that satisfies these requirements. The new technology considerably differs from all other known synthesis methods and overcomes their main weaknesses. The experimental results demonstrate that it produces very fast, compact and low-power circuits. The new technology has however many more major advantages that are discussed in the paper. [C1488]

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The following topics are dealt with: quantum technology; nanotechnology; and microtechnology. [C1490]

"Preface"

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"A Novel Scaling Theory for Effective Conductive Path Effect of Double Gate (DG) MOSFETs for Nano-Scale CMOS Circuit Design"

The steady down-scaling of complementary metal oxide semiconductor (CMOS) device dimensions has been the main stimulus to the growth of microelectronics and computer-aided ultra large scale integration (ULSI) design. Double gate (DG) SOI MOSFET is one of the most promising technologies for ultimate scaling of CMOS technology. By studying the subthreshold conducting phenomenon of DG MOSFETs, the effective conductive path effect (ECPE) is employed to acquire the natural length to guide the design. With ECPE, the minimum channel potential is used to monitor the subthreshold behavior. The effect of ECPE on scaling factor significantly improved the subthreshold swing compared to conventional scaling rule. The accuracy of results obtained using our analytical model is verified using 2-D numerical simulation. The model offers the basic designing guidance for double-gate MOSFETs. [C1493]

"Fabrication and evaluation of V-shaped MOS transistor probe"

The V-shaped metal-oxide-semiconductor (MOS) transistor probe is fabricated and evaluated to detect the surface electric properties. The V-shaped structure is selected for the better lateral stiffness compared with the simple rectangular structure and the specific dimensions are determined using the parallel beam approximation (PBA). The conductive nano tip is grown with the focused-ion-beam (FIB) system, which delivers the electric properties from the sample surface to the MOS transistor. Since the MOS transistor has the high working frequency and the high sensitivity, the device can detect the small electric properties with the high speed. The fabricated device is applied to the various test patterns like the metal lines and PZT poling regions. The results represent the well defined measurement patterns and show the promising aspect of the surface electric property detection with high sensitivity and high working frequency. [C1494]

"PTSMT: A Tool for Cross-Level Power, Performance, and Thermal Exploration of SMT Processors"

Simultaneous Multi-Threading (SMT) processors are becoming popular because they exploit both instruction-level and thread- level parallelism by issuing instructions from different threads in the same cycle. However, the issues of power and thermal management hinder SMT processors fabricated in nano-scale technologies. Power and thermal issues in SMT processors not only limit the achievable performance, but also have a direct impact on the cost and viability of these processors. While several performance simulation tools to explore the performance aspect of SMT processors early in their design phase exist, there is a lack of early power and performance evaluation tools for SMT processors. To this end, we have developed PTSMT: a tightly coupled power, performance and thermal exploration tool for SMT processors. In this paper, we demonstrate that PTSMT can automatically and effectively accomplish power, performance and thermal exploration of SMT processors at various levels of design hierarchy, at the application level, microarchitecture level, and physical level. Our experimental results show that: at the application level, number of contexts into which an application is divided could affect performance by 2.2times, energy by 52%, and peak temperature by 35degC; and at the microarchitecture level, context swapping during run time could reduce energy by 9% and improve performance by 8%. These observations indicate the size of the design space which can be explored using PTSMT. [C1495]

"Reconfiguring CMOS as Pseudo N/PMOS for Defect Tolerance in Nano-Scale CMOS"

End-of-the-roadmap nanoscale CMOS is expected to suffer from significant defectivity due to manufacturing defects, random process variations, and wear-out during normal operational. To ensure acceptable yield and reliable operation of the circuit during its life-time, future circuits must be equipped with significant defect-tolerance capabilities. Traditional defect-tolerance approaches are too expensive to be applied to general purpose circuits. In this paper, we propose a defect-tolerant CMOS logic gate architecture that exploits the inherent functional redundancy in static CMOS. This is accomplished by reconfiguring the CMOS logic gate to a pseudo-NMOS-like gate in the presence of a defect. The resulting defect-tolerant logic architecture incurs only a modest area overhead. The proposed gate design can tolerate defects in either the pull-up or pull-down network of the gate. The architecture can tolerate multiple defects across the logic gates of a CMOS logic circuit. The effectiveness of the proposed defect tolerance technique and its impact on circuit delay and power is studied. It is shown that the technique imposes little delay overhead (less than 6%) but incurs power dissipation overhead (less than 20%) in the presence of defects. [C1496]

"Loss-Tolerant Quantum Coin Flipping"

Coin flipping is a cryptographic primitive in which two spatially separated players, who in principle do not trust each other, wish to establish a common random bit. If we limit ourselves to classical communication, this task requires either assumptions on the computational power of the participants or it requires them to send messages to each other with sufficient simultaneity to force their complete independence. Without such assumptions, all classical protocols are so that one dishonest player can completely bias the outcome to his choosing. If we allow for quantum communication, on the other hand, protocols have been introduced that limit the maximal bias that dishonest players can produce. However, those protocols would be very difficult to implement in practice because they cannot tolerate realistic losses on the quantum channel between the participants or in their quantum storage and measurement apparatus. In this paper, we introduce a novel quantum protocol and we prove its unconditional security even when such losses are taken into account. [C1497]

"Surface Plasmon Resonances in Diffusive Reflection Spectra of Multilayered Silver Nanocomposite Films"

Ion beam mixing of silver-covered oxide films by 400 keV argon ions induces the formation of silver nanoparticles on the oxide surface. Using consecutive conformal dielectric deposition and ion beam mixing, multiple layers of the nanoparticles can be fabricated. By means of diffusive reflection and absorption spectroscopy, surface plasmon resonances of silver nanoparicles are investigated in SiO2, Al2O3and TiO2films containing single and double layers of the Ag nanoparticles. We show that, compared to the extinction spectra, the diffusive reflection spectra allow clear observation of the excited plasmon modes and their modifications due to the dielectric environment and the interaction between the particles. [C1498]

"A Scheme to Entangle Nanomechanical Resonators and Microwave Cavities"

A scheme able to entangle at the steady state a nanomechanical resonator with a microwave cavity mode of a driven superconducting coplanar waveguide is proposed. The nanomechanical resonator is capacitively coupled with the central conductor of the waveguide and stationary entanglement is achievable up to temperatures of tens of milliKelvin. Although not easy to reach experimentally it would provide a viable way to entangling many nano resonators via a common cavity field. [C1499]

"A New Approach for Modelling Circuits Containing NAND Gates Using Biomolecular Computing"

In the past few years, a lot of work has been done on simulating Boolean Circuits with biomolecular computation. In this paper, we present a new DNA-based evaluation algorithm for a Boolean circuit consists of NAND gates. This algorithm employs standard bio-molecular techniques. The contribution of this research is that the proposed model has been implemented using only three molecular operations. Furthermore, the number of passes in each level is decreased to less than half of existing models. Also the proposed implementation avoids the use of error-prone techniques such as PCR. These advantages have led to a faster, easier and more efficient algorithm. Time complexity of this algorithm is proportional to the depth of circuit. [C1500]

"Towards Multistate Nanocomputing: The Implementation of a Primitive Fuzzy Controller"

In the following article we present the generalization of the basic building blocks of quantum-dot cellular automata (QCA). The bistable QCA cell, which can be used to represent two well defined states, is enhanced in a way that allows the representation of three logic values. The significance of such structures is presented through the study case of a simplified control system. [C1501]

"A Quantum Network Manager that Supports a One-Time Pad Stream"

We have begun to expand the NIST quantum key distribution (QKD) system into a quantum network to support secure cryptography. We are starting with a simple three-node network, one Alice switched between Bob1 and Bob2. To support such a quantum network, we have implemented a quantum network manager that not only handles the switch and QKD protocol startup operations but also handles multiplexing and synchronization of secret key streams. We describe the function, structure and interfaces of this quantum network manager and report on initial switching overhead. We also discuss some steps we plan to take to optimize that overhead as well as hide its latency for certain applications. [C1502]

"Secure Message Relay over Networks with QKD-Links"

This paper presents extensions to the classical point- to-point protocol PPP [RFC1661] and IPSEC [RFC 2401] in order to build networks that can do unconditionally secure message relay. Our work addresses the problem of how to integrate quantum key distribution (QKD) in networks such that little effort needs to be put on protocol engine adaption and network topology design. This article demonstrates how to ensure correct routing and secure authentication between adjacent QKD-capable nodes, in particular, it is demonstrated how a person-in-the-middle attack can be countered using universal hash functions. [C1503]

"DNA as Building Block for Self-Assembly of Micro-components"

Biological processes, and in particular DNA hybridization, offer the potential to form the basis for the assembly of devices at micro- and nano-scales. Our aim is to imitate nature to self-assemble micro-scale parts (<100 microns) using DNA hybridization attachment process. In this paper, a new mechanical DNA hybridization modelling scheme is proposed in order to determine the feasibility of such processes. We expose here how and why DNA hybridization process can provide a good bound to self assemble components, and how molecular modelling methods allow to understand the physical mechanism of this process. Furthermore, the strength of DNA hybridization can be measured and optimised to corroborate and validate the modelling state using an experimental technology based on atomic force microscopy. [C1504]

"Stochastic Processes in Machine Intelligence: Neural Structures Based on the Model of the Quantum Harmonic Oscillator"

This paper studies neural structures with weights that follow the model of the quantum harmonic oscillator. The proposed neural networks have stochastic weights which are calculated from the solution of Schrodingers equation under the assumption of a parabolic (harmonic) potential. These weights correspond to diffusing particles, which interact to each other as the theory of Brownian motion (Wiener process) predicts. It is shown that conventional neural networks and learning algorithms based on error gradient can be conceived as a subset of the proposed quantum neural structures. The learning of the stochastic weights (convergence of the diffusing particles to an equilibrium) is analyzed. In the case of associative memories the proposed neural model results in an exponential increase of patterns storage capacity (number of attractors). [C1505]

"Study on leaching rule of nano particles from Eucalyptus camaldulensis wood"

Now water, adhesives and other assistants are severely wasted because the extractive of Eucalyptus wood is enriched. What's worst, water pollution becomes more serious because of the polluting extractives of Eucalyptus wood. Therefore, based on the single-factor method, the fresh E. camaldulensis shavings were treated in the sorbitic extractor and supersonic wave extractor. The extractives were analyzed by ZETA and SIZER to find out the leaching rule of nano particles from E. camaldulensis wood, hence to obtain the way to lower the negative effect of the extractives. The results were following as: (1) the regression curve showed that the extraction mass increases when the extracting time extends in the sorbitic extractor; (2) diameters of leached nano particles distribute from 37.8 to 106 nm by volume evaluating indicator, and 28.2 to 91.3 nm by number evaluating indicator in the sorbitic extractor. The particles with diameters of 4150~5560 nm, 1110~6440 nm and 4150~5560 nm are too few to test, and their volume are only 0.3%, 2.6% and 0.3% respectively, however, they can bring barrier of wood extractives on wood permeability and obstructive action of wood turpentine on pulping; (3) the volume of the particles with diameter of 28.2~78.8 nm was 80.1%, the number of the particles with diameter of 24.4~50.7 nm was 89.0%, and the volume of 190~396 nm particles is 15.2%, but its number was very less. Therefore, not only extraction mass is increased but also the grouping number of leached nano particles from E. camaldulensis is lowered in supersonic wave extractor. [C1506]

"Dynamic mechanical analysis of nano-SiO2 /bismaleimide composite"

This paper presents the effect of nano-SiO2on the thermal stability of composite materials. A series of composites with different nano-SiO2contents are prepared by polymerizing nano-SiO2, chopped carbon fiber and bismalemide resin. Nanocomposites are characterized by dynamic mechanical analysis. The results indicate that the content of nano-SiO2exhibit significant improvements on glass transition temperature (Tg) with Tg elevation by increasing concentration of nano-SiO2. The elevatory Tg is the result of steric hindrance by nano-SiO2particles in the nano-composite. [C1507]

"Effect of nano TiO2 on state of cure and pyrolytic reaction of phenol-formaldehyde resin"

Phenol-formaldehyde resin is used as the most adhesive to produce waterproof plant-based composite. However, this product contains phenol and formaldehyde which can be easily released to pollute air. Based on the single-factor method, the effect of nano TiO2on situation of cure and pyrolytic reaction of PF resin was studied by FT-IR and Py-GC/MS. The result of FT-IR spectrograms showed that the absorbencies of Ar-OH, Ar and Ar-O-Ar of PF/TiO2composite were lower than that of PF, and there were no peaks of PF/ TiO2composite at 820 cm-1and 760 cm-1, indicating that nano TiO2couldn't improve the situation of cure of PF resin. There were components including carbon dioxide, D,.alpha.-tocopherol, 1,3-bis(trimethylsilyl) benzene, phenol from PF resin in 590degC He gas. However, the 20 compounds including phenol,2,4,6-trimethyl-, phenol, 2-methyl-, phenol, 2,4-dimethyl-, benzene,1,3-dimethyl-, 9-anthracenamine,9,10- dihydro-, phenol,2-ethyl-, benzene,1,2,3-trimethyl-, phenol were identified by Py-GC/MS after PF/TiO2composite was pyrolyzed in 590degC He gas, and phenol and phenol derivants were found in the compounds. The result showed that nano TiO2could effectively delay the pyrolysis of PF resin. [C1508]

"Designing Micro/Nano Systems for a Safer and Healthier Tomorrow"

Summary form only given. The ongoing scaling and hybridisation of manufacturing technologies enables us to attain unprecedented levels performance as well as to integrate electronic and fluidic circuits with sensors and actuators. Smart micro/nano systems will be the building blocks of wearable and ambient systems, that gather and integrate heterogeneous data in real time and operate and communicate in a wireless and ultra low power mode. These systems will foster a revolution in health and environmental management, with the final objective of improving security and quality of life. At the same time, they will create a large market of components and systems, and a renewed perspective for electronic design and manufacturing companies. To accomplish such an ambitious goal, new technologies and architectures must be matched and tailored to the operational environment by solving novel an challenging design and optimisation problems, through the creation of novel design methodologies and tools. [C1509]

"A monolithic 3D fully-differential CMOS accelerometer"

This study presents a novel inertia sensor design to monolithic integrate x, y, and z-axis accelerometers on a single chip. The chip is implemented using the TSMC 0.35 mum 2P4M CMOS process, and post metal wet-etching and dielectric dry-etching processes. Thus, the fully-differential capacitance sensing in-plane and out-plane CMOS accelerometers are realized. The measurement results demonstrate the sensitivities for in-plane and out-of-plane accelerometers are 3.9 mV/G and 0.9 mV/G, respectively. The coupling ratios for in-plane and out-plane accelerometer are 3~5% and 15~30%, respectively. [C1510]

"TiN coating/glass substrate system fabricated for hot-embossing stamp at multi-scale"

For the hot-embossing lithography, imprinting stamp with long-life span, good anti-wear property and precise geometrical shape, is much expected for pushing forward the technology to industrial application. By analyzing disadvantages of current Si and SiO2imprinting stamps, this paper presents TiN coating/glass substrate system as the stamp material, in which the glass plates serves as substrate and the hard TiN coating is fabricated for the nano-patterns. To fabricate the stamp, firstly, several microns TiN coating is deposited on the glass by ion-beam deposition system, then focused ion beam etching system is used to fabricate a series of nano-patterns on the TiN coating. The primary hot-embossing imprinting results indicate good results for PMMA. Hereby it is believed that conventional hard coating TiN could be potentially a good choice for realizing the long-life imprinting and improving the life duration of the imprinting stamp greatly. [C1511]

"Ultra-low-powered CNTs-based aqueous shear stress sensors integrated in microfluidic channels"

We have developed carbon nanotubes (CNTs) based aqueous shear stress sensors integrated in microfluidic channels. The sensors utilized electronics-grade carbon nanotubes (EG- CNTs) as sensing elements, and were built by combining MEMS- compatible fabrication technology with AC dielectrophoretic (DEP) technique. The assembled sensing element has a room- temperature resistance of ~100 to 200 Omega by using the original concentration of 1:1 EG-CNTs in DI-water. The I-V measurements of EG-CNTs show the heating effects of the sensors, and the current required to induce the nonlinearity of EG-CNTs is in the order of 100 mu Ultra-low-powered CNTs-based aqueous shear stress sensors integrated in microfluidic channelsA, which implies the operation power of the sensor is in the range of Ultra-low-powered CNTs-based aqueous shear stress sensors integrated in microfluidic channelsW. Upon exposure to DI- water flow, the characteristics of the sensor have been investigated at room temperature under constant current (CC) activation mode. It was found that the electrical resistance of the CNT sensors increased linearly with the introduction of constant fluidic shear stress. We have tested the response of the sensors with flow velocity from 0.3 to 3.4 m/s. The experimental results show that there is a linear relation between the output resistance change and the flow velocity to the one-third power. This result proved that the CNT sensors work with the same principle as conventional MEMS thermal shear stress sensors but only require ultra-low activation power (~1 muW), which is ~1000 times lower than that of conventional MEMS thermal shear stress sensor. [C1512]

"QCA based multiplexing of 16 arithmetic & logical subsystems-A paradigm for nano computing"

In this work, we make use of a new computing paradigm quantum cellular automata (QCA) to describe the design and layout of arithmetic and logical function generator (ALFG). ALFG is made up of several blocks whose outputs are multiplexed for an intended functionality. The design of ALFG was made using the basic elements of technology such as inverter and majority voter. The layout and simulation results are presented using QCADesigner tool. A total of 16 arithmetic and logical operations can be performed on a pair of 4bit vectors. The ALFG presented, offers functions beyond a normal ALU such as shift, parity, XOR, rotate and multiplication along with basic operations. The total area consumed by ALFG is 11.37 mum2with aid of 9 clocks to give the final output from the generator. The building blocks of ALFG can be added into a 4bit processor in order to make it feasible for additional applications. [C1513]

"Effect of the nanocrystal formation on the properties of the electroless Ni-P deposit"

The deposits of electroless nickel-phosphorus fabricated in different process were studied by means of OM, XRD and DTA. Three different kinds of microstructure, such as nano-crystalline, amorphous and co-existence of both, could be obtained by adjusting the process. Moreover, the hardness of the deposit changed according to the different microstructure. The hardness of deposit had a great increasing when the whole matrix was almost nanocrystalline structure. DTA results also indicated that the formation of nanocrystalline phase could improve the thermal stability of deposit. This conclusion provided a good theoretical basis for this Ni-P deposit using for wear and corrosion resistances in the technology area of MEMS/NEMS. [C1514]

"The wave-guide characteristic of a novel optical fibre doped with the nano-material as InP"

Combined with the nano-technology, the optical fibre doped with nano-material as InP is manufactured by using the MCVD (modified chemical vapor deposition) technology. Proved experiments, this novel optical fibre has an excellent wave-guide characteristic. The graphs of presentation of the core and the propagation constant beta have been simulated by using the FEM (finite element method). Then the effective refractive index neffap 1.400 of this fibre is calculated, and these are the foundations for our future research on this fibre. [C1515]

"Through-wafer interconnects using carbon nanotubes synthesized by chemical vapor deposition"

In this paper, through-wafer interconnects using carbon nanotube bundles grown by thermal chemical vapor deposition have been reported. The authors have demonstrated a reliable process of synthesizing aligned carbon nanotube bundles through two bonded silicon wafers. The top wafer (100 mum thick) with patterned through-holes allows carbon nanotubes to grow vertically from the catalyst layer (Fe) on the bottom wafer. The maximum length and minimum diameter of the bundles are 200 mum and 30 mum, respectively. The resistivity of the bundles is measured to be 0.0148 Omegacm by using a nano-manipulator. [C1516]

"On Modeling and Testing of Lithography Related Open Faults in Nano-CMOS Circuits"

Scaling of transistor feature size over time has been facilitated by corresponding improvement in lithography technology. However, in recent times the wavelength of the optical light source used for photolithography has not scaled in the same rate as that of the minimum feature size of the transistor. In fact, starting with 180 nm devices, the wavelength of optical source has remained the same (at 193 nm) due to difficulties in finding a flicker-free, high energy, coherent light source with compatible improvement in lens material for focusing this light. Consequently, upcoming technology nodes (65 nm, 45 nm, 32 nm and 22 nm) will be using a light source with wavelength much greater than the feature size. This creates a peculiar problem where line width on manufactured devices is a function of relative spacing between adjacent lines. Despite numerous restriction on layout rules, interconnects may still suffer from constriction due to this peculiarity also known as forbidden pitch problem. A small manufacturing variation turns the constrictions to open faults. Gate leakage current is a significant concern for present and upcoming technology nodes. Due to gate leakage, an open fault is not truly an open circuit. Our simulation studies show that the leakage current steers the floating input of a gate to certain meta- stable states. This property actually makes it easier to detect open faults either through side channel excitation or by stuck-at tests. The major contributions of this paper are (i) lithographic simulation based identification of potential open fault sites, (ii) identification of meta-stable input states for these open inputs, (iii) length calculation for side channel signals for definitive detection of open faults. Together, they provide a complete CAD framework for testing lithography related open faults. [C1517]

"Fabrication of a micro-PCR chip with a heat-sink using TiO2 nano-Fluid"

In this paper, a newly-designed micro-PCR chip with a heat-sink using TiO2nano-fluid is proposed. The chip consists of three parts; a top part with the micro channel including an integrated heater and sensor, a middle part of the micro chamber that specimens react in, and a bottom part of the micro-fluidic channel that the nano-fluid flows into as the role of a heat-sink. The nano-fluid made use of the TiO2material. In order to investigate the heating of a micro chamber, an infrared thermal imaging system measured temperature changes in the chambers. [C1518]

"Roller-based laser assisted direct imprinting for nanofabrication"

This paper reports an improved nanofabrication method based on laser-assisted direct imprinting (LADI) technology. The key element in this improvement is to introduce a quartz roller into the LADI process. The quartz roller optically focuses an incident UV laser light into a line onto a silicon substrate, and mechanically compresses a quartz mold against the silicon substrate. Under the action of both laser melting and mechanical pressure, the mold can imprint into the silicon and transfer the mold's surface features directly to the silicon substrate. This roller-type LADI approach has several significant advantages as compared to the original planar type LADI. It transforms the LADI process into a large-area, continuous, and high throughput nano-fabrication method. Experimental tests in this work demonstrate the direct fabrication of nano-structures of 500 nm line width with an imprinting speed of 5 times 60 mm2per minute in a continuous configuration. [C1519]

"New Optoelectronic Materials"

Optoelectronics is a very materials dependent technology. The metastable growth of new alloy materials and strain have significantly increased the performance and addressable wavelength regions due to these materials technology enhancements. The growth technologies, new materials and resulting devices are described. [C1520]

"2D Cantilever Array SPM using Optical Interference"

This paper proposes a 2D cantilever array SPM using optical interference for a parallel nano imaging in a large area measurement. We achieved large-scale integration with 50,000 probes fabricated with MEMS technology, and measured the optical interference patterns with CCD. The multi-probes are made of SiN by MEMS process, and the multi-probes are joined with the Pyrex glass by anodic bonding. We designed, fabricated, and evaluated the characteristics of the multi probe chip. We took some interference patterns by CCD and measured the position of them. Using image processing technique, we could detect the interference patterns. We calculated the probe height using the interference displacement and made 3D graph of the measured object surface. As a result, it was confirmed that this multi-probe chip using interference patterns is effective in measurement for a parallel nano imaging. Based on the principle, we composed the Multi-probe 2D cantilever array SPM system, and evaluated the fundamental characteristics. [C1521]

"Key technologies for solid state lighting"

The latest development of the key technologies including improvement of the internal quantum efficiency and external quantum efficiency of the high-power GaN-based LEDs, packaging and system application was reviewed and analyzed in detail. [C1522]

"Photonic MEMS: From Laser Physics to Cell Biology"

This paper reviews the recent progress from optical MEMS to photonic MEMS, nano- photonics and biophotonic MEMS, which represents a latest trend of the expansion and penetration of the MEMS technology to the nano and bio areas. Different types of devices are demonstrated as the examples of the natural synergy of MEMS with the photonics, including thermo-optic switches, tunable lasers, injection-locked laser systems, nano-photonic bandgap devices and biophotonic cell chips. The use of MEMS not only produces better integration, robustness and compactness, but also improves the functionalities and specifications of the devices. [C1523]

"China's Information Industry: Government Programs, Plans and Initiatives"

The situation and development prospect of information industry in China are firstly described in this presentation. The development strategies, plans and R&D projects on information industry are then introduced. Finally, the technique innovations are remarked. [C1524]

"Rump Session 1: Strategic Research and Engineering Innovation"

Advances in telecommunication and information technologies are fueled by engineering innovations arising from strategic research. Strategic research may be defined as that mission-oriented research which pursues specific and realistic goals leading to practical applications. Prior to the telecom bubble of year 2000, much of the strategic research was conducted in the industry, while the academe pursued largely fundamental research leading to knowledge acquisition. Globalization and competition led to the dissolution of much of the fundamental and long-range strategic research in the industry, leaving the work to be carried out in the academe supported by government agencies. This rump session will examine the present global research environment in IT and telecom industries, addressing issues relating to industrial and societal needs, incremental and disruptive applications, funding processes and efficiencies, long-range strategic visions, and other matters of cogent interest. [C1525]

"1.54 μm Monolithically Integrated GaSb Quantum Well Laser Diode on Silicon Operating at 77K"

We present a GaSb quantum well laser diode grown monolithically on a Si(100)-5° substrate. The device lases under pulsed, 77 K conditions at 1.54 μm with threshold current density of 1 kA/cm2for a 100 μm times 1 mm stripe. [C1526]

"III-V nanowires: growth mechanisms, properties and applications in nanooptics and nanoelectronics"

In this work we present an overview of some recent results in the field of growth mechanisms, fundamental properties and applications of III-V semiconductor nanowires. [C1527]

"Tracking the Origins and Explosive Growth of the Internet"

The Internet had its origins more than 30 years ago in a US government research project with the modest goal of linking a few high power computers around the country. It erupted as a commercial success about 10 years ago thanks to a remarkable unplanned confluence of several innovative technologies: broadband fiber optic communications, the personal computer and the Web browser. The story of its progress and present impact provides an excellent example of the importance of supporting infrastructure in society in promoting innovation, in other words, success breeds success. [C1528]

"Academic Research on Lightwave Technology in Mainland China"

Mode of our national economic growth becomes more innovative. Missions, funding process, technical contents and some achievements of our national academic research funding programs on lightwave technology will be described. Author's vision will be presented for discussion. [C1529]

"Study On The Photonic Crystal Made By Gyrotropic Medium"

FEM is employed for analyzing performance of the Photonic crystal consisting of gyrotropic medium which can be adjusted by changing the biased magnetic field. It indicates the possibility of R/D a novel performance tunable photonic crystal. [C1530]

"Structure Study of Amorphous SiOx Films"

Two FTIR spectra bands of amorphous SiOxfilms prepared by sputtering technology were detected. Different structures corresponding to them were studied according to the CFM mode and RBM mode. [C1531]

"Anisotropic Wet Etching in Application of SOI-based Nano-Optoelectronic Devices"

A size reduction technology based on anisotropic wet etching is presented, which can break through the limitation of lithography resolution and find extensive application in SOI-based nano-optoelectronic devices. [C1532]

"A Short-Pulsed MOPA Source and Its Application in Distributed Optical Fiber Raman Temperature Sensing System"

We have demonstrated a short-pulsed optical fiber MOPA source, which generates 12 W, >1 ns pulses at a wavelength of 1550 nm. The repetition rate of the pulses can be adjusted continuously from 10 Hz to 70MHz. The source is tested in a 2.4 km distributed fiber Raman temperature sensing system, achieved a temperature resolution of plusmn5K. By using wavelet transformation, the temperature resolution is improved to plusmn1K. [C1533]

"Preparation of TiO films by Cathode Multi Arc Ion and its Performance"

TiO films were prepared by custom-made Cathode Multi Arc Ion equipment. Experimental test results reveal that our equipment can easly deposite big area scale TIO, particle size is in nanometer scale . [C1534]

"Optical generation of millimeter-wave by using external quadruple-frequency modulation

technique"

A technique to optically generate millimeterwave based on external quadruple-frequency modulation is presented. By using two cascaded intensity modulators with a variable optical delay line, wideband continuously tunable millimeter-wave is obtained without any optical filters. [C1535]

"4-arm MZM modulator used in microwave generation"

A 4-arm Mach-Zehnder modulator (MZM) used as a key component of a microwave generator is proposed, the operation principle of the of the generator is described and simulated. [C1536]

"List of Student Posters"

First Page of the Article [C1537]

"Development status of optical communication and market opportunities in China"

Optical communication has lived through its winter, and is coming in spring season. How about the development situation of optical fibre communication in China? In this presentation the development and application status of communication technologies in China from system point of view were introduced at first. Then, according to some investigation data, the market opportunities of optical communication equipments, optical fibre cables and components in China were described. [C1538]

"Rump Session 2: Market and Doing Business in China"

With the dominance of manufactured consumer goods, China has now emerged into high-tech areas including communications and information technology products. The rump session will invite several business executives to discuss the opportunities and challenges for developing such endeavors in China. Current status and future directions in optical communications technologies will be addressed and comparisons between the business models in the West and in China will be discussed. [C1539]

"Light Matter Interaction Effects in III-V and II-VI Quantum Dot Micreresonators"

Engineering the interaction of light with matter allows one to tune important properties of solids like e.g. the spontaneous emission rate or the spontaneous emission coupling factor into a laser mode. We have investigated light matter interaction effects in semiconductors using (QD) micropillar cavities and micro disks containing dots with strongly varying oscillator strength and different Q-factors in III-V and II-VI systems. Due to the three dimensional electronic confinement the quantum dot excitons act as the solid state equivalent of atom-like emitters. The three dimensional optical confinement in the cavities results in discrete photon modes. The energies of the QD excitons can be tuned in and out of resonance with the optical modes by temperature tuning. In the experiments on weak and strong coupling great care is taken to populate the cavity with only a single photon generated by the dot on resonance. This can be demonstrated nicely by studies of photon correlations for a quantum dot exciton in the strong coupling regime. Due to improvements in epitaxy and patterning technology it has been possible to further increase the Q factors of the micropillar cavities. We obtain Q values up to 160.000 for 4 mum diameter cavities, which decrease approximately linearly with the pillar diameter. The values for the vacuum Rabis splitting vary from about 140 mueV to about 20 mueV, when the oscillator strength of the InGaAs dots decreases from 50 to 10. Much larger values of the vacuum Rabi splitting are observed in II-VI microrings with embedded dots, where the strongly increased oscillator strength of the II-VI dots results in splittings of about 0.7 meV. [C1540]

"Self-consistent Microscopic Description of Charging Effect on Phase Coherence in Ultrasmall Josephson Tunnel Junctions"

We discuss the effect of charging energy on phase coherence from a microscopic point of view. Physics is characterized by single electron charging energy Ec and Josephson coupling energy Ey It is shown that currents due to Cooper pair tunneling from partially phase-coherent regime (Ej/EcLt1) to phase-incoherent regime (Ej/Ecrarr0) can be seamlessly described up to higher order tunneling processes, provided that generalized charged states of the island is introduced. [C1541]

"Design, Fabrication and Application of Integrated VCSELs"

Vertical cavity surface emitting lasers (VCSELs) have unique properties that enable integration that is nearly impossible with conventional waveguide lasers. This paper describes the design, growth/fabrication technologies and applications for a broad range of integrated VCSEL structures. [C1542]

"Tracking the Origins and Emergence of Photonic Integrated Circuits"

Summary form only given. The concept of integrating many photonic devices on a chip was first proposed in 1969, based on the early success of integrating electronic circuits. After 38 years, large-scale photonic integrated circuits are just now emerging as a commercial success (with the initial public stock offering of Infinera). Considerable effort is now devoted to combining the photonic and electronic components on one carrier and eventually on one chip. The story of its progress and present promise provides an excellent example of the importance of massive investments in processing technology with a focus on yield and performance. [C1543]

"Economics and Strategic Innovation for Systems Application in Optical Communications"

Strategic innovation for system applications in telecom requires forethought and process management, which should be applied with a clear understanding of integration and deployment issues and their economic implications. Whereas new enabling technologies can evoke revolutionary changes of system and network infrastructures and operations, as well as significant impact on the service providers' business viability and financial sustainability, non-strategic (not-well-thought-through) technology developments can often be thwarted by the continuing enhancement of the embedded base. My talk will present a perspective on strategic innovations in optical communications, discuss their impacts on the telecom industry, consider the present needs and dilemmas of the service providers, and describe some of the on-going research directions that promise viable applications. [C1544]

"Synthesis and Characterization of Polyimide/silica Nanocomposite Films"

In the paper, a kind of polyimide nanocomposite films was made by synthesizing polyimide/silica nano-particle matrix resin through the hydrolysis and poly-condensation of varies ratio of tetraethoxysilane (TEOS) and dimethyldiethoxysilane (DMES) in the solution of polyamic acid (PAA) solution dissolved in N, N-dimethylacetamide (DMAc), followed by rotating it on glass substrates and heating at high temperature. The 3-aminopropyltriethoxysilane (APrTEOS), which serves as a coupling agent, was chosen to enhance the compatibility between the polyimide (PI) and the silica (SiO2). The chemical structure of the films was characterized by FT-IR. The results of TGA proved that the thermal stability can be improved by well dispersion of inorganic components not more than 16wt%. [C1545]

"A Novel Hardware Architecture for Self-adaptive Systems"

This article focuses at studying the implementation of the self-configuration concept on a novel unconventional hardware architecture. This proposed programmable architecture implements self-placement and self-routing which, due to its intrinsic design, enable the development of systems with self-configuration, self-repair and/or fault tolerance capabilities [1],[2]. For scalability issues, the architecture has been defined as a regular array of homogeneous elements. It is able to analyze and modify its own circuits. This means that the functionality can be modified and improved over time, leading to more versatile designs. The system can check for faulty cells or regions and simply work around them. Those cells can be marked as bad regions so the system can keep working. This permits to deal with imperfectly-manufactured cell arrays, which is a key issue in the extremely complex systems envisioned for the future micro and nano technologies. [C1546]

"Suspension plasma spraying: Process parameters and resulting coating architecture"

Due to the large volume fraction of the internal interfaces, finely structured coatings (nano- or submicronsized) should exhibit better properties than the ones structured at a microscale. Suspension plasma spraying (SPS) appears as a technology permitting to manufacture such coatings and consisting in injecting within a plasma jet a liquid suspension of solid particles. Compared to plasma spraying of micron-sized particles, SPS exhibit several major differences: i) a more pronounced sensitivity to arc root fluctuations requiring to adapt operating parameters; ii) a shorter spray distance; iii) a higher thermal flux transmitted from the plasma jet to the substrate. Several operating parameters, including suspension characteristics and suspension injection parameters, play relevant roles in the suspension processing and the resulting coating architecture. [C1547]

"Characterization of nano-seconds pulsed streamer discharges"

Pulsed power technology has been used in many applications such as control of NOXand SOXfrom exhaust gases, treatment of dioxins, removal of volatile organic compounds, generation of ozone and excitation of excimer laser. Since pulse duration of applied voltage to discharge reactor has a strong influence on energy efficiency of pollutants removal, the development of short pulse generator is paramount important for practical applications. The discharge observation of the short duration pulse voltage is an essential aspect for understanding plasma physics of this new field. In the present work, the characteristics of the developed nano-seconds (ns) pulse generator, which has the pulse duration of 5 ns, and the observation results of nano-second (ns) pulsed streamer discharges in atmospheric air are presented. The developed ns pulse generator consists of a high pressure spark gap as a lower inductance self-closing switch, a triaxial Blumlein line as a pulse forming line, a coaxial energy transmission line as a connection between the Blumlein and a load, and a pulse charging source. The triaxial Blumlein line is filled up with transformer oil as insulation and dielectric medium. The ns pulse generator outputs the positive voltage, having 2 ns of rise time and 5 ns of pulse duration. The maximum output voltage reaches up to 100 kV. The propagations of the positive and the negative ns pulsed streamer discharges in a coaxial electrode were observed using a high speed gated ICCD camera and a high dynamic range streak camera. During the both polarities of ns pulsed streamer discharges, the primary and the secondary streamers propagated from inner wire to outer cylinder electrodes. This phenomenon has good agreement to the previous works which are observed in the cases of sub-μs pulsed streamer discharges. However, the propagation velocity of the primary streamers in the present work is approximately 6 times faster than the previous one. This i--s because that the velocity of primary streamers dependent on applied voltage to electrode and ns pulse generator is able to apply the higher voltage to electrode than sub-μs pulse generator. [C1548]

"Design and Test of Microfluidic Biochips"

Microfluidics-based biochips are revolutionizing laboratory procedures involving molecular biology. Advances in microfluidics technology offer exciting possibilities for high-throughput DNA sequencing analysis, protein crystallization, drug discovery, immunoassays, and environmental toxicity monitoring. Another emerging application area for microfluidics-based biochips is clinical diagnostics, especially the immediate point-of-care diagnosis of diseases. Defect tolerance is a key requirement for biochips that are used for healthcare and environmental monitoring. There is a need to deliver the same level of computer-aided design (CAD) support to the biochip designer that the semiconductor industry now takes for granted. These CAD tools will allow designers to harness the new technology that is rapidly emerging for integrated biofluidics. This talk will present early work on design and test techniques for microfluidic biochips. The speaker will describe synthesis tools that can map behavioral descriptions to a droplet-based microfluidic biochip and generate an optimized schedule of bioassay operations, the binding of assay operations to functional units, and the layout and droplet flow-paths for the biochip. Cost-effective testing techniques will be presented to detect faults after manufacture and during field operation. It will be shown how on-line and off-line reconfiguration techniques can be used to easily bypass faults once they are detected. Thus the biochip user can concentrate on the development of the nano-and micro-scale bioassays, leaving implementation details to design automation tools. [C1549]

"Memories in Scaled technologies: A Review of Process Induced Failures, Test methodologies, and Fault Tolerance"

The inter-die and intra-die variations in process parameters (in particular, threshold voltage (Vt)) can lead to large number of failures in an SRAM array, thereby, degrading the design yield in nanometer technologies. To improve parametric yield of nano-scaled memories, different circuit and architectural level techniques can be used. In this paper, we first analyze and model different SRAM failures due to parameter variations, and discuss test methodologies to test for process variation induced failures. Next, we describe two different self-repairing techniques-at the circuit level, using adaptive body biasing and at the architecture level, using built-in-self-test (BIST), redundancy and address remapping. The discussed self-repair mechanisms can improve design yield much beyond what can be achieved using row/column redundancy and error correcting codes (ECC) alone. [C1550]

"Magnetic Resonance in Ni-Zn-Fe Spinel Doped Opal Matrix"

In this work the microwave properties are studied of 3D-nanocomposites obtained by insertion of nanoclusters of (Ni-Zn) ferrite in the opal matrix with diameter of the nano-spheres 270 nm. The measurements are carried out using two methods, the first with the sample placed in the cross section of the rectangular waveguide and the second with a sample in the cavity. It is shown that there is effective interaction of electromagnetic field with the sample. Magnetic field dependence of the transmission coefficient is resonant in shape. Several branches of the magnetic resonance have been observed including the acoustic branch. It has been found that the transmission coefficient module can vary up to 70% under the action of magnetic field. Such great variations could be applicable for the magnetic field driven electronic devices of the millimeter wavelength band. [C1551]

"Optical Properties of Materials on Basis of Multi-Wall Carbon Nanotubes at Millimeter Wave Range"

In this work, two measurement techniques for real and imaginary parts of the refractive index at millimeter wave range for application to nano-materials on basis of multi-wall carbon nanotubes (CNT) are modernized via measurement of: 1) coefficients of reflection and transmission; and 2) shift of the interference minimums. The first technique is modernized for measurement in thin (<0.5 mm) specimens with taking into account the multiple re-reflections inside thin specimen with small attenuation. The second technique which was developed earlier for specimens where the value of the real part of the refractive index is much more than the imaginary one is not applicable for CNT specimens where these values are of the same order of magnitude. Here, this technique is modernized for specimens with significant imaginary part of the refractive index. [C1552]

"UV-based Nano Imprint Fabrication of Gold Grating Couplers on Silicon-on-Insulator"

Fiber-to-waveguide gold grating couplers are fabricated using UV-based nano imprint lithography and lift-off on top of an unprocessed silicon-on-insulator chip. Over 22% efficiency and a 1 dB bandwidth of 36 nm is demonstrated in the telecom band. [C1553]

"Micro- and Nanobiological Systems: New Technologies and Applications"

Summary form only given. Nanotechnology has recently been applied to a wide range of biological systems. In particular, there is a current push to examine the interface between the biological world and micro/nano-scale systems. In this paper, the author presents ongoing work in microfluidics, biosensors, and nano-bio interfaces. Specific topics are included in the development of a DNA-based, microfluidic detection system and its use for both pathogen identification and forensic DNA analysis. In addition, the author covers current studies in magnetic-microfluidic integration, bacterial quorum sensing, bacterial adhesion, and novel optical detection systems. Some of the unique biological considerations for these systems are discussed, as well as issues relating to device fabrication and testing. [C1554]

"Static Power Reduction in Nano CMOS Circuits Through an Adequate Circuit Synthesis"

This paper addresses the power reduction issues in nano CMOS circuits, and focuses on the static-power and power-efficient circuit synthesis. It shows that the circuit synthesis approaches applied in today's commercial EDA-tools are not power-efficient in most cases, and experimentally demonstrates a high power-reduction potential of an adequate circuit synthesis. It also shows that our novel information-driven approach to circuit synthesis is able to robustly construct low-power circuits for the contemporary and future CMOS circuits. [C1555]

"Optofluidic Technologies"

Optofluidics refers to adaptive systems that integrate optical and fluidic devices. Micro and nano-fluidics enable novel devices which introduce liquids into optical structures. We discuss recent optofluidic developments, including optically powered vapor pumps. [C1556]

"A biosensor based on rotary molecular motors"

A biosensor based on FoF1-ATPase with immunological and biochemical techniques to achieve the goal of clenbuterol detection is constructed. The enzyme FoF1-ATPase is a molecular motor that converts the chemical energy stored in the molecule adenosine tri-phosphate (ATP) into mechanical rotation of its gamma sub-unit. During steady state catalysis, the three catalytic sites of FoF1-ATPase operate in a cooperative fashion such that at every instant each site is in a different conformation corresponding to a different stage along the catalytic cycle. Notwithstanding a large amount of biochemical and, recently, structural data we still lack an understanding of how ATP hydrolysis in FoF1-ATPase is coupled to mechanical motion and how the catalytic sites achieve cooperativity during rotatory catalysis. It's found that different loads onto the subunit of chromatophores could affect its synthesis activity to different extent. The detecting mechanism was depended on proton-flux driven by rotary catalytic ATP synthesis. The results clearly showed that the detection of clenbuterol by the biosensor was 10-12g/L. The results showed that the new biosensor may prove to be a useful nano-device for super-sensitive detection. The activity of FoF1-ATPase is affected with different loads of rotary molecular motors. [C1557]

"Effect of Surface-treated Nano-silica on Thermal Behavior and Flame Retardant Properties of EVA/ATH composites"

The effects of nano-silica with different surface treatment on thermal stability, flame retardant properties and mechanical properties of ethylene-vinyl acetate copolymer (EVA) /alumina trihydrate (ATH) composites are discussed by thermal gravimetric analysis (TG), limited oxygen index (LOI) and tensile properties. The results of TG show better thermal stability of composites with nano-silica. The maximal weight loss rate is obviously decreased with the addition of nano-silica. Furthermore, the composites with surface treated nano-silica possess better thermal stability and lower weight loss rate. More residues left at 600Г,В°C reveal that surface treated nano-silica can promote the charring of the composites. Thus, improved flame retardant properties of composites with surface treated nano-silica can be discovered as a result of much higher LOI value. Meanwhile, such composites also show improved tensile properties than EVA/ATH at the same loading levels of fillers. [C1558]

"Future of Nano CMOS Technology"

CMOS technology has been developed into the sub-100 nm range. It is expected that the nano-CMOS technology will governed the IC manufacturing for at least another couple of decades. Though there are many challenges ahead, further down-sizing the device to a few nanometers is still on the schedule of International Technology Roadmap for Semiconductors (ITRS). Several technological options for manufacturing nano-CMOS microchips have been available or will soon be available. This paper reviews the challenges of nano-CMOS downsizing and manufacturing. We shall focus on the recent progress on the key technologies for the nano-CMOS IC fabrication in the next fifteen years. [C1559]

"Low Temperature Performance of Deep Submicron Germanium pMOSFETs"

The electrical characteristics of germanium (Ge) pMOSFETs with high-Г,Вї dielectric and gate lengths down to 125nm have been studied as a function of temperature down to 77K. The effective hole mobility improves from 235cm2/Vs at room temperature to 490cm2/Vs at 77K due to the reduction of phonon scattering. We report a drive current enhancement of 1001 Г,ВїA/Г,Вїm at 295K to 1394Г,ВїA/Г,Вїm at 77K for L = 125nm and VG-VT = VD = -1.5V and a reduction in the off-current by 1-2 decades. The decrease in the subthreshold slope from 100mV/dec to 37mV/dec at 77K would allow power supply voltage scaling, further reducing the off-state current, and making Ge transistors suitable candidates for low temperature CMOS applications. [C1560]

"Formation of Silicon Nanopores and Nanopillars by a Maskless Deep Reactive Ion Etching Process"

This paper presents a maskless process to create silicon nanopores and nanopillars by inductively coupled plasma deep reactive ion etching (ICP DRIE). Preliminary controllability on densities of pores and pillars as well as dimensions of pillars was demonstrated. The pore generating process was also used to create porous polysilicon films for surface micromachining applications. A buried channel was successfully released using the porous polysilicon film fabricated by this method. Nanopillar technology was applied to micro fuel cells to significantly increase the active surface area of silicon-based electrodes. [C1561]

"Thermally Driven Bimorph Nano Actuators Fabricated using Focused Ion Beam Chemical Vapor Deposition"

Bimorph nano actuator fabricated with focused ion beam chemical vapor deposition (FIB- CVD) on MEMS heater is presented. The nano bimorph structure is composed of C14H10and W(CO)6and the transferred thermal energy generated from the MEMS heater increases bimorph temperature. Due to the thermal strain mismatch of the two materials, carbon and tungsten, the nano bimorph bends toward C indicating larger CTE of tungsten containing material. The measured stroke is 600 nm projected from top and bimorph actuation is repeated for over 100 times without any indication of degradation of failure under controlled input voltage. Relation between measured stroke, difference in coefficient of thermal expansion (CTE) and temperature rise is derived using Denavit-Hartenberg notation and bimorph structure analysis. DeltaCTE is calculated to be 1.87 X 10-6K-1, which is necessary value to design the presented type nano bimorph actuators with different geometry/dimension and to predict their operational conditions and expected performance. [C1562]

"MEMS and Nano Technology for the Handheld, Portable Electronic and the Automotive Markets"

Large consumer markets, such as the market for handheld, portable electronic devices and the market for automobiles, rely on new technologies to meet more demanding goals for cost, performance, size, weight and power. The role of both MEMS and nano technology in these large markets will be described. MEMS technology is already a mature technology in the automotive field, but new MEMS devices, as well as new nano sensors show promise to revolutionize automotive technology by making possible the measurement of new physical quantities that have never been directly measured in the automotive field before. For automotive applications, the primary factors are cost and performance. For handheld, portable electronic devices, both MEMS and nano technology will be used for increasing the functionality of the wireless communication, but then be applied to providing additional functionality. For these electronic applications, the primary factors are performance, size and power. A wide variety of examples will be given as the overall trends in these markets are described and illustrated. [C1563]

"Micro and Nano Chemical System on Chip"

Integrated micro chemical systems have been expected as evolutional tools for high speed, functional and compact instrumentations for analysis, synthesis, bio and related sciences and technologies. We have developed general methods for micro integration of chemical systems on the basis of the concept being similar to electronics. In place of resistor, capacitor, and diode in IC, micro unit operations for mixing, extraction, phase separation, etc. have developed as integrated components of microchemical systems. There are two directions of our microchip chemical technologies. One is to make these technologies practical and to commercial use of micro-meter scale chemical system on chip. And the other one is to extend the method to nano-meter scale chemical experiment which is opening new horizon of chemical research tool. [C1564]

"Alumina MEMS Platform for Impulse Semiconductor and IR Optic Gas Sensors"

In the presentation, we discuss the application of a novel MEMS technology based on a fabrication of thin alumina film (TAF). The membrane is fabricated by the electrolyte spark oxidation of aluminum. The membrane consists of nano-crystalline gamma-aluminum oxide and has a thickness of 10-30 microns. It was shown that this membrane chip can be used for the fabrication of gas sensors (semiconductor, thermocatalytic, and optic) operating in impulse regime. The thermal response time of the heater is of about 80 ms, the chip remains working after 7 millions on-off cycles at 450degC. [C1565]

"A Nanobiosensor Fabricated by Nanoimprinting Technology"

A new biosensor with a high sensitivity and a low process cost is presented in this paper. Localized surface plasmon resonance generated inside the nanogrooves was verified to have a high sensitivity and this structure could be produced using a nano imprinting technology which realizes a high reproducibility and a mass-production. The present sensor had five times as high sensitivity as the conventional colloidal localized surface plasmon resonance sensor. And the detection of BSA antigen using the present sensor was attained in this research. [C1566]

"Silicon NANO-ESI Emitters for Mass Spectrometry: A Mixed Micromechanical and Microfluidic Design"

We present nanoelectrospray ionization (nanoESI) emitter chips based on a microcapillary slot fabricated using silicon-on-insulator (SOI) technology. We combine microelectromechanical systems (MEMS) and microfluidic design rules to ensure the rigidity of the structures by taking into account the effect of capillary forces present following the introduction of liquids into MEMS. The optimized fabrication process enables cost-effective batch production of chip-based micromachined nanoESI emitter chips. The nanoESI emitter chips were tested using nanoESI-mass spectrometry. [C1567]

"Stacked SiO2/Si Nanonail Array Fabricated by Spacer Technology for Biomedical Applications"

This paper reports well-controlled nanonail array with Si bodies and stacked SiO2heads for biomedical nano-extractions and protein localizations. The nanonails with well controlled dimensions are fabricated by multi-crossed spacer technology which we have developed. The nail bodies with the minimum diameter of 24 nm and nailheads with 11 nm tip-radius are successfully achieved. 100 nm spacing and 1.2 mum nail height are also obtained. Nano water droplets are observed to condense at the hydrophilic nailheads in environment-scanning electron microscope. Fluorescent test shows that fluorescein solution is only dipped at the nailheads, while the hydrophobic Si is immune. The stacked nanonails are also used for protein capture after chemical decorations. [C1568]

"PC-SMZ-Based All-Optical Flip-Flop Switch: PC-FF"

Recent development of a symmetric Mach-Zehnder type, ultra-small and ultra-fast all-optical switch (PC-SMZ) composed of GaAs-based two-dimensional photonic crystal (2DPC) waveguides and InAs-quantum dots (QDs) has resulted in a new proposal of a PC-based optical flip-flop switch (PC-FF). Nano-photonic technologies involving state-of-the-art PC-SMZ and new problems for the PC-FF are reviewed. [C1569]

"Novel Tellurite Glasses and Nanocluster Doped Silica for Photonics"

The topic of this review is a summary of the photonics research currently performed at the Material Science and Chemical Engineering Department at Politecnico di Torino, with an emphasis on novel tellurite glasses and nanocluster doped silica for photonics. The fabrication and characterization of novel tellurite glasses and their optical fibers, with the aim of obtaining laser sources operating in the near infrared, will be reviewed. Doping with Tm, Yb and Ho have been investigated and different pumping schemes are evaluated in order to optimize laser performance. Nanocluster doped glasses, which are of great interest for nonlinear applications in telecommunications as well as for different types of plasmonic sensors, will also be discussed. Specifically, the fabrication and characterization of nano-metal glass composites manufacturing by RF sputtering. [C1570]

"Cells and Biomolecules Handling Micro/Nanofluidic Systems"

Micro Electro Mechanical Systems (MEMS) technologies and top down nano-technologies have been applied for the biological cell analysis. Micro/nano fluidic devices and systems for biological cells and biomolecules handling are described. [C1571]

"Technology Challenges for Silicon Nanophotonics and Beyond"

The development of Si-based photonics has been far behind the development of electronics for long time. There are two reasons for that. As silicon is an indirect band gap semiconductor, achieving light emission and gain is quite difficult. On the other hand, for using silicon as a light guiding material for passive devices, the main constrains until recently were relatively high propagation losses and high fiber-to-waveguide incoupling losses. The general trend towards more compact photonic devices together with progress in fabrication techniques resulted in the development of two nano-photonic technologies for next generation optical devices: photonic crystals and nanowire waveguides-based devices. To drastically increase the integration density and achieve subwavelength confinement of light along the propagation direction, plasmonic waveguides have been proposed. Surface plasmons are electromagnetic modes constituted on the interface between a metal and a dielectric. The tradeoff between the light confinement and propagation loss has here a vital importance. [C1572]

"Enabling technologies for 3D System on Chip (SoC) integration and examples of 3D integrated structures"

3D Integration of patterned semiconductors circuits or/and integrated sensors requires some knowledge of vertical circuits stacking architecture and available technologies to realise expected by this integration performances. 3D architectures have emerged as serious contender in the challenge of functionality and potentiality increasing. Innovative circuit design, new advanced substrates, improved thin layer materials, new integration processes and technical approaches elaborated in last generation tools have grandly contributed in emerging various forms of 3D integration and packaging. In the context of More Moore and More than Moore considerations, the road maps place the vertical circuits stacking and associated post processing of stacked elements as a very serious opportunity for new generation of ICs. Furthermore, the mixing of advanced ICs with integrated passives, image sensors, mechanical and optical micro and nano-systems etc., based on a 3D architecture have been developed during the last years. That contributes in emerging of new generation of System on Chip (SoC) with new or increased functionalities. Some of them are on the merge of commercialisation and many continued advancements and improvements are expected in the near future. In most applications cases of 3-D integration, successive staking requires the patterned wafers or dies which have already a complex integrated structures, furthermore these structures are often fragile and sensitive to the conditions of complementary processing. Therefore, before 3D integration a selection of adapted process will be done and carefully checked for its technological compatibilities. We propose to examine the advanced methods of patterned wafer or die vertical integration and discuss its compatibility approaches for 3D integration processing. Some examples of demonstrators achieved at LETI will illustrate the patterned structures transfer, with original performances or improved characteristics thanks to 3D archi- tecture and integration processes. Advanced front-end and back-end architecture will be discussed regarding the 3D-integration challenging requirements: ICs density increasing, interconnections distance reduction, new above IC functions development, multiple functions in smart integrated hetero-structures and systems... The wafer level integration concept will be illustrated by: the double gate MOS architecture (BDGMOS), the completely integrated (front and back-end) circuits aligned transfer and deep via achievement for chips interconnection, the innovative concept of capacitive interconnections for chip-to-chip communication, the multiple transferred circuits for above IC application. Furthermore the recent developments in die-to-wafer bonding will be reported, illustrating heterogeneous structure integration for optoelectronic devices. [C1573]

"A Probabilistic Logic for Nanoscale Devices"

A logic with probabilistic characterization is suitable for expressing the states of nanoscale devices. This paper describes a novel method of calculating probability distribution of nano gate states. It is based on the Markov random field theory with new features, such as clique potential, probability density of initial nodes. We demonstrate the effectiveness of the method by basic gates and circuits. The analysis shows that the device probability distribution highly depends on the system structures and temperature parameters. [C1574]

"Knowledge Management and Reuse in Industrial Approaches: Know-how Reuse and Transfer"

Knowledge Management and Reuse in technological application has gone through an evolutionary process to involve people as workforce, processes and technology as infrastructure solution to retain, analyze, organize, improve, and share expertise and data basis. Comprehensive Technological topics and distributed project employees nowadays need a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve Industrial-organizational performance. For example reuse and management of IT and know-how, and their research activities towards nano-scale phenomena with applications in fuel and biologically inspired materials has already given new impetus to the birth of new expertise and to the improvement of existing products. It is also following the value-added chain from raw material, basic material, and work material to components or systems. In addition to the core areas of mining, metallurgy, and materials, the knowledge-oriented composite-organization provides research competence in scientific and technical fundamentals, in environmental engineering and industrial management in iron and steel industry and alike. [C1575]

"Transistor Leakage Components & Effect of Leakage on VCO performance"

In the past 10 years, CMOS technology scaling has continued at the rate of every 1 frac12 to 2 years per node. As CMOS technology advanced in to nano technology regime, static power or standby power increases at a much faster rate than dynamic power or active power, and it is expected to dominate the total device power dissipation. In this paper, we will review major leakage components that contributed to the significant rises in standby power and show the relationship between gate leakage and VCO performance. The results clearly show that the projected leakage at the 45 nm node for advanced transistors will result in VCO performance that will not meet the stringent requirements for 3G solutions and beyond unless additional noise reduction techniques are utilized. [C1576]

"High-Precision Control of Linear Actuators Based on Internal Model Control"

In recent years, a high-precision stage has received great attention due to the progress of nano-technology. This paper presents a fast-response and high-precision control method based on the internal model control in the case where the controlled object has the integral characteristic. Firstly, we refer the problems when the internal model control (IMC) is applied to the integral plant. Next, in order to overcome these problems, we introduce the disturbance observer to IMC. The disturbance observer-based internal model control (DIMC) system has the advantages of no-overshoot, easy-design and simple-realization comparing to the conventional IMC method for the integral objects. Experimental results with an ultra-precision stage demonstrate that the proposed control system achieves high-precision positioning performance with robustness to frictional disturbances. [C1577]

"Analysis and Design for the Nano-positioning XY-Stage Based on the MEMS Technology"

In order to realize nano-positioning for operating on the micro-object under the nano-scale condition, the paper presented a novel single crystal silicon (SCS) nano-positioning micro XY-Stage, which bases on the technology of Micro Electro Mechanical Systems (MEMS) and integrates with the functions of drive and detecting position. This XY-Stage is fabricated on a single-crystal-silicon by combining the technology of the deep reactive ion etching (DRIE) at silicon with anode bonding processes. Lateral electrostatics comb drive is used as driving power to drive the movable stage in the x-direction and y-direction and the displacement of the movable stage is detected by the position sensors. Then the signals derived from the sensors are used to build up the closed-loop control to improve the XY-Stage positioning precision. Especially, each comb-drive actuator adopts pull-pull mode to increase the electrostatic force. The developed XY-Stage of 2000times2000 mum2is suspended in the center of the chip by four sets of folded beam, detecting beam and bending flexure composite springs. The paper modeled the structure and used finite element method (FEM) to analyze the structure of the XY-Stage, maximize moving distance, resonant frequency and modal shape of the XY-Stage. The simulation and analysis result showed that under 30 V driving voltage, the efficient driving force is 649.8 muN and a 13.5 mum moving stroke in each of four directions. Simultaneity, the mechanical coupling is very small (0.0114 mum); and the first-order resonant frequency is 1121 Hz, above of all verified the XY-Stage is reasonable and practical further. [C1578]

"Applications of Piezo-Actuated Micro-Robots in Micro-Biology and Material Science"

This paper presents a few examples of manipulators and micro-robots based on piezo-actuators developed in the Laboratoire de Systemes Robotiques (LSRO) at EPFL. Three working principles was described (bender, inch-worm, inertial drives) and illustrated through examples for various applications (neurology, microbiology, electro discharge machining, nano-material testing and assembly of carbon nanotubes). Our goal is to demonstrate that an innovative mechanical design can make it possible to realize extremely simple manipulators working in the nanometer range for applications in micro-biology and nanotechnologies. [C1579]

"Commercialization of MEMS and Nano Manufacturing"

MEMS (microelectromechanical systems) or nanotechnology is expected as one of the most promising R&D fields for the future business success, as MEMS or nanotechnology has a variety of applications from electronics to bio-technology. However R&D investment to MEMS facility is too heavy even for the large scale companies. Although MEMS foundry services by private companies have been introduced in these five years in Japan, their targets are not small batch production or R&D but mainly large or middle batch production. The number of products of the most MEMS applications is now limited and not enough to be called as "mass production" level except for automobile sensors and ink-jet heads. The above mentioned is the reason why AIST has started R&D activities and services for MEMS commercialization. The activities include foundry service to promote MEMS industry, R&D on Desktop MEMS or Nano Factory. MEMS foundry activities in AIST are described in "MN-One" strategy with special emphasis laid on cost effective micro/nano fabrication and new materials integration to MEMS with rapid realization of new ideas by collaboration. Desktop MEMS and nano factory concept is proposed and the desktop prototypes of EB writing machine and nanoimprint machine are presented. This is mainly targeted for reduction of R&D cost and time, and eventually the speedy realization of ideas to be a winner in high technology based business. [C1580]

"Direct Metal Patterning by Inkjet Technology"

Inkjet technologies are believed to be suitable for the mask-less production of various electronics devices. The "Printable Electronics" by inkjet technologies makes big benefits as showed below; 1) direct printing of metal pattern on large substrate, 2) manufacturing of a small quantity but many kinds of devices 3) real-time production by digital design 4) small loss of coating materials. In this paper, jetting performance of Ag nano particle dispersed ink with a print head for industrial uses will be described. The material compatibility of a print head against ink solvents, and surface control of the printed substrate will be discussed for stable ejection and reliable patterning. [C1581]

"Direct Fabrication of Super -Fine Wiring and Bumping by Using Inkjet process"

A super-fine inkjet technology that enables fine pattern processing by super fine droplets measuring less than 1 micro-meter are developed. Direct drawing of metal wires having a width of just a few microns have we have been achieved by using a conductive paste which is made from nano-metal particles as an ink. Furthermore, direct forming of three-dimensional structures at any point on the substrate have been demonstrated, by taking advantage of the fast drying by such fine droplets. The process is simple and it can be carried out on the desktop in the air at room temperature. This technology should be useful from the keywords of current packaging trend of miniaturization and integration. [C1582]

"Conductive Adhesives: Alternative to High Temperature Solders and The Future"

Isotropic conductive adhesives have excellent attributes as heat-resistant lead-free high temperature interconnection materials as well as those enabling low temperature manufacturing of circuits. Ag metallic particles from nano-scale to micron-scale are combined with organic matrix to provide sound high-temperature lead-free interconnection. Micron-sized Ag particles paste can provide flexible wiring in combination with silicone-based resin. The ultra flexible skin sensor for a robot was successfully fabricated from the newly developed Ag-silicone conductive adhesive. Ag nanoparticle pastes have been successfully adopted to ink-jet wiring and the multilayered circuit layers on a SiP structure with Ag nanopastes demonstrated the potentials of the new printed electronics technology. Lowering process temperature for Ag nanoparticle pastes finally reached room temperature wiring in air atmosphere. [C1583]

"Fluorescent property of triethylene-glycol di (7-(N, N'-diethylamino))-coumarin-3-carboxylate"

Triethylene-glycol di (7-(N, N'-diethylamino))-coumarin-3-carboxylate was synthesized and the photoluminescent behavior was discussed. This compound exhibits a strong blue emission peak at 464 nm and has potential possible to explore organic electroluminescent materials. [C1584]

"Fabrication of 3D micro-structures in polymer photovoltaic devices based on soft nanoimprint lithography technology"

A nano-imprint lithography (NIL) technology is approached to fabricate the organic hetereo-structure of the photovoltaic (PV) device. Experimental results reveal that fabrication of PV devices can improve its power conversion. [C1585]

"Technology and Properties of CrN Films Deposited by Multi-Arc Ion Plating"

CrN films were deposited using Multi Arc Ion equipment on M35 steel. The experiment results indicate that the flow ratio of N2 to Ar play an important role in the properties of films. [C1586]

"Crystal Structure, UV-vis Absorption and Fluorescent Properties of a Novel Coumarin Derivative"

A novel 3-(1H-4-methyl-benzotriazol-1-yl)-4-methyl-benzo[7,8]coumarin(MBMBC) containing an electron-transporting moiety (benzotriazole) was characterized single crystal X-ray crystallography and UV-vis absorption spectra. The compound exhibits strong blue emission and may prove to be important class of OLED material. [C1587]

"Enhanced Sensitivity of Mass Detection Using the First Torsional Mode of Microcantilevers"

Using higher resonant modes of microcantilevers promises higher sensitivity in the bio/chemical molecular detection. Compared with the first flexure modes, the first torsional mode can provide an improved mass-sensing resolution due to the higher quality factor. For the accurate characterization of the torsional mode and further detection of the multi-mass attached to the microcantilevers, models based on the Rayleigh-Ritz method, considering the attaching positions of the micro and nano objects adhered to the microcantilevers is developed. An ragweed pollen, as target mass are located on different positions on a commercial microcantilever for the contrastive experiments of the first and second flexure and the first torsional resonances in the air. From experimental vibration spectrums of the "cantilever-object" system, we can get that the mass sensitivity of the torsional mode is an order higher than the conventionally used the first flexural mode. The torsional mode can offer significantly enhanced mass sensitivity within the realm of existing microcantilever technology. [C1588]

"Issues and Advancement of Macro and Nano Intelligent Mechatronics"

The mechatronics system is the integration of mechanical, electrical, information, communication and nano/micro level technologies in the design, manufacture and operation of industrial products and processes. Mechatronics system emphasizes the key factors in integration, intelligence, communication functions which includes actuators/sensors, control of mechatronic systems, microelectromechanical systems (MEMS), mechatronic devices, human-machine interface/haptics, embedded computing and software engineering, networked and embedded mechatronics and design/integration methodologies for mechatronic systems etc. Mechatronics on specific engineering systems to which mechatronics play key roles, such as: automotive systems, mobile robots, precision motion control systems, bio-mechatronics, nano/micro manipulation and nano robotics. In this presentation, we will discuss the state-of-the-art of intelligent mechatronics in the macro and nano world and to present recent advances made research results and perspectives of the future development in this multidisciplinary field of intelligent mechatronic systems. [C1589]

"Dependence of thin film growth on substrate temperature Kinetic Monte Carlo simulation of thin film growth"

A three-dimensional KMC technique has been developed for simulating growth of thin films. The surface roughness and the relative density of the films were simulated as functions of growth substrate temperature and deposition rate. [C1590]

"Timing Driven Layer Assignment Considering Via Resistance and Coupling Capacitance"

As fabrication technology keeps advancing, many nano effects have become increasingly evident. With the steady increase in the number of metallization levels and the shrinking size of vias, via resistance has increased and affected the wire delay greatly. Furthermore, the wire delay is affected more by coupling capacitance instead of wire self capacitance. These problems must be considered in modern VLSI physical design. Traditional approaches only controlled the amount of vias and coupling, and did not optimize wire delay caused by via resistance and coupling capacitance directly. In this paper, we propose a timing driven layer assignment considering via-induced-delay and coupling-induced-delay simultaneously. First, path based timing analysis is used to find the timing-critical part of a circuit. Second, a via aware timing model is suggested to calculate wire delay. Third, the procedure of layer assignment is guided by a guiding factor which decides how to assign a net on an appropriate layer pair for direct delay optimization. Experimental results on benchmark circuits show that timing driven layer assignment is necessary and the proposed greedy algorithm is promising. [C1591]

"Enhanced Light-emission from Crystalline Silicon in Microdisk Resonators"

Microdisks were fabricated on silicon-on-insulator. Sharp resonant luminescent peaks, corresponding to the whispering-gallery modes, were observed in the disks. Integral photoluminescence intensity from crystalline silicon was significantly enhanced due to the microdisks. [C1592]

"Oxide Nanoparticles Synthesized in a Microwave Plasma Torch"

Nanomaterials have attracted considerable attention from researchers, since the discovery of carbon nanotubes by Iijima. Due to their peculiar structural characteristics and size effects, nanomaterials exhibit some novel physical properties that are different from those of the bulk materials. In this work, we described a synthesis method of cadmium oxide (CdO), zinc oxide (ZnO) and carbon black (CB) using a microwave plasma torch and characterized the as-synthesized CdO, ZnO and CB. CdO and ZnO were synthesized by making use of an oxygen microwave plasma torch at atmospheric pressure. Cadmium and zinc meshes in solid were used as starting materials. The as-produced CdO nanopowder consisted of typical nano-cubic structures and the mean crystallite size was approximately 48 nm. The ZnO nanopowders synthesized consisted of nanorods from 100 to 200 nanometers in length. CBs were synthesized with different N2 contents in a gas mixture by a microwave plasma torch at atmospheric pressure. Methane (CH4) as a source of carbon atoms was directly injected into the microwave plasma torch. The CBs were mainly thornbush-shaped and turbostratic structures. Finally, the oxide nanoparticles were characterized by X-ray diffractometer (XRD), field emission scanning electron-microscope (FESEM) and field-emission transmission electron-microscopy (FETEM). [C1593]

"More Than Moore's Law: Nanofabrics and Architectures"

In the nanoelectronics era with ever smaller devices and higher densities, power dissipation and fault tolerance are the two most critical issues to be resolved. The fabrication of reliable and less power dissipating nanosystems requires new approaches to nanodevice integration, which makes Nano Architectonics one of the emerging research directions. This paper presents an example of recent progress of using carbon nanotubes as a nanofabric in working towards this objective. As an alternative route to the traditional electron-based circuitry, we also discuss the feasibility of spin-based nanofabrics consisting of spin-based memory elements united via spin wave buses. These approaches are most notably developed by the Focus Center Research Program (FCRP) -Center on Functional Engineered Nano Architectonics (FENA) and the Nanoelectronics Research Initiative (NRI) -Western Institute of Nanoelectronics (WIN). [C1594]

"A Study of Strengthening Nano-Technology New Product Value by Using Internet-Marketing technology"

Currently, the fast development of the nanotechnology takes all the attention of the world. Following the development of the nanotechnology, all over the world, including governments, companies, and academic communities all wants to gain profit by using this new technology. For Nano-technology firms, it is important to be able identify, select, assimilate, exploit, and protect its nano-related technologies they had developed, but an successful marketing strategies could give them enough competitive advantages in existing and often saturated markets to become market leaders in their respective markets. The marketing strategy is often critical to the firm's survival. As a result, for succeed in promoting nanotechnology product, it will be the most important to understand the market. [C1595]

"Generation of Manpower for Teaching, Research and Industry at the Centre for Converging Technology"

Today we are at the convergence of nano-bio-info technologies. This age will create historical revolution and we must be at driver's seat to contribute towards these societal changes. It is with this idea that a Centre for Converging Technology (CCT) has been established at our University to generate highly trained manpower for teaching, research and industries in diverse fields of nano-bio-info technologies. The present paper discusses the creation of (CCT) at the University of Rajasthan, which is the first of its kind in the country, to educate vast number of population of students in these fields. In this Centre 10 semester, five year integrated Masters Course for 120 students has been introduced first time in July 2006. The Masters program has two years of common curriculum and in 3rd year students are to enter specialized field after that some of them can join industries. The last two years of education are of specialized nature in the field of nano-bio-info technologies. In various research laboratories of the University students are pursuing doctoral and post-doctoral research in various areas of nanosciences. Undergraduate prerequisites of master's program, program curriculum, needs of the laboratory facilities and infrastructure for CCT have been incorporated. It has been proposed to initiate national and international collaboration with various Institutes, Universities, Laboratories and Scientific Agencies for the development of CCT, leading to revolution in the human life enrichment. Brief description of the University, State of Rajasthan and Jaipur has been given for national and international students. The world may declare the twenty-first century, as a century of nanoscience research and technology convergence leading to revolution in human life enrichment. [C1596]

"Coevolutionary cycles of convergence: will "NBT" become the next ICT?"

Convergence between technologies can be regarded as an increasingly emerging trend, and has received particular attention in the coming-together of previously distinct products and solutions within the information and communication technologies (ICT) industry. In previous research, the overall impact of the convergence phenomenon remains ambiguous. Whereas some scholars suggest convergence to be associated with disintegration, entry and growth, others relate the phenomenon to opposite effects, such as consolidation and shakeouts. This inconsistency in managerial conceptions on convergence formulates a need for an integrated understanding. Within a multi-case study approach, the convergence within information and communication technologies (ICT) has been observed through studying the coevolution of actors in a converging environment, and patterns in innovation dynamics and managerial responses have been identified. In reflection with existing models of innovation cycles, a model for convergence innovation processes is elaborated and discussed. In particular, the reasoning within the ICT case set is transferred onto the currently emerging entrepreneurial activities in the intersection between nano- and bio-technologies (NBT), resulting in a comparison between ICT and NBT convergences, and deriving recommendations from a retrospective to a predictive context. [C1597]

"Processing and Characterization of Nano Aluminium Powder Using Electric Explosion Process (EEP)"

Summary form only given. Nanoparticles are larger than individual atoms and molecules but are smaller than the bulk solids. Due to unique phenomenon which occurs in nano particles, their properties can be selectively controlled by engineering the size, morphology and the composition of the particles. These nano materials will have enhanced or entirely different properties compared to their bulk properties. The important objective of the present study is to produce high purity nano powders using pulse power technique. The advantage of the pulse power technique of generation of nano powder, is that the particle size could be controlled by varying the injected power and is an cost effective method of generation of metal nano powders. The literature on the pulsed power technique to generate nano metal particles is scanty and hence it is very essential and important to understand the influence of different parameters on the production of nanoparticles. Having known all, in the present study, the influence of polarity of the charging voltage, charging voltage magnitude, pressure of the operating medium and the length and size of the exploding wire, on the production of the nano particles were analysed. The mechanism of generation of nano particles using pulsed power technique is explained in detail. The microstructural and the thermal properties were analysed through TEM, AFM, WAXD, and TG-DTA studies. Composition analysis were done using energy dispersive X-ray analysis (EDAX). Characteristic change in the produced nano particle size was analysed using statistical techniques. The relationship between different control parameters on the particle size were explained in detail. The impacts of binary gas on particle size produced by EEP are discussed. The thermodynamics and kinetics of micro-structural evolution of aluminium nanoparticles are discussed. The particle size distribution of the powders are measured in the present investigation. The characteristics of the nano al- uminium particles are compared with that of its bulk counterpart. [C1598]

"Simulation of Statistical Variability in Nano MOSFETs"

Using 3D statistical numerical simulations we study and compare the impact of various sources of statistical variability in nano-CMOS transistors including random discrete dopants (RDD), line edge roughness (LER), polysilicon granularity (PSG) and interface roughness (IR). We show that the random dopant induced parameter fluctuations in conventional MOSFETs become a showstopper, impacting already adversely on their integration in SRAMs, and may force early transition to UTB SOI and double gate device architectures. [C1599]

"Conductivity improvement of microstructures made by nano-size-silver filled formulations"

The most important problems connected with R&D work for microelectronic industry are miniaturization all electronic devices and ready equipment. This trend has no other options especially on the telecommunication, computers, advanced microelectronics and military fields. Those current trends are giving quite new requirements for all R&D teams, especially those, which are creating new technology, new materials and production methods. Right now is generally well known that Ink-Jet technology offers very new possibilities for production much better packaging circuits. Also is clear that for this purpose is a wide selection of several type materials with different functions (conductance, resistance, etc.). Of course Ink Jet method creates many new requirements not only for technology and production equipment, but mostly for materials which will be used. As example dispensing speed is as high as up to 2000 dots/sec, and such dispensing parameters create quite strong limitations connected with properties of dispensed medium-especially viscosity which should be less than 60 mPas. During each "shoot" very high acceleration is created up to 105 g. Within a few microseconds drop velocity variation up to 10 m/s occurs. This phenomenon requires the highest uniformity for dispensed medium. The Ink-Jet technology is used year by year wider for microelectronic packaging [1,2] and areas for printing very low pitch matrix (e.g. very fine pitch paths, antennas) seem to be extremely attractive. But there are special demands for ink-jet printing materials. The most important, as we've mentioned, is very low viscosity value and especially highly homogenous structure (like molecular fluid parameters) to avoid sedimentation and separation during dispensing process. Additionally, for electrical conductivity of printed structure, the liquid has to contain a number of percentage conductive filler with nano-sized dimension to avoid the printing nozzle blocking. The nano-size silver seems to be one of the best candidates for this purpose, especially when it's particle size dimensions will be less than 10 nm. It is important to remember, that silver atom size has diameter 0.28 nm, so such a small filler particle is comparable with size of binder fluid molecule. This is classical situation when formula will has stable properties. [C1600]

"High Energy Density Dielectrics for Transmission Line"

High energy density materials are being developed for use in pulsed power area, such as Transmission Line in pulse generator, symmetric Blumlein or asymmetric Blumlein in Dielectric wall Accelerator. The High energy density materials could reduce the device physical size and improve the device's efficiency. The ceramics and polymer/ceramics composition have been studied in our lab. To increase the breakdown strength, the dielectric compositions are being developed based on glass, and Epoxy. The nano-technology has been used in glass composite for getting better electrical performance. The diameter of BaTiO3powder adding in epoxy is about 2 to 4 micron. The test samples have been fabricated. The permittivitv of glass/BaTiO3is over 400 and its field strengths over 100 kV/cm and 300 kV/cm under DC voltage and nanosecond pulses, respectively. [C1601]

"Influence of Image Charge Potential on High Current Field Emitted Electron Flows in a Nano-Diode"

In recent years, it is of interest to extend the classical models of space charge limited (SCL) flows to quantum regime. It was found that the classical value of the 1D Child-Langmuir (CL) law is enhanced by a large factor due to quantum effects. Similar effects were also found in the SCL bipolar flow. A review of the quantum CL law can be found in a recent review paper. Recently, a model has been developed to study the transition of electron field emission to quantum CL law in a nanogap . In this paper, we study the importance of the image charge potential in a nanogap to show that the classical form of the image charge potential is no longer valid if the vacuum gap is too small. Thus, we will present a correction to the image charge potential and calculate the IV characteristics of electron emission in a nano-diode over a wide range of voltage biases, which includes the space charge effects. [C1602]

"Influence of the microstructure on the mechanical properties in pulsed plasma nitriding AISI P20 steel"

Plasma technologies are widely used in surface engineering processes of metals. Basically, these treatments improve the mechanical, tribological, and chemical properties of the material such as wear resistance, hardness, fatigue resistance, friction, and corrosion resistance. In this work, a comprehensive study of the influence of the microstructure on the mechanical properties of AISI P20 steel treated at different temperatures by pulsed plasma nitriding is reported. The processes were done by using a pulsed plasma industrial system. The samples were characterized by nano-indentation (hardness), X-ray diffraction (XRD), scanning electron microscopy (SEM) and X-ray dispersion spectroscopy (EDS). At lower treatment temperatures (360degC), a high density of small lamellar precipitates, constituted by more epsiv-Fe2,3N phase than gamma-Fe4N phase, is formed. At intermediate treatment temperatures (480degC), big lamellar precipitates, constituted by more gamma-Fe4N phase than epsiv-Fe2,3N phase, are formed at grain boundary. At higher treatment temperatures (520degC), the nitrided layer does not contain lamellar precipitates and it is only constituted by alpha-Fe phase saturated in nitrogen. Hardness depends on distribution of precipitates and crystalline phases (microstructure). The higher hardness values are obtained when more and smaller lamellar precipitates are presented and constituted by more epsiv-Fe2,3N phase. [C1603]

"Characterization of Nano-Seconds Pulsed Streamer Discharges"

Summary form given only. Pulsed power technology has been used in many applications such as control of NOxand SOxfrom exhaust gases, treatment of dioxins, removal of volatile organic compounds, generation of ozone and excitation of excimer laser. Since pulse duration of applied voltage to discharge reactor has a strong influence on energy efficiency of pollutants removal, the development of short pulse generator is paramount important for practical applications. The discharge observation of the short duration pulse voltage is an essential aspect for understanding plasma physics of this new field. In the present work, the characteristics of the developed nano-seconds (ns) pulse generator, which has the pulse duration of 5 ns, and the observation results of nano-second (ns) pulsed streamer discharges in atmospheric air are presented. The developed ns pulse generator consists of a high pressure spark gap as a lower inductance self-closing switch, a triaxial Blumlein line as a pulse forming line, a coaxial energy transmission line as a connection between the Blumlein and a load, and a pulse charging source. The triaxial Blumlein line is filled up with transformer oil as insulation and dielectric medium. The ns pulse generator outputs the positive voltage, having 2 ns of rise time and 5 ns of pulse duration. The maximum output voltage reaches up to 100 kV. The propagations of the positive and the negative ns pulsed streamer discharges in a coaxial electrode were observed using a high speed gated ICCD camera and a high dynamic range streak camera. During the both polarities of ns pulsed streamer discharges, the primary and the secondary streamers propagated from inner wire to outer cylinder electrodes. This phenomenon has good agreement to the previous works which are observed in the cases of sub-frac14s pulsed streamer discharges. However, the propagation velocity of the primary streamers in the present work is approximately 6 times faster than th- e previous one. This is because that the velocity of primary streamers dependent on applied voltage to electrode and ns pulse generator is able to apply the higher voltage to electrode than sub-frac14s pulse generator. [C1604]

"Chromatographic alignment combined with chemometrics profile reconstruction approaches applied to LC-MS data"

This paper presents a full proteomics analysis LC-MS (Liquid Chromatography-Mass Spectrometry) chain combining bio, nano and information technologies in order to quantify targeted proteins in blood sample. The objective is to enable an early detection of pancreatic cancer. We focus on the data processing step which estimates the proteins' concentration. First, we pre-process the data in order to correct time shift between the experiments. We propose to use block matching algorithm. Second, quantification of protein is performed using chemometrics approaches and more precisely CLS, PLS, N-PLS and PARAFAC algorithms. Performances of the various methods have been compared on cytochrome c protein LC-MS analyses. [C1605]

"Approach for producing TiO2 thin films in large scale"

TiO2thin film was prepared using vacuum metallising system (VMS). The technology is developed for the mass production to deposit TiO2thin film on the substrate of metal or nonmetal materials. [C1606]

"Fault Models and Yield Analysis for QCA-Based PLAs"

Various implementations of the quantum-dot cellular automata (QCA) device architecture may help many performance scaling trends continue as we approach the nano-scale. Experimental success has led to the evolution of a research track that looks at QCA-based design. The work presented in this paper follows that track and looks at implementation friendly, programmable QCA circuits. Specifically, we analyze a novel, QCA-based, programmable logic array (PLA) structure, develop an implementation independent fault model, discuss how expected defects and faults might affect yield, and look at the design in the context of a magnetic implementation of QCA. [C1607]

"Efficient Transistor-Level Sizing Technique under Temporal Performance Degradation due to NBTI"

Temporal performance degradation in VLSI circuits due to Negative Bias Temperature Instability (NBTI) has emerged as a challenging design issue in nano-scale technology. In this paper, we analyze the impact of NBTI degradation in circuit performance in terms of timing, and show that under worst case scenario, one can expect more than a 10% degradation in the maximum circuit delay after 3 years (~ 108 seconds) operation time. Based on this observation, we propose an efficient transistor-level sizing algorithm based on a modified Lagrangian Relaxation (LR) technique to account for the temporal degradation of circuit and guarantee lifetime reliability of circuit under NBTI. The technique reformulates the sizing problem by considering the fact that only the rising (0 rarr 1) delays of CMOS logic gates are affected by the NBTI. Experimental results on several ISCAS'85 benchmarks have shown that our proposed transistor-level sizing approach can reduce the area overhead of conventional cell-level sizing method by an average of 43%. [C1608]

"Research on Methods of Interaction between Light and Materials in Micro Field"

This paper discusses the methods of contradictory conversion; spiral development and a mutation caused by quantitative changes based on the research of material particles, and explain the interaction and mutual transformation between light and materials. [C1609]

"Influence of Copper Phthalocyanine on the Performance of Distyrylarylene Blue Organic Light Emitting Diode"

The current-voltage characteristic analysis reveals that the mechanism of enhancing the performance of the distyrylarylene blue organic light emitting diode by using Copper phthalocyanine is the improved hole injection from anode to hole transporting layer. [C1610]

"The Defects of Silicon Reacted with Carbon Content Vapour in ULSI Nano-meter-Generation Technology"

This investigation considers in detail a defect called "silicon substrate damaged defects" and also introduces these defects' forming mechanisms and their root causes. These defects are likely to become increasing important in the future of deep-sub micrometer ULSI's situation. Two conditions typically result in silicon damaged defects during manufacturing processes namely: (1) watermark with carbon content and (2) the electrical charges accumulated on the silicon wafer surface. [C1611]

"World to Chip Sample Introduction"

The effort to pursue a greater quality of life has given rise to an entire industry devoted to acquiring technology that produces accurate medical diagnoses in a shorter amount of time than is currently possible. The goal is a very small, self contained system that is available to doctors in offices and to medical personnel in field situations. This goal has nearly been realized through recent advances in micro and nano technologies that allow diagnostic systems to shrink to the size of a microchip. However, as systems shrink in size, smaller sample introduction methods are needed. This paper explores three different possibilities for introducing sample from the macro environment to that of a micro-chip in a Micro Total Analysis (mu-TAS), or Lab-on-Chip (LOC), scenario. In addition to the world-to-chip possibilities, this paper also explores methods to maximize the quantity of sample delivered to specific locations on the chip for processing, while minimizing the chip area. The use of a fixed displacement, solenoid activated micropump, is verified as one method of sample entry. Standard Luer Lock syringes were also used in conjunction with Luer to 1/8 NPT fittings. Finally Hamilton micro syringes were used with UpChurch fluidic interconnects. The chip layouts included several different angles of intersection between two channels, as well as the use of multiple, smaller channels. The three methods are judged on ease of consumer use, ease of manufacturing, and finally overall reliability of the method. Preliminary results indicate that the micropump solution is the easiest for consumer use, is reliable, but is difficult to implement. The Luer lock fittings also provide easy consumer use; however, reliable sealing in combination with the shear volume of the syringes hinder implementation. Finally the Hamilton micro syringes in conjunction with UpChurch fluidic interconnects is difficult for personnel in the field to implement, but offers a reliable and easily implement- ed method of sample introduction. [C1612]

"Application of Cold Plasma Technologies in Fiber/Polymer Composites"

In this paper, the characteristics of cold plasma technologies are introduced briefly. The influence of cold plasma treatments on the adhesion between the fiber and the polymer is described. [C1613]

"The Application of Vacuum Deposition in Automobile Illumination"

The article elaborates a set of large-scale automation equipment, which is applicable to the reflector thin deposition of automobile illumination according to the work of our laboratory, and its experimental results are also introduced. [C1614]

"Application of Entire Optical Fiber Network Communication to Distributional Control System in Railway Stations"

The driving of the outdoor field equipments and acquisition of their conditions are realized by applying technology of entire optical fiber network communication and distributional control structure, and extending the execution level of signal control system to the far most of railway scene. [C1615]

"Controller of Target Power Supply in Multi-Arc Ion Vacuum Deposition"

A controller based around DSP techniques is built. The purpose of controller is to isolate the faulty or failed target power supply to a nicety, and ensure safety with minimal disruption to vacuum deposition. [C1616]

"Fabrication of Highly ordered pore arrays by soft nanoimprint lithography"

A soft nano-imprint lithography (NIL) technology is approached to fabricate the pore arrays nanostructures. Experimental results reveal that the proposed process can fabricate highly ordered pore arrays with a low cost. [C1617]

"A Schiff base Zinc Complex and its Photoluminescent Properties"

A new complex, ZnL, was synthesized and characterized by spectral data (infrared, UV-vis, fluorescence), in which the ligand compound is N1,N2-bis (pyridine-2-ylonethylene) benzene-1,2-diamine (L). ZnL exhibits a strong emission peak at 414 nm. [C1618]

"Study of Carbon Nano-Tube Photo-electronic Devices by Nano-Imprint Lithography"

Nano-imprint lithography (NIL) technology is presented to fabricate carbon nano-tube (CNT) arrays for field emission (FE) and sensor devices by process control and optimization. Results reveal that the CNT arrays are high resolution and fidelity. [C1619]

"Techniques to Optimize the Selectivity of a Gas Sensor"

The efficient use of a gas sensor is related with its characteristics of performance and its efficient design. In this paper, a set of techniques with the aim of optimizing the selectivity of a sensor gas to a particular gas or a set of gases is presented. Gas sensors based on micro and nano technology using the principle of the change of electrical resistance are specifically analyzed. The design considerations are given for each technique proposed and some characteristics in respect to their performance are established. [C1620]

"E-Beam Hard Disk Drive Using Gated Carbon Nano Tube Source and Phase Change Media"

A novel high speed, high capacity electron-beam recording technique using nano technology in a hard disk drive form factor is described. The e-beam source is a carbon nanotube (CNT) emitter and can be gated at rates up to several gigahertz. The planned recording media is phase change with sub-nano second response times, and data read-out by secondary electron emission is anticipated. The key parameters for generating the recording beam are described and a preliminary design is discussed in which the CNT based read/write head replaces the magnetic head in a standard hard disk drive (HDD). The technique sidesteps limits associated with HDD technology and potentially provides far higher recording densities and higher data rates than possible with conventional magnetic-recording. The NS3 nanotech disk (NTD) approach may provide a path forward for HDD's to the low nanometer mark scale. [C1621]

"CMOS Integrated Nano-Photonics is now a Commercial Technology"

Summary form only given. It has become apparent, that silicon technology can provide many of the requirements for nano-photonic integration, including many of the common opto-electronic components. Intel and Luxtera have both recently announced 10 Gb/sec optical modulators, integrated into silicon. Actually, all the other customarily required opto-electronic components are available now in silicon, as well. Continuous wave optical power can be provided from off-chip, just as dc power is currently provided from off-chip. The first commercial applications are emerging, are optical 10 Gb/s Ethernet, and Infiniband, a standard for communicating among multi-processors in an array, and in general, optical substitutes for electrical cables. [C1622]

"Error Tolerance of DNA Self-Healing Assemblies by Puncturing"

Self-assembly is affected by high error rates due to incorrect tiles in nano-technology manufacturing. Tile sets that can heal (fully or partially) an erroneous assembly have been proposed. Self-healing requires growth to be restarted such that erroneous tiles can be removed and the correct tiles to bind to the aggregate. Punctures can be used for this purpose. The goal of this paper is to characterize an intentionally induced puncture (and its relevant properties) on an erroneous tile site in the assembly. This allows to propagate any newly generated error away from the source of growth (i.e. the seed tile), such that self-assembly can continue along specific directions. Different types of puncture are considered with respect to growth direction, error and aggregate types. Puncture resilience is analyzed using a new characterization metric; different tile sets are investigated in detail. Analytical and simulation results are provided. [C1623]

"Functional specifications of an integrated proteomics information management and analysis platform"

Detecting proteins in human blood holds the promise of a revolution in cancer diagnosis. Also, the ability to perform laboratory operations on small scales using miniaturized (lab-on-a-chip) devices has many benefits. Designing and fabricating such systems is extremely challenging, but physicists and engineers are beginning to construct such highly integrated and compact labs on chips with exciting functionality. This paper focuses on the presentation of the requirements of the information technology layer in such an integrated platform been developed in the LOCCANDIA project. LOCCANDIA is a specific targeted research project (STREP) funded under the 6th framework program of the EC. Its ultimate objective is to develop an innovative nano- technology based (lab-on-a-chip) platform for the medical- proteomics field. The paper presents the main engineering aspects, challenges and architecture for creating an Integrated Clinico-Proteomic Environment. The environment will be used to monitor and document the analysis and discovery chain and to allow the physician to interpret the digital spectrogram data delivered by the mass spectrometer, for diagnostic purposes. [C1624]

"Converging Micro-Nano-Bio-Information & Communication Technologies Towards Integrated Systems: the Contribution of the EU Information Society Technologies Program"

The world of micro & nano technologies and systems has significantly evolved in the last few years. A paradigm shift has emerged which ranges from single silicon devices to a multitude of materials and integrated systems. The research approach has evolved accordingly: from mono-disciplines to multi-disciplinary research involving physics, mathematics, chemistry, medicine, biotechnology, mechanics, and micro-nano electronics. The development and integration of heterogeneous technologies at the interface of nanotechnology, biotechnology and information & communication technologies towards miniaturised, multifunctional and cost-effective systems is being attracting great interest and effort, world wide. In particular, under the research and technology development framework programme (FP) 6 of the European Union [2002-2006], the Information Society Technologies program (1ST), micro-nano systems sector2, invested more than 100 meuro through academic and industrial cooperative projects, striving a balance between technological innovation (discovery) and integration into functional systems that can be plugged into real-life environment (applied R&D). The group of EC-funded projects on Micro-Nano-Bio Convergence Systems, "so-called" MNBS, is made by projects developing systems that use a vast array of technologies to integrate across traditional boundaries between the micro-nano- bio, and info worlds, enabling a wide range of applications from health care to food quality monitoring. The group could be divided, at its current stage, in two main categories:-Biosensors, DNA & protein arrays, biochips, lab on chip, and other miniaturised systems enabling point of care, in vitro molecular diagnosis, and biological analysis. Such projects develop and integrate components and modules e.g. microfluidics, biosamples preparation, sensing, detection, signal processing and data reading/handling. Applications in biomedicine and healthcare include e.g. early cancer-- diagnostics, prognosis and disease recurrence (e.g. breast, prostate, lung and colorectal), malaria detection, diabetes monitoring and deep vein thrombosis early detection. Another promising research line is on wearable biochemical sensing though sweat analysis, targeting applications such as sports and human performance, obesity and wound healing.-Body sensors, implantable systems, endoscopic probes, active electrodes and other miniaturised systems interacting with the human body to enable several applications e.g. drug delivery, repairing of vital functions and diagnosis. These projects develop and integrate components and systems e.g. sensors, actuators, micro/nano electrodes, power supply, signal & data processing, and wireless telecommunication modules to fulfil predefined applications requirements. Such examples are smart implant sensors and systems e.g. glaucoma & retina sensor, intra-cranial pressure sensor, cochlear implant, functional electrical stimulation for limp motion, activity monitor, sphincter sensor and biosensor for blood glucose monitoring. Other examples include endoscopic probes (for gastrointestinal tumor recognition and therapy), active neural electrode system for stimulation and recording of brain activity and disorders; drug delivery through intraoral microsystem; non invasive Sensors and systems for attention, stress, vigilance and sleep on the go. The cluster aims at, promoting excellence and relevance within the community, building critical mass of activities with clear visibility and societal impact, as well as identifying possible synergies and common interest topics for further collaboration e.g. packaging, manufacturing, common infrastructure, standardization, ethics, testing-validation, market analysis & roadmapping, as well as dissemination, awareness and education. The paper will present the R&D strategy, the on-going activities and future challenges addressed by MNBS cluster. [C1625]

"Effects of High Temperature Anneals and 60 Co Gamma Ray Irradiation on Strained Silicon-on-Insulator (sSOI)"

Strained silicon-on-insulator (sSOI) was exposed to high-temperature (1200-1350degC) annealing and high-dose 60Co gamma-ray irradiation (51.5 kGy) to study the tenacity of the bond between the strained Si film and the underlying buried oxide. All samples were characterized by UV Raman, pseudo-MOSFET (psi-MOSFET) current-voltage, Hall mobility, and photoluminescence (PL) to verify any change in strain. UV Raman, PL and psi-MOSFET measurements show no strain relaxation for the high temperature annealed samples and only very slight relaxation for the gamma-ray irradiated samples. In previous studies, the stability of the strain with thermal processing and nano-patterning was analyzed with optical or X-ray methods. [C1626]

"Bio-Nano-Info Integration for Personalized Medicine"

Every disease has genetic and molecular basis. For example, in 2005, cancer became the number one killer in the USA for people under the age of 85. It is estimated that 1.3 million people will be diagnosed with cancer and more than 560,000 people will die each year. The underlying reasons for these statistics include the biological complexity of cancer as a disease which we are just now beginning to understand. The human genome project and other advanced technologies such as bionanotechnologies bring new hope to patient care because they can potentially address the disease on the molecular level. These new technologies, when linked to an individual patient's molecular profile, can provide personalized and predictive early detection, diagnosis, prognosis tracking, and novel targeted therapies. In concert with development of these advanced technologies we must develop ways to validate the novel biotechnologies; methods to analyze the high volume of data coming from genomics, molecular imaging, and bionanotechnologies; and methods to interpret these data and make relevant predictions for patient care. This workshop keynote lecture will focus on how linking molecular biology, with advances in nanotechnology and information technology, to speed up the discovery and development process and clinical translation that leads to the advances in patient care. Specifically, the workshop keynote lecture will cover topics in ontology, data mining, data management, and image analysis that enable biomarker-based diagnosis, molecular imaging probe design, and therapeutic development. [C1627]

"The Research of Biosensor Building on F0 F1 -ATPase"

A biosensor building on F0F1-ATPase for clenbuterol detection is constructed. The energy for ATP synthesis is provided from downhill proton transport along the proton gradient across membranes. This potential is formed by the electron transfer chains of respiration. The fluorescence probe F1300, which was sensitive to pH changes, was labeled into inner chromatophores to indicate the proton-flux during ATP synthesis. It's found that different loads onto the beta-subunit of chromatophores could affect its synthesis activity with different level. According to this principle, a biosensor was constructed based on ATPase to detect clenbuterol and the detecting mechanism depended on proton-flux driven by rotary catalytic ATP synthesis. The experiment results showed that the precision of clenbuterol detection by the biosensor could reach 10-12g/L and the new biosensor might prove to be a useful nano-device for super-sensitive detection. [C1628]

"Functional IC analysis through chip backside with nano scale resolution-E-beam probing in FIB trenches to STI level"

Successful measurements, applying the EBP to the backside of thinned circuitry, using test structures and commercial chips have been demonstrated. In addition to the well known CCVC a new contrast mechanism named space charge coupled voltage contrast (SCCVC) was detected, which strongly increased the EBP signal measured directly on the transistor source or drain regions. Therefore, measurements are possible as long as the electron beam can be placed on a transistor well area, which is larger than the lower metal lines by a factor of 3. The voltage signal has been produced correctly with 100mV noise margin on one of the test structures and since the coplanarity of the trench bottom to silicon surface is excellent, the same accuracy can be expected for any DUT when the process is properly calibrated. As a result, the presented method is very promising since the lateral resolution potential of an EBP system is only limited by the low energy E-beam diameter. Improvements in this field have not been used to enhance EBP in recent years but even with the present systems, measurements on sub-50nm technology seem to be possible. Furthermore, optical methods are struggling with their resolution limits and therefore backside EBP can become a very powerful method in the near future. [C1629]

"Integrated Nanoporous Silicon Nano-explosive Devices"

The explosive properties of porous-silicon, impregnated with an oxidant, were researched. A porous layer structural model is proposed to model the pore and crystallite dimensions as a result of the electrochemical etching of porous silicon layers. A gravimetric experimental technique is described whereby the pore dimensions and specific surface area of porous regions can be determined, resulting in a new relationship between pore size and specific surface area. The properties of different oxidants were investigated. The filling of the pores by the oxidant is a strong function of pore size and the type of oxidant used. The experimentally observed nano-explosive Figure of Merit (FOM) is a function of the effective surface area in the porous region covered by the oxidant. It was found that there is an optimum pore size for the most energetic explosion. Future applications for this new technology are proposed. [C1630]

"Mobility-Enhanced MOS Device Technologies in Nano-CMOS era"

This paper reviews our recent results on these carrier-transport-enhanced CMOS structures on the Si platform for future high performance and low power LSIs.The improvement of carrier transport properties can be obtained through a variety of ways including the optimal choices of surface orientations, channel directions, strain configurations and channel materials are summarized. [C1631]

"Silicon Nanowire Field Effect Devices By Top-Down CMOS Technology"

There has been tremendous advancement in the development of novel nano-technologies for future CMOS nanoelectronics. The challenges and opportunities have been widely discussed with the focus on the choice of materials, processes of implementation and innovative non-classical device architectures to continuously meet the scaling requirements. Among the non-classical device architectures, Gate All Around (GAA) FET with nanowire (NW) channel body offers the ultimate electro-static control and thus has the potential to push the gate length to few nanometers. The key challenge for NWs to be widely adopted in semiconductor industry is that they have to be formed by large scale manufacturing methods. Especially, for CMOS applications, the methods should not lead to contamination issues. [C1632]

"Near-field images of surface plasmon eigenmodes in gold nanogratings"

In this study, we have fabricated gold nanograting structures by using a focused-ion-beam system. The nano-optical properties were examined by using both the scattering- and transmission-mode near-field scanning optical microscope (NSOM). The surface plasmon (SP) eigenmode in this periodic nanostructure is directly observed by the scattering-mode NSOM. Two SP waves, localized fields and propagating waves, generating in the near field were found by the transmission-mode NSOM, and the dependence of wavelengths was studied. The relations of scattering- and transmission-mode results were discussed as well. [C1633]

"Static Power Consumption in Nano-CMOS Circuits: Physics and Modelling"

Static power consumption due to excessive leakage currents is a major problem in CMOS digital ICs with gate lengths of 90 nm and below. In this paper the physics and modelling of these currents is discussed, with special emphasis on variability and its effect on the statistical spread of the static power consumption and total power consumption. [C1634]

"Differential Drag as a Means of Spacecraft Formation Control"

This paper investigates the feasibility of using differential drag as a means of nano-satellite formation control. Differential drag is caused when the ballistic coefficients of the spacecraft in a formation are not equal. The magnitude of differential drag depends on the difference in ballistic coefficients and also the altitude of the spacecraft formation. AGI's Satellite Tool Kit is used initially to assess the magnitude of drifts caused due to differential drag for different altitudes. This information is then used to show that it is feasible to use differential drag for spacecraft formation control. A simple PID controller is then implemented that adjusts the cross sectional areas of the satellites such that the energies of the orbits remain equal. Results are presented that show that the control law can maintain the formation separation with reasonable accuracy. [C1635]

"A Novel Carbon Nano Tube based Wick Structure for Heat Pipes/Vapor Chambers"

The paper introduces the novel concept of using carbon nano tube (CNTs) based wick structures for high performance heat pipes and vapor chambers. This ongoing research aims to replace the copper wick structures with high conductive CNT wick structures. Individual carbon nanotubes possess extremely high thermal conductivities of the order of 2000-3000 W/m-K. With such a material as the wick in a heat pipe, the effective thermal conductivity of the fluid saturated wick will be significantly higher that a copper-based wick. [C1636]

"Development of Junction Temperature Decision (JTD) Map for Thermal Design of Nano-scale Devices Considering Leakage Power"

As semiconductor technology keeps scaling down, leakage power grows significantly due to the reduction in threshold voltage, channel length, and gate oxide thickness. As the junction temperature increases in nano-scale devices, leakage power increases drastically. This phenomenon motivates the processor and package designers to take into account thermal effects due to the large leakage power for highly reliable design of high-performance systems. In this paper, an analytical methodology for estimating the junction temperature and initial temperature range was provided to avoid diverging junction temperature status in nano-scale devices. For this purpose, junction temperature decision (JTD) map and initial temperature limit (ITL) map was newly introduced. [C1637]

"MULTI-MODAL IMAGE REGISTRATION USING ORDINAL FEATURES AND MULTI-

DIMENSIONAL MUTUAL INFORMATION"

This paper proposes to use a new feature, namely ordinal feature, for image registration tasks. The ordinal features are extracted by passing through the images through the generalized ordinal filter bank, which effectively encodes the spatial information between neighboring voxels and specific microstructural information in the images. The ordinal feature is integrated with the image intensity to form a two-element attribute vector. Then, four dimensional mutual information is used as the similarity measure. The experimental results show that the proposed method is more robust than the conventional MI-based method and the method using Gabor features. The accuracy is comparable for the three approaches [C1638]

"SUPPORT VECTOR MACHINES FOR AUTOMATIC DETECTION OF TUBERCULOSIS BACTERIA IN CONFOCAL MICROSCOPY IMAGES"

This paper presents an image segmentation method based on support vector machines classifiers at a pixel level. We apply this method to quantify the amount of Mycobacterium tuberculosis in confocal microscopy images for drug-discovery within the context of high content screening (HCS). To deal with the performance constraints of HCS, we propose a model-selection algorithm that finds the best classifier's hyperparameters by optimizing both classification rate and complexity. We validate our HCS adapted approach against commonly used readout techniques [C1639]

"A POWERFUL STRATEGY FOR SEGMENTING INTERDIGITATED AND CRIMPED FIBER BUNDLES IN BIOLOGICAL SOFT TISSUES"

Biological soft tissues such as tendons, ligaments, articular cartilages and blood vessels consist of collagen fibers that may form collagen fiber bundles (CFBs). In order to develop reliable biomechanical models, it is crucial to have a tool available for the identification of the structural arrangement of CFBs in soft tissue. The task of bundle segmentation becomes quite difficult if the bundles touch each other, show a significant fiber crimp and are only partially visible. A strong fiber crimp leads to high-variance local orientations within a bundle that considerably complicate the bundle segmentation. Straightforward segmentation that combines regions of similar local orientations will fail. In this work we propose a fully automatic vision algorithm that is able to segment even strongly crimped and densely arranged but linearly oriented CFBs [C1640]

"CONFORMAL CONTOUR MAPPING FOR NEUROSURGERY OUTCOME EVALUATION"

Contour mapping of surgical resection of cortex is very important in neurosurgery outcome evaluation. Based on advanced MR and PET imaging technologies and our landmark-constrained brain conformal mapping, we present a practical and accurate approach to map the resection contour on the cortical surface from post-surgery brain images to presurgery ones. The approach can accommodate and combat the possible changes of the brain in shape and size over time. To free the user from manually defining the resection contours, we propose an automatic identification algorithm based on dynamic region growing on the cortical surface. We also present an effective method to calculate the area of the region enclosed by the resection contour on the cortical surface. The overall framework provides surgeons an accurate assessment of the agreement between functional PET abnormalities and the extent of surgical resection [C1641]

"Fabrication of SixNy Nanomechanical Structures Using Traditional Lithography and Gas Isotropic Etching"

We presented a novel idea for the fabrication of nanomechanical structures using a combination of traditional lithography technology and gas isotropic etching. The process starts from a 4" p-type silicon wafer, then two SixNyand SiO2layers are alternatively deposited. After the patterning using traditional lithography with 2-mum resolution, SixNypattern is obtained which is then used as the hard mask for gas isotropic etching, and a narrowed nanoscale SiO2pattern is realized. The obtained structures can be further used to form nanochannel or nanoresonant devices. The SEM images show a nano-channel with triangle section and a suspended nanoscale SixNymechanical structure. The minimum structure size is in the range of 100 nm. [C1642]

"Synthesis of Polybenzoxazine and Nano-Barium Titanate for a Novel Composite"

Polymer-ceramic composites are suitable materials for low temperature fabrication of embedded capacitor technology. Dielectric properties of composites can be improved by adding amount of high dielectric constant ceramic powders (i.e. barium titanate). In this study, the composites with 0-3 connectivity were fabricated from barium titanate (BaTiO3) ceramic powders and polybenzoxazine as a polymer matrix. It was found that the dielectric constants of composites at frequency range of 1 kHz -10 MHz increase with increasing the amount of BaTiO3, and shows low frequency dependence. By adding 70wt% of BaTiO3, the dielectric constant at 10 MHz significantly increased from 3.56 of pure polybenzoxazine to 13.2 at room temperature. Dielectric losses of these composites are less than 0.016. Subsequently, Yamada's model with a shape parameter about 5.2 was proposed to describe the dielectric behavior of BaTiO3/polybenzoxazine composites. [C1643]

"The Simulation for Pressure Loss of Microchannel Heat Sinks Inlet"

Microchannel device is one of the prominent applications in micro and nano technologies. Basic theory for micro fluid is developing, but pressure loss in inlet and outlet of microchannel is paid little attention. Some researches show that the pressure loss in microchannel is only 10 percent, while that in inlet and outlet is up to 90 percent. So it becomes more important to analyze the pressure loss in inlet and outlet. Computer simulation can be used effectively to forecast the transport properties in micro-scale, and to give some estimates to new devices before they are manufactured. In this paper some kind shape of inlet was modeled and simulated, pressure distribution data in inlet area were acquired. By simulation analysis, we reckon that the pressure loss made by flow resistance is about 13.58 percent, made by flow direction change is about 48.58 percent, and made by cross section change is almost 37.84 percent. [C1644]

"Nanofabrication of Mesoporous Pt Electrode on Micro Pillars for CMOS Integrated micro-LOC Applications"

In this paper, a newly proposed non-enzymatic Pt electrode, mesoporous Pt on micro pillars Pt electrode, is designed, fabricated, and characterized on silicon substrate by using bulk micromachining and nano technologies. The fabricated micro/nano Pt electrode has cylindrical hexangular arrayed nano Pt pores with a diameter of 3.2 nm which is formed on top of the micro pillars Pt electrode with approximately 6 mum in diameter, 6 mum in space, and 50 mum in height. The measured current responses of the fabricated plane Pt, mesoporous Pt, and mesoporous Pt on the micro pillar Pt electrodes are approximately 9.9 nA/mm2, 6.72 muA/mm2, and 7.67 muA/mm2in 10mM glucose solution with 0.1M phosphate buffered saline (PBS) solution, respectively. On the other hand, the measured current responses of the fabricated plane Pt, mesoporous Pt, and mesoporous Pt on the micro pillar Pt electrodes are approximately 0.15 muA/mm2, 0.56 muA/mm2, and 0.74 muA/mm2in 0.1 mM ascorbic acid (AA) solution with 0.1 M phosphate buffered saline (PBS) solution, respectively. This experimental results show that the proposed micro/nano Pt electrode is highly sensitive and promising for CMOS integrated and electrochemical analysis based non-enzymatic micro-LOC applications. Since the proposed micro/nano Pt electrode can also be simultaneously fabricated with the micro-fluidic mixer with the micro pillar structure, the LOCs (laboratory-on-a-chip) can be much smaller, cheaper, and easier to be fabricated. [C1645]

"Fabrication and Characterization of carbon nanotube tip modified by focused ion beam"

The paper described on the development of a scanning probe microscope tip with CNT (carbon nanotube). Dielectrophoresis was used for assembling the CNT on the sharp end of a Si AFM tip. To adjust the morphology of the CNT tip, focused ion beam (FIB) was systematically used. The straightness of the CNT tip was improved and its length was controlled by cutting a part of the CNT. Tip's characteristics in non-contact AFM(atomic force microscopy) mode was mainly dealt with various experimental results such as wear, deep trench measurement, and high resolution imaging. Comparing to the conventional Si tip, a CNT-modified FIB tip was stronger to wear, more traceable to deep trench structure and more adaptable to figure out the fine structure like anodic aluminum oxide (AAO) structure. It is expect that CNT-modified tip is very promising for industrial usage of AFM. [C1646]

"Assembly and Characterization of Nanodevice using Carbon Nanotubes and Nanowires"

We report the assembly and characterization of three types of Ag, SnO2, and Ga2O3nanowires (NWs) and two types of carbon nanotubes (NTs) using dielectrophoresis. The NWs and NTs were individually assembled using an experimental approach based on the dielectrophoretic force equation. After depositing a Pt top electrode using a focused ion beam, we investigated the I-V curves of NW and NT devices. [C1647]

"Non-Crosshybridizing Oligonucleotide Building Blocks for Accurate, Scalable Nanofabrication"

The urgent need in the field of nanotechnology is functional, reliable, and scalable techniques for more complicated and controlled nanostructures in order to realize nanoscale materials and devices that have practical use and more capability than existing technologies. This paper addresses this need by presenting an in vitro protocol to select large non-crosshybridizing (NCH) libraries of oligonucleotides that provide a large address space of DNA sequences with which to increase both complexity and control in DNA-directed self-assembly processes. The selection protocol was experimentally verified and confirmed. The resultant large NCH libraries would allow self-assembling complex nanostructures with more precise control, leading to reliable, scaled-up, cost-effective manufacturing of nanoscale devices and systems. [C1648]

"A Design and Implementation of Wireless Sensor Network Security on Nano-Qplus Platform"

The sensor network features characteristics such as nodes being densely distributed, large quantities of nodes being scattered around, necessity of frequently changing the network topology as well as utilizing broadcasting system for communication. It also reflects a wireless network environment where batteries and computing powers are limited that it would be difficult to even make a decision on whether surrounding nodes are in credible conditions. Not only the numbers of nodes through which sensor nodes communicate exceed one, but additional research on password key control is required. It would be used on mutual authentication between nodes as well as authentication and enciphering by using limited sensor resources within the sensor network, which is based on the mesh structure. This paper makes statements on encryption algorithm, key management, security protocol, authentication and essential security elements of secure routing. It will be acting as basis of developing security mechanism, which will provide confidentiality of the MAC class level, authentication and integrity on a sensor network environment referred as the nano-Qplus platform. [C1649]

"AUTOMATED 3-D QUANTIFICATION OF BRAIN TISSUE AT THE CELLULAR SCALE FROM MULTI-PARAMETER CONFOCAL MICROSCOPY IMAGES"

Brain tissue is the most complex tissue in the mammalian anatomy. It is structurally complex, containing diverse cell types and vasculature with complex spatial relationships. It is also complex in terms of molecular constituents, and their relationship to the structural constituents. There is a need for technologies to map normal and injured brain tissue and compute appropriate quantitative measurements in support of a large number of investigations. We present a systematic methodology named FARSIGHT (fluorescence association rules for image-based insight), combining multi-parameter immuno-histochemical labeling, three-dimensional confocal microscopy, linear unmixing, segmentation, and associative morphometry to map and quantify diverse aspects of brain tissue. In addition to morphometric measurements of individual structures from individual imaging channels, we propose the use of distance maps, distance-weighted integrals, and distributions as an efficient basis for computing a versatile set of such associative measurements. These features enable classification of all the major cell types, and computation of their inter-relationships. [C1650]

"3D X-RAY IMAGE GUIDANCE IN INTERVENTIONAL RADIOLOGY"

In minimally invasive interventions, providing detailed three-dimensional information on the anatomy at the site of the instrument has the potential to improve navigation, to reduce intra-operative radiation and intervention time, and to increase the number of interventions that can be carried out minimally invasively The increasing availability of calibrated X-ray imaging systems and 3D rotational X-ray imaging has large potential to facilitate 3D navigation in the intervention room. In this paper we provide an overview of our recent research towards using this imaging technology for 3D guidance in neurovascular interventions and vertebroplasty. [C1651]

"NanoMon: A Flexible Sensor Network Monitoring Software"

In this paper, we present a sensor network monitoring software, named NanoMon, which has a highly flexible architecture and is able to support various user requirements arising in their individual wireless sensor network applications in an adaptive manner. With NanoMon, users can specify their own sensor types and custom GUI components by using a simply describable configuration file; and it can be automatically integrated to NanoMon GUI framework to support user-specific sensor network applications. NanoMon employs a widely used database, MySQL, to manage sensing data and node information of several types of sensor network applications and also to provide sensor data history and conditional sensor data look up functions. NanoMon provides well defined packet form at and transmission procedure to communicate with various sensor network platforms with no dependency on any specific WSN platforms; and it can publish sensing data received from sensor networks to other external monitoring devices via Internet using well defined XML packet format and transmission procedure. For platform independency, NanoMon is implemented in Java language. [C1652]

"A Software Technique to Improve Yield of Processor Chips in Presence of Ultra-Leaky SRAM Cells Caused by Process Variation"

Exceptionally leaky transistors are increasingly more frequent in nano-scale technologies due to lower threshold voltage and its increased variation. Such leaky transistors may even change position with changes in the operating voltage and temperature, and hence, redundancy at circuit-level is not sufficient to tolerate such threats to yield. We show that in SRAM cells this leakage depends on the cell value and propose a first software-based runtime technique that suppresses such abnormal leakages by storing safe values in the corresponding cache lines before going to standby mode. Analysis shows the performance penalty is, in the worst case, linearly dependent to the number of so-cured cache lines while the energy saving linearly increases by the time spent in standby mode. Analysis and experimental results on commercial processors confirm that the technique is viable if the standby duration is more than a small fraction of a second. [C1653]

"Attracting More Students with New Engineering Programs"

The University of Twente decided to develop and offer new educational programs in order to meet new trends and attract more engineering students. They also wondered if they could increase the limited interests of females in studying engineering. The faculty Science & Technology, a combination of the former faculties of Applied Physics and Chemical Engineering started some new BSc and MSc programs in engineering. These include Biomedical Engineering (BME), Advanced Technology (AT) and Nano Technology (NT). In the following we focus on Biomedical Engineering as one of the new academic education programs. In this paper a simple input-output model is used for the description of the various elements. [C1654]

"Cyclic-CPRS: A Diagnosis Technique for BISTed Circuits for Nano-meter Technologies"

A cyclic-CPRS (column parity row selection) technique is presented to diagnose built-in self tested (BISTed) circuits, even in the presence of many unknowns and transient errors. The novel cyclic scan chains retain the transient errors and unknowns in the CUT until they are fully diagnosed. Instead of masking the unknowns, Cyclic-CPRS directly diagnoses the unknowns as if they were errors. Direct diagnosis of unknowns not only eliminates the masking circuitry but also enhances the diagnosis resolution. Experimental results show that Cyclic-CPRS is very successful even in the presence of 10% errors and unknowns. The proposed technique is especially suitable for nanometer technologies, in which transient errors and systematic defects are becoming serious problems. [C1655]

"MULTIVIEW REGISTRATION OF CARDIAC TAGGING MRI IMAGES"

This paper introduces a new method based on k-nearest neighbors graphs (KNNG) for bringing into alignment multiple views of the same scene acquired at two different time points. This framework is applied to cardiac motion estimation from tagging MRI sequences. Features acquired in each view are collected in a high dimensional feature space and an efficient estimator of alpha-joint entropy (alphaJE) is used for selecting the optimal alignment. In order to register 4D datasets, an analytical expression of the alphaJE estimator was derived, enabling a fast implementation of gradient based optimization. The technique was tested in a set of six sequences and the results compared with respect to manual measurements made at tag crossing points, obtaining good accuracy and low processing times compared to published state of the art methods [C1656]

"A NEW IMAGE ANALYSIS APPROACH FOR AUTOMATIC CLASSIFICATION OF AUTISTIC BRAINS"

Autism is a developmental disorder characterized by social deficits, impaired communication, and restricted and repetitive patterns of behavior. Recent neuropathological studies of autism have revealed abnormal anatomy of the cerebral white matter (CWM) in autistic brains. In this paper we introduced a novel approach to classify autistic from normal subjects based on a new shape analysis of cerebral white matter gyrifications for both normal and autistic subjects. The proposed shape analysis technique consists of three main steps. The first step is to segment cerebral white matter from proton density MRI images using a priorly learned visual appearance model for the 3D cerebral white matter in order to control the evolution of deformable boundaries. The appearance prior is modeled with a translation and rotation invariant Markov-Gibbs random field of voxel intensities with a pairwise interaction model. The second step is to extract the gyrifications of cerebral white matter from the segmented cerebral white matter. The last step is to perform shape analysis to quantify the thickness of the extracted cerebral white matter gyrifications for both autistic and normal subjects. The preliminary results of the proposed image analysis has yielded promising results that would, in the near future, supplement the use of current technologies for diagnosing autism [C1657]

"TRACKING OF MIGRATING GLIOMA CELLS IN FEATURE SPACE"

A new approach for tracking cell migration by performing tracking task in a blob feature space instead of the original image is proposed. The feature space is obtained through multi-scale blob detection, where the bright modes correspond to cells in the original image. Mode seeking is realized using a mean shift algorithm. Besides cell tracking, the method considers cell disappearing, appearing from the view, cell splitting and merging as well, the events that frequently happen in an image sequence. Results obtained from a real dataset indicate that the method performs well and with an acceptable speed. The method provides a useful tool for tracking cell migration automatically. [C1658]

"PROGRESS IN BREAST CADx"

The accuracy of a medical imaging examination depends on both the quality of the image acquisition and the quality of the image interpretation. For more than half a century, computer technology greatly improved image acquisition systems, e.g., with the development of various advanced tomographic imaging modalities. Computer technology is also contributing to the quality of the image interpretation process by incorporation of CAD, i.e., computer-aided detection (CADe) and computer-aided diagnosis (CADx). CADe involves the use of computer analyses to indicate locations of suspect regions in a medical image. The characterization, diagnosis, and patient management are left to the radiologist. CADx involves the use of computer analyses to characterize a region or lesion, initially located by either a human or computer, leaving the final diagnosis and patient management to the radiologist. We present here our progress in CADx for breast cancer using mammography, sonography, and breast MRI [C1659]

"LOCALIZATION FLUORESCENCE MICROSCOPY USING QUANTUM DOT BLINKING"

Blinking of fluorescent quantum dots can be used to discriminate them, which allows their successive localization. One method of separating non-moving blinking objects from a time series of images is by using independent component analysis (ICA). Here we investigate with the help of simulations, how well 5 particles within the radius of one point spread function can be separated and localized and how the precision of object position depends on various imaging parameters. As proposed previously (Lidke et al., Opt. Expr. 13, 2005) the vision is to take the step from localizing to painting an image, which we called `Pointillism'. In contrast to methods based on identification of subframes showing only single particles, which practically limits the method to distance measurements between two targets, separation methods such as ICA can separate several overlapping particle images. [C1660]

"A SHAPE INDUCED ANISOTROPIC FLOWFOR VOLUMETRIC VASCULAR SEGMENTATION IN MRA"

Evolutionary schemes based on the level set theory are effective tools for medical image segmentation. In this paper, a shape prior is introduced which can be useful for vessel segmentation and can produce elongated structures. For a hypothetical evolving implicit surface, using the gradient vectors of its signed distance transform (SDT) a shape measure is introduced that is maximized whenever the local surface resembles a cylinder. Using this shape prior, a new functional is defined and the optimization is obtained by applying Frechet derivative. We show that this yields an anisotropic expansion term that propagates the surface in the tangential direction of vessel. This prior is then combined with edge information to produce a complete level set scheme for vessel segmentation. We have applied our method to five real MRA data sets and comparison has been made with a state-of-the-art vessel segmentation method. Presented results indicate that using this method a significant improvement is achievable and the method can be an effective tool to extract vessels in MRA intracranial images [C1661]

"NOISE AND ARTIFACT REMOVAL IN KNIFE-EDGE SCANNING MICROSCOPY"

Knife-edge scanning microscopy (KESM) is a recently developed technique that allows fast and automated imaging of several hundred cubic millimeters of tissue at sub-micron resolution. Successive sections are captured in registration by imaging the specimen concurrently with cutting by a diamond-knife ultramicrotome. Because this imaging technique is relatively new, we are currently investigating ways to improve image quality and data rate. In addition, certain imaging artifacts are unique to this technology and the time required to perform corrective image processing is a concern due to the high rate of image capture. In this paper, we describe algorithms that can be used to process KESM images in order to obtain the quality necessary for subsequent segmentation and modeling. There is also emphasis on making these algorithms independent of global information within the image so that they can be more easily parallelized. [C1662]

"Workshop Speech: Role of University Research for Open Innovations in MNT"

The role of University in MNT has been becoming more and more essential since the Micro Nano Technology (MNT) requires not only innovative seeds to open up a new application fields but also both well-qualified persons in MNT who lead this field. To meet these requirements, interdisciplinary and international collaboration and cooperation in education and research is crucially important. Firstly, part of related activities related to MNT in Kyoto University are introduced, such as the education program in MNT, the organization of newly established Micro Engineering Department, and research organization of Research Institute of Nano Science & Technology which is the lateral organization of several departments and colleges on nanotechnology. Secondly, two research topics in MNT, nano-scale material mechanical property characterization and nano-components assembly on

MEMS which are pursued at Micro Nano System Laboratory are introduced as the tentative themes for further international collaboration and cooperation. [C1663]

"Continuous-variable quantum information with three-mode Gaussian states: allotment,trade-off, teleportation, and telecloning"

We introduce a simple procedure-based on passive optical elements-to produce pure three-mode Gaussian states with arbitrary entanglement structure (upon availability of an initial single-mode squeezed state). We analyze in detail the properties of distributed entanglement, showing that the promiscuity of entanglement sharing is a feature peculiar to symmetric Gaussian states that survives even in the presence of significant degrees of mixedness and decoherence. Next, we discuss the suitability of the considered tripartite entangled states to the implementation of quantum information and communication protocols with continuous variables. This will lead to a feasible experimental proposal to test the promiscuous sharing of continuous-variable entanglement, in terms of the optimal fidelity of teleportation networks with Gaussian resources. As a byproduct, optimal resource states for various communication protocols (among which asymmetric telecloning) will be exactly determined. [C1664]

"Symbolic and numeric quantum circuit simulation"

Simulation fulfills an important mechanism for the study and the development of many areas. Quantum computation simulation tools have become essential, because no effective quantum hardware has been implemented yet. However, the currently available simulators have serious deficiencies, which makes the description of this new computational paradigm incomplete. This article presents a universal quantum circuit simulator, called Zeno, and the symbolic extension that is being developed to it. The extension will allow a symbolic description of the system's state allied to the graphical representation of the circuit to be visualized together. Users will be able to work in a faster and more efficient way than making this calculations by hand. The extension will make possible a faithful description of the system computation like the descriptions observed in related literature. [C1665]

"DFT studies of closely bound ground state of (N2-N2)+1 ionic dimmer"

A detailed DFT study of the ground state of (N2-N2)+1ionic dimer has been carried out in closely bound region from 1.2 Aring to 2.50 Aring using different DFT methods and Basis sets. A real potential energy minima has been found to exist at r = 1.20 Aring and R = 1.63 Aring for D2hsymmetry group. The potential energy levels and other physical properties of the dimmer are reported at B3LYP / 6-311++g** level of the theory. D2hsymmetry group has been found to be the most stable structure. [C1666]

"Biometric Nanotechnology and Nonlinear Dynamics"

The biological approach to nanotechnology-biomimetic nanotechnology- is a new field in the area of nanostructuring and specially nonorobotic. Mimicking biology to extract useful strategies, needs good knowledge of its exquisite dynamic (evolutionary nonlinear dynamic) which arises from a vast network of molecular interactions and structure-function hierarchical solidity from small scales (nano) to large scales (macro). In this sense the identification of self-assembly processes in living systems and their self-organized dynamical states with the knowledge about their sensitivity and selectivity have paved the way for developing new strategies for controlling the dynamic of self-assembled structures in nanoscale. Hence by mimicking the way in which biological structural components are built, the process of pattern formation or self-assembly can be directed in a desired form. [C1667]

"Qunits in Two Way Quantum Key Distribution"

Works in two way deterministic quantum cryptography protocols using qubits and qutrits have seen the nontrivial generalization of the protocol to accommodate the use of all mutually unbiased bases (MUB). Here we consider the use of qunits (quantum systems of n dimensional Hilbert space) in a similar protocol and working with cases where the number of MUB is n +1 we show that n qunits are necessary to generalize the use of all available MUBs. We also provide a recipe that would allow for encoding with unitary efficiency. [C1668]

"Quantum Key Distribution with Classical Bob"

Secure key distribution among two remote parties is impossible when both are classical, unless some unproven (and arguably unrealistic) computation-complexity assumptions are made, such as the difficulty of factorizing large numbers. On the other hand, a secure key distribution is possible when both parties are quantum. What is possible when only one party (Alice) is quantum, yet the other (Bob) has only classical capabilities? We present two protocols with this constraint, and prove their robustness against attacks: we prove that any attempt of an adversary to obtain information (and even a tiny amount of information) necessarily induces some errors that the legitimate users could notice. [C1669]

"Transfering Proofs of Zero-Knowledge Systems with Quantum Correlations"

The use of quantum correlations to attack security protocols is an important research line deserving growing attention. An important class of cryptographic protocols used as building blocks for several other more complex protocols is zero-knowledge proof systems. One of the properties that zero-knowledge proof systems are assumed to satisfy is that it is impossible for the verifier to show to a third party that he has interacted with the prover (impossibility of transferring proofs). Herein, it is shown how Bell pairs, together with tamper-proofing, can be used to break the impossibility of transferring proofs for an important class of zero-knowledge proof systems. [C1670]

"Foreword"

{no data available} [C1671]

"First International Conference on Quantum, Nano, and Micro Technologies-Copyright"

{no data available} [C1672]

"First International Conference on Quantum, Nano, and Micro Technologies-Title"

{no data available} [C1673]

"Diner based Channel Access Protocol for Nano-Machines"

Diner based access channel (DAC) protocol is a dynamic channel allocation protocol. This protocol has been developed specifically for networking nano-machines, however, it can be utilized for any mobile ad hoc network (MANET). The operation of the protocol is based on the way a diner operates. This paper presents the DAC protocol for any MANET describes its concept, algorithm and working, and also discusses its application areas. [C1674]

"DNA and quantum theory"

Molecules are the basis of life. They can be considered as a quantum system. So it is necessary to enter quantum mechanics in biological discussions. In this paper we consider the DNA molecule as a quantum system. We discuss the relation between heredity, biology and DNA and quantum systems. We also find a relation between the quantum information and some bio-processes such as cell division, heredity, and cloning. Finally we conclude that in cell division, DNA-replication and cloning all information in DNA are different. [C1675]

"Anisotropic Plasmon Resonance of Surface Metallic Nanostructures Prepared by Ion Beam Mixing"

Nanodimensional island films prepared by ion beam mixing (IBM) of silver layer on oxide substrates are studied by means of optical absorption spectroscopy and scanning electron microscopy. During bombardment by 400 keV Ar+ions the Ag film is transformed into surface islands having size in the range of 30 -120 nm and volume nanoclusters with diameter less than 10 nm. The silver islands, in general, have shape close to oblate spheroid and exhibit splitting of the dipolar surface plasmon resonance observed in extinction spectra. High fluence irradiation induces viscous oxide flow and push-in of the surface islands into the oxide substrate. The dimensions of the surface structures depend on the IBM conditions and substrate material. The changes in the island geometry and push-in depth produce changes in the extinction spectra. [C1676]

"Comparison of two bounds of the quantum correlation set"

From a geometric viewpoint, quantum nonlocality between two parties is represented as the difference of two convex bodies, namely the sets of possible results of classical and quantum correlation experiments, the latter of which is called the quantum correlation set. Whereas little is known about the quantum correlation set, Tsirelson's theorem (1980) can be seen as the exact characterization of possible pairwise quantum correlations, where mean values of individual observables are discarded. In this paper, we compare two previously shown bounds of the quantum correlation set in the case where two parties have m and n choices of dichotomic observables, respectively. One bound comes from the direct application of Tsirelson's theorem and the no-signalling condition. The other bound, recently introduced by Avis, Imai and Ito, refines the application of

Tsirelson's theorem in the previous bound. We show that for any m, n ges 2, this new bound is strictly tighter than the earlier bound. In other words, there are correlations that satisfy Tsirelson's theorem, but are not realizable in a quantum setting. [C1677]

"Strain Silicon Optimization for Memory and Logic in Nano-Scale CMOS"

Straining of silicon improves mobility of carriers resulting in speed enhancement for transistors in CMOS technology. Traditionally, silicon straining is applied in a similar ad-hoc manner to the whole die including logic and memory. Speed enhancement achieved for both NMOS and PMOS devices is desirable in logic circuits for performance enhancement because both PMOS and NMOS devices lie in critical delay paths. In SRAM cells however PMOS devices are not in the delay path and hence made small to minimize cell area and improve the write stability of the cell. Hence, speed enhancement of PMOS does not result in any reduction in cell access time and in fact it degrades the cell write ability. Hence, optimal method and amount of silicon straining for logic and memory should be different. In this paper, we propose an optimal straining solution for both logic and memory. Based on simulation results in a predictive 45nm process technology, the proposed straining solution enhances circuit performance by 15.6% in SRAM and 39.3% in Logic while satisfying stability requirements. We also propose a co-design optimization methodology that allows optimizing circuit parameters (such as transistor sizing and supply voltage) and process parameters (in this case amount of silicon straining) at the same time for both low power and high performance targets. We found that co-design of supply voltage and silicon straining is very helpful for both low power and high performance targets, whereas co-design of sizing and silicon straining dose not provide any considerable improvements. Our results show that by co-design of supply voltage and silicon straining, power reduction of 38% and 49% is achieved in SRAM and logic, respectively. We also expanded our co-design approach for joint optimization of various circuit and device parameters such as supply voltage, straining, and threshold voltage. The results show that the co-design can reduce leakage by 80% and improve performance by 50%. The dev- eloped optimization methodology thus provides a device and circuit co-design framework which is essential as the technology continues to scale to nano-scale regimes [C1678]

"Etching of poly 3C-SiC by magnetron RIE and its application to surface micromachining"

Magnetron reactive ion etching (RIE) properties of polycrystalline (poly) 3C-SiC thin films grown on thermally oxidized Si wafers by atmospheric pressure chemical vapor deposition (APCVD) were characterized in this paper. Poly 3C-SiC has been etched by CHF3, which can form a polymer as a function of side wall protective layers, O2and Ar gases. The magnetron RIE, in particular, can etch SiC at a lower ion energy than the commercial RIE system. Etch rates were obtained ranged from 20 Aring/min to 400 Aring/min according to various conditions, such as gas flow rates, chamber pressure, and RF power The etched poly 3C-SiC film was undamaged and stable at 70 W. Moreover, the best vertical structures were improved by the addition of 40 % O2and 16 % Ar with the CHF3reactive gas. Therefore, poly 3C-SiC etched by the magnetron RIE has the potential to be applied to microstructures for micro/nano electro mechanical systems (M/NEMS) applications. [C1679]

"On NBTI Degradation Process in Digital Logic Circuits"

Negative bias temperature instability (NBTI) has been identified as one of most critical and most pressing degradation issues in nano-scale technologies. Yet most current studies published in literature on NBTI degradation have been limited to either at the device physics level or at the computer architecture level. This paper provides a first in depth study of the NBTI degradation process at the logic level in digital circuits. It demonstrates that the methods used in the existing studies lead to unduly pessimistic results and therefore they must be modified. The paper also compares the effectiveness of some of the known solutions that address NBTI degradation. Several new conclusions are drawn from our study which are important and help identify new research directions that can be taken in view of the more realistic assumptions made in this paper [C1680]

"Combating NBTI Degradation via Gate Sizing"

NBTI is becoming one of the dominant circuit reliability concerns in nano-scale technologies. We believe that designers can combat NBTI degradation using appropriate circuit constraints. This paper presents a design technique to tolerate NBTI degradation by gate sizing. We provide an NBTI-aware gate sizing problem formulation and propose a solution method. The experimental results for MCNC'91 benchmark circuits show that for NBTI tolerance the purposed method results in less than 1% area increase in most cases while a formulation based on traditional performance focused methods may lead to over 4% area increase [C1681]

"Plenary Speech: Micro- and Nano-Technologies for Automotive Research"

In this talk, current and future research directions for micro- and nano-technologies applicable to the automotive sensor market will be presented. There exists an opportunity for new research to provide new micro- and nano-technologies that in the short run may not yet compete with the existing automotive sensor technologies, but in the long run are likely to surpass them. Historically, automotive sensor technology has been transitioning through three phases, from 1) early phases in which simple driver information is generated, to 2) computer-in-the-loop control systems to 3) complete driving experience mode selection. This existing technology is in phase 3, and for this phase to be successfully completed, new sensors that have higher resolution, greater bandwidth and lower cost must be developed. The new micro- and nano-technologies will provide that solution. A number of micro- and nano-sensors, currently under development, will be described and reviewed. These include 1) resonant micro strain sensors to determine the smallest deflections of even the most rigid of metal automotive parts, 2) micro sensors that show promise of measuring temperature, acceleration, pressure and strain inside the automobile engine combustion chamber, 3) nanowire and nanotube sensors made using a new, room temperature fabrication method that allows the nanowires and nanotubes to be fabricated directly on CMOS chips and 4) miniaturized, low-cost, micro RF systems to detect the presence of pedestrians in the path of the vehicle. These sensors, and others, promise to revolutionize the automotive sensor market. [C1682]

"Challenges in the Design of an Impulse Radio Based Ultra Wide Band Transceiver"

Ultra wide band (UWB) is one of the key emerging short-range wireless technology that can answer many of the problems faced by narrow band technologies. UWB offers all the advantages of spread spectrum including GHz of RF bandwidth and high data rate. UWB signals are virtually undetectable operating at noise like low power levels. UWB offers very fine range resolution and also immune to multipath fading. Conventionally UWB is defined as carrier free, impulse based radio, which communicates in time domain by only using sharp rising pulses of the order of fraction of nano seconds. In this paper challenges in the design and development of impulse radio based ultra wide band transceiver is explained. Antennas that work in time domain, UWB impulses that meet the required FCC mask on EIRP and digitizer that has to sample and process at the rate of Gigasamples per second are some of the key challenges [C1683]

"Cellular Nonlinear Network with Spin Wave Bus"

We propose and analyze a cellular nonlinear network based on semiconductor nano-structure consisting of multiple layers of two semiconductors along with an incorporated ferromagnetic layer-spin wave bus. A bi-stable elementary logic cell of the proposed CNN consisting of two resonant tunneling diodes inductively coupled with the ferromagnetic layer. The local interconnections of nano-cells are achieved via the spin waves propagating in the spin wave bus. The cells are biased by the common column contacts and only the edge cells have individual I/O ports. Using approximate tunneling characteristics and experimentally obtained data for spin wave propagation in CoFe thin film, we simulated the coupling between an individual cell and spin wave bus. The proposed CNN architecture for nano-structures possesses powerful computing potential to be beneficial for many practical applications [C1684]

"Towards Model-Checking Quantum Security Protocols"

Logics for reasoning about quantum states have been given in the literature. In this paper, we extend one such logic with temporal constructs mimicking the standard computational tree logic used to reason about classical transition systems. We investigate the model-checking problem for this temporal quantum logic and illustrate its use by reasoning about the BB84 key distribution protocol. [C1685]

"Architecture of the Secoqc Quantum Key Distribution network"

The European projet Secoqc (Secure Communication based on Quantum Cryptography) aims at developing a global network for unconditionally secure key distribution. This paper specifies the requirements and presents the principles guiding the design of this network, and relevant to its architecture and protocols. [C1686]

"Anonymous Transmission of Quantum Information"

We propose first protocol for anonymous distribution of quantum information that can be used to implement either channel with anonymous sender or channel with anonymous receiver. Our protocol achieves anonymity and message secrecy with unconditional security. It uses classical anonymous transfer. It tolerates disruption of the protocol, but the number of disrupters must be limited by the quantum Gilbert-Varshamov bound. This bound can be exceeded provided a specific entanglement distillation procedure will be used. A different version of the protocol tolerates any number of disrupters, but is secure only when receiver does not actively cooperate with other corrupted participants. A simplified version of this protocol was experimentally realized for 5 participants, but with different motivation [see Zhao et al., 2004]. [C1687]

"Quantum Entanglement, Non-Locality and Secure Computation"

In this paper, we demonstrate that nanoscale phenomenon can be applied not only in device level but also in high layer applications, such as secure computation. We study the possibility of performing secure computation by building non-local machines based on quantum entanglement and non-locality, which are phenomena available only at the nanometer scale. Comparing with classical secure computation algorithms, the security of this protocol is based on physical laws, instead of any unproven mathematic conjecture. [C1688]

"A Fast and Accurate approach for Full Chip Leakage Analysis of Nano-scale circuits considering Intra-die Correlations"

This paper presents an accurate and efficient approach for estimating the full chip leakage in the presence of intra-die variations. We use an accurate model for leakage in which the leakage is exponentially dependent on a quadratic function of the device parameters. The intra-die correlations in the device parameters are accounted by representing the parameters in terms of abstract independent random variables using Karhunen-Loeve expansion. The total circuit leakage is computed using an efficient sum operation. Our results on ISCAS89 benchmark circuits show a speed up of up to 500times compared to Monte Carlo analysis, with average percentage difference in mean and variance being less than 1.5% [C1689]

"Systems, Nano-technology and SiP"

The on-going trend towards nanoscale technologies creates enormous opportunities for integration of complex functions and features. Many challenges have to be overcome in order to exploit nanoscale technologies for mass production: particularly relevant are CMOS SoC challenges such as low power, design for manufacturability and analog design. However, in order to provide a usable electronic function, any SoC needs to be packaged or assembled in a system in package, with its own set of challenges and requirements. The authors illustrate how NXP Semiconductors is overcoming the above [C1690]

"Concurrent Optimization of Technology and Design for Nano CMOS"

As we move to 45nm and beyond, our ability to manage the need for increased integration together with the drive for higher system performance and lower power presents many challenges to technology and design. It has become no longer possible to consider technology advancement without considering the overall optimization of the transistor and circuit design for full entitlement together with the cost of the chip. This paper looks at the key challenges and technology discontinuities that we face as we move into the nano CMOS regime, and some of the approaches being developed to address them [C1691]

"Design and Analysis of Hybrid NEMS-CMOS Circuits for Ultra Low-Power Applications"

Integration of nano-electro-mechanical switches (NEMS) with CMOS technology has been proposed to exploit both near zero-leakage characteristics of NEMS devices along with high ON current of CMOS transistors. The feasibility of integration of NEMS switches into a CMOS process is illustrated by a practical process flow. Moreover, co- design of hybrid NEMS-CMOS as low power dynamic OR gates, SRAM cells, and sleep transistors is explored. Simulation results indicate that such hybrid dynamic OR gates can achieve 60-80% lower switching power and almost zero leakage power consumption with minor delay penalty. However, the hybrid gate outperforms its CMOS counterpart both in terms of delay and switching power consumption with increase in fan-in beyond 12. Additionally, it is shown that the proposed hybrid SRAM cell can achieve almost 8times lower standby leakage power consumption with only minor noise margin and latency cost. Finally, application of NEMS devices as sleep transistors results in upto three orders of magnitude lower OFF current with negligible performance degradation as compared to CMOS sleep switches. [C1692]

"CAD-based Security, Cryptography, and Digital Rights Management"

Manufacturing variability is inherent to many silicon and nano-scale technologies and can be manifested in many different ways and modalities (e.g. power and delay). We propose a flow that starts with gate-level integrated circuit (IC) characterization which results in unique identification (ID). The ID's are an integrated part of the design functionality and software and provide a basis for conceptually new CAD-based security protocols. As an examples, we present a new IC metering schemes that ensure very low overhead and digital right management in horizontally integrated IC market. Therefore, after many years of CAD importing and benefiting from many other areas such as numerical analysis, theoretical CS, VLSI design, computer architectures, and compilers, CAD has its historical chance to impact many fields of computer science and engineering through manufacturing variability-based security and right management. [C1693]

"Beyond Low-Order Statistical Response Surfaces: Latent Variable Regression for Efficient, Highly Nonlinear Fitting"

The number and magnitude of process variation sources are increasing as we scale further into the nano regime. Today's most successful response surface methods limit us to low-order forms-linear, quadratic -- to make the fitting tractable. Unfortunately, not all variational scenarios are well modeled with low-order surfaces. We show how to exploit latent variable regression ideas to support efficient extraction of arbitrarily nonlinear statistical response surfaces. An implementation of these ideas called SiLVR, applied to a range of analog and digital circuits, in technologies from 90 to 45 nm, shows significant improvements in prediction, with errors reduced by up to 2IX, with very reasonable runtime costs. [C1694]

"Characterization and Estimation of Circuit Reliability Degradation under NBTI using On-Line IDDQ Measurement"

Negative bias temperature instability (NBTI) in MOSFETs is one of the major reliability challenges in nano-scale technology. This paper presents an efficient technique to characterize and estimate the lifetime circuit reliability under NBTI degradation. Unlike conventional approaches, where a representative fMAX(maximum operating frequency) measurement from timing critical circuitry is used, we propose to utilize the standby circuit leakage IDDQas a metric to detect and characterize temporal NBTI degradation in digital circuits. Compared to the fMAXbased approach, the proposed IDDQbased technique benefits from lower test cost and improved capability of estimating reliability of complex circuitries such as ALUs and SRAM arrays. We have derived an analytical expression for circuit IDDQfrom the analytical PMOS Vtdegradation model (DeltaVtprop t1/6). The proposed model is verified with measurement data obtained from a test chip fabricated in 130 nm technology. Furthermore, we examine the possible applications of our proposed IDDQbased NBTI characterization. We show that the temporal degradation in static noise margin (SNM) of SRAM array and fMAXof random logic circuits are highly correlated to the IDDQmeasurement, and this relationship can be used to predict long term circuit reliability. [C1695]

"A Fully-Automated Desynchronization Flow for Synchronous Circuits"

Variability is one of the fundamental problems faced by nano-scale electronic circuits and is expected to become even worse as process technology scales. Desynchronization is a design methodology, which converts a synchronous gate- level circuit into a more robust asynchronous one. In this paper, we describe the first fully-automated desynchronization design flow, based only on contemporary synchronous EDA tools and a new point tool for performing the desynchronization transformation. The flow was used to implement, down to mask layout level, a simple pipelined processor in a 90 nm industrial library. We show that the desynchronization methodology can be easily integrated into contemporary industrial EDA flows. Results, on the design implemented, indicate that desynchronized circuits exhibit increased variability tolerance and better average case performance, for a small area and power overhead. [C1696]

"Modeling and Analysis of Non-Rectangular Gate for Post-Lithography Circuit Simulation"

In the nano regime it has become increasingly important to consider the impact of non-rectangular gate (NRG) shape caused due to sub-wavelength lithography. NRG dramatically increases the leakage current and requires geometry dependent transistor models for post-litho circuit simulation, hi this paper, we propose a coherent modeling approach for non-rectangular gates based on equivalent gate length (Le). A gate-voltage dependent model of Le is developed which is scalable with design conditions, continuous across weak and strong inversion regions, accurate for both leakage and saturation current, and compatible with standard circuit analysis tools. We systematically verify this approach with 65 nm TCAD simulations. A generic CAD algorithm is further proposed to predict the value of Le under various non-rectangular geometries. The interaction with the narrow-width effect is efficiently convolved in this method. Depending on the gate geometry, the leakage current can vary more than 15X at 65 nm technology node. Our analytical method well captures this effect. Finally, we extrapolate the impact of NRG effect on future technology generations. The proposed model can be easily extracted from TCAD tools or direct silicon data. It bridges the gap between lithography, simulation, and circuit analysis for measuring transistor performance under increasingly severe NRG effect. [C1697]

"Why Nano-DSP Will be Fan-In Constrained"

This paper studies for the first time the performance of von-Neumann multiplexing (vN-MUX) when stuck at fault model is considered. In this study, vN-MUX is applied to majority (MAJ) gates of small fan-ins (Г,Вї = 3, 5, 7, and 9), and respectively the corresponding redundancy factors (R = 6, 10, 14, and 18). This study is extremely important for a deeper understanding of vN-MUX, especially when considering the unreliable behavior of future nano-devices. The analysis confirms and enhances on well-known theoretical results, and is exact as being obtained using Bayesian network. Finally, the extension to device level will allow us to characterize vN-MUX with respect device failures for the first time ever. The results are very timely and are explaining a strange (non-linear) behavior of vN-MUX that was first reported two years ago (based on extensive Monte Carlo simulations). [C1698]

"Feasibility of SAB using Nano-adhesion Layer for Low Temperature GaN Wafer Bonding"

GaN wafer bonding has been developed using conventional fusion techniques at high temperature. However, the future integration of complex 3D or photonic devices, a low temperature bonding technique, should be developed. Using the surface activated bonding (SAB) method, we demonstrated that surface activation by Ar fast atom beam irradiation is effective for room temperature bonding of GaN to Al, Si, and GaN. Because Ar atom irradiation of the GaN surface induces a modified layer revealing a Ga-Ga bond over an approximately 0.6 nm thickness, and an exposure of the surface to residual gases longer than 1.7xl0-4Pa s leads to re-oxidation of the activated surface which results in a drastic decrease of the bond strength, it is concluded that a nano-layer enriched by Ga on the GaN surface may contribute to the formation of direct GaN wafer bonding at room temperature. [C1699]

"Overview of Metal Lifted Failure Modes During Fine-Pitch Wirebonding Low K/Copper Dies with Bond Over Active (BOA) Circuitry Design"

The size of IC device has been reduced resulting from the reduction of both transistor gate length and bond pad pitch. Since 180 nm node, wafer fab technology has decreased the gate length more aggressively than the assembly site does with bond pad pitch. Both bond over active (BOA) and fine pitch wirebonding have been implemented simultaneously in order to minimize the white space area in the die. Combination of BOA, fine pitch wire bonding and low k/copper technology have thus become a new development scope for wire bonding technology development works. Several failure modes have been observed while utilizing this new technology combo. The Aluminum Cap Lift yield loss during the wirebond process was reported. The delaminated interface is Ta and copper at the aluminum cap bonding pad region. The Copper Metal Lift failure was also observed for FSG (fluorine-doped silicon glass) -Copper wafer technology. Copper Metal Lift failure is defined as the delaminated interface found between FSG and the barrier layer (e.g. Ta). The delamination interfaces for both Aluminum Cap Lift and Copper Metal Lift failures have been determined with several failure analysis techniques. Some of these techniques are standard FA tools such as TEM (Transmission Electron Microscope) and Auger depth profiling, and some are more special, e.g. nano-indentation. Root cause for each failure mode and its corresponding corrective actions will both be disclosed in this paper. Moreover, the Tilted Metal Lift failure was also observed during wire pull test as ball bond diameter reduced for fine pitch wirebonding. Its root cause will be disclosed too. [C1700]

"Silicon, Low-K Dielectric, and Nano-Scale Metal Interface Characterization Using Stress-Engineered Superlayer Test Methods"

Thin film layers are utilized in emerging microelectronics, optoelectronics, and MEMS devices. Typically these thin film layers are composed of different materials with dissimilar properties. A common mode of failure for thin films is delamination caused by external loading or intrinsic stress present in the materials. To characterize bonded thin film material systems, it is necessary to measure the interfacial fracture toughness. When material thicknesses approach micro and nano scales, interfacial fracture toughness measurement is a challenging task. Accordingly, innovative test techniques need to be developed to study interfacial fracture parameters. The ongoing research at Georgia Institute of Technology is developing fixtureless delamination test techniques that can be used to measure interfacial properties of nano-and micro-scale thin films. The modified decohesion test (MDT) and the single-strip decohesion test (SSDT) are such fixtureless tests under development. In these tests a thin film interface material of interest is deposited on a substrate and delamination is driven by a superlayer material with high intrinsic stress sputter-deposited on-top of the interface material. A deposited release layer material allows for the contact area between the interface material and the substrate to be controlled. These tests differ in geometry but share the same generic methodology and can be used for a number of material systems over a wide range of mode mixity. This paper presents the methodology and implementation of the MDT and SSDT tests and compares results to better understand their scope. A case study of the interfacial fracture toughness as a function of mode mixity for titanium and silicon interface was performed to determine which test should be used for low-k dielectric (Black DiamondTM) and tantalum. Lastly, ongoing research on low-k and tantalum interface is discussed. [C1701]

"Characterization of Nano-grained High Aspect Ratio Through-wafer Copper Interconnect Column"

Through-wafer interconnect is one of the key technologies for fabricating next-generation compact 3D microelectronic devices. The microstructure and mechanical properties of high aspect ratio through-wafer electroplated copper interconnects are reported in this paper. Copper was deposited in very high aspect ratio (~15) and narrow DRIE etched through-vias (15 mum) in silicon substrate by electrodeposition. With the presence of nano-scale grains and higher density of nano-twins, the copper columns were found to have significant higher hardness and tensile strength than that of conventional coarse-grained copper, while retaining an electrical conductivity comparable to that of pure copper. The grain structure of electroplated copper was found out by atomic force microscope and transmission electron microscope. The induced strain, a result of mismatch in coefficient of thermal expansion, was studied by digital image speckle correlation analysis, when the copper interconnects were subjected to a temperature cycle from 25degC to 125degC. [C1702]

"Perspective of the Future Semiconductor Industry: Challenges and Solutions"

The semiconductor industry currently faces serious challenges and changes on both the business and technology fronts. The business environment is becoming more difficult. The huge investment required for new fabrication facilities is forcing many IDMs (Integrated Device Manufacturers) to change their business model to either fablite or fabless. The significant costs to develop the next generation process technologies are necessitating joint development between various companies. Furthermore, due to severe competition in the mobile and digital consumer markets, low chip prices and short time-to-market are both essential for survival. To satisfy these market requirements, heavy R&D expenses and resources are needed. However, its return on investment is becoming marginal and even uncertain. To overcome this difficult situation, the industry is experiencing consolidation of once proudly independent companies. On the technical side, controlling chip yield, power consumption and design complexity have become extremely difficult in the nano-technology era. This talk will present a perspective on how the semiconductor industry must respond to these challenges by developing new markets, new products, and new technologies. The solutions will come from (i) collaborations with key customers for new markets and products, as well as, with key partners for new technologies, and (ii) technology breakthroughs with innovative ideas, such as 3-D package, fusion technologies (OneDRAM, OneNAND), variation-tolerant designs, and low leakage devices. These approaches can lead to lower chip costs and relieve physical uncertainty problems. [C1703]

"Enhanced Adsorption of Glucose Oxidase by Introducing Artificial Porosity into Polypyrrole Based Glucose Biosensors"

A polypyrrole (PPy) based biosensor fabricated on a Pt plated nano-porous alumina electrode has been described. By selecting nano-porous electrodes, the enzyme adsorption has been increased and the usage of a cross linking agent has enhanced the performances of the sensor remarkably. A thin film of PPy/PF6-was synthesized with 0.05 M Pyrrole, 0.1 M NaPF6at a current density of 0.3 mA/cm2for 90 s. The immobilization was done by physically adsorbing 5 muL of glucose oxidase (GOx) on PPy thin film. Glutaraldehyde (0.1 wt.%, 5 muL)was used for cross-linking. The synthesized films were characterized by using amperometric electrochemical technique and scanning electron microscopy (SEM). Amperometric responses were measured as a function of different concentrations of glucose. Nanoporous electrodes lead to high enzyme loading. Stability, sensitivity, reproducibility and repeatability have been increased with the usage of cross-linking. [C1704]

"1-V Linear CMOS Transconductor with -65 dB THD in Nano-Scale CMOS Technology"

This paper presents a high linearity MOSFET-only transconductor based on differential structures. The linearity is improved by mobility compensation techniques as the device size is scaled down in the nano-scale CMOS technology. Transconductance tuning could be achieved by transistors operating in the linear region. The simulated total harmonic distortion (THD) under 1-V power supply voltage shows 12 dB improvement of the proposed version, and -65 dB THD can be achieved for a 1 MHz 700 mVppdifferential input. Monte-Carlo simulation over the corner variation and transistor mismatch guarantees the shown performance. The static power consumption is 130 muW. Simulation results demonstrate the agreement with theoretical analyses. [C1705]

"Chemical Mechanical Nano-grinding of GMR Magnetic Recording Heads for Hard Disk"

To avoid eroding and electro static damaging of GMR stack, mechanical nano-grinding is a traditionary way to obtain a sub-nanometer smooth magnetic recording head surface. The material of the substrate of the recording head is AlTiC, but the materials of the pole tip is consists of metal and alloy. Because the pole tip material is softer than the substrate material, it is difficult to avoid the pole tip recession (PTR) from the substrate by traditionary way. In this way, the PTR can be controlled under ten nanometers. But, as the increasingly development of the storage technology, areal density is increased swiftly, a new polishing way must be find to minimize PTR to reduce magnetic space loss. Chemical mechanical nano-grinding experiment was carried out with a float-piece polisher with tin plate to achieve more planar and smooth surface. Ethylene glycol with 6% colloidal silica (30% SiO2of 10 nm particle size) was used as basal solution. The pH of the solution was adjusted to a range of 9-10 by adding organic alkali. Reactive solution was added to help remove substrate materials. Non-ionic surfactant has long C-H chain and viscosity solution was used to protect metal and form boundary lubrication. Other addition agents such as corrosion inhibitor, complex chelating agent, etc. were used to avoid metals eroding. An appropriate conductivity was ensured to avoid GMR corrosion and ESD damage. Scanning electron microscope (SEM), atomic force microscope (AFM) and X-ray photoelectron spectroscopy (XPS) instrument were used to measure the head's surface. The images of pole tip and the GMR stack were clear, neither erosion nor ESD damage were found. Zero PTR can be achieved; the pole tip not only didn't recess but even protrude from the substrate. Yet, TiC phase protrude from the substrate surface to some extent because that TiC is inert than A12O3. Another experiment was carried out to enhance the mechanical reaction to eliminate the TiC- protrusion. Grain size of 125 nm monocrystalline, 250 nm monocrystalline and grain size of 80 nm polycrystalline was used in chemical mechanical nanogrinding with the same basal slurry. The rotate speed of the plate is 25 r/min and the cycle is 30 min. The result showed that the largest PTR and the smallest TiC protrusion was obtained with grain size of 250 nm monocrystalline diamond, while the smallest PTR and the largest TiC protrusion was obtained with 80 nm polycrystalline diamond. Then 250 nm monocrystalline was used in the first nanogrinding procedure and 80 nm polycrystalline was used in the last nanogrinding procedure, in this way, a smooth substrate surface and a planar recording surface was achieved. The roughness Rms of the substrate is 0.59 nm and the PTR is 0.7 nm measured with AFM. So, chemical mechanical nanogrinding may be viable for GMR magnetic recording head polishing in industry, nearly zero PTR and sub-nanometer surface can be achieved by adjusting the chemical and mechanical interactions. [C1706]

"Nanotechnologies and Nanomaterials for Thermal Management of Microsystems"

Summary form only given. One important function of microsystem packaging is to remove the heat generated by the integrated circuits (ICs). The thermal management of microsystems has now become more crucial as the power density of ICs increases dramatically. To remove the big amount of heat is a big challenge for the packaging technology. An attractive solution is to utilize new developed nanotechnologies and nanomaterials to enhance the heat removal from microsystems. This paper generally reviews the related research work performed at SMIT center. Three approaches are presented: thermal interface materials (TIMs) made of electrospun nanofibers and nano thermally conductive particles, microchannel coolers based on carbon nanotubes (CNTs), and CNT-based high thermally conductive interconnects. These three techniques provide a systematic solution to the efficient thermal management of microsystems. [C1707]

"Ink-jet Printing of Nano Materials and Processes for Electronics Applications"

Ag metallic particles from nano-scale to submicron-scale are combined with organic solvent to provide fine circuits and interconnection. Ag nanoparticle pastes have been successfully adopted to ink-jet wiring and the multilayered circuit layers in a SiP structure. Ink-jet printing with Ag nano particle pastes demonstrated the potentials of the new printed electronics technology. Lowering process temperature for Ag nanoparticle pastes finally reached room temperature wiring in air atmosphere. [C1708]

"Investigation of Dielectric Strength of Electrospun Nanofiber Based Thermal Interface Material"

Electrospinning is a historical technology which has existed for over seventy years. Recently, it has been introduced to make a novel electrospun nanofiber based thermal interface material (nano-TIM). Until now, there are few articles on the dielectric properties of nanofiber. Since the electrical insulation property is an important parameter for thermal interface materials, we investigated the dielectric strength of electrospun nano-TIM in this paper. The experiment data have shown that the nano-TIM materials have dielectric strength of 5.82 kV/mm, which is believed to be adequate for microelectronics applications. Further analysis and FEM simulation further revealed the breakdown mechanism. Reasons for the low dielectric strength as compared with that of bulk polymer were also discussed in this paper. [C1709]

"Motion Equations and Model of High Temperature Superconductor (HTS) Momentum Wheel Proposed for attitude control of Micro/Nano Satellites"

Recently, the satellite research is more focused towards the development of micro and nano satellites. The reason behind this is that the development and launching of micro and nano satellites have less risk and less cost involved. This paper is about the attitude control of micro/nano satellites which are relatively smaller in size and weight if compared to the conventional satellites. The barriers, for the attitude control of these satellites, are the less mass and the less power budget. Hence, the normal attitude sensors and actuators cannot be used.

The attitude control system of the micro and nano satellites relies on a novel technology known as Micro Electro-Mechanical Systems (MEMS) technology. In this paper, use of high temperature superconductor (HTS) magnet momentum wheel has been proposed for the attitude control system of micro and nano satellites and the design, working principles and the mathematical model of the HTS momentum wheel are elaborated. In the end the mathematical model of the HTS momentum wheel has been analyzed on the basis of simulation results. [C1710]

"Nano Layers in the Bismuth Telluride Semiconductive Alloys that are Used in Nano Satellites"

The level-to-level and island growth of nano-layers: copper, nickel and boron realizes spontaneously between the layers Te1-Te1in the process of the directed crystallization of bismuth telluride (doped by easily diffusing impurities). This was proved by the electron-microscopic photos of the chipped surface (0001) Bi2Te3<B>, Bi2Te3<Cu> and Bi2Te3<Ni>. The wide set of island sizes 50-200 nm was revealed. The appearance nature of nano-layers, islands and their enlargement in the interlaminar space of the layered crystal of bismuth telluride is the same as on the open surfaces of the systems semiconductor-metal. The two-dimensional islands, which combining form the wetting layer of nano-thickness appear on the initial steps of the growth. It is established, that the copper layers, nano-sized by the height, are charged with extremal behavior of Hall thermoelectromotive force and other kinetic parameters Bi2Te3<Cu>. The temperature dependencies of coefficients of Hall, electroconductivity, mobility and other kinetic parameters revealed the oscillation character. These extremums can be connected with the consecution of the phase transfers, known as order-disorder transfers, connected with positional order. The anomal increase of the mobility of the charge carriers (more, than in 5 times) in the direction along axes of the (0001) Bi2Te3<Cu> layers at the temperature 105K is observed so it will be a great improvement that can be used in nano satellites. [C1711]

"Oxidation Process and Different Crystallographic Plane Orientation Dependence Simulation in Micro and Nano Scale Structures"

Thermal oxidation is one of various methods used for neighboring element isolation. Problems of thermal oxidation, related with LOCOS, PBL and SWAMI technologies was researched. The main purpose of this paper is to present stress, which appears during thermal oxidation in micro and nano scales levels in mentioned above technologies. Also relationship between thermal oxidation and crystallographic planes orientation are analyzed, because growing oxide rate is different on surface and edges with the same crystallographic planes orientation. Thermal oxidation process is simulated with ATHENA and the deal-grove model is used for the oxide growth kinetics. [C1712]

"Properties of Carbon Nanotube Antenna"

Carbon nanotube as microwave antennae have expansive prospect of application, such as: nano-interconnect technology, fiber communication, aviation communication, because of the small size, light weight and good electronic properties. In this paper, we discuss some of the properties of carbon nanotube antennae, e.g., current distribution on the single antenna, re-radiation lobe pattern of single antenna, is shown. [C1713]

"Selective Formation of High Density InAs Quantum Dot Arrays Using Templates Fabricated by the Nano-Jet Probe"

We have demonstrated the selective area growth of high density InAs quantum dots (QDs) in the square regions by using site-controlled InAs dots that were formed in the desired regions as templates. These fabricated InAs dots for the templates were enabled by the use of a specially designed atomic-force-microscope (AFM) cantilever, referred to as the Nano-Jet Probe (NJP). Using the NJP, two-dimensional (2D) arrays of ordered In nano-dots were fabricated in the desired square regions on a GaAs substrate. These In nano-dots were directly converted to InAs QD arrays by subsequent annealing with irradiation of arsenic flux. By using the converted QD arrays as strain templates, self-organized InAs QDs with high density were formed in the selected square regions. [C1714]

"Epitaxial Lateral Overgrowth of InP in Micro Line and Submicro Mesh Openings"

Towards achieving a large area of InP on silicon, a study of ELOG of InP on InP has been undertaken on lines with different orientations and with openings that are 100 mum long and 10 mum wide. This knowledge has been transposed on sub-micro mesh structures. By this method we have obtained 2 mum thick InP on a mesh patterned InP. The layer exhibits room temperature photoluminescence (PL) with a full width half maximum of 24 nm. We propose that this intensity can be increased if nano-sized openings are used. [C1715]

"Low power FPGA design using hybrid CMOS-NEMS approach"

Higher integration density of nanoscale CMOS causes two major design challenges in SRAM-based Field Programmable Gate Array (FPGA) designs: large power dissipation (contributed by both leakage and dynamic power) and reduced reliability of operation. In this paper, we propose a hybrid design approach for SRAM-based FPGA that can leverage on non-volatile carbon nanotube based nano electro-mechanical systems (NEMS) switches for low static and dynamic power. Simulations show that the proposed CMOS-NEMS lookup table (LUT) based circuits can achieve a reduction of up to 91% in total power at iso-performance, compared to the conventional CMOS-based LUT circuits. [C1716]

"Innovative design of nano-vacuum triode"

An innovative procedure for the realization and the assembly of vacuum triode based on carbon nanotube cold cathode is proposed. The aim of the proposed technique is to avoid the typical problem due to the growth of carbon nanotube in the triode structure. The obtained electrical properties of the realized triode fully confirm the validity of the technique. [C1717]

"Predictive Simulations and Optimization of Advanced Ultra-Shallow Junction formation for Nano-CMOS devices"

In this paper, modeling and predictive simulations of advanced junction formation for CMOS devices based on atomistic kinetic Monte Carlo (kMC) process simulator are presented. First, we will briefly discuss the different challenges and alternatives for the formation of advanced ultra-shallow junctions for the forthcoming generation of CMOS devices. We will present the physical atomistic modeling used in term of damage evolution, dopant diffusion and clustering, interaction with interfaces and the impact of impurities, which are crucial for accurate simulations. Subsequently, comparisons with a wide range of SIMS, sheet resistance measurement as well as electrical device characteristics showed that experimental results were remarkably well reproduced by the simulations. Finally, we shall demonstrate that device optimization can be achieved based on kMC process simulations, even for novel co- implant processes. This paves the way for the use of kMC in the design of devices and the optimization of junction formation to improve device performance. [C1718]

"2007 Spanish Conference on Electron Devices"

The following topics are dealt with: electron devices; materials, technology and process simulation; modeling and devices simulation; characterization and reliability; sensors, actuators and MEMS; photovoltaic and optoelectronic devices and displays; micro and nano-devices; RF microwave and power devices. [C1719]

"Nano-Scale Conductive Films with Low Temperature Sintering for High Performance Fine Pitch Interconnect"

In this paper, a novel nano-scale conductive film which combines the advantages of both traditional anisotropic conductive adhesives/films (ACAs/ACFs) and nonconductive adhesives/films (NCAs/NCFs) is introduced and developed for next generation high performance ultra-fine pitch packaging applications. This novel interconnect film possesses the properties of electrical conduction along the z-direction with relatively low bonding pressure (ACF-like) and the ultra-fine pitch (< 100 nm) capability (NCF-like). Unlike typical ACF which requires 1-5 vol% of conductive fillers, the novel nano-scale conductive film only needs less than 0.1 vol% conductive fillers to achieve good electrical conductance in the z direction. The nano-scale conductive film also allows a lower bonding pressure than NCF to achieve a much lower joint resistance (over two orders of magnitude lower than typical ACF joints) and higher current carrying capability. With low temperature sintering of nano-silver fillers, the joint resistance of the nano-scale conductive film could be as low as 10-5Ohm, even lower than the NCF and lead-free solder joints. The insertion loss of nano-scale joints are almost the same as the standard ACF or NCF joints, suggesting that the nano-ACF joints are suitable for reliable high frequency adhesive joints in microelectronics packaging. The reliability of the nano-scale conductive film after high temperature and humidity test (85degC/85%RH) was also improved compared to the NCF joints. In order to reduce the silver migration and maintain a good insulation/dielectric property in the x-y plane for the nano-scale conductive film, self-assembled molecular wires (SAM) are used to passivate/protect the silver nano fillers. The protection of silver nano particles with molecular monolayers reduced the silver migration dramatically and no migration was observed upon application of high voltages (up to 500 V) due to the formation of surface chelating compounds between- the SAM and nano silver fillers. The migration behavior of SAM passivated nano-Ag conductive adhesives was investigated by analyzing the results with the migration model. [C1720]

"Integrating Nano-logic into an Undergraduate Logic Design Course"

The goal of this work is to motivate our students and enhance their ability to address newer logic blocks namely majority gates in the existing framework. We use a K-map based methodology to introduce a few novel nano-logic design concepts for the undergraduate logic design class. We want them to possess knowledge about a few fundamental abstracted logical behaviors of future nano-devices and their functionality which in turn would motivate them to further investigate these non-CMOS emerging devices, logics and architectures. This would augment critical thinking of the students where they apply the learnt knowledge to a novel/unfamiliar situation. We intend to augment the existing standard EE and CS courses by inserting K-map based knowledge modules on nano-logic structure for stimulating their interest without significant diversion from the course framework. Experiments with our students show that all the students were able to grasp the basic concept of majority logic synthesis and almost 63% of them had a deeper understanding of the synthesis algorithm demonstrated to them. [C1721]

"Failure Analysis of an Anomalous Subthreshold Current in Nano-Scale NAND Flash Memory"

As the design rule of NAND-type memory decreases down to sub 100 nm tech regime, one of important problems is the control of the parasitic transistor phenomenon. The parasitic transistor which causes subthreshold kink at high substrate bias is a common phenomenon for STI (shallow trench isolation) technology, especially for isolation whose pitch needs to be shrunk. To resolve the degradation of device performance by the subthreshold hump, many process solution has been reported (Park, 2000). Furthermore, in the fabrication of nano-scale silicon device, accurate 2D failure analysis is one of the important fields to be solved. In this paper, we present the numerical simulation study of STI implant process factor to suppress anomalous hump effect and investigate feasibility of the application of scanning capacitance microscopy (SCM) and chemical staining method in 2D failure analysis of 70nm NAND flash device [C1722]

"Estimation of NBTI Degradation using IDDQ Measurement"

Negative bias temperature instability (NBTI) has emerged as a major reliability degradation factor in nano-scale CMOS technology. In this paper, we analyze the impact of NBTI degradation in both the maximum operating frequency (fMAX) and the total standby leakage current (IDDQ) of digital CMOS circuits. Our analysis shows that due to NBTI, both fMAXand IDDQreduce with time with a fix exponent of 1/6 (~t1/6). Based on this analysis, we develop temporal fMAX-IDDQmodel and apply it to several ISCAS'85 benchmark circuits designed using BPTM 70nm file. Results show that fMAXand IDDQcan reduce by more than 8% and 30% in 3 years operation time, respectively. Furthermore, we show that fMAXand IDDQdegradations are highly correlated throughout the operating lifetime, and using this fact, one can avoid expensive fMAXtesting and predict fMAXdegradations as a function of IDDQmeasures. [C1723]

"International Master Degere in Micro and NanoTechnology for Integrated Systems"

In this paper we present the new joint Master Degree in micro and nano technology for integrated systems (Master Nanotech) between the Grenoble Institute of Technology (INPGrenoble, France), the Politecnico di Turino (Italy) and the Ecole polytechnique de Lausanne (EPFL, Switzerland). The success of this new program relies both on its very specific syllabus and its international nature. [C1724]

"Vacuum fluorescent displays using field emission technology"

Display Technology in recent years is undergoing major revolutions. Display devices using Field Emission technology is slowly gaining momentum. The basic physics in this process is governed by the Fowler Nordheim equation. However in this particular approach the emitter has a dimension which is many orders of magnitude larger than the de-Broglie wavelength of the emitted particles. On the other hand if the size of the emitters can be reduced to nanometer scale or even lesser, the intensity of the electric field at the tip of the emitters can be increased. Keeping this particular point in view we discuss in this article, Field Emission Display (FED) devices using Carbon Nano Tubes (CNT). One should note that this reduction in dimension of the emitters introduce new finite size effects to the emission mechanism. In this paper we investigate some of these aspects including the density and finite size correction. [C1725]

"VLSI beyond CMOS Devices: Nano, single electron and spintronic devices"

The structural complexity of VLSI chip has been increasing at an exponential rate over the last thirty years. The phenomenal growth rate sustained primarily by the constant advances in manufacturing technology, as well as by the increasing need for integrating more complex functions on chip. Answering the needs of rapidly rising chip complexity has created significant challenges and aided the development of many areas, e.g. development of computer aided design (CAD) tools, chip design, fabrication, packaging, testing and reliability qualification. The main objective, however, remains device miniaturization. Device miniaturization results in reduced unit cost per function and in improved performance. As a result, the cost per bit of memory chips has almost halved every two years for successive generation of random access memories. Cost of logic ICs also have gone down. As device dimension decreases, the intrinsic switching time in MOSFETs deceases linearly, since the intrinsic delay is given approximately by the channel length divided by the carrier velocity. The device speed has improved by four orders of magnitude since 1960s. [C1726]

""VLSI beyond CMOS devices: Nano, single electron and spintronic devices""

• Due to the size limitation even with scaling down of the MOSFET technology cannot continue forever.. It will hardly go beyond a few nm, even if adequate lithographical technology will be available. As a consequence, the search for the new principles of operation of the small-size devices is becoming more and more important. • They possess radically different properties from those of bulk semiconductors. • This change in the effective dimensionality offers fascinating changes in electric, magnetic, optical and vibrational properties. • The electron mobility is high in those devices • Researches on the (nanodevices) quantum devices continue to be both challenging and exciting as novel structures with different material having different properties are developed. • They are useful for millimeter and sub millimeter wave applications • They have potential advantages that make them attractive for nonlinear functions • It is possible to realize high-frequency, low-power consuming and low-dimensional devices. • Application of soft computing tool can help in the optimization of system parameter of the quantum (nanodevice) devices to get devices of desired characteristics. • On -line optimization during fabrication But quantum devices have inherent limitations • material and process related limitation. • power limitation • wiring limitation • quantum mechanical limitation and • system architecture limitation • The most likely candidate for future ultra-dense digital circuits. • A single electron is sufficient to store information. • The power consumption is drastically reduced. • Ultimate form of the electron device. • The speed power product is predicted to lie close to the quantum limit. • The processing speed of such device will be nearly equal to electronic speed. • The exquisite sensitivity is a--bout five orders of magnitude higher. • The integration density is higher than that present in VLSI / ULSI level. [C1727]

"Session Abstract"

All nanoscale technologies that are being proposed to replace CMOS, including nano-CMOS itself, will be unreliable: great parameter variations and high defect rates should be anticipated. Timing will be difficult to control and predict. Noise will be important. Soft errors will appear even at ground level. In many cases, like molecular nano-electronics, nanowires will be short, precluding the implementation of a global clocking network directly in nano. Consequently, asynchronous (clockless) logic seems an ideal, and probably unavoidable choice, for the design of digital circuits in nanotechnology. In this talk, I will report on a preliminary investigation in implementing asynchronous QDI logic in molecular nano-electronics, taking into account the restricted geometry, the lack of control on transistor strengths, the high timing variations. I will show how the main building blocks of QDI logic can be successfully implemented in a somewhat idealized molecular nanotechnology; I will illustrate the approach with the layout of an adder stage. Simulations will be used to demonstrate the remarkable robustness of those circuits in the presence of parameter variations and noise. Most results apply to nano-CMOS as well. [C1728]

"On the Design of a Photonic Network-on-Chip"

Recent remarkable advances in nanoscale silicon-photonic integrated circuitry specifically compatible with CMOS fabrication have generated new opportunities for leveraging the unique capabilities of optical technologies in the on-chip communications infrastructure. Based on these nano-photonic building blocks, we consider a photonic network-on-chip architecture designed to exploit the enormous transmission bandwidths, low latencies, and low power dissipation enabled by data exchange in the optical domain. The novel architectural approach employs a broadband photonic circuit-switched network driven in a distributed fashion by an electronic overlay control network which is also used for independent exchange of short messages. We address the critical network design issues for insertion in chip multiprocessors (CMP) applications, including topology, routing algorithms, path-setup and tear-down procedures, and deadlock avoidance. Simulations show that this class of photonic networks-on-chip offers a significant leap in the performance for CMP intrachip communication systems delivering low-latencies and ultra-high throughputs per core while consuming minimal power [C1729]

"Fatigue Strength and Damage Behaviors of Multi-Scale Metallic Films and Multilayers"

An understanding of fatigue reliability of thin metal films and multilayers with layer thickness ranging from micrometers to nanometers is becoming more and more important not only due to the rapid development of micro and nano technology, but also because of the demends of the fundamental research interests in small scale materials. In this paper, we will firstly present a couple of new testing methods for fatigue of metallic mutlilayers. Then, the current state in studies on fatigue strength and damage behaviors of thin metal films and multilayers are reviewed. Fatigue strength of the thin metal films investigated previously and that of the Cu-X multilayers measured by us recently were presented. Microscopic characterization of fatigue crack initiation in the thin metal films and the multilayers shows that there exists a significant variation in fatigue damage behaviors with decreasing layer thickness. The relationship between fatigue properties and microstructures of the materials, especially effects of length scale is discussed. The possible research directons about fatigue of metallic multilayers are suggested. [C1730]

"Thermopower Profiling Across a Silicon P-N Junction Through the 2ω Signal Measurement of AC Current-Heated Tip-Sample Nano-Contact"

Thermopower profiling with nanometer resolution has important applications in the development of nano-structured high ZT thermoelectric materials and in dopant density profiling of nanoelectronic devices. The authors suggested a new AC type thermopower measurement technique and demonstrated it with a simple experimental setup. Thermopower distribution across a silicon p-n junction was measured point-by-point at every 10 nm free from the noises due to built-in potential and photo-ionization effect and compared with theoretical result. Although this new AC type thermopower measurement technique could not follow the sharp variation of the theoretical thermopower near the p-n junction, it could identify a smooth peak of thermopower distribution in the depletion layer of the p-n junction [C1731]

"Using Formal Methods and Agent-Oriented Software Engineering for Modeling NASA Swarm-Based Systems"

NASA is conducting research on advanced technologies for future exploration using intelligent swarms of robotic vehicles. One of these missions is the Autonomous Nano Technology Swarm (ANTS) mission that will explore the asteroid belt using 1,000 cooperative autonomous spacecraft. From an engineering point of view, the complexity and emergent behavior of this kind of system is one of the main challenges that has to be overcome, since it makes the behavior of the swarm unpredictable. In NASA, many approaches are being explored towards this goal, mainly, a tailored software engineering approach, called agent-oriented software engineering, and formal methods. In this paper, we report on the main advances we have made towards modeling, implementing, and testing NASA swarms-based concept missions [C1732]

"Modeling for NASA Autonomous Nano-Technology Swarm Missions and Model-Driven Autonomic Computing"

NASA ANTS autonomous nano-technology swarm missions will be operating in the universe, and therefore rely much on high autonomy. This paper presents a novel technology for NASA's ANTS missions, named as model-driven autonomic computing. As the foundation for the technology, a new model is constructed for the ANTS system. Exceeding other existent models, the new hierarchical model overcomes the challenges of largeness, complexity, dynamicity and unexpectedness possessed by the ANTS system. Then, the paper exhibits the structure and functions of virtual neuron that is basic unit together with the model for the model-driven autonomic technology in ANTS missions. The paper also deploys self-configuration, self-healing, self-optimization and self-protection for ANTS. A case study, examples and simulations are illustrated. [C1733]

"Computational Intelligence Based Intelligence Control for Stepping Motors and a Mobile Robot is "Mascot Robot" Project"

Intelligent control for 5 phase stepping motors is presented based on computational intelligence technology. It enables to divide each revolution/rotation into 5 million equiangular positions by keeping normal speed, torque, low vibration, small heat loss, and low electric power consumption. The products are now being released in the real market. The outline of the algorithm is mentioned with several experimental results by using DVD demonstration. The stepping motors are used in a part of the on going "Mascot Robot" project included in "Development Project for a Common Basis of Next-Generation Robots" sponsored by NEDO (New Energy and industrial technology Development Organization, Japan), i.e., the nano drive controlled stepping motors are used to develop a mobile part. Its design-concept is also introduced by using DVD video images. [C1734]

"Manufacturing and Characterization of Nano Silver Particles Based Thermal Interface Material"

Today's technology is tuned towards faster, smaller and better efficiency. This trend has resulted in tremendous heat being generated in microelectronics components and if not properly managed, it can result in failure of microelectronics components. A critical issue is the removal of this heat generated. We report here a new type of nano thermal interface material (Nano-TIM) using the electrospinning process with nano silver particle as thermal enhancement filler. With the electrospinning process, polymer nanofibers are formed in nano scale in diameters.

The morphology of the nanofibers is of optimum importance and scanning electron microscopy (SEM) was used to analyze it. The characterization of the nanofibers was carried out using thermo-gravimetric analyzers (TGA) and differential scanning calorimeter (DSC) to determining the degradation and melting temperature of the nanofibers. The mechanical property was analyzed using an Instron micro-functional mechanical tester. The work shows that nano-TIM with nano silver particles has significant potentials to replace conventional thermal pad materials. [C1735]

"Printable Nanocomposites for Advanced Organic Packaging"

This paper examines the use of nanocomposites or materials in the area of printing technology. A variety of printable nanomaterials for advanced organic packaging have been developed. This includes nano capacitors and resistors as embedded passives, nano magnetic materials, multifunctional materials, etc. Nanocomposites can provide high capacitance densities, ranging from 5 nf/inch2to 25 nF/inch2, depending on composition, particle size and film thickness. The electrical properties of capacitors fabricated from BaTiO3-epoxy nanocomposites showed a stable capacitance and low loss over a temperature range from 25degC to 100degC. A variety of printable discrete resistors with different sheet resistances, ranging from 1 ohm to 120 Mohm, processed on large panels (19.5 inches times 24 inches) have been fabricated. Low resistivity nanocomposites, with volume resistivity in the range of 10-4ohm-cm to 10-6ohm-cm depending on composition, particle size, and loading can be used as conductive joints for high frequency and high density interconnect applications. Thermosetting polymers modified with ceramics can produce low k dielectrics with k value in the range between 5.41 and 3.59. Similarly, low loss dielectric materials can be produced form mixing epoxy with silica or other low loss fillers. Reliability of the nanocomposites was ascertained by IR-reflow, thermal cycling, pressure cooker test (PCT), and solder shock. Change in capacitance after 3X IR-reflow and after 1000 cycles of deep thermal cycling (DTC) between -55degC and 125degC was within 5%. Most of the nanocomposites in the test vehicle were stable after IR-reflow, PCT, and solder shock. [C1736]

"Performance of Silver Nano Particles as an Electronics Packaging Interconnects Material"

Silver nano particle materials are investigated for use in microelectronics packaging as an innovative lead-free interconnect material. The nano particle materials were evaluated in terms of mechanical, electrical, metallurgical, and reliability performance. The silver nano particles are around 8 nm in diameter and are sintered at a temperature of 230 C to form material nearly indistinguishable from the bulk metal. Sintering behaviors are examined to see how the nano particles form grains with different sintering process conditions; resistivity is measured to estimate the electrical performance of the sintered nano particles; adhesion tests are conducted for measuring the adhesion strength of the processed silver nano particle materials with other packaging materials; leakage current measurement is performed to see the silver electro-migration effect; frequency response is measured for RF applications, and thermal shock tests are conducted to evaluate the electronics packages of electronics packages using the silver nano particle interconnect materials. [C1737]

"Crystallographic Features of Copper Column Growth by Reversible Pulse Current Electrodeposition"

Interconnection with single crystal could be attractive for more reliable, predictable and multifunctional electronics assembly at micro-to nano-scale, if each crystal joint has the same crystal structure and orientation. To achieve single crystal copper column growth, electrodeposition has been carried out with the assistance of reversible pulse plating techniques. Initial experiments to understand how plating process will influence the crystal growth provided a guidance for electrodeposition of single crystal copper columns. It has been found that reversible pulse current in large degree changed the morphology of electrodeposited copper compared to the direct current electrodeposition. Pulse parameter such as peak current density and frequency also affected the crystal growth and morphology of copper column formation. It has appeared that achieving single crystal growth by pulse plating alone is found to be less successful. Therefore, the challenges still exist to achieve single crystal copper column formation by electrodeposition. The possible future approaches may consider the related techniques including substrate treatment prior to deposition and ultrasonic agitation during deposition would be beneficial to eliminate the sites of nucleation. [C1738]

"Characterization and Reliability Verification of Wafer-Level Hermetic Package with Nano-Liter Cavity for RF-MEMS Applications"

Wafer-level packaging (WLP) is a very promising candidate for RF-MEMS packaging, especially in the mobile applications, due to the lower cost and higher volume throughput relative to the component level packaging. However, the long-term reliability of WLP is still one of the critical concerns for the commercialization of RF-MEMS devices. In this paper, a wafer-level hermetic packaging scheme based on through-wafer interconnects and wafer-to-wafer bonding will be reviewed in terms of their construction, fabrication process, and electrical/mechanical performance. The film bulk acoustic resonators (FBARs) sealed with the wafer-level packaging scheme were also undergone through harsh environment tests, such as the pressure cooker test for 300 hours, the high humidity storage test at 85degC/85%RH for 1000 hours, the high temp storage test at 125degC for 1000 hours and the temperature cycling test (-55~125degC) for 1000 cycles, to investigate the long-term reliability of the packages. The performance evaluation and reliability results of the package will also be presented. [C1739]

"Electrospun Nano-Fibrous Polymer Films with Barium Titanate Nanoparticles for Embedded Capacitor Applications"

Continued miniaturization, increased performance, as well as increased reliability of microelectronics require development of new design and manufacturing methods. Embedding discrete passive components into the substrate has been identified as a solution capable of accommodating a portion of the future demands on microelectronics. As embedded passive components are fundamentally different from discrete passive components, development of new materials is necessary. These new materials must meet requirements on manufacturability, electrical performance, reliability and cost. This paper presents the results of a parametric study where electrospun nano-fibrous polymer films containing barium titanate nanoparticles have been evaluated as possible dielectric materials for embedded decoupling capacitor applications. The study is of experimental character and demonstrates a novel technique for manufacturing of embedded capacitor dielectrics. Samples were produced with a standard electrospinning setup using various processing parameters. The produced samples were electrically characterized by guidance of the ASTM standard, using a parallel-plate test fixture and a HP 4284A precision LCR meter. The properties studied were specific capacitance and dissipation factor. Two different polymers were studied, designated polymer A and polymer B. Successful samples of polymer A and polymer B loaded with barium titanate were electrospun and characterized. Scanning electron microscopy (SEM) was used to characterize the surface morphology of the electrospun films. Polymer A samples showed good mechanical performance with and without barium titanate loading. Polymer B samples demonstrated a contrary behavior having inferior adhesion to the substrate and being brittle. Inclusion of barium titanate nanoparticles into the samples, of both polymer A and polymer B, showed indications of improved adhesion to the substrate and higher Young's Modulus of samples. It was shown that inclusion of ba- rium titanate into polymer A significantly changed the electrical properties of the films, increasing both specific capacitance and dissipation factor but also drastically reducing the frequency stability. The highest achieved specific capacitance for polymer A loaded with barium titanate was approximately 210 pF/cm2. High dissipation factors, reaching up to 0.6, were observed. Characterization of electrospun pure polymer B revealed a frequency stable dielectric with a low dissipation factor in the order of 0.01. The achieved specific capacitance was approximately 54 pF/cm2. Polymer B with 50.0 weight percent barium titanate nanoparticle loading, reaching values of 175 pF/cm2, had a different dispersion showing less frequency stability. As previously, inclusion of particles led to increased dissipation factors, reaching values of approximately 0.7. [C1740]

"Reliability of Nano-Structured Nickel Interconnections Replacing FlipChip Solder Assembly without Underfill"

This paper reports the reliability of fine pitch interconnections using nano-structured nickel as the primary interconnection material. Assembly was accomplished with different bonding methods to provide organic compatible low-temperature fabrication. Au-Sn and Sn-Cu were used for solder-based assembly of nanonickel interconnections. Low modulus conductive adhesives impart lower stresses in the interconnections and enhance reliability though they add electrical parasitics. These were used as an alternate bonding route and compared to solders. Test vehicles were fabricated at 200 micron pitch to evaluate the reliability with different bonding routes. Different CTE substrates-FR4 with 18 ppm/C, advanced organic boards with 10 ppm/C, novel low CTE (3 ppm/C) substrates based on carbon-silicon carbide (C-SiC) were evaluated. No underfilling was used in all the test vehicles evaluated in this study. High frequency electrical characterization was performed to compare the electrical parasitics from different bonding routes. Nanometal bumps bonded with conductive adhesives showed the highest reliability withstanding 1500 cycles. This technology can be easily downscaled to submicron and nanoscale unlike the current solder technologies leading to true nanointerconnections. [C1741]

"The Effects of ONO thickness on Memory Characteristics in Nano-scale Charge Trapping Devices"

In the use of single/few electrons in distributed storage for nonvolatile, low power and fast memories, providing statistical reproducibility at the nanoscale is a key challenge since relative variance has a radicndependence and we are working with limited number of storage sites. We have used defects at interfaces of dielectrics to evaluate this reproducibility and evaluate the performance of memories. These experiments show that nearly 100 electrons can be stored at 30 nm dimensions, sufficient for reproducibility, and that a minimum of tunneling oxide thickness is required to assure reliable retention characteristics. Different tunneling oxide thicknesses and the effect of low doped drain (LDD) process is investigated to draw these conclusions. [C1742]

"The mM-Hypercube"

Unlike today's semiconductor devices whose input/output signals are associated with surges of electrons, the signals in nanodevices are associated with states or counts of electrons. This is one of the revolutionary technologies in the design of nanoICs. Traditional logic design methodologies may not satisfy the requirements and properties of nanoscale computing devices, such as the stochastic nature of signals and processes, localized molecular connections, and increasing demand on fault-tolerance computation [1]. Much attention has been devoted to the search of the logic design models for the representation of combinational nanoICs and sequential nanoICs, i.e., the N-hypercube and the M-hypercube, respectively [1, 2]. This paper proposes the mM-hypercube which not only provides a hypercube representation of finite state machines in m-valued nanodimensions but also satisfies the requirements for highly parallel computation and multi-valued structure of nanodevices. The transmission nodes of an mM-hypercube can implement nanodevices with states operated by multiple electrons which produce multiple transactions from one state node to many state nodes. Thus, the mM hypercube model is a more general logic design model for future advanced nanoICs. [C1743]

"Nano chemical detection with carbon nanotubes"

Single-walled carbon nanotubes (SWNTs) have had significant impact on the development of gas sensors in the last decade. However, useful applications of SWNTs are limited by the lack of manufacturable routes to device formation. This Highlight article chronicles recent progress in this area and demonstrates the great promise of a new room temperature deposition method for SWNT networks in gas sensing applications. This liquid deposition technique allows the deposition of pre-treated, highly aligned SWNT networks on a wide variety of substrates. A significant advantage of SWNT-network sensors is that fluctuations in the electrical response of individual SWNTs become less important as the size of the network increases. Therefore, the overall density of the network rather than the physical properties of any individual SWNT can control device properties. [C1744]

"New Aspects of Nano-meter Structures of Porous Low-k Films and Their Impacts on Cu/Low-k Processes for 65 nm and Beyond TEM Tells What?"

Nano-meter order structures of porous low-k films have been successfully characterized by a transmission electron microscopy (TEM). Two proposed applications will be presented in this paper. Using a TEM tomographic technique, 3-dimensional structures of pores in porous low-k films have been quantitatively evaluated and it was shown how the pore structures influenced on materials penetration phenomena into the porous structures. A valence electron energy loss spectroscopy (V-EELS) combined with a scanning TEM (STEM) clearly showed distributions or change of dielectric constants in the porous low-k trench structures with nm-order spatial resolution induced by plasma processes such as dry etch and ash with or without change in composition. [C1745]

"Nano-Scale Mechanical Responses of Sn-Ag Based Lead-free Solders"

The mechanical properties of the Sn-3.5Ag lead-free solder alloys were characterized in different size scales by nanoindentation technology. Some of the principle mechanical properties, such as Mayer's hardness, reduced Young's modulus and the strain rate sensitivity index were assessed. In particular, the strain rate sensitivity index is extracted from the creep deformation of the solder alloys at the dwell time of target load based on the Miyo-Nix method. It was found that the mechanical properties of the Sn-3.5Ag solder alloy were indeed size dependent. That is, the micro-scale BGA balls showed different mechanical properties from the conventional bulk specimens. According to the strain gradient theory, the non-homogeneous microstructure of the Sn-3.5Ag alloy may be responsible for the creep deformation variation of the micro-scale BGA solder balls. In addition, the influence of aging on the mechanical properties was also discussed. [C1746]

"Nondestructive Sensor Applications for Remote Sensing of Multiphase Fluid Flow Measurements"

The paper talks about the current technology and operations of the various multiphase flow sensing and measurement devices; their applications to down stream operations as well as the possible application to royalty and custody measurements of crude and hydrocarbon products. It highlights current research, field test studies and viability of such devices using nano technology for better precision and higher accuracy in the measurement of volumetric through puts for exports and domestic consumption. [C1747]

"Towards a New Nanoelectronic Cosmology"

Gone forever, are the days of smooth roadmap scaling, with its more-or-less-simple design rules, adequate supply voltages, and unimpeded circuit shrinkage. As scaling moved ahead to nanometer dimensions, things changed. Devices became more difficult to predict, and global performance degraded due to leakage and dispersion. One of the consequences of this deteriorating situation has been that increased parameter variability has led to a significant mismatch between simulation and actual-measurement results, at all levels. While many of these effects have been already well-known to analog designers, the surprise, now, is that they are more broadly important, even in digital design, where previously available noise margins have almost disappeared. Clearly, deep understanding and modeling of all underlying physical causes is urgently required to guide the right choices at all levels. Conceptually, such understanding will lead to acceptable levels of performance, manufacturability, and yield, at ever-decreasing feature sizes. Meanwhile, the increased parameter variability observed today, as one technology node invites the next, reveals the tight coupling of the four seemingly-independent dimensions of design, motivating the need to configure a new nano-cosmology, one in which global optimization results only from an intricate balance between the process, device, circuit, and system aspects of design. In this new nano-cosmology, the emerging concept of generalized design-for-manufacturability (GDfM) unifies current design-for-manufacturability (DfM), manufacturing-for-design (MfD), and design-for-yield (DfY), coupling all of the above-mentioned dimensions within a new space where their inter-dependence is revealed and exploited. Tightly-coupled physical-electrical-mechanical-process modeling and simulation, will allow early detection of the impact of design choices at all levels. This creates a 4D knowledge continuum reminiscent of the ideas of general relativity, ones e- xtremely rich in consequences for the future of nanoelectronic design. [C1748]

"The Center for Non-Destructive Nano Evaluation of Electronic Packaging (nanoEVA), a New Research Facility in Dresden"

The challenge of nano packaging requires new non-destructive evaluation (NDE) techniques to detect and characterize very small defects like Kirkendall voids or micro cracks. Imaging technologies with resolutions in the sub-micron range are desired. Possible evaluation methods are for example x-ray microscopy, x-ray tomography, ultrasonic microscopy and thermal microscopy. However, techniques with this resolution can not be found on the market. The Center for Non-Destructive Nano Evaluation (nanoeva) is launched to develop this equipment jointly with the electronics industry and to transfer the knowledge to colleagues in industry and research institutions. The new center is a common organization of Fraunhofer IZFP-D and the Centre of Microtechnical Manufacturing (ZmuP) of the Technische Universitat Dresden. [C1749]

"Nano-optics for chemical and materials characterization"

We have developed a hybrid microscope which combines structured-illumination techniques with Raman-spectroscopy to record 100 nm resolution images with chemically-specific contrast. We will show images of semiconductor nanostructures and discuss the techniqueГ‚Вїs advantages and requirements. [C1750]

"Hollow nano-magnetic resonators mediated by photothermal effects: Towards the realization of highly-tunable mid-infrared negative permeability"

Using a rigorous-coupled-wave analysis combined with a thermo-optical sensitivity prediction scheme, we show that nano-engineered magnetic resonators exhibit strong tunable magnetic response in mid-infrared, which can be effectively used for realizing a negative magnetic permeability. [C1751]

"Two decades of MEMS -- from surprise to enterprise -"

This paper gives a brief overview of MEMS research and commercialization in the past two decades, its present status, and future prospects. The historical development of MEMS technology is followed in relation to devices enabled by developed technology For the present status, the importance of MEMS design and fabrication infrastructures is discussed in order to help more MEMS products to be successful in high-end market. Two future trends in low cost fabrication, nano miniaturization, and system integration of heterogeneous functional elements are observed. [C1752]

"Shape control of filamentous motor proteins for bio-nano driving units"

This paper describes a technique for controlling the shape of filamentous motor proteins for the bio-nano driving units in MEMS devices. In this experiment, we have used Actin, a protein to construct cytoskeleton actin monomers (G-actin) polymerize in high salt condition and form filaments (F-actin); the filaments move when they bind with the motor protein (Myosin) in ATP (adenosine tri-phosphate) solution. Fascin, a putative bundling protein, tightly bundles several F-actins together to form tight bundles of actin [1]. When G-actin and the fascin solution was confined and polymerized in the polydimethylsiloxane (PDMS) or parylene micro chambers, we found that the polymerized actin bundles followed the geometry of chambers, and then formed several shapes, such as circles, rods, triangles or squares. Since the bundled actins still have motility, we believe this technique is useful for forming a desired pattern of bio-molecular motors toward the actuation of MEMS/NEMS devices. [C1753]

"Novel MEMS Piezoresistive Sensor Array Cell"

The future of analytical methods based on micro-fabricated cantilever sensors is critically sensitive to parallel processing: some because of the increased throughput required, but others, because of the complexity of the value to analyze. Parallel functioning needs arrays with cantilevers having two additional properties, simultaneously: to be addressable and to be independently actuated. Fulfilling these two requirements together, causes substantial increasing of complexity of both: layout and manufacturing technology. In present paper we demonstrate a novel design of MEMS-cell solving upper dilemma. The cell consists of four integrated cantilevers, having a single piezo-resistor each and different resonance frequencies. Samples of e-NOSE piezoresistive sensor using micro cantilevers on n-type, <100> Silicon, have been fabricated applying combined dry and wet etching techniques. The cantilever dimensions were chosen to provide approx. 1.5 kHz resonance frequency gap between any two neighbor sensors. The integrated bimorph actuator is common for all four of them, which fit very well a particular application. The behavior of the new cell was studied and its optimization according to both: manufacturing technology and application criteria was discussed. [C1754]

"Negative index bands in sub-wavelength metallic gratings"

We describe negative group index surface plasmons in nano-structured metallic gratings. The periods and amplitudes of silver gratings exhibiting negative group index, as well as the attenuation lengths of the negative-index surface waves, are derived. [C1755]

"Fragmented membrane MEM bulk lateral resonators with nano-gaps on 1.5μm SOI"

The design, fabrication and experimental investigation of 21 MHz MEM bulk lateral resonators (BLR) on 1.5 mum silicon-on-insulator (SOI) fragmented membranes with 100 nm air-gaps are reported. Quality factors as high as 33'000 are measured under vacuum at room temperature, with 20 V DC bias and low AC-power. The influence of temperature on the resonance frequency and quality factor is studied and discussed from 80 K and 380 K. A very high quality factor of 182'000 and a motional resistance of 165 kOmega, are reported at 80 K. The paper shows that high-quality factor MEM resonator can be integrated on partially-depleted thin SOI, which demonstrates the possibility of making full-integrated hybrid MEM-CMOS integrated circuits for future communication applications. [C1756]

"Low-voltage limitations of memory-rich nano-scale CMOS LSIs"

The low-voltage limitations of memory-rich nano-scale CMOS LSIs using bulk CMOS and fully-depleted (FD) SOI devices are described, focusing on CMOS inverter and flip-flop circuits such as six-transistor (6-T) cells in SRAMs and sense amplifiers in DRAMs. The limitations strongly depend on the ever-larger VTvariation, especially in SRAM cells and logic gates, and are improved by using the FD-SOI as well as by using repair techniques. Consequently, two possible LSIs are predicted to coexist in the deep-sub-100-nm generation: high-VDDbulk CMOS LSIs for low-cost low-standby-current applications and low-VDDFD-SOI LSIs for low-power applications. [C1757]

"Synthesis of nano-sized CoSb3 -based skutterudites using a modified polyol process"

Nanostructures provide a high concentration of grain boundaries, which can reduce the thermal conductivity of thermoelectric (TE) materials and favor an increase in their thermoelectric figure-of-merit, ZT. In this paper, we report the synthesis of nanocrystalline high purity CoSb3via a modified polyol process using CoCl2ldr6H2O and SbCl3as precursors dissolved in tetra-ethylene glycol (TEG). This one-step synthesis process is efficient and fast, and requires a relatively low synthesis temperature of 240degC. This solution-based method also offers several advantages, such as high productively and low cost. [C1758]

"Surface enhanced raman with nano-holes"

First Page of the Article [C1759]

"Thermo-plasmonic resonances in hybrid metallo-dielectric nano-particles: Towards tunable

standalone nano-sensors"

We theoretically investigate the intense nano-focusing of light through a novel family of metallo-dielectric nano-particles mediated by thermo-plasmonic resonances. The results show a significant sensitivity of the plasmonic resonance to temperature and environmental fluctuations. [C1760]

"Second-harmonic generation driven by local field asymmetry in noncentrosymmetric gold Nano-Ts"

We demonstrate that second-harmonic generation from noncentrosymmetric gold nano-Ts with nanogaps is governed by asymmetric distribution of the local fundamental field, and not strictly according to field enhancement in small nanogaps. [C1761]

"Proxels for Reliability Assessment of Future Nano-Architectures"

As devices are scaled towards the infinitesimal, the occurrences of defects and failures will certainly increase. This is a statement that has been repeated on numerous occasions recently. Therefore, accurate evaluation of reliability should be considered-besides area, power, and delay-as one additional design parameter of future nano-circuits. The goal of this paper is to evaluate the applicability (for this particular task) of the recently developed proxel-based method. The paper will include a background on the proxel-based method, its customization for the particular task at hand, as well as experimental results regarding its applicability towards reliability evaluation of nano-circuits. [C1762]

"Optimization of design parameters of a prototype CCD-based lens-coupled imaging system for the detection of beta particles in a microfluidic chip"

Microfluidic chips are an emerging technology that facilitates the study of molecular processes in nano-liter levels in a finely controlled manner. A prototype imaging system capable of detecting and quantifying very small amounts of beta particles in a microfluidic chip, utilizing a scintillator, an optical lens, and a charge coupled device (CCD), was developed and proof of concept was previously demonstrated [1]. In this study, we optimized the system design parameters, such as CCD binning and types of scintillators, and evaluated the system performance for spatial resolution and minimum detectable activity. Pixel binning of the CCD during readout process improved the signal-to-noise ratio with no spatial resolution degradation in beta particle imaging of 18F, up to a binning of 3times3 in our study, which was equivalent to 44 mum times 44 mum pixels in an object plane with a magnification of 0.5. The full width at half maximum (FWHM) of line sources with a finite width of 115 mum were measured to be 493 mum with a plastic scintillator and 289 mum with a CsI(Tl) scintillator. The minimum detectable activities were measured to be 360 pCi/mm2with a plastic scintillator and 40 pCi/mm2with a CsI(Tl) scintillator for a 5-min acquisition. [C1763]

"Control to concentrate drug-coated magnetic particles to deep-tissue tumors for targeted cancer chemotherapy"

The control problem for concentrating drug-coated magnetic nano-particles to deep-tissue tumors in a patient is developed and initial control ideas are presented In current implementations of magnetically-controlled drug targeting, stationary magnets (creating static magnetic fields) are held outside the patient's body, these magnets attract the nano-particles to their corners, and hence focus them to tumors at or near the skin surface. Deep tissue tumors cannot be targeted in this way. Dynamic control of magnetic fields can allow drug targeting to tumors deep in the body, creating high drug concentrations at the tumor (effective treatment) with low concentrations in the rest of the body (eliminating life-threatening side-effects), and thereby dramatically improving chemotherapy treatment. Here we synthesize the control problem (accurately stating the problem definition is itself a serious challenge), show initial results for focusing magnetic particles to a target in air by feedback control of magnetic fields, and present a first-cut approach for doing the same inside the human blood vasculature network and the surrounding tissue. As such, we are presenting preliminary results in a long-term effort: the development of control algorithms and sensing/actuating technology to concentrate chemotherapy drugs to deep tissue tumors for dramatically improved treatment of cancer. [C1764]

""More than Moore"-The changing international landscape, strategy and solutions of micro/nanoelectronics"

In the past decades, the main stream of microelectronics progresses is mainly powered by Moore's law, with two focused development arenas, namely, IC miniaturization down to nano scale, and SoC based system integration. While microelectronics community continues to invent new solutions around the world to keep Moore's law alive, there is increasing momentum for the development of "More than Moore" (MtM) products and technology that are based upon or derived from silicon technologies but do not simply scale with Moore's law. Typical examples are RF, Power/HV, Passive, Sensor/Actuator/MEMS, Bio-chi/packages, SiP, SSL. This increasing momentum of MtM is trigged by the increasing social needs for high level heterogeneous system integration including non-digital functions, the necessity to speed up innovative product creation and to broaden the product portfolio of wafer fabs, and the limiting cost and time factors of advanced SoC development. It is believed that MtM will add value to society on top of and beyond advanced CMOS and conventional packaging, with fast increasing marketing potentials. This two hours course will cover mainly:-Technology development trends of Micro/nanoelectronics-Business development trends of Micro/nanoelectronics-Strategic research agenda of "More than Moore"-Paradigm of "More than Moore" business creation-European's vision, strategy and practices for micro/nanoelectronics [C1765]

"Study of Nano-grinding for GMR Magnetic Recording Head"

The objective of this research is to better understand in what way the ultra smooth hard disk magnetic head (the individual head also called 'slider') surface is formed in nanogrinding. A float-piece polisher was used to achieve ultra smooth and planar surface in nano-grinding way. The SEM was used to observe the diamond abrasive used in nano-grinding and the plate embedded with diamond abrasive. The slider surface was measured with SEM and AFM before and after nano-grinding. Though the micro-cutting of the continuous plane of the slider surface may exit, it was demonstrated that the un-continuous asperity of the slider surface can't be ignored in nano-grinding. According to the statistic analysis of the slider surface, the asperities are removed and replaced by a series of smaller asperities step by step, in this way, smoother surface is achieved gradually, and finally, a sub-nanometer smooth surface was achieved. A theoretical model was developed to illustrate the removal of single asperity removed by abrasive. The removal force taking by a single abrasive was calculated according to the model. Pole tip can be protected in some extent because of the regular arrange of the abrasive, so more planar slider surface was achieved in nano-grinding. Combined with the model and the distribution of the asperity of slider surface, the quality of the slider surface can be estimated and the nano-grinding procedure can be optimized. [C1766]

"3-D Large-Scale IC/MEMS Co-Integration Using Liquid Solder for Flip-Chip Assembly"

In this paper, we discuss a flip-chip packaging method using liquid solder for 3D large-scale electronic/MEMS co-integration. This approach has been inspired from self-assembly technique which is emerging as one of the main methods for fabrication of heterogeneous micro-and nano-systems. We proposed to form solder bump by coating liquid solder directly on electrodes of a MEMS chip based on sophisticate microstructures of electrostatic microactuator array. Self-alignment and assembly techniques for electronic receptor chip were also detailed in order to achieve efficient flip-chip of MEMS and Electronic chip without any stiction and contamination problem. Functionality of the system has been validated and perspectives discussed. [C1767]

"Design, optimization, analysis and control topics in nanotechnology ad MEMS courses"

This paper discusses the use of a systems theory, design coverage and control topics in nanotechnology and microelectromechanical systems (MEMS) courses developed and offered in the College of Engineering in RIT. The multidisciplinary nano and microengineering have accomplished a phenomenal growth over the last twenty years due to the rapid advances in microelectronics, molecular technologies, bulk and surface micromachining, computer-aided-design (CAD), etc. Recent fundamental and applied research and developments in molecular electronics and informatics have been notably contributed to the current progress. Enabling nano/micro engineering utilizes and depends on the fundamentals, software and hardware. These prominent developments largely depend on modern engineering and science providing the end-users with the needed technologies and design concurrency. With the increasing demands in high-performance envisioned nanosystems and emerged microsystems, designers apply new concepts. The role of nanotechnology and MEMS courses in the engineering curriculum is examined. We discuss the integration of design, optimization, control and analysis topics in Nano Science, Engineering and Technology (NanoSET) and MEMS courses. The MEMS curriculum consists of three courses, e.g., MEMS design, MEMS fabrication and MEMS systems evaluation. We stress the need for systems theory, in addition to basic fundamentals coverage and fabrication emphasis. The developed courses ensure the overall educational, professional and curriculum objectives. [C1768]

"ZNO-on-nanocrystalline diamond lateral bulk acoustic resonators"

This paper reports, for the first time, on thin-film piezoelectric-on-diamond composite bulk acoustic resonators. These resonators benefit from the large elastic modulus of the nano-crystalline diamond to increase the resonance frequency, and the high electromechanical coupling of the piezoelectric transduction to reduce the motional impedance. More than 1.8times increase in the resonance frequency is measured for devices fabricated on 2 mum thick diamond compared to the same size devices made on 6 mum thick silicon on insulator substrate. A device with 5 mum feature size exhibits a high resonance frequency of 1.2 GHz. A small motional impedance of 225 Omega is reported for a device operating at 173 MHz. The temperature coefficient of frequency (TCF) is measured to be as small as -2 ppm/degC as a result of including an oxide layer in the device structure. [C1769]

"Nano-metal-ink-based electrode embedded in parylene HARS with the aid of the capillary effect"

Microfabrication technology for free-standing parylene high-aspect-ratio structures (HARS) with embedded electrodes has been developed. Nano- metal ink is infused into capillaries in parylene HARS using the surface tension force. Micro electrodes in complex parylene springs have been successfully developed, and their robustness is demonstrated under large-amplitude in-plane vibration of the springs. [C1770]

"Effect of nano stripe carbonized-polymer electrode on high S/N ratio in electrochemical detection"

This paper presents a scaling effect of the nano stripe electrode made of carbonized-polymer on the S/N ratio in electrochemical detections. It is well known that microelectrodes show higher sensitivity and higher S/N ratio. Downsizing of electrode, however, causes a reduction in signal current. Co-author has proposed a novel theoretical concept of a stripe electrode to solve this trade-off. The S/N ratio increases with downsizing the width of the stripe electrode because the noise current exponentially decreases. The nano stripe electrode with 450 nm in width and 15 mum in the center-to-center separation of the electrode could achieve 17.15 times higher S/N ratio than that of a planar electrode having the same corresponding area size. Furthermore, comparisons of experimental and theoretical S/N ratios will be discussed. [C1771]

"Computational study of a MEMS-based catalyzed micro-thruster with homogeneous chemical reaction"

Miniaturized satellites have attracted numerous interests due to their increasing demands for space missions. In contrast to traditional satellites, the operations of the nano-scale or even pico-scale satellites require extremely low levels of thrust and precise spatial maneuverings. Micro-electro-mechanical-system (MEMS) technology has demonstrated great potentials in various industrial applications such as automobile, electronics, medicine, and life science fields, etc. and is well-suitable to meet the fabrication requirements of a micro-thruster. Furthermore, the liquid catalyst-based micro-propulsion system which is driven by the catalytic decomposition of the hydrogen peroxide (H2O2) with the catalysis of an aqueous ferrous chloride (FeCl2) solution is proposed under the considerations of the advantages of simplicity, high reliability, fewer external power input, the prevention of aging problem of heterogeneous catalyst, and environmentally friendly nature. However, the experiment of the liquid catalyst-based micro-propulsion system is difficult because the development of the fabrication processes for micro-thruster will take much time, and the problem of the tube connection and the control of the excessively small flow rate are not overcome easily. Thus, the numerical simulation was utilized to study the micro-fhruster in this preliminary investigation. Due to the immaturity of the current numerical study of the heterogeneous chemical reaction, the numerical simulation of the chemical reaction in micro-fhruster is simplified to homogenous chemical reaction. Two 2-D computational models which consist of an injector, reaction chamber and nozzle, as well as are referred as the Ml and M2, respectively, were used in this study. The numerical solutions are based on solving the conservation equations of mass, momentum, energy, and species transport. Simulation results showed that the average temperature, oxygen concentration, and velo--city of M2 model at outlet were higher than those of Ml. The differences of the parameters described above between Ml and M2 increased as the temperatures of inlets rose. These meant that the hydrogen peroxide consumption in M2 was higher than that in Ml, i.e. the performance of M2 model was better than Mi's. Besides, the effect of the variation in positions where the ferrous chloride is injected was very small in M2 model. Also the different ratios of mass flow rate of aqueous hydrogen peroxide solution and aqueous ferrous chloride solution were calculated in this study. The results showed that the performance of the mass flow rate ration of 3:1 was the best, 1:1 was middle, and 7:1 was the worst. [C1772]

"Nanopackaging: Nanotechnologies and electronics packaging"

The importance of nanoelectronics and "electro- nanotechnologies" in the future is sufficiently well recognized to have become the subject of industrial and government policy roadmaps. Similarly, the academic world is responding with graduate level courses, (although with few textbooks so far.) As for electronics packaging, the field requires students to be "subject multilingual". Candidate next-generation nanoelectronics technologies, (e.g. single-electron transistors, quantum automata, molecular electronics, etc.,) are generally hyper-sensitive to dimensional change, if based on quantum-mechanical electron tunneling, and this is just one example of how appropriate packaging will be essential to the success or failure of these technologies. Packaging strategies must therefore be developed in parallel with the basic nanoelectronics device technologies in order to make informed decisions as to their commercial viabilities. [C1773]

"Optical-fluidic Sensors in LTCC- technology"

The successful usage of LTCC modules within micro reaction systems especially with micro fluidic systems is state of the art since a few years. There are mixers, valves, pumpes und different kinds of micro reactors available. But one problem isn't solved yet. This is the integration of optical windows into LTCC-modules. These windows apply the ability of inline spectroscopic measurement and steering of chemical reactions in LTCC micro reactors. The best would be the integration of available commercially glasses in improved LTCC materials. These conditions allow the development of smart sensors in fluidic LTCC-micro reaction systems with all advantages of the LTCC technology. The main topic of this paper is the integration of optical windows into LTCC- modules. These windows allow a view into or through a fluidic channel or a reaction chamber. Possible applications are the monitoring and investigation of fluids and gasses and their photometric investigation. The shown LTCC modules enhance the application field of the LTCC in the micro reaction technology. A module is presented which allows a view through a reaction channel with the dimensions of 1 mm2. Photometric detection of Au nano particles in aqueous solution have been carried out. [C1774]

"The Monte Carlo approach to transport modeling in deca-nanometer MOSFETs"

In this paper, we review recent developments of the Monte Carlo approach to the simulation of semi-classical carrier transport in nano-MOSFETs, with particular focus on the inclusion of quantum-mechanical effects in the simulation (using either the Multi-Subband approach or quantum corrections to the electrostatic potential) and on the numerical stability issues related to the coupling of the transport with the Poisson equation. Selected applications are presented, including the analysis of quasi-ballistic transport, the determination of the RF characteristics of deca-nanometric MOSFETs, and the study of non-conventional device structures and channel materials. [C1775]

"Disturbance observer-based internal model control with an adaptive mechanism for linear actuators"

In recent years, a high-precision stage control has received great attention due to the progress of nano-technology. A fast-response and high-precision control method based on the internal model control in the case where the controlled object has the integral characteristic is reported. The disturbance observer-based internal model control (DIMC) system has the advantages of no-overshoot, easy-design and simple-realization comparing to the conventional IMC method for the integral objects. However, an overshoot is generated when the model/plant mismatch exists. In the proposed method, since the plant model is explicitly included in the controller, the compensation for the dynamical change of the plant is easily realized by giving an adaptive identification mechanism to the plant model. Experimental results with an ultra-precision stage demonstrate that the proposed control system achieves high-precision positioning performance. [C1776]

"Nano-level 3-D measurement system using combination of 3-wavelength laser lights"

To improve the productivity of very large scale of TSIs or large LCD panels, the nano-technologies to inspect the TSIs are required. To remove the less than one-micrometer contaminants on the TSIs, it is required to extract their positions and 3-D shapes, precisely. To meet with these requirements, a nano-level 3-D shape extraction method has been introduced and the measurement results are described. Here, the basic idea of this method and the measurement result using improvement method are described. To extract a nano-level 3-D shape, the method using laser interference images is effective. Interference image is produced by light reflected by TSI and by reference mirror. At this time, if the position of reference light is changed at regular intervals, the brightness of same coordinate of interference images change like a sine wave. When position heights of TSI differ between two coordinates, the brightness of interference image differs and the phases of brightness pattern differ according to height between each pixel. And combining with different wavelength laser lights, different brightness is able to measure more than one wavelength. Took-up table method is used to combine the multi-wavelength laser light measurement. [C1777]

"Force Feedback Control for Block Spring Motor"

High precise positioning and force control are based on nanotechnology. Nanotechnology, especially nanometer positioning technology with high speed and robust force feedback control requires the utilization of a variety of technical fields including magnetic recording, biotechnology and the semiconductor industry. Until now there have been various actuator systems proposed, but the structure models have only working distances of either under a millimeter or over ten millimeters. A structural model with working distances ranging several millimeters has not yet been designed. Therefore we are proposing a new structure design of actuator that would allow us to build actuator systems with working distances between those parameters. This new actuator consists of a voice coil motor and a new guide with an elastic support mechanism. The elastic support mechanism consists of a special spring which is restricted to moving only one-way. This new ESM does not cause any lose motion, mechanical play or friction with motion. Since characteristically voice coil motor thrusts and displaces the elastic support mechanism linearly, highly precise positioning and force control can be realized using a simple controller. This paper will provide basic data for developing future nano-actuator systems. [C1778]

"Optimum Quaternary Galois Field Circuit Design through Carbon Nano Tube Technology"

The geometry dependant threshold voltage of carbon nanotube FETs (CNFETs), has been often used to design a ternary logic family. However, for the last couple of decades, multiple-valued logic (MVL) such as ternary (base=3) or quaternary (base=4) logic styles has attracted considerable attention. MVL circuits can reduce the number of operations necessary to implement a particular mathematical function and further, have an advantage in terms of reduced area. As we progress into an era of nanotechnology, molecular devices are becoming promising alternatives to the existing silicon technology. Carbon nanotube field effect transistors (CNFETs) are being extensively studied as possible successors to silicon MOSFETs. Research has started in the earnest to understand the device physics of CNFETs as well as to explore possible circuit applications. Implementable CNTFET circuits have operational characteristics to approach the advantage of using MVL in voltage mode. In this paper through using of CNTFET characteristics, we presented new CNTFET circuit design to implement optimum quaternary Galois field logic. [C1779]

"Self-assembly of graphs"

Self-assembly is a process in which simple objects autonomously combine themselves into larger objects. It is considered as a promising technique in nano-technology. In this paper, we propose a graph-based self-assembly model. Two simple graphs G1and G2with a vertex of common degree overlap and a new self-assembled graph is formed. Besides studying the properties of these self assembled graphs, we answer the question: can a given set of graphs be generated through the process of self-assembly? If so, how to find the generator that could generate the given set of graphs by the process of self-assembly. The question of the existence of the minimal generator is also discussed. The necessary and sufficient condition for a graph Hto be obtained by the iterated self-assembly of the graph Gis also answered. We also conclude that the problem of finding the generator is decidable. [C1780]

"Three-dimensional nano electronics by dielectrophoretic assembly on a flexible substrate"

In this paper, we demonstrate three-dimensional assembly of nanoscale materials, including single-walled and multi-walled carbon nanotubes and Au nanoparticles on a flexible parylene-C substrate. The assembly technology combines top down fabrication (fabrication of the three-dimensional microplatform) and bottom up dielectrophoretic (DEP) assembly of different nanomaterials. [C1781]

"Quantum Computing and Information Acquisition"

Due to the rapid advances made in Nano-Biotechnology, optical control of molecular dynamics and quantum computation, there is an increasing need to understand the fundamental structure, from the systems theoretical point of view, of the control and observation of quantum mechanical systems for designing advanced sensors and actuators. In this presentation we start with a discussion of the design, synthesis, and control of engineering problems and how the advances of technology helping to solve complex engineering problems. We proceed to discuss the recent trends in quantum computation and quantum computer. Then, we present the differences between the quantum control and measurement problems and the classical control and measurement problems. We conclude with a list of recent applications of quantum phenomena to build new sensors and other systems for information acquisition. [C1782]

"Si/SiGe Epitaxy: a Ubiquitous Process for Advanced Electronics"

This contribution is focusing on low temperature epitaxy of SiGe alloys that are required in advanced devices. In a first part, we give a certain background on RTCVD and SiGe(C) materials. In a second step, we develop some specific applications important and fundamental in our technologies: selective epitaxy of SiGeC for bipolar base and Si/SiGe epitaxies for the fabrication of thin films CMOS. In each case, we present major improvements of the process capabilities or innovative structures. And finally, we propose the association of Si/SiGe epi and SiGe selective etch as an effective way to fabricate objects at the nano-scale. [C1783]

"Ferrite-Partially-Filled on-Chip RF Inductor Fabricated Using Low-Temperature Nano-Powder-Mixed-Photoresist Filling Technique for Standard CMOS"

This paper reports new fully-CMOS-compatible on-chip RF inductors with Ni-Zn-Cu and Co2Z-type ferrite-partially-filled structures fabricated using a novel low-temperature nano-powder- mixed-photoresist filling technique. Measured improvements are up to +35% in L and +250% in Q across multi-GHz with f0to 11.4 GHz. [C1784]

"610 GHz InAlAs/In0.75 GaAs Metamorphic HEMTs with an Ultra-Short 15-nm-Gate"

Ultra-short-gate InAlAs/InGaAs high electron mobility transistors (HEMTs) have been successfully fabricated with nano-gate fabrication technology and epitaxial optimization. We obtained an extrinsic maximum transconductance (Gm,max) of 1.65 S/mm and a current gain cutoff frequency (fT) of 610 GHz for 15-nm-gate HEMTs on GaAs substrates. Through a delay time analysis, the ultrahigh fTof this work is explained by an enhanced average electron velocity under the gate (Vave) of 4.3 x 107cm/s, which was a result of reduction of gate length (Lg) and epitaxial engineering. This report is the first experimental demonstration of 15 nm InAlAs/TnGaAs metamorphic HEMTs (MHEMTs) with an extremely high fTof 610 GHz. [C1785]

"Sensing Temperature in Water using FIB CVD Nano Thermal Sensors"

In this paper we illustrate the fabrication process of nano temperature sensor probe using focused ion beam chemical vapor deposition (FIB-CVD) of tungsten over atomic force microscope (AFM) cantilevers, to be used in sensing temperature distribution in local area. We present the fabrication approach & modifications for making this sensor probe capable of sensing temperature distributions not only in air but in water environment as well. The nano sensor probe was calibrated in water using the hot stage of the environmental scanning electron microscope (ESEM). The experimental results show the positive characteristics of the temperature coefficient of resistance (TCR). We also illustrate the response of the sensor to sudden changes in the surrounding medium. The characteristics of this sensor probe were compared to previously reported temperature sensing devices. The comparison verifies that our sensor is relatively uncomplicated and reliable in fabrication. The capability of sensing temperature in water will allow our sensor to be used in wide range of bio-applications, especially in studying thermogenesis in single cells. [C1786]

"Effect of silica on the non-linear electrical property of polymer composites"

The electrostatic discharge (ESD) control in semiconductor devices is a very important task during the manufacturing stage or for final users. Utilizing polymer based varistors has great advantages in process temperature and dimensional control over the conventional oxide non-linear conductors as a protection mean for electronic device from ESD transient. [5,8] In this paper, the effect of nano-fumed silica on the non-linear electrical property of polymer-metal composites was investigated. We have found that the concentration of silica as an insulating filler plays an important role on the evolution of non-linear IN characteristics of the polymer composite. Furthermore, a polymer composite did not show its non-linear IN characteristics until enough insulative phases were provided within the polymer composite. [C1787]

"Single-electron circuit for stochastic data processing using nano-MOSFETs"

A MOSFET-based circuit utilizing single electrons is demonstrated at room temperature. Individual electrons randomly passing through the nanoscale silicon-on-insulator (SOI) MOSFET are monitored by an electrometer in real time. Such a random behavior of single electrons is used for random-number generation suitable for a data processing which stochastically extracts the optimum solution among various ones. The use of electron transport in MOSFETs provides high controllability of the randomness, which prevents extracted solutions from staying at undesirable local minimum, as well as fast generation of random numbers. The present result promises new single-electron applications using nanoscale MOSFETs. [C1788]

"Future of silicon integrated circuit technology"

CMOS technology has been developed into the sub-100 nm range. It is expected that the nano-CMOS technology will governed the IC manufacturing for at least another couple of decades. Though there are many challenges ahead, further down-sizing the device to a few nanometers is still on the schedule of International Technology Roadmap for Semiconductors (ITRS). Several technological options for manufacturing nano-CMOS microchips have been available or will soon be available. This paper reviews the challenges of nano-CMOS downsizing and manufacturing. We shall focus on the recent progress on the key technologies for the nano-CMOS IC fabrication in the next fifteen years. [C1789]

"High-precision control of linear actuators with nonlinear friction"

In recent years, a high-precision stage control has received great attention due to the progress of nano-technology. A fast-response and high-precision control method based on the internal model control in the case where the controlled object has the integral characteristic is reported. The disturbance observer-based internal model control (DIMC) system has the advantages of no-overshoot, easy-design and simple-realization comparing to the conventional IMC method for the integral objects. However, an overshoot is generated when the model/plant mismatch exists. In the proposed method, since the plant model is explicitly included in the controller, the compensation for the dynamical change of the plant is easily realized by giving an adaptive identification mechanism to the plant model. Experimental results with an ultra-precision stage demonstrate that the proposed control system achieves high-precision positioning performance. [C1790]

"Fundamental analysis of resistive nano-crossbars for the use in hybrid Nano/CMOS-memory"

As a possible successor for CMOS memory, hysteretic materials organized in crossbar structures are currently being investigated. Here, passive materials are of special importance as they maintain their functionality even when scaled down to the nanometer domain. With their regularity and inherent device density so-called nano-scaled crossbars seem to be very interesting for future components beyond the present scope of the ITRS-CMOS roadmap. But, due to their passive behavior they will not be capable of operating on their own without active devices that restore signal levels. This work investigates the limitations resistive hysteretic crossbars face due to their very nature and what performance CMOS read circuits will have to offer to let hybrid circuits result in a functional new technology. [C1791]

"The future outlook of memory devices"

Summary form only given. Since the inventions of silicon memory devices at early 70's, silicon memory devices have been advanced with unprecedented pace which results in exponential growth of storage capacity of memory devices, and now they reach to 1Gb density with 60 nm node for DRAM and 16 Gb density with 50 nm node for NAND Flash. During the evolution of silicon memory devices for the last 3 decades, silicon memory devices on-and-off faced critical challenges which seemed to be very difficult to surmount at initial stage, but those challenges were eventually cleared by appropriate cost-effective solutions and some of challenges paradigm shifted silicon memory technologies from simple and common planar technology to complicated and diversified technologies such as planar transistor with 3-D capacitor and recently 3-D transistor with 3-D capacitor and etc. However, as the silicon technologies further enter deep nano-scale dimensions, silicon memory devices will encounter much critical challenges originated from ultimate limit of the transistor scaling and shallow margins in manufacturing due to ever-increasing fabrication costs resulting from technical complexities. Although there seems to be no unanimous solutions for silicon memory devices in future, most of experts working in silicon memory area, however, believe that silicon memory technology will be given right solutions down to a 20 nm node where a transistor contains only a small number of electrons, which is believed to be a practical limit to avoid noise errors owing to random telegraph noises, signal variations due to 1/radicn statistics, and fluctuations due to both rough edges of propagating lines and thickness variations and so forth. In addition, there are still many unknowns about the deep nano scaled memory devices. Thus, in this paper, in order to find the right directions of future semiconductor memory devices, key challenges and their possible solutions will be mainly discussed in views of basi- cs and key features of semiconductor memory devices, key technologies and designs. [C1792]

"Large-area molecular junctions"

Although still a relatively new field, molecular electronics can be regarded as the next evolutionary stage for plastic electronics. Molecular electronics holds the potential to fabricate elements for electronics circuits with a functionality that is embedded in just a single layer of molecules. Instead of using photolithography or printing techniques to etch or print nano-scale circuit features, molecular electronics can be engineered to use organic molecules that spontaneously form the correct structures via self-organization. Especially the theoretical prediction of unipolar rectifiers has led to a worldwide effort on the experimental verification. Transport through single molecules has been investigated by scanning probes, break-junctions and metallic cross bar devices. Molecular devices have been reported showing intriguing phenomena as rectification, negative differential resistances, stochastic switching, the Kondo-effect and conductance switching. The reproducibility however, is doubtful. Rectification is due to contacts and not related to the functionality of the molecule; negative differential resistances appear to be due to irreversible electrochemical reactions and stochastic switching due to molecular diffusion. Progress in the field of molecular electronics is hampered by the lack of reliable and reproducible data. In this presentation we will present a novel technology to fabricate in high yield large-area metal/self-assembled monolayer/metal junctions. The technology is based on the use of a conducting barrier in between the monolayer and the top metal to prevent the formation of shorts, and on processing junctions in photolithographically defined via holes to prevent cross talk. The technology is optimized for alkane(di)thiols to benchmark the electrical transport. [C1793]

"Model to hardware matching for nano-meter scale technologies"

With technology scaling becoming ever more difficult, the drive to continue to deliver performance and density has led to increasing technology complexity. Examples include the pervasive application of resolution enhancement techniques (RET) to enable sub-wavelength lithography and achieve circuit density, and strain engineering to improve device mobility and achieve circuit performance. The result of this increasing technology complexity has been a corresponding increase in the complexity of design/technology interaction. This phenomena demonstrates itself as a drastic increase in the number and complexity of design rules. Many of these rules are the result of the increase of the number and magnitude of systematic effects. In addition to these systematic sources of variability, we have an increasing host of random variations such as line edge roughness, which impacts channel lengths, and random dopant fluctuations, which impact threshold voltage. The net result has been a reduction in our ability to reliably predict the outcome of the manufacturing process. Given that the integrated circuit design process is based completely on our ability to create computer models of the expected behavior of a design, this gap in predictability is a source of grave concern. Model to Hardware matching attempts to close this gap by developing techniques, tools, and design components which can be used to improve technology predictability. [C1794]

"Low-voltage limitations of memory-rich nano-scale CMOS LSIs"

The low-voltage limitations of memory-rich nano- scale CMOS LSIs using bulk CMOS and fully-depleted (FD) SOI devices are described, focusing on CMOS inverter and flip- flop circuits such as six-transistor (6-T) cells in SRAMs and sense amplifiers in DRAMs. The limitations strongly depend on the ever-larger VTvariation, especially in SRAM cells and logic gates, and are improved by using the FD-SOI as well as by using repair techniques. Consequently, two possible LSIs are predicted to coexist in the deep-sub-100-nm generation: high-VDDbulk CMOS LSIs for low-cost low-standby-current applications and low-FDDFD-SOI LSIs for low-power applications. [C1795]

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"Long Live Small Fan-in Majority Gates Their Reign Looks Like Coming!"

This paper explores the reliability of three different minimum fan-in majority gates full adder (FA) designs, and compares them to the performance of a standard XOR-based FA. The study will provide insights into different parameters that affect the reliability of these FAs. The paper will also present estimates for the power consumption and the speed achieved by some of these FAs. All these simulations show that minimum fan-in majority gates FAs are: (i) more reliable; (ii) faster; while also (Hi) consuming less power (than a standard XOR-based FA). The detailed reliability results will be extrapolated to link to the probability of failure of the elementary (nano-)devices. Such speed-power-reliability performance analyses are certainly essential and very timely for a better characterization of circuit designs, but also for identifying those designs amenable to future nanoelectronic technologies. The main conclusions are that small fan-in majority gates perform better than standard Boolean gates in all cost functions: speed, power, area, and reliability. [C1797]

"Reliability Analysis of Quantum Cellular Automata Circuits Using Bayesian Networks"

Quantum cellular automata (QCA) is a new technology in nanometer scale as one of the alternatives to nano cmos technology, QCA technology has large potential in terms of high space density and power dissipation with the development of faster computers with lower power consumption. This paper considers the problem of reliability analysis of Simple QCA circuits at layout level like QCA latches and NOT circuit. The tool used to tackle this problem is Bayesian networks (BN) that derive from convergence of statistics and Artificial Intelligence. QCA circuit is transformed in to Bayesian framework for getting the probability of correct output and Reliability analysis performed on the resulting circuits for finding the defective cells in QCA circuit. This will increase overall efficiency of circuit and hence speed of the circuit with lower power consumption. [C1798]

"The Monte Carlo approach to transport modeling in deca-nanometer MOSFETs"

In this paper, we review recent developments of the Monte Carlo approach to the simulation of semi-classical carrier transport in nano-MOSFETs, with particular focus on the inclusion of quantum-mechanical effects in the simulation (using either the Multi-Subband approach or quantum corrections to the electrostatic potential) and on the numerical stability issues related to the coupling of the transport with the Poisson equation. Selected applications are presented, including the analysis of quasi-ballistic transport, the determination of the RF characteristics of deca-nanometric MOSFETs, and the study of non- conventional device structures and channel materials. [C1799]

"The future outlook of memory devices"

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"Large-area molecular junctions"

Although still a relatively new field, molecular electronics can be regarded as the next evolutionary stage for plastic electronics. Molecular electronics holds the potential to fabricate elements for electronics circuits with a functionality that is embedded in just a single layer of molecules. Instead of using photolithography or printing techniques to etch or print nano-scale circuit features, molecular electronics can be engineered to use organic molecules that spontaneously form the correct structures via self-organization. [C1801]

"Design the Nano manipulation system based on AFM: A system view with force feedback research"

The main goal of Nano technology is to analyze and understand the matter at the atomic and molecular level. While the researchers of Nano technology are lack of an efficient tool which can manipulate the material such as CNT to accomplish the CNT-FET or CNT-sensor. The manipulation robot based on AFM tip can perform the nano manipulation with the enhanced reality. This paper shows a system view of the Nano manipulation system and the system design of the manipulation system. We can build nano manipulation robot based on the system we design with the help of haptic device. [C1802]

"Molecular Communication A Biochemically-Engineered Communication System"

Molecular communication uses molecules (i.e., chemical signals) as an information carrier and allows biological and artificially-created nano- or cell-scale devices to communicate over a short distance. It is a new communication paradigm and is different from the existing communication paradigm that uses electromagnetic waves (i.e., electronic and optical signals) as an information carrier. Key research challenges in molecular communication include design of a sender, design of a propagation system, design of a receiver, design of a communication interface, and mathematical modeling of the molecular communication components and system. This paper describes the design and the initial experimental results of a communication interface, a propagation system, and a receiver in molecular communication. [C1803]

"Arithmetic and architectural design to reduce leakage in nano-scale digital circuits"

Most of the power consumption, in standard CMOS, has in the past been related to the dynamic activities. However, in nano-meter scale technologies the static power, i.e. leakage, is an important contribution to the total power consumption. This paper discusses static and dynamic power reduction methodologies on architectural and arithmetical level. Techniques to reduce the static power consumption in digital applications for nano-scale CMOS technologies are addressed. A 79% arithmetic reduction of the static power consumption is indicated, by using serial arithmetic instead of bit-parallel. Digit-serial arithmetic shows power reductions between 32 and 67%, depending on the digit size and technology. [C1804]

"How Many Gates do we Need in a Transistor?"

The migration from single-gate to multiple- gate SOI transistors is inexorable but still includes a number of hesitations and dilemmas. In this context, we review the main motivations, technological achievements, physics-related implications and future challenges. Specific aspects governing the operation of multiple-gate transistors are discussed with the aim of clarifying the strategic trends. The physics mechanisms are briefly evoked. The road is difficult with many turns; hopefully, it looks long enough. Generic milestones are: nano-size, multiple-gates, innovative ideas and multi-facet SOI technology. [C1805]

"Robust Assembling System for Photosynthesis-Based Microbiosensors"

A micro-biosensor is a complex device and, at micro-nano scale, the stability of multiple phenomena interactions depends critically on a multitude of factors. To build a robust micro-biosensor, a special attention for reliability issues must be paid. In a previous work, solutions for building an amperometric micro-biosensor based on the inhibition of the photosynthesis process at cyanobacteria, are introduced. In this paper, the improvement on reliability criteria of the innovative assembling system of the micro-biosensor is presented. First, the technological conditions for performing the mounting processes where established following the directions resulting by the "design for reliability" approach. The devices where tested by accelerating the relaxing of the internal stresses. In a second stage, the technological conditions where optimised, based on the experimental reliability results. [C1806]

"Nano-Metrology between Necessity and Reality"

Microscopes (optical, scanning probe, atomic force, WLI, SNOM, confocal) are being increasingly used as metrology tools in industrial applications, thus driving an increasing demand for accuracy in these instruments. Some properties commonly measured in nanotechnologies are feature spacing (pitch), feature height (or depth), feature width (critical dimension), and surface roughness. To achieve high accuracy in all these measurements, the scales of an instrument should be calibrated. A quasi-generalized confusion between resolution and accuracy makes researchers not habituated to measurement to use high resolution instruments in improper conditions and report results with too many significant (?!) digits. The last digit must be not the resolution but the one indicated by the uncertainty of measurement. As a rule for the commercial instruments used for observation in nanosciences and nanotechnologies, their intrinsic accuracy is not indicated, but only the resolution. Necessary commentaries regarding nanometrology are presented in this paper. [C1807]

"Synthesis of threshold logic circuits using tree matching"

Threshold logic has been known to be an alternative to Boolean logic for over four decades now. However, due to the lack of efficient circuit implementations, threshold logic did not gain popularity until recently. This change is motivated by new and efficient alternative CMOS implementations for threshold logic and futuristic nano devices like RTDs and SETs which possess inherent threshold properties. This paper motivates the need for threshold logic, and justifies it as an alternative design technique in the post-CMOS era. We present a novel synthesis algorithm for threshold circuits based on tree matching. In comparison with the previous state of the art methods the proposed method demonstrates an improvement of 25% in the number of gates required (max improvement is 50%) and comparable circuit depth. [C1808]

"High efficiency solar photovoltaic and thermo-photovoltaic device technologies"

This paper presents a review of various PV cell technologies, discussing advanced device structures, manufacturing processes and cell performances. The focus will be on silicon (single crystalline, polycrystalline, amorphous), III-V, II-VI, Cu-In-Ga-Se based cells. Cells and systems designs for incorporating light concentrators and for utilizing multiple light wavelengths will be discussed. For TPV applications, methods to manufacture low cost high efficiency cells based on bulk crystals of ternary III-V semiconductors will be presented. Some of our advanced cell designs for MTPV systems based on back-illumination will be shown. Higher efficiencies are predicted for TPV systems using nano-structured photonic band-gap crystal emitters (PBG-TPV). Some of the initial theoretical predictions and development of individual components for PBG-TPV and their characteristics will be discussed. [C1809]

"Concepts in next generation photovoltaic devices-materials engineering perspective"

Summary form only given. Over the next quarter century photovoltaic (PV) electricity generation is projected to grow at a double digit rate. Advancements in PV device architecture, improvements in processing technologies, manufacturing scale-up, and a broader adoption of grid-interconnection standards are expected to enhance this growth further. In this presentation current state of the art in PV device fabrication techniques will be reviewed as well as concepts for developing photovoltaic devices that are nano-architectured to achieve higher device efficiency and for lowering the manufacturing costs by the use of traditional processing techniques will be discussed. [C1810]

"SEM investigations of the surface and cross-section features of ZnO NWs under FIB treatment"

We investigated vapour phase epitaxy (VPE)-grown ZnO nano-wires (NWs) on a Si substrate by scanning electron microscopy (SEM). SEM investigations show that there are single NWs and ensembles of NWs, among which we found straight and bend, perfect and non-perfect NWs, as well as NWs with clean surfaces and surfaces with the dark spots and features. After focused ion beam (FIB) polishing we found that every NW has a clean homogeneous surface, which allow us to conclude that all those dark spots and surface features of the NWs really are just surface features. The FIB milling gives information of the deeper interior of the NWs. [C1811]

"QCA-LG: A tool for the automatic layout generation of QCA combinational circuits"

Quantum-dot Cellular Automata (QCA) is a promising successor for CMOS transistor technology, while allowing the implementation of logic circuits using quantum devices, such as quantum dots or single domain nano magnets, a new set of tools must be developed to assist the design and implementation process. Examples of such tools are the QCADesigner for handmade layout and physical simulation, and also tools for majority logic optimization. Since no tool is available for assisting the QCA layout generation, we propose tool to automatically generate the layout of QCA circuits. This tool, designated by QCA-Layout Generator (QCA-LG), was integrated in a general QCA technology design flow, accepting the most used formats of the synthesis tools and producing the layout output according to the QCADesigner tool. Therefore, the layout of a logical circuit described in VHDL is automatically generated, and can be further optimized by hand and simulated using the QCADesigner. Examples of layouts automatic generated by the QCA-LG are presented for simple logical circuits, and are also compared with optimal layouts designed by hand. [C1812]

"Networks of Research Collaboration in China: Evidence from Nanotechnology Publication Activities, 1990-2006"

The article shows there has been exponential growth overall in nano publication in China, there has been only linear growth in international publication collaboration. Potential explanations for this include increased internal incentives for publication in China in WoS-listed journals and for Chinese researchers to return home. However, there are quality differences between articles by author and collaboration type. Statistical testing indicates that internationally collaborated articles, articles by scholars in Chinese Academy of Science or top 10 Chinese universities, and articles involved Hong Kong scholars are more likely published in journals with high impact factors (IF), and receive high citations. These findings help to highlight China's emerging strengths in nanotechnology and the role of network relations in underpinning these developments. [C1813]

"Nanodistricts in the United States: Metropolitan Trajectories and Clustering (December 2007)"

There are a number of theories that suggest emerging technologies will not be distributed equally across a region, rather they will be concentrated in certain locations. If this is the case, this distribution has implications for where future economic opportunities as well as future risks will be concentrated. In this paper, we probe nanotechnology (hereafter nano) research and commercialization at a regional level. The aim of this research is to examine the top 30 "nanodistricts" or metropolitan areas in the US with more than 1000 nanopublications in the 1990-2006 timeframe. We explore the factors underlying the emergence of these metropolitan areas into this top class through exploratory cluster analysis. We find that while most of the leading nanodistricts are similar to top cities in previous rounds of emerging technologies, there is also the surfacing of new geographic concentrations of nanotechnology research. Some of the latter types of nanodistricts are found in nontraditional places for new technology development that have large concentrations of research at a single government facility or university research institution. This finding suggests that concentrated investments in nanotechnology R&D into a single institution can elevate the profile of a region that has lacked previous technological prominence. However, questions are raised as to whether nanotechnology-related knowledge will be able to be exploited and commercialized in these new research locations. [C1814]

"Fundamental concepts of power and energy measurement with the computer-aided-design tools"

Computer-aided design (CAD) tools are frequently employed to verify the design objectives before the fabrication of an integrated circuit. Circuit simulators typically provide built-in functions to measure the power consumption. However, the accuracy of the measured power is mostly overlooked since the approximations and the methodology used by the existing built-in power estimation tools are not well documented. A blind-trust in the CAD tools may lead to gross errors in the power estimation. A generic methodology to accurately measure the power and energy consumption with circuit simulators is described in this paper. An equation to calculate the device power consumption based on the different current conduction paths in a MOSFET is presented. An expression for the total power consumption of a complex circuit is also derived by explicitly considering the different circuit terminals including the inputs, the outputs, and the body-contacts. Results indicate that the built-in functions of commercial circuit simulators can produce significant power measurement errors in a 65 nm CMOS technology. For deeply scaled nano-CMOS circuits producing significant leakage, a conscious power measurement with the proposed explicit methodology is recommended for an accurate pre-fabrication circuit characterization. [C1815]

"Thermal behavior of Sn nanowires for nano-interconnection"

First Page of the Article [C1816]

"Microsystems engineering from nano to micro and macro"

Biological systems are networks of structures at different physical scale hierarchies that operate at performance levels set by fundamental physical limits, under severe constraints of size, weight and energy resources. They are indeed, engineering marvels of heterogeneous integration and structural complexity. In this talk I begin first with an overview of emerging information technologies. I then proceed to describe work in my lab demonstrating how we are exploring the characteristics of the devices at the different physical scales, from nano to micro and macro to obtain useful functionality at the system level. I will describe microsystems for bio-sensing, polarization imaging and interferometric optical readout. Our systems incorporate silicon integrated circuits, electromechanical elements, active and passive micro-optical elements, as well as "soft" polymer and biological macromolecules. Looking ahead at the challenges that we face as we seek to synthesize such heterogeneous microsystems, Nature, is undoubtly, a good place to draw inspiration! [C1817]

"Adaptive filters realized with nano-scale VLSI circuit technology"

This paper investigates design strategies for achieving reliable performance in VLSI adaptive filters that are prone to transient errors due to increasingly smaller feature dimensions and supply voltages of the CMOS circuits. First it will be shown that stochastic search algorithms (e.g. Particle Swarm Optimization) have a natural resistance to transient errors. It is then shown how modular hardware based on residue number system (RNS) coding can be designed to more effectively manage transient errors in adaptive filters with stochastic search algorithms. [C1818]

"Modeling of temperature effects on nano-CMOS devices with the predictive technologies"

Predictive technology model (PTM) enables early device and circuit characterization by providing the research community the expected profiles of devices in the future technologies. The parameters that need particularly accurate estimation are the speed and the power consumption. Fluctuations in the die temperature affect the device characteristics thereby altering the performance of integrated circuits. Furthermore, increase in the doping concentration and the enhanced electric fields in scaled devices tend to affect the rate of change of device parameter variations when the temperature fluctuates. For precise characterization of the MOSFETs at various temperatures, the parameters that model the temperature effects have to be accurately extracted. With the PTMs, however, the model parameters that characterize the temperature effects are typically transferred from an older technology generation without any change. This inappropriate transfer of parameters across different generations of predictive CMOS technologies may lead to gross errors during the characterization of CMOS circuits at various die temperatures. In this paper, the principle factors that determine the device characteristics when the temperature fluctuates are presented. The impact of technology scaling on the temperature fluctuation induced variation of the device parameters is illustrated. The parameters that model the temperature effects of the predictive technologies are compared. The study indicates that the device and circuit characterization with the PTMs may not be reliable at temperatures other than a single nominal temperature where the critical model parameters are extracted. [C1819]

"Temperature-adaptive body-bias and supply voltage scaling for enhanced energy efficiency in nano-CMOS circuits"

Temperature dependent propagation delay characteristics of CMOS circuits will experience a complete reversal in the near future. Contrary to the older technology generations, the speed of standard zero-body-biased circuits in a 32 nm CMOS technology is enhanced when the temperature is increased at the nominal supply voltage. The enhancement of circuit speed provides new opportunities to lower the energy consumed by active circuits at elevated temperatures. Temperature-adaptive supply and threshold voltage tuning techniques are proposed in this paper to reduce the high temperature active mode energy consumption without degrading the circuit speed. Results indicate that the energy consumption can be lowered by up to 21% by dynamically scaling the supply voltage at elevated temperatures. An alternative technique based on temperature-adaptive reverse body-bias exponentially reduces the leakage currents as well as the parasitic junction capacitances of the MOSFETs. The temperature-adaptive threshold voltage tuning through reverse body-bias yields an active mode energy reduction by up to 29.8% as compared to the standard zero body-biased circuits at high temperatures. [C1820]

"Reducing Leakage Power in Fixed Coefficient Arithmetic"

Most of the power consumption has in the past been related to the dynamic activities, in a CMOS circuit. However, the static power, i.e. leakage, is a major contribution to the total power consumption, in present nano-meter scale technologies. This paper discusses static power reduction methodologies on architectural and arithmetical level. Novel arithmetic techniques to reduce the static power consumption in digital applications for nano-scale CMOS technologies are addressed. An arithmetic reduction of the static power consumption down to 6 % by using bit-serial arithmetic compared to bit-parallel is indicated. [C1821]

"In-depth measurement of 60GHz band near-field and transmission mode microscopy"

The study on the near-field microscopy at the millimeter- and submillimeter-wave bands has been flourishing for diagnosis of bio-, nano- and micro-structures. In this research, the in-depth detection capability in the near-field by the transmission mode measurement at 60 GHz band has been investigated. First, the groove engraved with various depth of 0.1- 0.9 mm, the in-depth resolution is 0.5 mm. Second, the voids with 1 mm-dia are formed by various in-depths at 0.5-10 mm under the surface of Teflon. The void down to 2 mm can be detected. Final, a pore on the TiO2sheet with the thickness of 2.4 mm, it is shown in scanning the surface that a pore with about 0.8 mm-dia located at the surface can be detected. [C1822]

"Design of high-Q photonic crystal cavities designed by air-holes infiltration"

We design novel photonic crystal slab heterostructures, substituting the air in the holes with liquid crystal, polymer or nano-porous silica. We demonstrate numerically that such cavities can have quality factors up to Q=106. [C1823]

"2007 International Semiconductor Conference"

The following topics are dealt with: nanoelectronics; microsystem technology; microphotonics; microwave devices and circuits; RF MEMS; advanced materials; materials for micro and nano scale; and power, high speed analog ICs. [C1824]

"Low Voltage Programmable Double-Gate MOSFETs Current Mirror and Its Application As Programmable-Gain Current Amplifier"

This paper presents programmable simple and cascode current mirrors, based on novel double gate (DG) MOSFETs. The programmable current mirror has a wide tuning range, a wide bandwidth and low supply voltage of 1V. As an application of the programmable current mirror, we present a programmable-gain current amplifier. SPICE simulation results for 100-nm DGMOSFET and 1V supply voltage indicate good performance for the proposed circuits. [C1825]

"System-Level Design for Nano-Electronics"

Latest fabrication technologies of self-assembly nano-circuits (carbon nanotubes, silicon nanowires, etc.) have deployed bottom-up techniques that reach feature sizes well below 65nm, holding great promise for future large silicon-based integrated circuits. However, new nano-devices intrinsically have much higher failure rates than CMOS-based ones. Thus, new design methodologies must address the combination of device-level error-prone technologies with system integration constraints (low power, performance) to deliver competitive devices at the nanometer scale. In this paper we show that a very promising way to achieve nano-scale devices is combining imperfection-aware design techniques during fabrication with gate defect modeling at circuit level. Our results using this approach to define a Carbon Nanotube Field-Effect Transistor (CNFET)-based design flow for nanoscale logic circuits attain more than 3ГѓВ— energy-delay-product advantage compared to 65nm CMOS-based ones. [C1826]

"Adhesive and mechanical properties of Carbon nanotube filled thermoplastic polyimide films for microelectronics packaging"

In this study the mechanical and adhesive properties of Multi-walled carbon nano- tubes (MWNTs) filled polyimide composite films (MWNT-PI) are investigated to determine their usefulness as thermo-conductive packaging materials in microelectronics. MWNTs were mixed in low wt% during synthesis at poly(amic acid) (PAA) stage. MWNT-PI films were characterized using DMTA and tensile testing to determine viscoelastic behavior and mechanical properties. Adhesive strength and adhesive energy of bonded samples were determined in accordance with ASTM D 1002 and ASTM D 3762 respectively. The fractured surfaces were examined by scanning electron microscope (SEM) to determine failure patterns. The results showed that viscoelastic behavior of MWNT-PI films changes from liquid-like to solid-like with increasing MWNT wt content. Elastic modulus and strength at break of the composite films were found to increase with increase in MWNTs wt%. However, elongation at break and breaking energy of films and lap shear strength and adhesive energy of bonded samples were found to initially increase with increase in MWNTs wt%, but then after a critical value decreases. [C1827]

"Response Surface Methodology for statistical characterization of nano CMOS devices and circuits"

The accurate prediction of the impact of process variations on circuit performance is very crucial in deciding the parametric yield of integrated circuits. This paper presents the simulation methodology for studying the impact of process variations on device and circuit performance in nanometer regime. In this paper, an empirical model for power and delay of 45 nm node CMOS inverter is build using the well-known response surface methodology. This work also compares the suitability of different response design in terms of model accuracy. [C1828]

"Nano-featured highly interconnective macroporous elastic scaffolds for cardiovascular tissue engineering"

The lack of suitable scaffolding materials and viable scaffold design is challenging the success of tissue engineering. In the present study, we developed a new scaffolding strategy using a secondary porogen, poly(ethylene glycol) dimethyl ether along with sieved salts based on traditional salt-leaching method. This new scaffolding technology could allow us to fabricate nano- featured highly interconnective macroporous biodegradable elastic scaffolds based on a newly developed crosslinked poly(l,8-octanediol citrate) (POC) for cardiovascular tissue engineering. [C1829]

"Directly Pumped Silicon Lasing"

Enhanced photoluminescence and 1.28 mum laser emission from nano-engineered silicon originating respectively from phonon k-selection rule breaking and point defect-mediated phononless recombination in an array of emissive structural deformation zones in a SOI wafer are reported. [C1830]

"Anything more than size in nanoelectronics"

In this talk, the author give a survey of this important technical field, and also efforts at National Nano Device Laboratories (NDL) for Si-based devices and architectures that maybe implemented along the roads toward 22 nm-node CMOS and beyond for more and more than Moore. In particular, the author deal with some device solutions using Ge or III-V semiconductors for enhancing performance and functionalities, as well as issues relating to so-called heterogeneous integration of these devices with existing Si chip systems. It is noted that for nano-sized p-MOS, Ge channel might be a good solution, but for n-MOS there are server limits even considering the implementation of some III-V semiconductors as the channel materials. Furthermore, some routes to integrate functional devices for electronic-photonic convergence and bio-electronic applications was also discussed. [C1831]

"Study on Physical Properties of Organic Resist Spacers on Color Filters"

The nano-particle photo spacers with superior physical characteristics has technically fabricated into the defined pattern using lithographic processes in color filters manufacture processing. Cylinder-like photo spacers with several heights on the surface of subpixel cells in the defined pattern can be achieved by modulating process parameters. The dimension, height and shape of photo spacers are consistent with the designed pattern size in the mask and promise the reliable stability of the photo spacer materials. Elastic recovery ratio of the defined pattern photo spacers is initially increased and then decreased with the increase of the applied loading. [C1832]

"20 years of Microprocesses and Nanotechinology Conference"

Summary form only given. The Microprocesses and Nanotechnology Conference (MNC) celebrates 20th anniversary this year. This paper presents the history and prospect of the MNC with looking back many papers presented at the conference. The MNC was established in 1988 for a conference discussing lithography and other micro-fabrication technologies for semiconductor industries in Asia, like the 3-beams-conference, now electron, ion, and photon beam technology and nanofabrication (EIPBN), in the United States and the micro-and nano-engineering (MNE), in Europe at the time. Over the past 20 years, the conferences were held mainly in Japan including twice holding abroad, in 1994 Taiwan and in 1998 Korea. Consequently, papers from Asian countries besides Japan have been increasing steadily since 1998. This year, papers from Asian countries exceed 35% of the total papers. The conference name of MNC was changed from the former name of Micro Process Conference (MPC) in 1997, expecting the increasing prosperity of nanotechnologies. The conference, then, have been coverings nano fabrication, nano devices and materials, and their physics and applications, as well as equipments (tool technologies) using photons, electrons, ions, and other energetic particles. To extend application areas further, MEMS and micromachining have been added to its scope in 1997, and also biotechnology and so-called lab-on-a-chip were added in 2000. Imprint lithography also was added in 2003. In this way MNC has played a key role not only being a center of excellence specializing in lithography but also providing a forum discussing on cross-disciplinary areas. In the presentation we introduce several papers selected from those contributed over the past 20 years which showed outstanding quality in originality or foresight. They presented new concepts and significant advances together with the background of the research at the time. We also introduce papers which have made outstanding contributions to the-introduction and growth of newly appearing the subjects. Some technologies have been faded out as time goes by, however the knowledge has lived on in succeeding generation. New things will be found by studying the old. The presentation material is exhibited in the MNC anniversary DVD booklet together with all abstracts for the 20 years of the conference series. [C1833]

"Embedded SRAM trend in nano-scale CMOS"

This paper describes an SRAM scaling trend in terms of bit-cell size and operating voltage (Vdd) in a nano-scale process generation. The key design solutions to extend a 6T SRAM lifetime are reviewed and discussed including a possible bit cell scaling trend comparing with an 8T SRAM as one of the successors. Each dependency of 3 key margins of write margin (WRM), static noise margin (SNM), and cell current (Icell) on the scaling ratio of Vdd and MOSFET channel feature size has been shown to clarify the real issues in the scaling. The bit cell area scaling trends of 6T and 8T SRAMs are predicted. It has been shown that the area of 6T will be getting closer to that of 8T at 32 nm and should cross over around 22 nm. [C1834]

"Leakage current control of nano-scale full adder cells using input vectors"

As CMOS technology scaling continues into the nanoscale domain, static or leakage power consumption becomes a vital design parameter. This paper proposes methods for reducing leakage currents by controlling the input vector in nano-scale full adder cells operating in either active mode or standby mode. With proper input vector control, it is possible to obtain over 40% leakage power savings for most of the full adder circuits presented. [C1835]

"Characterization of 90 nm SOI SRAM Single Cell Failure by Nano Probing Technique and TCAD Simulation"

The single cell failure of a 90 nm SOI SRAM cell presents a difficult challenge for physical failure analysis, including cross sectional TEM, planar TEM, PVC, and FIB. The physical analysis of the failing SRAM cells by these techniques often did not find any visual defects. In order to locate the defects of the failed SRAM cells, a characterization of the transistors of the failing SRAM is needed. A nano probing technique performed in a failure analysis lab allows us to identify anomalies of the transistor characteristics, like Vt asymmetry and low Id current. With the help of TCAD simulation, a correlation between the failure mode and electrical measurement can be established and a process fix can be implemented. [C1836]

"Effect of Variable MgO doping on Structural, Electrical and Thermal properties of PZT Pb[CZr0.7 Ti0.3]O3 nano ceramics derived by Sol-Gel Technology, to be used as Dielectric Material for Temperature Sensitive Variable Capacitors"

Lead zirconium titanate (PZT) piezo ceramic system was discovered by Jaffe.et.al. The coexistence of rhombohedral and tetragonal phases at morphotropic phase boundary (MPB) composition, has been well established by various researchers across the globe to have superior dielectric and piezoelectric properties. Modification of various properties of PZT nano ceramics by addition of dopants have been researched extensively for further improvement of dielectric and piezoelectric properties, so as to make them suitable for various applications such as actuators, transducers and ceramic capacitors. One significant merit of PZT ceramic over other synthetic engineering composites is that, by doping foreign ions to substitute a part of the host atom; can modify their piezoelectric and dielectric properties significantly, depending on the site occupied by the ion in the ABO3type perovskite structure. The dopants are classified as isovalent, acceptor or donor. For isovalent doping, the substituting ion has the same valency and the same ionic size as the replaced ion. For example Sn+4substitute (Zr,Ti)4+or Ca+2substitute Pb+2, which has been shown, to enhance the dielectric properties[4]. The isovalent substitution generally causes a little influence on the dielectric properties due to fluxing effect of the doping ions during the period of sintering and hence makes characterization technique easier. For acceptor doping, the substituting ion have lower valency and ionic size as compared to the replaced ion. For example Fe+3, Mg+2can substitute (Zr,Ti)+4or Na+can substitute Pb+2. The existence of intrinsic lead vacancies introduce space charge and internal field inside the PZT grains. It restricts the domain motion, thereby increasing the cohesive field but reduces the dielectric constant significantly. These are known as hard PZTs, because higher electric field is-required to pole these ceramics. The donor ions on the other hand reduce the concentration of intrinsic oxygen vacancies, created due to PbO evaporation during sintering. These substituting ions have higher valency and ionic size as compared to replaced ions. The donor ions introduce lead vacancies to maintain the charge neutrality, for example La+3can substitute Pb+2or Nb+5can substitute (Zr,Ti)+4. The increase of lead vacancies can generate electrons by ionization. Most of the holes from the Pb vacancies are compensated by electrons from donor level to make the resistivity high. They can be easily poled and hence are called soft PZTs due to lower electric field values required to pole these ceramics successfully. They are known to have higher dielectric properties. The main objective of the present work is to investigate the effect of MgO doping with variable weight percentage on structural and dielectric properties of PZT having a fixed Zr/Ti ratio of 70/30, prepared by sol-gel technique, which has been reported to be superior over solid state reaction technique used earlier, with a view to homogeneity, purity and reactivity of the prepared sample. Thereby determining the best doping percentage of Mg with PZT (70/30) with respect to a linear variation of dielectric constant with temperature over a wide range, so as to make the doped material suitable to be used as a thermal sensor, when incorporated as dielectric in a variable capacitor. [C1837]

"Accurate Performance Evaluation of HEMT Devices for High-Speed Logic Applications through Rigorous Device Modelling Technique"

Tremendous progress has been made recently in the research of novel nanotechnology for future nano-electronic applications. Among all the possible technologies, III-V FETs particularly the heterostructure high electron mobility transistors (HEMT) have demonstrated promising results to be the future device technology for high-speed logic applications. Precise evaluation of the delay performance for HEMT requires highly accurate intrinsic device models extracted from available measurements. In this paper, a rigorous device modelling technique based on 3-D full wave electromagnetic analysis of the device structure is presented. This technique is efficient and accurate, and the determined equivalent circuit model fits the measured S-parameter very well within the frequency range of interest. [C1838]

"Crosstalk and delay optimization techniques for nano scale interconnects"

As integrated circuits (ICs) are scaled into nanometre dimensions and operate in gigahertz frequencies, interconnects have become critical in determining system performance and reliability. In this paper we propose a new approach to investigate crosstalk reduction techniques which helps to have simultaneous optimization of interconnect delay and crosstalk noise in deep submicron VLSI circuits. The optimization problem is modelled by solving a new cost function to find a minimum cost for both crosstalk noise and delay which are conflicting in nature. Through MATLAB software, a system of three coupled wires is modelled as a RC distributed network. The results indicate the number of optimum available solutions including wire sizing, wire spacing and buffer insertion in which crosstalk reduction techniques can be useful for both crosstalk noise and delay. [C1839]

"Detection and review of crystal originated surface and sub surface defects on bare silicon"

The continuous dimensional reduction for micro-and nano electronics is driving the technology for yield relevant defect detection. Defects originating in the crystal are always present in silicon wafers. Due to miniaturization, the size of these defects becomes comparable to the feature sizes of future technology generations. Therefore, they are identified as a future yield limiting mechanism. This paper shows that crystal originated sub surface defects impact the performance of dark Held Scanning Surface Inspection Systems with respect to defect counts, defect classification, defect sizing, and capture rate. [C1840]

"Eliminating uT induced memory fails through waferless auto clean"

In this paper, micro trenching (muT) on silicon substrate caused by the poly gate etch process, was found to be the root cause of memory bin failures (MBIST) in our 0.15 mum devices. Through advanced FA techniques using CAFM (conductive atomic force microscopy) & nano probing, we found that the micro trenching MBIST failures occurs primarily due abnormal leakage across the gate due gate oxide damage next to the micro trench. In severe cases transconductance degradation of the Pass gate (PG) transistor was observed. We discovered the micro trenching phenomena was due to 'cold' poly etcher chamber effect. A novel method by running Pre-WAC (waferless auto clean) using the O2 and SF6 gas before polysilicon etch was found to be effective in eliminating the fails. [C1841]

"Process Integration of Inkjet Printing and Electroless Plating for LTCC Substrates"

This paper reports on our latest development in mask-less patterning of conductors on LTCC (Low Temperature Co- fired Ceramic) by integrating inkjet printing with electroless plating process. The objective of this process integration is to realize reliable, high aspect interconnections and passives on LTCC substrates. Due to the intrinsic properties of the inkjet printable ink, the printed ink typically forms thin film. Hence the resistance of the traces is much higher than conventional bulk metal traces. In this study, we aim to alleviate these limitations by integrating the inkjet printing process with electroless plating process. Co-fired LTCC was used as the substrate, and silver nano-particle colloidal solution was used as printing ink. Conductive lines were inkjet printed on LTCC substrates, followed by curing in conventional oven. Thickness of the conductive traces was successfully plated up to 76 mum. The optimization of inkjet printing process, surface study of inkjet printed seed layer and process integration are presented with details. [C1842]

"Determination of Mechanical Properties of Differently Oriented ГЃВџ-Tin Crystals in Small Solder Joints and Small Tensile Specimens using EBSD and Nano Hardness Measurements"

In modern electronics solder joints are mostly composed of a lead-free solder alloy and interfaces of tin, nickel/gold or copper at the component and the circuit board side. Mostly SAC (SnAgCu)-alloys will be used in electronic products with high tin content. In the course of design and development the volume of these solder joints decreases rapidly. With this the solder joint exists only of some-one to four-single tin crystals with eutectic parts, and the percentage of the intermediate compounds that grow at the interface of the component/circuit board and solder increases rapidly. The orientation of the anisotropic tin crystal and the intermetallic phases plays an important role concerning the reliability of a solder joint. However, very few information about their physical and mechanical properties is known in literature depending on their orientation. The orientation of the tin crystals was determined by EBSD measurements in cross sections of solder joints and tensile specimens. Micro/Nano hardness measurements and tensile tests of differently oriented beta-tin crystals in solder joints and small tensile test specimens were made to get information whether the grain orientation influences the mechanical behaviour as hardness, Yield strength and tensile strength. The nano hardness was determined by Vickers indentation. For example, the Vickers hardness of different oriented tin crystals-between [320] and [001] orientation-ranges between 16 and 28 VHN (0.16-0.28 GPa). The [001] oriented crystals show the highest hardness. A correlation to the other material parameters as Yield strength and tensile strength will be discussed using stress-strain diagrams of different SAC alloys. [C1843]

"Electrical Noise Analysis of an Integrated Patch-Clamp Amplifier"

This paper presents an evaluation of electrical noise sources and signal-to-noise limitations in a fabricated integrated patch-clamp amplifier. We also present numerical calculation of the theoretical noise of the patch-clamp system. Our fabricated device was measured to have less than 4pA of rms noise at 10 kHz bandwidth, similar in performance to commercial bench- top systems. The integrated patch-clamp can accurately measure nano-Amperes of current and is intended for a high-throughput system that can screen a large number of cells in parallel. The fabricated device consumes 1480 by 1300 mum of silicon area and 3.2 mW at 3.3 V of power. The device was fabricated using AMI 0.5 mA Micron technology. [C1844]

"Device optimization of bulk FinFETs and its comparison with SOI FinFETs"

FinFETs are the leading candidates for sub 32nm technology node owing to their increased immunity to short channel effects and better scalability. Most of the fabricated FinFETs are on SOI substrates. But fabrication of FinFETs using the bulk CMOS substrates instead of SOI technology is also of interest since it reduces the process costs. But bulk FinFETs have the disadvantage of sub channel leakage for very short channel lengths. Reported work on Bulk FinFETs, use highly doped channel for preventing the leakage. Body doping just beneath the fin is also considered a possible way to prevent this leakage. In this work, we evaluate the effect of different body doping profiles in un-doped channel bulk FinFETs, for controlling the sub channel leakage and propose the optimization of the same. We also bring out the other advantages of body doping such as an increased immunity to body effect from the circuit performance point of view. We also show that device parasitics play a crucial role in the optimization of nano scale bulk FinFETs. [C1845]

"Modeling and Simulation of Nano-Interconnects for Nanophotonics"

In this paper we model and simulate some nano-interconnects for nanophotonics. Both frequency- and time-domain methods are used for their analyses. Different cases are considered for nano-interconnects, including the nanostrips and coupled nanowires. It is observed that these structures guide the signals to the desired positions effectively at nano scale level. [C1846]

"Package-On-Package Mechanical Reliability Characterization"

POP (package-on-package) integration is achieved by stacking laminate substrate packages in vertical direction and interconnecting them with solder balls. Some mechanical reliability issues were addressed through POP development. In particular, package warpage and Si delamination were dominate issue. Package warpage was characterized with FEM-modeling, Shadow Moire and viscoelastic property measurement. Substrate and mold compound optimization techniques are explained in this paper. Also, Si delamination was characterized with FEM-modeling, OMI strain tool (digital image analysis), scratch tester and stress senor TEG. Si surface strength was measured with scratch tester. Si stress and displacement in the package were measured with OMI strain and stress senor TEG. Design optimization for Si delamination is also explained in this paper. Board level drop test performance is also critical issue for POP. So, nano particles of a solder effects on drop test performance is described. Co, Ni, Pt, Al, P, Cu, Zn, Ge, Ag, In, Sb or Au inclusions in Sn-Ag based lead free solders were evaluated to study if these nano particles can improve drop test performance. It was found that some nano particles could improve the performance. This papers describes POP mechanical reliability characterization with some tools. [C1847]

"Application Oriented Micro-Nano Electro Mechanical Systems"

Micromachining is an extended IC fabrication based on photo-fabrication, deep etching, anodic bonding and other advanced process technologies. This is used to produce MEMS (Micro Electro Mechanical Systems) featuring multi-functions, small size and low cost. Nanostructures such as CNT (Carbon Nano Tube) can be also included in the MEMS by nanomachining. MEMS are used as value added key components in systems. Examples of application oriented MEMS developed with attention to packaging and circuit integration will be described below. Silicon rotational gyroscope has been developed for the purpose of motion control and navigation. The principle and the photograph are shown. A 1.5 mm diameter silicon ring which is electrostatically levitated by digital control using capacitive position sensing and electrostatic actuation is rotated at 75,000 rpm. The rotation is based on the principle of a variable capacitance motor. A 5mum radial gap between the ring rotor and stator electrodes is formed using deep RIE (Reactive Ion Etching) of a silicon wafer. The silicon is anodically bonded on both sides to glasses which have electrodes. The chip is packaged in a vacuum cavity to prevent a viscous dumping. This inertia measurement system can measure two axes rotation and three axes acceleration simultaneously with high precision (sensitivity 0.01 deg/s and 0.2mG respectively). [C1848]

"Eduction's Position Control of the Incorporated Gallium in the Diamond-like Carbon Deposited by Focused-Ion-Beam Chemical-Vapor-Deposition"

Summary form only given. Deposited materials by focused-ion-beam chemical-vapor-deposition (FIB-CVD) have a lot interesting material characteristics. It contains the gallium (Ga) because Ga is implanted by Ga+FIB irradiation. Atomic ratios of the diamond-like carbon (DLC) deposited by using phenanthrene (C14H10) as a gas source for FIB-CVD is C: Ga = 95: 5. And, it is noted that the incorporated Ga in DLC is segregated again from DLC by annealing treatment. By annealing treatments at approximately 400 degree C, the segregated Ga is appeared on the DLC surface in form of the sphere. However, Ga sphere is appeared on the random position of DLC surface. There have not yet been any reports concerning the method for the eduction's position control of

Ga contained in DLC deposited by FIB-CVD. So, the several experiments were carried out to examine the eduction process of incorporated Ga from the nanostructure made of DLC. As a result, we found that the eduction's position control of Ga sphere could be achieved by via hole fabricated on the nanostructure using FIB-etching. In this experiment, DLC pillar was fabricated by a spot irradiation of 30 kV Ga+FIB with a beam current of 8 pA. And a via hole was fabricated on the tip of DLC pillar by FIB-etching. Ga sphere was obtained on the tip of DLC pillar by 15 min annealing treatment at 350 C. Atomic ratio of Ga sphere formed by annealing treatment was C: Ga = 2.4: 97.6. Furthermore, DLC wall structure was fabricated by FIB-CVD, and three via holes were fabricated by FIB-etching. By annealing this structure, we obtained Ga sphere on the top of DLC wall structure. In this way, we found that the Ga sphere was formed on the via hole inevitably. From these results, the Ga eduction mechanism is presume as follows; the incorporated Ga moves toward the via hole, Ga is accumulated in the via hole, Ga sphere is formed finally because Ga has the large value of the surface tension (720-mN/m). In this way, we achieved the eduction's position control of the incorporated gallium using the via hole. This technique is the utilizable technique as a junction technique such as a nano-bump technique to combine the nanoelectromechanical devices. [C1849]

"Fabrication of Nonvolatile Nano-Floating Gate Memory with Self-Assembled Metal-Oxide Nano-Particles Embedded in Polyimide"

In this article, the nonvolatile nano-floating gate memory (NFGM) device was fabricated with self-assembled metal-oxide nano-particles embedded in a polyimide gate insulator and characterized. [C1850]

"Nanocomposite Field Effect Transistors based on Zinc oxide/polymer blends"

Significant progress is being made in the realization of thin-film transistors (TFTs) for application in various electronic devices and circuits [1-5]. Currently, one of the important challenges in this area is to design low-cost and stable organic semiconductors that possess high field-effect mobilities for constructing low-power high-speed transistor devices. However, there are only limited stable and cheap organic semiconductors that are applicable for OTFT applications. Here, we report the work in our laboratory that focus on stable, inexpensive and high field-effect mobility nano-composite materials for the potential application in OTFT technologies. Solution processed polymer based nano-composite field effect transistors with wide band gap semi-conducting ZnO nano-tetrapods and nano-crystals dispersed in the polymer matrix were utilized to study the field effect behaviour. The electrical characteristics of polymer based wide band gap nano-crystal or nano-tetrapod composite devices exhibit an increase in the hole mobility up to two orders of magnitude higher than the pristine polymer. The fabricated devices that contained a layer of MEH-PPV only exhibited p-channel behaviour with a hole mobility up to 10-4cm2/Vs, similar to previously reported.3Figures 1a and 1b show the TEM (transmission electron microscope) images of ZnO nanocrystals or tetrapods dispersed in MEH-PPV solutions, respectively. The size of the nanocrystals is around 5 nm (Figure 1a) and the legs of the tetrapods are around 100 nm in width (Figure 1b). Figure 2 shows the electrical behaviour of the devices fabricated from MEH-PPV and nanocomposite with ZnO nanocrystals or tetrapods. [C1851]

"Using FIB SEM to control the critical dimensions of nano-structured materials"

Application of state-of-the-art focused ion beam technology (FIB), in combination with high-performance scanning electron microscopy (SEM), gives the ability to perform advanced nanofabrication, via sputtering or chemical vapor deposition. Numerous parameters must be considered in order to achieve high quality results, particularly where stringent critical dimensions are required or when dealing with challenges such as electrically insulating and/or soft materials. [C1852]

"Fabrication of nano-patterns composed by metal nanoparticles with photo-nanoimprint"

Nanopatterns of alkanethiol-capped gold nanoparticles are fabricated on photocurable polymer surface using a photo-nanoimprint method. The surface morphology of the nanopattern is observed by scanning electron microscopy and transmission electron microscopy. Spherical gold nanoparticles with a 3.5 nm average diameter and 500 nm line width is obtained. [C1853]

"Development of focused-ion-beam (FIB) machining systems for fabricating 3-D micro- and nano-structures"

This study has developed a three-dimensional (3D) focused-ion-beam (FIB) etching system and a method for machining 3D sensor structures. The FIB etching equipment enables precision cuts to be made with great flexibility for micro- and nano-structure on thin films and single crystals. Hence, the FIB etching system offers a variety of new applications in the area of imaging and precision micro-machining. [C1854]

"Compact Nano-Electro-Mechanical Non-Volatile Memory (NEMory) for 3D Integration"

A new electro-mechanical non-volatile memory (NVM) cell design is proposed and demonstrated for the first time. The fabricated cells operate with relatively low program/erase voltages and large sensing margin. Because only dielectric and metal layers are required, this cell design is suitable for post-CMOS fabrication. As the cell area is reduced, low operating voltages can be maintained by scaling the vertical dimensions of the cell. Nanometer-scale electro-mechanical memory technology is therefore attractive for high-density embedded memory applications. [C1855]

"Probe technologies for micro/nano measurements"

Conventional probes for dimensional measurement of parts in macro scale are no more capable for the meso- to micro-sized parts that require accuracy to the degree of 100 nm to 10 nm. This paper will discuss the needs of probe technologies for micro/nano measurements. Both of the non-contact and contact types of probes will be addressed. For the non-contact probe, the principles and applications of focus probe and confocal microscope are introduced. Developed systems show the focus probe can reach to the accuracy of 1 nm and the confocal microscope has 0.1mum accuracy. For the contact type, the fabrication of micro probe tip and a newly developed 3D touch probe are described. Experiment shows the minimum contact force can be as small as 50 muN. [C1856]

"Nano thermal sensors for sensing temperature in water environment"

In this paper we illustrate the fabrication process of nano temperature sensors using focused ion beam chemical vapor deposition (FIB-CVD) of tungsten over atomic force microscope (AFM) cantilevers, to be used in sensing temperature distribution in local area. We present the fabrication approach & modifications for making these sensors capable of sensing temperature distributions not only in air but in water environment as well. The nano sensor was calibrated in water using the hot stage of the environmental scanning electron microscope (ESEM). The experimental results show the positive characteristics of the temperature coefficient of resistance (TCR). We also illustrate the response of the sensor to sudden changes in the surrounding medium. The characteristics of this sensor were compared to previously reported temperature sensing devices. The comparison verifies that our sensor is relatively uncomplicated and reliable in fabrication. The capability of sensing temperature in water will allow our sensor to be used in wide range of bio-applications, especially in studying thermogenesis in single cells. [C1857]

"Modeling and simulation of footing effect in DRIE process"

In this paper, the footing effect of DRIE process is studied and simulated. Based on the charging mechanism of the footing effect, local electric field and ion deflexion caused by the charging is very important for the precise simulation of the footing effect. Thus, we first modeled and numerically simulated the charging effect to calculate the local electric field and deflexed ions, and then couple the numerical simulation results to the DROPIE to emulate the footing profile evolution. Finally the footing effect has been simulated successfully and compared with experimental results, they agree each other very well. [C1858]

"Cu2O nanorods with large surface area for photodegradation of organic pollutant under visible light"

Cu2O nanorods with extraordinary large surface area are synthesized by polyol method successfully. Their photocatalytic property is evaluated by the photodegradation of brilliant red dye under visible light irradiation. For comparison, Cu2O nanocubes are synthesized and evaluated with photocatalytic property as well. The results show that the photocatalytic activity of the Cu2O nanorods is more than one time higher than that for Cu2O nanocubes under visible light. Additionally, the structure of the Cu2O nanorods is very stable and they can not be oxidized to CuO even during the photocatalytic reaction process. It is noticeable that this kind of Cu2O nanorods has remarkable large surface areas 47.6 m2/g, which is about forty times as large as that for as-prepared Cu2O nanocubes and it is also three times larger than that for the reported porous Cu2O nanoparticles. The large surface area of Cu2O nanorods leads to its higher adsorption ability to the brilliant red dye and excellent high photocatalytic activity under visible light. Since Cu2O nanorods are very stable and have high photocatalytic activity under visible light, they are expected to be used in photocatalytic oxidation technology practically in the future. [C1859]

"Size Reduction Technology of SOI-based Nano-waveguides"

Based on conventional lithography and anisotropic etching of Si, a size reduction technology is proposed to achieve low-loss nano-scale optical waveguides in silicon-on-insulator (SOI), which would find abroad applications in highly-integrated optical interconnects and integrated photonic circuits. [C1860]

"Examining amplification and nonlinear properties of novel Quantum Well Optical Fiber (QWOF) for future photonic communications"

In this paper, we propose a novel structure of optical fiber to investigate its amplification and nonlinear properties. We employ both nano and optical fiber technologies in our proposed novel structure so-called Quantum Well Optical Fiber (QWOF) where an InP quantum well exists between the core and inner cladding of proposed QWOF. In the developed model, InP is chosen as a semiconductor dopant to examine its amplification and nonlinear properties. From our experimental results, the proposed QWOF shows its significant amplification properties for wavelength between 1080 nm and 1491 nm. Amplification properties also found in wavelength 906 nm~1044 nm and 1524 nm~1596 nm. Though the exact nonlinear parameter could not be determined, a lower bound of 3.87x106W-1/m was calculated for gamma where an effective core area has value 2.27236x10-11m2. [C1861]

"Theoretical study on the selective emitter radioisotope micro battery"

Radioisotope micro battery has the capability of meet the requirements of micropower. This paper investigated the two distinct parts and the structure characteristics of the selective emitter radioisotope micro battery. Compared with the conventional Back Surface Filed radioisotope micro battery, the selective emitter radioisotope micro battery has two distinct parts: (1) a deeply diffused region with high surface doping concentration under the metal contacts and the adjacent region; (2) a surface passivated, shallow diffused region with a relatively low surface doping concentration in active region. Thus formed a lateral n+-n junction between the heavily diffused region and the shallow diffused region, a n+-p junction under the metal contacts, and a p-n junction at the other regions as the same as the conventional Back Surface Field radioisotope micro battery. Therefore, compared with the conventional Back Surface Field radioisotope micro battery, the selective emitter radioisotope micro battery has a lot of advantages: (1) improve the collection efficiency of the electron hole pairs; (2) improve the output voltage of the radioisotope micro battery; (3) reduce the series resistance of the radioisotope micro battery; (4) reduce the surface recombination rate of the electron hole pairs; (5) reduce the effect of the diffusion dead layer, thus improve the overall performance of the diffusion layer. In conclusion, the selective emitter structure is proved to be one of the effective ways to improve the conversion efficiency of radioisotope micro battery in the course of deeply analyzing on its advantages. [C1862]

"High performance electron and hole current switching in double-hetero tunnel-junction n-i-p quantum dot transistor"

A double-hetero tunnel-junction structure is introduced to the electron and hole current switching n-i-p type quantum dot transistor to improve its switching clearness. Previously the n-i-p type semiconductor quantum dot transistor was suggested on a first step model of an idea of electron and hole current switching including no recombination effect in a quantum dot and simply based on a homo tunnel-junction structure. Results in this paper show that there is some degree of recombination current in the homo tunnel-junction type and it is difficult to obtain an adequate clearness of switching performance, and newly introduced double-hetero tunnel-junction structure suppresses the recombination current and it gives a way to obtain a sufficient switching clearness. [C1863]

"A novel nanoliter liquid dispensing technology for protein crystallization"

Recently, high-throughput protein crystallization requires the ability to transfer submicroliter volumes of sample with a large range of viscosities. In this paper, a solenoid-based non-contact liquid handling instrument with high-speed flow sensor was developed to meet this requirement. The flow sensor-driven dispenser with feedback control automatically compensates for encountered differences or changes in sample viscosity by adjusting the valve opening time or system pressure. Also, the non-contact liquid dispensing process was investigated with computational fluid dynamics (CFD) models, which make us understand the droplet breakup process in more detail and make dispensing nanoliter droplet fall off successfully without attach to the nozzle. Experiments were carried out with different dispensing volumes, coefficient of variance (CV) has been shown to be below 3% at 1 mul and approach 8% at 50 nl. [C1864]

"Study of piezoresistance effect of carbon nanotube-PDMS composite materials for nanosensors"

Samples of novel nanocomposites of multiwalled carbon nanotube and poly (dimethylsiloxane), i.e., CNT-PDMS, at different filler concentrations are prepared. The mechanical/electrical and piezoresistance properties of these nanomaterials are studied in detail. The gauge factor (GF) of this nanocomposite, dependent on the content of

CNT, ranges from 1.38 to 12.4. Since the CNT-PDMS can be easily used as a novel piezoresistor using low-cost MEMS technology, this nanomaterial has decent potential in nanosensors and PDMS-based microfluidic systems. [C1865]

"Novel sloped etch process for 15nm InAlAs/InGaAs metamorphic HEMTs"

We developed a new technology that reduces gate length with modified sloped etch process to fabricate nanometer scale high-electron mobility transistors (HEMTs). The polymer deposition and Si3N4etching with positive slope make this technology realizable. A HEMT with this technology has merits of both fine length definition beyond the limit of an electron beam (E-beam) lithography system and overcoming the metal filling problem caused by a high aspect ratio. Using this technology, we could get 15 nm gate length from initial 40 nm line pattern. The fabricated 15 nm InAlAs/InGaAs metamorphic HEMTs (MHEMTs) have high DC and RF performance characteristics, a transconductance of 1.6 S/mm, a cutoff frequency fT of 580 GHz. [C1866]

"Effect of single grain boundary position on surrounding-gate polysilicon thin film transistors"

In this paper, single-grain-boundary-position-induced electrical characteristic variations in 300 nm surrounding-gate (i.e, gate-all-around, GAA) polysilicon thin film transistors (TFTs) are numerically investigated. For a 2T1C active-matrix circuit, a three-dimensional device-circuit coupled mixed-mode simulation shows that the switching speed of GAA TFT can be improved by nine times, compared with the result of the circuit using single-gate (SG) polysilicon TFTs. The position of single grain boundary near the drain side has an ill effect on device performance, but the influence can be suppressed in the GAA polysilicon TFTs. We found that under the same threshold voltage, the variation of threshold voltage can be reduced from 15 % to 5 %, with varying of gate structures of the GAA polysilicon TFT. [C1867]

"Composite Structure and Size Effect of Barium Titanate Nanoparticles"

Almost impurity and defect-free barium titanate (BaTiO3) nanoparticles with various sizes from 20 to 430 nm were prepared using 2-step thermal decomposition method. The nano-structures of these particles were analyzed using a synchrotron radiation X-ray diffraction (XRD). As a result, it was found that the BaTiO3nanoparticles had composite structure consisted of (a) internal tetragonal layer, (b) Gradient-Lattice-Strain Layer (GLSL) and (c) surface cubic layer. [C1868]

"Single molecule nanobiology for elucidating the mechanism involved in utilizing fluctuations by biosystems"

Biomolecules assemble to form molecular machines such as molecular motors, cell signal processors, DNA transcription processors and protein synthesizers to fulfill their functions. Their collaboration allows the activity of biological systems. The reactions and behaviors of molecular machines vary flexibly while responding to their surroundings. This flexibility is essential for biological organisms. The underlying mechanism of molecular machines is not as simple as that expected from analogy with man-made machines. Since molecular machines are only nanometers in size and has a flexible structure, it is very prone to thermal agitation. Furthermore, the input energy level is not much difference from average thermal energy, kBT. Molecular machines can thus operate under the strong influence of this thermal noise, with a high efficiency of energy conversion. They would not overcome thermal noise but effectively use it for their functions. This is in sharp contrast to man-made machines that operate at energies much higher than the thermal noise. In recent years, the single molecule detection (SMD) and nano-technologies have rapidly been expanding to include a wide range of life science. The dynamic properties of biomolecules and the unique operations of molecular machines, which were previously hidden in averaged ensemble measurements, have now been unveiled. The aim of our research is to approach the engineering principle of adaptive biological system by uncovering the unique operations involved in utilizing fluctuations by biosystems from molecular machines to brain. [C1869]

"Carbon nanotube bundle-based low loss integrated inductors"

In this paper, we propose low loss on-chip inductors for mixed-signal circuits leveraging single-walled carbon nanotube (SWCNT) bundles. We develop a model for the high frequency current re-distribution in SWCNT bundles, which we find can have a large effect on the resistance and quality factor of nanotube-based inductors. We compare the performance of optimized inductors realized using SWCNT bundles and standard copper technology. The results indicate that SWCNT bundle-based inductors can provide up to a 144% increase in quality factor. The higher quality factors of SWCNT bundle-based inductors enable up to an 80% power consumption decrease in low noise amplifiers, which are critical circuits in integrated wireless receivers. [C1870]

"Microrobot-based nanoindentation of an epoxy-based electrically conductive adhesive"

Microrobot-based nanoindentation is a relatively new testing technique, which uses microrobot based methods for performing nanoindentation experiments. The use of the microrobot-based nanoindentation is a example how microrobotic technology can help the materials research. In this work, the hardness of an epoxy-based silver-filled electrically conductive adhesive (ECA) type PC 3002 has been determined using this method. Flat ECA specimens have been investigated after a first curing at 70degC for 120 minutes, respectively after a curing time of 150 minutes, 180 minutes, 240 minutes, 300 minutes, and finally after 325 minutes at the same temperature. The maximum indentation depth was 1 mum. The hardness of the ECA has shown an increase with the increase of the curing time at constant temperature. The set-up uses a Berkovich diamond tip for performing nanoindentation tests. The set-up requires calibrations with reference specimens (fused silica and sapphire) for calculating hardness and Young's modulus of the tested material. Preliminary results are very promising: by comparing the slope of the loading stage of the nanoindentation tests on different specimens, the difference in hardness can be qualitatively evidenced. [C1871]

"Testing molecular devices in CMOS/nano integrated circuits"

Molecular electronics may improve the speed and density of circuits as the limitations of CMOS become more stringent. However, due to the difficulties in manufacturing molecular circuits, it may be beneficial to use a hybrid model initially, composed of both molecular and CMOS components. The molecular feature size of such devices can yield high density memory applications, which are expected to reach 1011 b/cm2. The defect rate in such systems is expected to be 10%, which still makes it an attractive technology due to overhead. The goal of this paper is to investigate techniques of detecting defects within molecular electronic structures. Essentially, the proposed techniques will lead to systems that are self-healing with minimal loss of memory improving the reliability and the utility of the manufactured memory. [C1872]

"Building blocks for delay-insensitive circuits using single electron tunneling devices"

This paper presents a set of basic building blocks that corresponds to a universal set of primitives for delay insensitive circuits. We propose single electron tunneling circuit topologies and verify them by means of simulations. The simulations performed with SIMON 2.0 indicate that the circuits function as expected. Moreover the proposed circuits are input-output level compatible thus they can be potentially utilized in the implementation of larger asynchronous circuits. [C1873]

"Evaporative pumping of liquid in nanochannel for electrical measurement of a single biomolecule in nanofluidic format"

We present a solution to obtain planar micro-electrodes self-aligned around a nanochannel drilled using focused ion beam (FIB) machining . The inter-electrode spacing is exactly that of the width of the nanochannel (100 to 600 nm). The system is sealed with a PDMS (polydimethylsiloxane) thin foil that includes microfluidic channels. We are aiming at manipulation and characterization of single biomolecules by taking advantages of electrical measurements at nanoscale. As a result of pumping in the nanochannel, it has been observed that high-speed motion of DNA molecules due to evaporation-coupled capillary action. Electrical detection and measurements are currently being conducted. [C1874]

"Nanopores fabricated by focused ion beam milling technology"

A new approach to fabricating nanopore is presented. It is based on focused ion beam (FIB) sputtering to mill through a silicon nitride (Si3N4) membrane first, then followed by aluminum nitride (AlN) thin film deposition through the milled hole to narrow the pore size. FIB sputtering properties of Si3N4membranes were investigated in order to achieve high aspect ratio holes through the membrane. The parameters of AlN deposition were optimized so that the final nanopore size can be finely controlled. A nanopore array with 70 nm pore-diameter was made in a Si3N4membrane by FIB milling technology. The following AlN deposition was able to narrow the nanopores further down to 12 nm pore-diameter. [C1875]

"RC circuit model for multi-walled carbon nanotubes"

To alleviate the problems associated with current copper interconnect technology, multi-walled carbon nanotubes (MWCNTs) have been proposed as a potential solution for on-chip communication in VLSI applications. In this paper, we develop an equivalent RC circuit model for MWCNT interconnect that captures both DC conductance and high frequency impedance due to capacitive effects. Based on the circuit model, we find that MWCNT-based interconnect can have substantially less delay than copper wires in global interconnect applications. [C1876]

"A fresh look at majority multiplexing when devices get into the picture"

In this paper we present the first detailed analysis of von Neumann multiplexing (vN-MUX) using majority (MAJ) gates of small fan-ins Delta (MAJ-Delta) with respect to the probability of failure of the elementary (nano-)devices. Only gates with small fan-ins have been considered, as gates with large fan-ins do not seem practical (at least in the short term) in future technologies. The extensions from an exact counting algorithm (for gate defects and faults only) to device-level failures will allow us to estimate and characterize MAJ-Delta vN-MUX with respect to device-level malfunctions. The reported results depart significantly from all known gate-level analyses-either theoretical or based on simulations. These should be quite important as providing a detailed picture of the behavior of MAJ-Delta vN-MUX when considering the (unreliability of the elementary) (nano-)devices (as opposed to gate-level only analyses). The main conclusion is that small fan-in gates (and redundancy schemes relying on such gates) are quite promising-in spite of all previous results at gate-level showing the contrary. [C1877]

"A rigorous surface-potential-based I-V model for undoped cylindrical nanowire MOSFETs"

A non-charge-sheet surface-potential-based compact drain-current model for long-channel undoped gate-all-around (GAA) silicon-nanowire (SiNW) MOSFETs is developed. The surface-potential equation is derived from cylindrical Poisson equation for undoped silicon and solved iteratively with a very good initial guess to reach equation residue below 10-16V within a few iterations. The single-piece current equation is derived and validated with numerical simulations for all operation regions without any fitting parameters. The results show that the proposed model can be used for bench-marking long-channel SiNW models, and demonstrate a first step towards a practical SiNW model for inclusion of various short-channel and quantum-mechanical effects. [C1878]

"In-situ TEM observation on nanostructure evolution during electrical stressing"

We evaluated the electrical properties and change of nanostructure of Cu doped SiO2and Ge2Sb2Te5(GST) thin film under electrical stressing. Specialized scanning tunneling microscopy (STM)-transmission electron microscope (TEM) holder, which allows us to do the electrical characterization and observation of in-situ nano-structural evolution simultaneously, used as a approach method to confirm the devices behavior. The Cu-SiO2/SiO2/Si structure observed that Cu nanoclusters, which are not fully crystallized, are randomly distributed. When voltage is applied, Cu becomes to grow and Cu cluster forms a closed packed line, which may a pathway for current flow. For GST/TiW/SiO2/Si structure, the GST film changed from amorphous phase to localized crystalline phase after electrical stressing. Localized crystallization might be due to the either joule heating or electron beam damages that are still need to be confirmed. [C1879]

"3D CMOL based on CMOS/nanomaterial hybrid technology"

CMOS molecular (CMOL) circuits promise great opportunities for future hybrid nanoscale IC implementation. In this paper, a novel three dimension (3D) architecture of CMOL circuit is introduced. It eliminates the special pin requirement, enabling feasible fabrication. It also doubles the density of nanowires of the original CMOL circuit, while providing similar operation performance. This work significantly advances applications of 3D integration in hybrid nanosystems. [C1880]

"Reliability of bi-stable single domain nano magnets for Cellular Automata"

Quantum cellular automata, also known as QCA, has been touted as a pragmatic use of quantum phenomena which currently are detrimental in nano-transistor technology. Recently, QCA technologies has expanded into magnetism, an area referred to as magnetic QCA, by exploiting the magnetic coupling interaction between neighboring cells (nano-magnets). The interactions of orderly fabricated nano-magnets and the viability of nano-magnetic structures as logical building blocks has yet to be explored in great detail. We have fabricated nano-scale magnetic QCA cells and currently the scope entails determining how factors such as material, size, placement, and surface roughness affect the magnetic properties and coupling interactions between the nano-magnetic QCA cells. [C1881]

"Direct-Write micro/nano-structure for flexible electronic manufacturing"

This article focuses on optimizing the electrospinning parameters, and developing a new method of Direct-Write (DW) micro/nano-structure based on Near-Field Electrospinning (NFES) for flexible electronic manufacturing. NFES is a new way to realize controllable electrospinning and precision-positioning of nanofiber, by which nano-structure with diameter from 50 nm to 500 nm can be fabricated orderly and accurately. A tungsten electrode with tip diameter of 25 mum is used to DW nano-structure, with the minimum bias voltage 600 V, minimum electrode to collector distance 500 mum. A micro-structure DW system is designed, by which micro-structure with diameter of several micrometers can be drawn. In this work, a needle tube of 232 mum inside diameter is used as spinneret, electrode to collector distance is various from 2 mm to 10 mm, and the collector moving speed ranges from 0.07 m/s to 7 m/s. The DW process and character of micro-structure such as line width, smoothness and thickness can be controlled by optimizing the electrospinning parameters. The DW micro/nano-structure is continuous and smooth, which can be drawn on expected site and in expected direction with accurate dimension. The new method based on NEFS with the advantage of narrower line width and smoother structure than traditional flexible electronic manufacturing technologies, which is more suitable for the development of flexible electronic manufacturing. [C1882]

"Growth of crooked silicon nanowires by carbothermal evaporation"

Silicon nanowires (SiNWs) were synthesized by carbothermal evaporation technique from starting materials of silicon powder mixed with activated carbon. The evaporated silicon is carried by flowing inert gas and collected on Si(111) substrate. The results show that SiNWs were formed in groups are straight at some part and vertically at the other part with each group grew in the same direction. Overlapping in the growth direction produced another group of nanowires with crooked morphology. The nanowires were formed in groups are straight at some part and vertically at the other part with each group grew in the same direction. Overlapping in the growth direction produced another group of nanowires with crooked morphology. [C1883]

"Advances of lighting technologies-From light bulbs to solid state light sources"

Major breakthroughs that took place chronically in the light source development are: the invention of incandescence light bulbs, the invention of lasers, particularly semiconductor lasers, and the high-brightness blue/white LED. Two of these represent the major advances in the lighting technologies. It is further shown that what we called "nano-science and technology" today, had played a critical role in commercialization of these great inventions. [C1884]

"9F-2 Heat Conductive Array Transducer for Phase-Conversion Molecular Imaging"

A heat conductive array transducer was designed for transmitting high power ultrasound as well as transmitting and receiving wideband pulse waves. In phase-conversion ultrasonic molecular imaging, tissue-selective nano-droplets are converted to contrast microbubbles by a long duration ultrasonic pulse with a relatively high amplitude. When a conventional imaging array transducer was used, sensitivity of transducer decreased caused by some breakdown processes. In this study, we firstly examined the breakdown process based on experiments and numerical simulations. The experimental result was consistent with the simulation result assuming peeling of the adhesive between two PZT layers. A new transducer structure using a heat conducting acoustic isolation layer (AIL) on a metal heat sink block was conceived to inhibit this type of breakdown while maintaining the wide bandwidth for imaging with a high resolution. Heat generated in the PZT and adjacent layers can diffuse into a metal heat conductor through the AIL. Since the AIL reflects pulses, a possible unwanted response due to reflection at the opposite side of the metal block will be suppressed. The temperature rise and the ultrasonic pulse response of the transducer were calculated using PZFlex. The temperature rise in the transducer immediately after driving at 40 V for 25 s with 1% duty ratio was 37 degrees for the proposed structure, much lower than that for the conventional structure of 56 degrees. No serious unwanted response was observed for the proposed structure. These results show that the proposed structure will be useful for a high-power wideband phased array transducer. [C1885]

"Simulation study of carbon nanotube x-ray tube structure"

An X-ray source, which is based on the field emission electron source, is being currently developed by using carbon nano-tubes (CNTs) for the applications to biological, medical and material diagnostic technology fields. In the design of triode type X-ray sources, the fine beam focus is important to acquire high resolution X-ray image. Therefore, the geometrical parameters such as electrode shapes and distances between each part must be optimized. In this study, four different shapes of triode structures were simulated and the beam focusing performances were presented according to voltage conditions of each triode parts. Results show that the concave shape cathode structure shows the best spot size and structural simplicity among the tested in this study. [C1886]

"Slow light in silicon nano-waveguide"

We propose a widely tunable slow-light delay element based on nano-scale silicon microring resonator assisted by parametric amplification. This scheme provides flexible adjustment of the delay time and bandwidth to adapt to different data rates. [C1887]

"K-2 High-performance and low-Power SRAMs design in nano-scale CMOS technology"

Summary form only given. Static random access memory (SRAM) is key to today's high-performance and low-power VLSI system design. Among various embedded memory technologies, SRAM is able to provide the highest performance while maintaining low standby power consumption. As Moore's law drives the CMOS technology feature size well below 100 nm regime, there are many new technology and design challenges facing today's SRAM development, including cell stability scaling and power management. In this presentation, the state-of-the-art CMOS technology scaling will be first examined. Key scaling challenges along with technology innovations such as uniaxial strain Si technology will be discussed. Then, the scaling of the SRAM cell design will be evaluated in light of the technology scaling. Various design techniques, e.g., the use of dynamic multi-VCC, in mitigating the scaling difficulties in read stability and write margin will be presented. Power reduction techniques will also be discussed from both process and design perspectives, including transistor design and use of dynamic sleep transistors. Design implementation based on the state-of-the-art CPUs will also be presented. [C1888]

"Syncretic Fields: Art, Mind, and the Many Realities"

In the late 20th century, the formative issues in digital art were about connectivity and interaction. Now at the start of the 3rd millennium, our post-digital objectives will increasingly be technoetic and syncretic. During the previous two centuries, there was much ado about e pluribus unum: out of many, one: a unified culture, unified self, unified mind, unity of time and space. Now at the start of this century, the reverse applies. E unum pluribus, out of one, many: many selves, many presences, many locations, many levels of consciousness. The many realities we inhabit-material, virtual, and spiritual, for example-are accompanied by our sense of being present simultaneously in many worlds: physical presence in ecospace, apparitional presence in spiritual space, telepresence in cyberspace, and vibrational presence in nanospace. In this respect, Second Life is the rehearsal room for future scenarios in which we will endlessly re-invent our many selves. As artists, we deal with the complexities of media that are at once immaterial and moist, numinous and grounded; and the complexity of the technoetic mind that both inhabits the body and is distributed across time and space. Where all these differences could be at odds with each other, we are in fact developing a capacity, mostly unconsciously, to syncretise. That is, to analogise and reconcile contradictions, while melding differences, such that art and reality are becoming syncretic. What today we build in the immateriality of cyberspace will tomorrow be realised concretely with nano technology. Our syncretic reality will emerge partly through the cultural coherence that intensive interconnectivity elicits, partly through the nano and quantum coherence at the base of our world-building, and through the spiritual coherence that informs the field of our multi-layered consciousness. [C1889]

"An automatic on-line thin-film thickness monitoring technique"

In this research, a non-contact optical technique known as laser ultrasound technique (LUT) technique is introduced for on-line or off-line thin film thickness measuring purpose. The LUT uses a pulsed laser to generate acoustic waves to travel along plate-like sample, and the acoustic waves are detected with a laser interferometer. Information of the thin film coated on the plate-like samples are extracted by analyzing the detected acoustic wave signals. This technique has advantages including (1) non-contact and non-destructive laser optical technique, (2) good sensitivity capable of measuring thin film thickness of 20 angstrom, or 2 nano-meters, (3) capable of performing in situ, on-line monitoring task, and (4) embedded hardware and software for automatic on-line monitoring. The current technology is ready for applications in flat panel display industries. [C1890]

"Robust self-assembly of interconnects by parallel DNA growth"

Self-assembly has been employed in nano-technology to build crystals using individual components (commonly referred to as tiles) with limited control. Templates of regular lattice structures for two-dimensional scaffolds and interconnects have been implemented by self-assembly. This paper proposes a diagonally-based growth scheme that is applicable to these templates. Differently from previous techniques (mostly sequential in execution), growth is allowed along two different directions in the aggregate, thus permitting a parallel mode of operation. This is made possible by initially utilizing a tile set and binding scheme to allow multiple seed tiles to grow along the main diagonal of the pattern. The conditions by which this type of new growth is possible at a reduced error occurrence in mismatched tiles, are presented; error tolerance is achieved by employing robust generation of the seed and diagonal tiles. Simulation results are presented using Xgrow [10]. [C1891]

"MicroGen: a MIAME compliant web application supporting distributed collaborative management and sharing of microarray experiment information"

Improvements of bio-nano-technologies and biomolecular techniques have led to increasing production of experimental data. Although routinely performed, high-throughput spotted microarray experiments are complex procedures entailing several protocols and actors with different technical roles. Complete information describing all experimental steps must be orderly collected to allow subsequent correct interpretation of experimental results. We developed MicroGen (http://www.bioinformatics.polimi.it/MicroGen/)> a Web system for managing information and workflow in the production pipeline of spotted microarray experiments. Its core is a multi-database system able to store all data characterizing different spotted inicroarray experiments according to the minimum information about microarray experiments (MIAME) standard. An intuitive and user-friendly Web interface enables the support of the collaborative work required in spotted microarray experiment production. [C1892]

"Novel nano-biosensors for life science systems and their applications in early, accurate, and non-invasive melanoma and other types of cancer detection"

Melanoma (the 5thand 6thmost common cancer in Caucasian males and females, respectively), is the most severe form of skin cancer, which is often fatal if recognized in its advanced stage. Melanoma is the tumor that originates from melanocytes (the cells that make the pigment melanin), and may develop from a nevus (commonly named "mole"). Clinically, it is very difficult to correctly differentiate nevi with atypical features or dysplastic nevi, and nevi of special sites from melanoma. Clearly, new, more powerful, less invasive, time consuming and expensive tools are needed for an early and accurate detection of melanoma. In order to address this need, we propose a development of a new set of tools, namely, carbon-nanotube-based biosensors for the early and accurate detection of melanoma. Once successful, we will modify and apply this new technology to early and accurately detect other types of cancer. [C1893]

"Performance and power evaluation of a 3D CMOS/nanomaterial reconfigurable architecture"

In this paper, we introduce a novel reconfigurable architecture, named 3D nFPGA, which utilizes 3D integration techniques and new nanoscale materials synergistically. The proposed architecture is based on CMOS-nano hybrid techniques that incorporate nanomaterials such as carbon nanotube bundles and nanowire crossbars into CMOS fabrication process. Using unique features of FPGAs and a novel 3D stacking method enabled by the application of nanomaterials, 3D nFPGA obtains a 4.5X footprint reduction compared to traditional CMOS-based 2D FPGAs. With a customized design automation flow, we evaluate the performance and power of 3D nFPGA driven by the 20 largest MCNC benchmarks. Results demonstrate that 3D nFPGA is able to provide a performance gain of 2.6X with a small power overhead comparing to the CMOS 2D FPGA architecture. [C1894]

"An LTCC design technique based on FDTD EM simulations"

This paper described the Low Technology Co-fired Ceramic (LTCC) design methodology at TMRND based on FDTD EM simulations that are required when designing the RF/microwave circuit. In this paper, 3D EM analysis and optimization with Finite Different Time Domain (FDTD) software Empire XcCeltrade from IMST was applied to achieve accurate modeling of the RF/microwave circuit using LTCC technology. A multilayer spiral inductor was selected for discussion to show this LTCC design technique. The main elements of the LTCC design technique relies on three important guidelines; use accurate component models, link the circuit schematic to the layout to reduce errors and finally link the layout to an EM simulator to detect coupling problems. [C1895]

"Can nano-photonic silicon circuits become an INTRA-chip interconnect technology?"

Surprisingly, nano-photonk silicon has already emerged as a commercial INTER-chip optical communications technology. This was made possible by Silicon-on-Insulator (SOI), technology, which integrates many of the optical communications components directly in silicon CMOS chips. Intel and Luxtera have both announced > 10Gb/sec optical modulators, integrated into silicon. All the other customarily required opto-electronic components; detectors, waveguides, splitters, couplers, filters, etc., are fully executed in CMOS designs, as well. Continuous wave optical power is provided from off-chip, just as dc power is currently provided from off-chip. The initial commercial applications are optical 10Gb/s Ethernet, Infiniband, and other INTER-chip, communications applications. The question to be addressed in this talk, is whether silicon nano-photonics can now make the final jump, to INTRA-chip optical interconnects? [C1896]

"UWB 3.1-10.6 GHz CMOS transmitter for system-on-a-chip nano-power pulse radars"

The building blocks of the transmitter for system-on-a-chip CMOS nano-power radar systems are presented. They consist of a novel fully integrated UWB pulse generator and a digitally programmable delay element. The pulse generator provides monocycle pulses with duration time close to 250 ps and 1-V peak-to-peak amplitude. In detail, the circuit provides a sinusoidal-like monocycle when activated by a negative edge of a trigger signal provided by a micro-controller. This activation can be delayed in the range 1-3 ns, by acting on a 5-bit programmable delay element, which provides a total set of 32 different delay times. [C1897]

"Room-temperature observation of large Coulomb-blockade oscillations from germanium Quantum-dot single-hole transistors with self-aligned electrodes"

A single Ge quantum-dot (~10 nm) forms and self-aligns with source/drain electrodes via SiO2tunneling barriers using thermal oxidation of a SiGe-on-insulator nanowire. Thereby, a Ge single-hole transistor with self-aligned electrodes is experimentally realized based on FinFET technology and features with clear Coulomb staircase/negative differential conductance and large Coulomb-blockade oscillation behaviors at room temperature. This work provides a simple approach to alleviate this nanofabrication bottleneck and thereby reduce series resistances and increase design freedom for SETs. [C1898]

"Nano-modified CFRPs as a novel material for the manufacturing of high efficient antennas"

The present work deals with the investigation of thermo-mechanical and electrical properties of nano-modified CFRPs in order to present the capacity to use this generation of novel materials in antennas applications. Among the issues discussed is the stiffness variation, the fracture toughness characteristics and the conductivity achieved at various levels of CNT doping of the epoxy matrix phase. [C1899]

"A performance analysis for single-walled metallic Carbon Nanotubes as global and intermediate on-chip interconnects"

This paper analyzes several delay estimates for metallic carbon nanotubes (CNT) as interconnects of very large scale integrated (VLSI) chips. A study of the 2005 edition of the international technology roadmap (ITRS) [1] for global/intermediate interconnects is presented to highlight the significant issues encountered with the projected performance of copper/aluminum interconnects till 2020. Then a worst case performance analysis of metallic CNTs is presented and compared versus copper interconnects. It is evaluated that the RC delay of CNTs does not meet the future RC delay requirements of on-chip intermediate and global wires. [C1900]

"Quantum boolean circuit is 1-testable"

Recently, a systematic procedure is proposed to derive a minimum space quantum circuit for a given classical logic with the generalized quantum Toffoli gate which is universal in classical boolean logic. Since quantum computation is reversible, we can use this property to build quantum iterative logic array (QILA). QILA can be easily tested in constant time (C-testable) if stuck-at fault model is assumed. In this paper, we apply Hadamard and general CCN gates on QILA circuits to make them 1-testable. As a result, for quantum boolean circuits, the number of test patterns is independent of both the size of the array and the length of the inputs. [C1901]

"Integration of the micro thermal sensor and porous silicon as the gas diffusion layer for micro fuel cell"

This work employs porous silicon as a gas diffusion layer (GDL) in a micro proton exchange membrane fuel cell (muPEMFC) and a micro direct methanol fuel cell (muDMFC). Pt catalyst is deposited on the surface of, and inside, the porous silicon to improve its conductivity. Porous silicon with Pt catalyst replaces traditional GDL, and the Pt metal that remains on the rib is used to form a micro thermal sensor in a single lithographic process. The GDL was replaced by porous silicon and used in a muPEMFC and muDMFC. Wet etching is applied to a 500 mum-thick layer of silicon to yield fuel channels with a depth of 450 mum and a width of 200 mum. The pores in the fabricated structure had a diameter of 10 mum; the thickness of the structure was 50 mum. Therefore, the GDLs of the fuel cell were fabricated using macro-porous silicon technology. Porous silicon was fabricated by photoelectrochemical porous silicon etching. The top-side of the fuel channel was exposed to light from a halogen lamp. The porous structure was fabricated at the bottom of the fuel channel and patterned by anodization; and the micro thermal sensors were integrated on the rib. The experimental results demonstrated that the maximums power density of muDMFC and muPEMFC were 1.784 mW/cm2and 9.37 mW/cm2. 30SCCM and 2 M methanol were used with 10 mum holes, various humidities and heating temperatures. [C1902]

"Quantum bit controller and observer circuits in SOS-CMOS technology for gigahertz low-temperature operation"

Quantum bit (qubit) control and readout requires controller-qubit-observer systems for rapid control signal generation and injection to the qubit gates, and observation of their final state projections. Conventionally, for solid-state qubits, this is achieved by generating the control signal at 300 K and transmitting it along very long coaxial cables that span from 300 K to sub-K (typically les 500 mK), then reading out the response from charge proximity sensors such as single-electron transistors along similar lengths of cable. Our approach is to fabricate the classical controller and observer circuits using a commercial foundry processed silicon-on-sapphire (SOS) RFCMOS technology for operation at low temperatures (either at 4.2 K, 1 K, or sub-K). We have demonstrated SOS-CMOS NFET and PFET device operation at 4.2 K, and sub-K that showed deviations from their 300 K characteristics, but with further experiments these were shown to have minimal effects on control circuit function. Using these results, we have fabricated and demonstrated a low-power proof-of-concept SOS-CMOS controller circuit (monostable 100 ps voltage-pulse generator) that can operate at sub-K temperatures in a dilution refrigerator. We briefly discuss experimental and conceptual schemes with which we can develop qubit control systems for cryogenic and lower temperatures. These low temperature experiments also demonstrate that commercial SOS RF-CMOS technology can be feasible for other low temperature and low power applications. [C1903]

"New NRZ-mode resonant tunneling bistable-to-monostable-to-bistable transition logic element operating up to 36 Gb/s"

In this paper, we present new resonant tunneling bistable-to-monostable-to-bistable transition logic element with non-return-to-zero (NRZ) mode output. The proposed circuit is composed of resonant tunneling diode (RTD)/high electron mobility transistor (HEMT) series connection (RHS) and RTD/HEMT parallel connection (RHP). Novel high-speed and low-power NRZ delayed flip-flop (D-F/F) operation has been successfully achieved using RTD/HEMT integration technology on an InP substrate. The operation of the fabricated circuit was confirmed up to 36 Gb/s with a very low power dissipation of about 3 mW at a power supply voltage of 0.9 V. [C1904]

"CMOS logic design with independent-gate FinFETs"

Fin-type field-effect transistors (FinFETs) are promising substitutes for bulk CMOS in nano-scale circuits. In this paper, it is observed that in spite of improved device characteristics, high active leakage may remain a problem for FinFET logic circuits. Leakage is found to contribute 31.3% of total power consumption in power-optimized FinFET logic circuits. Various FinFET logic design styles, based on independent control of FinFET gates, are studied. A new low-leakage logic style is presented. Leakage (total) power savings of 64.7% (14.5%) under tight delay constraints and 91.2% (37.2%) under relaxed delay constraints, through the judicious use of FinFET logic styles, are demonstrated. [C1905]

"Distributed voting for fault-tolerant nanoscale systems"

In this paper, we propose a distributed voting strategy to design a robust NMR system. We show that using inexpensive current-based drivers and buffers, we can completely eliminate the centralized voter unit and do the majority voting among N modules in a distributed fashion. Our strategy achieves high reliability that is vital for future nano systems in which high defect rate is expected. Experimental results are also reported to verify the concept, clarify the design procedure and measure the system's reliability. [C1906]

"Work in progress-Introduction of K-map based nano-logic synthesis as knowledge module in logic design course"

This work in progress reports an effort of introducing knowledge module regarding novel nano-devices and novel logic primitives in undergraduate logic design class. Our motivation is to make our students aware of fundamental abstracted logical behaviors of future nano-devices, their functionality. This effort would also help the students use their existing knowledge of K-map based logical synthesis into constructing logic blocks for novel devices that uses majority logic as basic construct. Moreover, additional to stimulating our students' interests, we are also augmenting their learning by challenging them to use their existing knowledge to analyze, synthesize and comprehend novel nano-logic issues through the worksheets and lecture modules. Whereas many efforts are focusing on developing new courses on nanofabrication and even nano-computing, we intend to augment the existing standard EE and CS courses by inserting knowledge modules on nano-logic structure for stimulating their interest without significant diversion from the course framework. [C1907]

"Isotopically Engineered Silicon Nanoelectronics"

Isotope engineering of silicon has been employed towards development of silicon-based quantum computers and complete modeling of nano-CMOS fabrication processes towards development of next-generation technology computer aided design (TCAD) systems. [C1908]

"Nano-Dispersed Liquid Crystal Tunable Negative-Zero-Positive Index Metamaterials"

Nematic LC's offer an excellent path toward achieving tunability in a variety of different terahertz and optical devices. We have presented technology that can take advantage of the properties of LC to realize the index of refraction tuning. Metamaterials consisting of LC-dispersed coated spheres were designed to have an index of refraction that tuned from negative to zero to positive at the frequency of operation. [C1909]

"Spherical resonators acting as rf replicas of plasmonic nanospheres"

The experimental investigation of recently proposed nanophotonic devices and metamaterials based on the plasmonic nanospheres is rather difficult and expensive using the present technology of nano-fabrication. Here, we propose the idea of scaled experiments in the RF regime, based on the spherical resonators that behave similarly to the plasmonic nanospheres. Two different designs, based on well-known Best's four-arm spherical resonator and on Stuart's spherical resonator were tested experimentally in 500 MHz and 1 GHz bands. It was found possible to construct the linear chains of the resonators and to demonstrate both the backward-wave propagation and the forward-wave propagation, which is consistent with already published theoretical predictions. [C1910]

"Experimental study on formation of the micro ripple pattern on Si surface using femtosecond laser pulse"

In this paper, the ablated patterns on Si (100) and Si (111) surfaces affected by femtosecond pulse laser are presented. The periodic structure termed ripples on silicon surface is investigated. Experiments are carried out on a femtosecond laser micromachining system with the wavelength 775 nm. Two kinds of ripples on the ablated surface are observed by SEM. Moreover, the direction of these two kinds of ripples is approximately orthogonal. The cross section image of the ablated region is showed which is cut by FIB in the orthogonal direction of the line of the center ripples. The forming process of the ripples is studied by AFM. [C1911]

"Study of Phase Change Random Access Memory (PCRAM) at the Nano-Scale"

In this paper, phase change random access memory (PCRAM) cells at the nano-scale was studied. A hybrid patterning process integrating with electron beam lithography (EBL) and optical lithography was used to fabricate nano-PCRAM cell. PCRAM cells with different feature sizes ranging from 40 nm to 200 nm have been fabricated and tested by an in-house developed tester which was capable of generation of pulse with short width. Electrical testing including programming current and speed have been conducted on the nano-cells. The resistance-current curves have shown a good scaling effect on the programming current against the cell size. Besides the current reduction, it was found that nano-PCRAM cells have shown an improved programming speed when its size reduces. RESET speed as fast as 2 ns was achieved for PCRAM cell with 45 nm. The improved speed was possible attributed to the nano-size effect due to the increasing contribution of the interfaces. [C1912]

"Optical piezoelectric transducer based nanoultrasonics"

In this work, we review our recent development on nanoultrasonics based on an optical piezoelectric transducer. By embedding strain patterns in piezoelectric nano-layers and by manipulating optical field intensity in temporal and spatial domains, THz nanoacoustic waves with an acoustic wavelength on the order of or shorter than 10 nm can be generated with a nanometer-scaled lateral spot size, much smaller than the excitation optical wavelength. Noninvasive subsurface ultrasonic imaging can thus be realized with a nanometer resolution. [C1913]

"Hardware architecture for nanorobot application in cerebral aneurysm"

This paper presents an innovative hardware architecture for medical use of nanorobots proposed as an advanced and precise tool for brain aneurysm instrumentation and diagnosis. The feasibility of the outlined architecture is supported by nanobioelectronics, clinical data, and wireless technologies, as embedded integrated system devices for molecular machine data transmission and control upload. The upcoming therapeutic possibility of using nanorobots for aneurysm treatments is the natural result from some recent developments and trends in nanoelectronics, wireless communication, remote power transmission, quantum dots, nanotubes, SOI, lithography, biomedical instrumentation, genome mapping, and photonics. To illustrate the proposed approach, we applied advanced 3D simulation techniques as a practical choice on methodology for medical nanorobotics architecture and integrated system prototyping. [C1914]

"THz detection cell for sub-wavelength bio-molecular sensing"

Design rules for a novel terahertz (THz) detection cell are presented that offer the potential for the first-time development of a microscope-system capable of collecting THz-frequency (e.g., 0.3-1.0 THz) spectroscopic signatures directly from microscopic targets such as bio-molecules. The proposed technological approach utilizes the sequential transfer of single electrons through a system of coupled quantum dots that has been designed to facilitate a statistically-based measurement of the radiation intensity. This paper focuses on the design of a suitable single-electron source (SES) that allows for required injection characteristics for a previously defined THz radiation detection cell (THz RDC). [C1915]

"Study on space morphology of micromolecule structure of some biologic samples by AFM"

In this paper, the space morphologies of micromolecule structure of some biologic samples were studied by AFM.IPC-208B, which was successfully developed by Chongqing University. AFM.IPC-208B is a high-resolution AFM, and its lateral and vertical resolution can reach 0.1 nm and 0.01 nm, respectively. The space morphologies of molecular structure of glutathione adulterated with zinc ion, target gene and sheep anti human immunoglobulin-IgG were observed by AFM.IPC-208B, and their structural parameters were also measured. The space morphologies of molecular structure of the above materials have never been seen in home and abroad reports. [C1916]

"Fabrication and evaluation of metal-oxide-semiconductor transistor probe"

The metal-oxide-semiconductor (MOS) transistor probe with the focused-ion-beam (FIB) nano tip is fabricated and evaluated for the surface electric properties. The high working speed and the high sensitivity of the MOS transistor improve the scanning speed and the system minimization. The device is fabricated with the standard CMOS process and FIB nano deposition. The device is applied to the patterned sample plate, and the measuring result shows the well defined line patterns. [C1917]

"A Novel Nano-Photonic Quantum Dots Optical Fiber (NQDOF) for future photonic communications"

The field of nonlinear optics is over forty years old, but is still fresh to our minds and currently producing novel research directives and applications. Indeed, with the advent of material engineering at the nano-scale, nonlinear optics is undergoing a new revolution. The study of high optical nonlinearity in nano material for quantum communication has generated interest in its potential use as material for photonic communication devices in future telecommunications. In this paper, we propose a novel nano-photonic quantum dots optical fiber (NQDOF) to investigate its nonlinear properties for future photonic communications. We employ both nano and photonic crystal fiber technologies in NQWOF where an InP is chosen as quantum dots in the core of optical fiber. In addition, we conduct a numerical study of nonlinear parameter for developed NQDOF using Femlab. The core of NQDOF with 6 mum in diameter and InP dots with diameter less than 10 nm exhibits waveguide properties at room temperature. [C1918]

"On the performance limits of emerging nano-MOS transistors: A simulation study"

Performance limits of n-channel MOSFETs are examined based on a quantum-corrected Monte Carlo simulation. We considered technology boosters such as ballistic transport, high mobility channel materials and three dimensional (3D) device architectures, and then investigated their quantitative advantages on device performance. As a result, we found that the quasi-ballistic transport is promising to improve a drive current in Si-MOSFETs. We also found that group III-V materials and Ge are expected to perform better than the Si devices, but to maximize the device performance of III-V MOSFETs, a lower resistive source and drain such as metal source/drain and also ultrathin body technique will be indispensable. Further, we proposed and developed a "fractional particle method" for 3D quantum-corrected Monte Carlo simulation, and also demonstrated that lateral quantum confinement becomes important in nanoscale 3D MOSFETs. [C1919]

"Optical forces on Quantum dots in the near field region of resonant metallic nano-structures"

In this work we examine the forces on a single quantum dot in the presence of resonantly enhanced electric fields and steep field gradients confined to a sub-wavelength region in the near-field of the structure. To accurately resolve the sub-wavelength geometrical features of this structure, we employ the AMR-FDTD method with local space and time grid refinement using a 3D grid interface interpolation algorithm that preserves the second-order accuracy of the original FDTD scheme and is stable for long time integration. Using AMR-FDTD gives detailed access to the near field structure of the enhanced fields and consequently the gradient forces experienced by the quantum dot (QD) located near the tips. [C1920]

"Short Course 2: Micro- and Nano-Machined Optics"

Optical components and systems are affected by this trend, too, which means that miniaturized optical lenses, prisms, gratings, and even artificial materials based on sub-wavelength structures have to be fabricated for a lot of applications. As a consequence, micro and nanolithography is challenged to realize complex optical elements, as well as artificial materials, both on the base of 2-D and 3-D microstructures. This course gives an introduction to micro-and nano-optics, will show the vision and give an overview of the relevant lithographic fabrication technologies. Specific problems and limitations of the technologies will be described as well. [C1921]

"Micro/nanoparticle detection: An impedimetric microsensor based on CMOS technology"

This paper proposes a microsensor designed for the detection of a single microparticle that has potential to be extended to nanoparticles. The complete system, comprised of a sensing microelectrode array, a microelectronic circuit and a microfluidic device, is implemented on a conventional complementary metal oxide semiconductor (CMOS) chip. To establish a Lab-on-Chip system intended for detecting particles by impedance measurement, the microelectrode array is constructed with multiple metal and via layers using a standard 0.18 mum CMOS process. The impedance variations caused by the presence of a particle are detected by a sensing circuit connected with microelectrodes on the same substrate. The system structure and post-processing of the CMOS chip are presented. The finite element method (FEM) simulation and preliminary experiments completed thus far have proved that identifying a single cell or particle is feasible with the system described here. Also presented are some potential micro and nanoscale applications of this chip that go beyond single particle detection that could be investigated in the future. [C1922]

"Improved Photoluminescence of InGaN Quantum Wells Grown on Nano-Patterned AGOG Sapphire Substrate by Metalorganic Vapor Phase Epitaxy"

Metalorganic vapor phase epitaxy of InGaN quantum wells on GaN template grown on nano-patterned AGOG sapphire substrate leads to improved luminescence intensity by 1.89-2.21-times, presumably due to the reduced defect density. [C1923]

"A new ice gripper based on thermoelectric effect for manipulating micro objects"

Manipulating small or micro objects has been a big challenging task in many areas. As the most basic tool to manipulate, fabricate, characterize, assemble and test the micro scale devices and biological samples, micromanipulation keeps receiving attentions over the area of micro technology especially micro automation. Research along this direction is becoming a major stream in the world. The paper presents a new type of ice gripper based on thermoelectric effect to form ice ball on the active part of the tip. The adhesion force of an intermediate, like water, is much greater in its solid phase than liquid phase. Enough force can be produced to pick a micro object by applying the principle. First, the theory the ice gripper based on is introduced. Next, an ice gripper is designed and the preliminary parameters which influence the ice ball formed are presented. It is shown that the ice gripper is a promising approach in micro manipulation, though some problems need to be solved. [C1924]

"Trends and Future Directions in Nano Structure Based Computing and Fabrication"

As silicon CMOS devices are scaled down into the nanoscale regime, new challenges at both the device and system level are arising. While some of these challenges will be overcome in the near future, nanoscale devices will have high manufacturing defect rates and will operate at reduced noise margins, exposing computation to higher soft error rates. Thus, a key challenge for the future will be building fault and defect-tolerant computing systems. Researchers are looking to develop hybrid systems that combine on the same chip CMOS-based circuitry with any number of alternatives, including circuits composed of nanowire or carbon nanotube devices. The big advantage of including these new devices on the same chip is the increased device densities, and potential drop in fabrication costs. On the other hand, integrating very large numbers of devices on a single chip leads to questions of how to manage so many devices with tight constraints on cost, performance, power, and reliability, without having it become a design complexity nightmare. In this paper, we review some key issues and trends arising from nanostructure based computing and fabrication, while providing a few examples of defect-tolerant circuits and architectures currently being proposed as alternatives to "traditional" computing based exclusively on CMOS technology. These include hybrid nanowire/CMOS designs, reconfigurable or redundant architectures, and designs based on probabilistic computing. We end with a discussion on future challenges and direction in nanoscale computing. [C1925]

"Reconstruction of the Digital Chinese Human"

The digital human project aims at the building of whole human body datasets, from nano to macro, including cells, DNA, tissues, organs and the systems. This paper presents the construction of virtual Chinese human(VCH) dataset, including data acquisition, image preprocessing, image registration, ROI segmentation and

3D visualization. Almost all the main anatomical structures in human body have been segmented and 3D reconstructed. Furthermore, we also developed some applications based on VCH dataset, such as, 3D anatomy atlas, virtual health science education software, virtual acupuncture, and Image-Guided Neurosurgery. Virtual Human dataset provides an indispensable framework for researchers in all the subjects related to human structure, and is potentially of great significance for the development of a myriad of sciences and technologies. [C1926]

"Clocking scheme for nanomagnet QCA"

Quantum-dot Cellular Automata (QCA) was previously demonstrated using aluminum tunnel junction single-electron transistor technology at mK temperatures, and molecular QCA is under development for operation at room temperature (RT). All of the basic building blocks needed for QCA have been experimentally demonstrated. Our work on nanomagnet-based QCA (NMQCA) holds the most promise for achieving viable RT operation in the near term. One requirement of the QCA architecture is a low-power clock structure. In this paper, we demonstrate the design and simulation of an on-chip low-power clock circuit that can facilitate the realization of the nanomagnet-based fully functional logic circuit on a single chip. [C1927]

"Real-time rigid-body visual tracking in a scanning electron microscope"

Robotics continues to provide researchers with an increasing ability to interact with objects at the nano scale. As micro- and nanorobotic technologies mature, more interest is given to computer-assisted or automated approaches to manipulation at these scales. Although actuators are currently available that enable displacements resolutions in the subnanometer range, improvements in feedback technologies have not kept pace. Thus, many actuators that are capable of performing nanometer displacements are limited in automated tasks by the lack of suitable feedback mechanisms. This paper proposes the use of a rigid-model-based method for end effector tracking in a scanning electron microscope to aid in enabling more precise automated manipulations and measurements. These models allow the system to leverage domain-specific knowledge to increase performance in a challenging tracking environment. [C1928]

"Si Nano-Photodiode with a Surface-Plasmon Antenna for SiON Waveguide-Integrated Structure"

We developed a Si nano-photodiode with a surface plasmon (SP) antenna for a SiON waveguide-integrated structure. We showed that interfacial periodic nano-scale metal-semiconductor-metal Schottky electrodes function as an SP optical antenna and also as an optical coupler between a SiON waveguide and a very thin Si-absorption layer. [C1929]

"Spin-MTJ based Non-volatile Flip-Flop"

Spin Transfer Torque (STT) writing approach based Magnetic Tunnel Junction (Spin-MTJ) is the excellent candidate to be used as Spintronics device in Magnetic RAM (MRAM) and Magnetic Logic. We present the first Non-volatile Flip-Flop based on this device for Field Programmable Gate Array (FPGA) and System On Chip (SOC) circuits, which can make these circuits fully non-volatile by storing permanently all the data processed in the Spin-MTJ memory cells. The non-volatility enables logic circuits to decrease significantly the start-up latency of these circuits from some micro seconds down to some hundred pico seconds. By using St microelectronics 90 nm CMOS technology and a behavior Spin-MTJ simulation Model in Verilog-A language, this non-volatile Flip-Flop has been demonstrated that it works not only in very high speed or low propagation delay, but also keeps low power dissipation and small cell surface. [C1930]

"Effect of process variation on field emission characteristic in surface conduction electron-emitters"

In this work, we explore the effect of process variation on field emission characteristics in surface conduction electron-emitters. The structure of palladium thin-film emitter is fabricated on the substrate and the nanometer scaled gap is formed by the focused ion beam (FIB) technique. Different shapes of nanogaps due to the process variations are investigated by the experiment and 3D Maxwell particle-in-cell simulation. Four deformation structures are examined, and it is found that the Type 1 exhibits high emission efficiency due to a stronger electric field around the apex and larger the emission current among structures. The electron emission current is dependent upon the angle of inclination of surface. [C1931]

"Modeling the drug release from 3D multi-layer microstructure with micro-chambers"

This paper presents a mathematical model for three-dimensional biodegradable multi-layer drug delivery microstructure with large array of micro-chambers. The simultaneous release of multiple drugs from this type of drug delivery microstructure is modeled using cellular automata (CA) and discrete iterations. The model can describe the dynamic behavior of drug release. Furthermore, simulations about this type of drug delivery microstructure enclosed two drugs are carried out. The simulation results show that the introduced mathematical model can act as the basis of a new optimal design methodology for three-dimensional biodegradable multi-layer drug delivery microstructure. [C1932]

"Room temperature microchannel fabrication for microfluidic system"

This paper reports a novel method to fabricate micro structures under room temperature, which could be used in microfluidic system. This micro fluidic system can be used to automatically transport liquid by evaporation at the end without any external driving force. Because the micro fluidic system chip was easy to be fabricated, and it didn't need dynamic temperature control system and driving pump, the cost of whole system would be cheap. Moreover, silicon dioxide is easy to integrate with other system by semiconductor technology. Therefore, it is a high economic technology to be applied on commercial products. [C1933]

"Manufacture of nanoscale structures through integrated top-down and bottom-up approaches"

Manufacturing technology designed to interface natural molecular components with a solid surface is fundamental in building higher-order complex functional structures from the nanoscale domain. Here, we present top- down fabrication approaches that define and guide the growth of natural molecular components, such as inorganic ions and proteins, and investigate how external control parameters can influence the growth of the resultant structures. Specifically, electron beam lithography was used to create nanoscale hydrophilic patterns on a hydrophobic substrate to entrap attoliter volumes of liquid containing inorganic ions. As these nanoscale droplets evaporated, they initiated the crystallization of the ions, resulting in the synthesis of nanoscale inorganic structures (-50 nm-300 nm). Through the use of scanning electron and atomic force microscopy, the effects of external control parameters, such as humidity and size of the hydrophilic patterns, to the formation of the resulting structures were quantified. In a separate but related effort, self-assembling actin filaments were grown from nanoscale binding sites created by electron beam lithography. High-aspect-ratio (~ 1000:1) structures were demonstrated while maintaining the nanoscale surface geometries. These two technologies have laid down a foundation for the systematic study of these synthesized structures in artificial engineered environments. [C1934]

"CMOS digitalized peak detector for a MEMS-based electrostatic field sensor"

This paper presents a new CMOS peak detector that directly converts the peak of a sine wave signal to its digital representation. This peak detector is capable of capturing peak points that carry the information of the electrostatic field, simplifying the sample-and-hold requirement. By making use of the voltage to time conversion (or voltage to duty cycle conversion), the method boasts the advantage of high resolution compared with the conventional way of using AD converters. The circuit is fabricated in Chartered 0.35 um technology and is further tested. [C1935]

"Real-time position error detecting in nanomanipulation using Kalman filter"

The main roadblock to atomic force microscope (AFM) based nanomanipulation is lack of real time visual feedback. Although the model based visual feedback can partly solve this problem, due to the complication of nano environment, it is difficult to accurately describe the behavior of nano-objects with a model. The modeling error will lead to an inaccurate feedback and a failed manipulation. In this paper, a Kalman filter is developed to real time detect this modeling error. During manipulation, the residual between the estimated behavior and the visual display behavior is real time updated. The residual's Mahalanobis distance is calculated and compared with an threshold to determine whether there is a position error. Once the threshold is exceeded, an alarm signal will be triggered to tell the system there is a position error. Furthermore, the position error can be on-line corrected by local scan method. With the assistance of Kalman filter and local scan, the position error not only can be real-time detected, but also can be online corrected. The visual display keeps matching with the real manipulation result during the whole manipulation process, which significantly improve the efficiency of the AFM based nano-assembly. Experiments of manipulating nano-particles are presented to verify the effectiveness of Kalman filter and local scan method. [C1936]

"Domain Structure in Ferroelectric PbTiO3 Nano-islands"

Evolution of complex ferroelastic domain structures of PbTiO3nano-islands grown epitaxially on Pt(001)/MgO(001) single crystal substrate by chemical solution deposition has been investigated by two-dimensional reciprocal space mapping technique using synchrotron X-ray diffraction. With decreasing lateral size and thickness of the nano-islands, the proportion of c-domains increased continuously and fully c-domain dominant structure was emerged. At the same time, some of a-domains in the twinned a/c/a/c type structure turned into the a-domains with defective domain boundaries aligned normal to the substrate plane. The relative proportions of two types of a-domains were also dependent on the lateral size of nano-islands. The smaller islands favored the aligned a-domains with defective domain boundaries, which seem to be due to extensive relaxation of confining strain imposed by the substrate. [C1937]

"Nanogenerators and Nanopiezotronics"

Developing novel technologies for wireless nanodevices and nanosystems is of critical importance for in-situ, realtime and implantable biosensing, biomedical monitoring and biodetection. It is highly desired for wireless devices and even required for implanted biomedical devices to be self-powered without the use of a battery. Therefore, it is essential to explore innovative nanotechnologies for converting mechanical energy (such as body movement, muscle stretching), vibration energy (such as acoustic/ultrasonic wave), and hydraulic energy (such as body fluid and blood flow) into electrical energy that can be used to power nanodevices. We have demonstrated an innovative approach for converting nano-scale mechanical energy into electrical energy using piezoelectric zinc oxide nanowire (NW) arrays. We have recently developed a DC nanogenerator driven by an ultrasonic wave. This represents a tremendous step towards realization of practical piezoelectric based nanogenerators. The mechanism of operation of the electric generator relies on the unique coupling of piezoelectric and semiconducting properties of ZnO as well as the elegant rectifying function of the Schottky barrier formed between a metal tip and the NW. Based on this principle, piezoelectric-field effect transistors, gated diodes, sensors and resonators have been fabricated. These form the fundamental components of nano-piezotronics. Piezotronics is the field of using coupled piezoelectric-semiconducting properties for fabricating novel and unique electronic devices and components. [C1938]

"Rapid production of biocompatible polymeric nanoparticles for functionalization via radio-frequency acoustic atomization"

This work demonstrates the use of surface acoustic wave (SAW) atomization together with a nonuniform evaporation and nucleation process to give sub-50-nm diameter monodisperse nanoparticles. SAW atomization is a straightforward and energy efficient technique to generate relatively homogeneous particle size distributions that can be carried out on a chip-scale microdevice for portable drug delivery applications or scaled up for industrial production. It employs technology originally developed for the entirely different purpose of signal filtering and multiplexing, and provides direct control over the size of the particles through adjustment of the operating frequency of the ultrasonic vibration. [C1939]

"Piezoresistor design for deflection angles decoupling measurement of two-dimensional MOEMS scanning mirror"

A novel micro-optical-electro mechanical systems (MOEMS) sensor technique is developed for optical scanning and space detection. As the core technology of the system, a two-dimensional scanning mirror with small volume, large deflection angles and high frequency is presented. A reflected optical beam on the mirror can be scanned more than 20 deg two-dimensionally. For the deflection angles decoupling measurement, piezoresistors are fabricated on the flexible beam linked with mirror. The coupling motions of the flexible beam are analyzed and the stress states of the piezoresistors are presented when the mirror is scanning two-dimensionally. For the measurement of one direction, four piezoresistors form a full Wheatstone bridge to counteract the influence of another direction. The motion of the flexible beam is decoupled and the deflection angles of each direction are obtained independently and precisely. The appropriate crystal directions and doping types of the piezoresistors are designed to obtain the larger piezoresistive coefficients for the high sensitivities. The method is proved correct and effective by the theoretic calculation and simulation analysis. The deflection angles measurement sensitivities for two directions are 396 mV/deg and 348 mV/deg respectively. [C1940]

"Tunable intrinsic phase shift between a spin torque nano-oscillator and an AC current"

We present magnetodynamic simulations, based on the Landau-Lifshitz-Gilbert-Slonczewski equations, of the interaction between a spin torque oscillator (STO) and an ac current (Iac). To avoide any extrinsic phase shift we inject the ac current at the intrinsic frequency (fSTO) of the STO. We nevertheless find an unexpected intrinsic preferred phase shift Deltaphi0between the STO and IacIn the in-plane precession mode (IP) the STO adjusts to a state where its resistance (or voltage) lags Iacabout a quarter of a wave length (Deltaphi0=87-94deg). In this regime Deltaphi0increases somewhat with the dc current. However, as the precession changes into the out-of-plane (OOP) mode, Deltaphi0exhibits a dramatic jump by about 180deg, i.e. the STO resistance now precedes Iacabout a quarter of a wave length (|Deltaphi0|=86deg). Deltaphi0can furthermore be tuned by changing one or more of the anisotropy field, the demagnetizing field or the applied field. At the IP/OOP boundary, the ac current mixes the two oscillation modes and both chaotic and periodic mixing is observed. We argue that the intrinsic Deltaphi0will impact any circuit design based on STO technology and will e.g. have direct consequences for phase locking in networks of serially connected STOs. [C1941]

"Key Integration Technologies for Nanoscale FRAMs"

We discuss key technologies of 180 nm-node ferroelectric memories, whose process integration is becoming extremely complex when device dimension shrinks into a nano-scale. This is because process technology in ferroelectric integration does not extend to conventional shrink technology due to many difficulties of coping with MIM (metal-insulator-metal) capacitors. The key integration technologies in ferroelectric random access memory (FRAM) comprise (1) etching technology to have less plasma damage; (2) stack technology for the preparation of robust ferroelectrics; (3) capping technology to encapsulate cell capacitors; and (4) vertical conjunction technology to connect cell capacitors to the plate-line. What has been achieved from these novel approaches is not only to have a peak-to-peak value of 675 mV in bit-line potential but to ensure sensing margin of 300 mV in opposite-state retention even after 1000 hours at 150degC. [C1942]

"Characterization of stackless vertically aligned carbon nanotube synthesized by thermal CVD with gravity effect and water-assisted etching"

In this work, thermal chemical vapor deposition with gravity effect and water-assisted selective etching have been employed to synthesize vertically aligned carbon nanotubes (CNTs) with high aspect ratio and low defect density. CNTs were grown by placing the substrate upside down along gravitational field and the periodic introduction of acetylene and low concentration water vapor through argon. The water vapor concentration and its introduction time are optimized for stackless growth of catalyst-removed CNTs. The water vapor concentration of 300 ppm and introduction time of 3 minutes was found to be an optimum condition. Vertically aligned CNTs of 8-15 nm in diameter and nearly 90 mum long are achieved. Characterization of CNTs by transmission electron microscope (TEM) confirms that the CNTs are of good quality with low defects and almost catalyst-free. Moreover, the fabricated CNTs have been characterized for electron field emission applications. The high aspect ratio CNTs exhibits reproducible low field emission with turn-on electric field of ~3 V/mum. [C1943]

"Single semiconducting zinc oxide nanowire based device for thermal and airflow sensing"

This paper reports a technology for fabricating a novel nanostructure-based device comprised of a single semiconducting zinc oxide (ZnO) nanowire suspended between two micro Au electrodes for sensor applications. The electric characteristics of the device before and after processed by Pt deposition using focused ion beam microscope were comparatively studied. Furthermore, the potential applications by using the device for thermal and airflow sensing were also investigated. The temperature coefficient of resistance of the ZnO nanowire was estimated to be about -2.61 times 10-3degC-1. The airflow sensitivity of the device is about 3 kOmega/m/s. Compared with conventional sensors, this device takes advantages of high sensitivity and ultra-low power. [C1944]

"MRI controlled magnetoelastic nano biosensor for in-vivo pH monitoring: A preliminary approach"

Biosensors are a predominant research field and aim at providing small and novel methods for bio-recognition, bio-actuation and embedded data analysis to the medical and bioengineering domains. Typical biosensor technologies exploit optical, electrochemical or mechanical detection methods. Although many biosensors are designed to use biological samples for recognition and treatment, some are designed to be implantable on animals or human for direct detection. The presented work suggests the use of a magnetoelastic based biosensor for the wireless transmission of physiological data through the human body at capillary level. When excited by an external magnetic wave at a given frequency, the magnetoelastic core enters in a vibrating state and emits an alternative magnetic field in response. Using an external RF coils such as the one found in a magnetic resonance imaging (MRI) system, the magnetic flux generated by the magnetoelastic sensor core is received and analyzed during its transient response. Using a pH sensible functional polymer coated on the sensor core, physiological data fluctuations are translated into resonant frequency shifts which, in turn, are picked up by the coil. A preliminary approach for the sensor design and system architecture is presented. [C1945]

"A Coupled Simulation and Optimization Approach to Nanodevice Fabrication with Minimization of Electrical Characteristics Fluctuation"

In this paper, a TCAD-simulation-based optimization methodology for nanoscale CMOS device fabrication is advanced. Electrical characteristics fluctuation is considered and minimized in the optimization process. Integration of device and process simulation is performed to evaluate device performances, where the hybrid intelligent approach enables us to extract optimal recipes which are subject to specified device specification. It is known that production of CMOS devices now are in the sub-65 nm region; therefore, electrical characteristics fluctuation should be simultaneously considered when we extract a set of optimal process parameters. Verification of the efficiency and accuracy of the proposed computational methodology is tested and performed on a 65 nm CMOS device. Compared with realistic fabricated and measured data, this approach achieves the performance of on-target design; in the meanwhile, it significantly reduces the threshold voltage fluctuation. We believe this approach provides a novel way to accelerate the tuning of process parameters and benefit technology of nanodevices. [C1946]

"First Experiences Teaching Experimental Nanoscale Science and Technology to Undergraduate Students"

This paper describes our experiences teaching experimental nanoscale science and technology to undergraduate students at the University of Cincinnati for the first time. The interdisciplinary course is open to science and engineering students. A prerequisite for the course is taking the preceding course "Introduction to Nanoscale Science and Technology." The experimental nanotechnology course is team taught by faculty members from the departments of physics, chemistry, chemical and materials engineering, and mechanical engineering. The course comprises of four laboratory modules. It was found that the students were very capable of performing the hands-on nanotechnology experiments. Lectures before the labs were critical to allow the students to understand the theory well enough to perform the experiments. The experiments and results are described in this paper. [C1947]

"Fabrication of Periodic Nanostructure in Nanoimprint Process"

In this paper nanoimprint molds with 50nm and 100nm feature size nanostructure were fabricated. The periodic pattern of a positive resist was formed on silicon wafer by electron beam lithography, and then the nanostructure of Si was etched using an inductively coupled plasma reactive ion etching (ICP-RIE) system. During the etching process, different ratio of C4F8gas was added to the original etching gases SF6/O2. By increasing the C4F8gas, the sidewall protection was improved. The C4F8gas also increased the etching resistance of the electron beam resist, and the nanoseale resist patterns were maintained through the etching process. The resist was removed after etching, and then the 50nm periodic nanostructure with aspect ratio 6 was obtained. To achieve nanoimprinting process with less damage, the possible sources of stresses resulting from the molding/demolding process, film solidification and thermomechanical mismatch during cooling were studied. [C1948]

"An Introductory Course in Nanoelectronics at the Senior/Graduate Level"

This paper describes the rationale, organization and topic coverage for a course introducing seniors and first year graduate students in electrical engineering and related disciplines to the exciting and revolutionary developments occurring in the electronics realm at the nanoscale, i.e. nanoelectronics. Included is a survey and introduction to carbon nanotube based FETs, devices based on electron spin (spintronics), nanowires and nanotransistors, single electron transistors and molecular electronics. Also examined are recent advancements in silicon devices, such as nanoscale and strained MOSFETs, multigate MOSFETs (FinFETs) and compositional grading at the nanoscale in SiGe HBTs. The bandgap engineering of multilayer semiconductor structures at the nanoscale and its use in modern III-V HEMTs, HBTs and quantum structures is also surveyed. Finally, briefly introduced are a variety of new nanoscale fabrication technologies that are emerging, such as micro-contact and dip pen nanolithography, and recently developed nanoscale imaging techniques, such as atomic force microscopy. While the available time in a single quarter or semester course does not permit an in-depth discussion of these topics, the course is intended to acquaint the student with the most recent developments at the forefront of the electronics field, to excite their curiosity and imagination, and to provide the student with a basic understanding of the underlying concepts to enable subsequent study. [C1949]

"Mega-Challenges for Nano-Silicon Technology"

First Page of the Article [C1950]

"Computing Division in the Electron Counting Paradigm using Single Electron Tunneling Technology"

Single Electron Tunneling (SET) technology appears to be a promising alternative for CMOS as it exhibits excellent power consumption and scalability features. Furthermore, it allows to perform computation in unconventional, but efficient ways which is exploited by the Electron Counting (EC) paradigm. In this paper we investigate SET division schemes that operate under the EC paradigm. We propose two schemes of which the fastest has a linear time complexity. The implementation of the latter is discussed in detail and simulation results are presented. The worst case delay is calculated as 39.2 ns and the worst case energy consumption is calculated as 1.23 eV. The area cost of the scheme is 146 elements. [C1951]

"A CMOS Sensor for Nano-Imaging"

We report on the design and measurements of a new direct electron imaging sensor. The active pixel sensor array consists of 512 by 550 pixels, each 5 by 5 μm in size, with a 8 μm epitaxial layer, to achieve an effective fill factor of 100%. Spatial resolution of 2.3 μm for a single incident e-has been measured. Tests have been performed with 200 and 300 keV beams, and an image of a catalase crystal, taken with the sensor, is presented. This novel sensor technology opens the door for studies of nanostructures and biological samples at higher resolution in both space and time. [C1952]

"Nanowires for Nanoscience and Nanotechnology"

First Page of the Article [C1953]

"Fabrication of a new cold cathode based on pulsed laser deposition of lanthanum monosulfide thin films"

Field emission properties of lanthanum monosulfide (LaS) thin films deposited by pulsed laser deposition (PLD) have been measured by building an array of new cold cathodes based on MEMS technology. The new cold cathode array has been fabricated by a sequence of steps on two separate [C1954]

"Design of Three-Dimensional Molecular Integrated Circuits and Molecular Architectronics"

This paper reports a unified synthesis taxonomy in design of three-dimensional (3D) molecular integrated circuits (MICs). TheseMICs, fabricated utilizing bottom-up molecular fabrication technologies, are designed as aggregated neuronal hypercells ([unk]hypercell). Each[unk]hypercell is implemented using molecular gates (Mgates) which composed from multi-terminal molecular electronic devices that exhibit and operate due to quantum phenomena. The intelligent library of[unk]hypercell aggregates,,[unk]hypercells,Mgates, molecular devices and data-structure primitives can be developed and utilized. To address complexity and technology dependence, this paper documents innovative methods in design, optimization, evaluation and verification of 3DMICs. The logic design ofMICs is accomplished by using a novel technology-centric concept based on the use of[unk]hypercells and linear decision diagrams. We initiate the developments of a 3D super-large-scale integration (3DSLSI) design concept. This paper reports a proof-of-concept CAD design tools illustrating and verifying the results for combinationalMICs. [C1955]

"Electron Transport Investigation of Thiophene Oligomers Based Molecular Wires"

We investigate the electron conductance of thiophene oligomers based molecular wires using the first principles method, which is based on the density functional theory and nonequilibrium Green's function. The molecular wires are built by bridging various thiophene oligomers (dimers, tetramers and hexamers with different inter-ring torsional angles) between two gold electrodes via terminal groups S and CN. The projected energy levels, energy gaps, transmission functions and current-voltage characteristics of the molecular wires are calculated and analyzed. Results show that the molecular wires with the planar structures of thiophene oligomers have larger electron transmission functions, hence better electronic conductance than those with twist structures. The conductance of molecular wires decreases when the chain length of the thiophene oligomer increases. The terminal groups between the oligomer and the electrode has nontrivial effects on the conductance of the wires. The results could provide a qualitative guidance for design molecular electronic wires. [C1956]

"Pattern Generation by Using Multi-Step Room-Temperature Nanoimprint Lithography"

We have demonstrated multi-step room-temperature nanoimprint lithography (RTNIL) using polystyrene (PS, average molecular weight 97 kg/mol) as the polymer layer for imprinting complex patterns. In separate experiments, single, double, and multiple (up to 10) sequential imprint steps were performed at imprint pressures between 1 to 30 MPa. To accomplish this demonstration, we designed and built a tool that controllably and repeatedly translated and pressed a sample into a stationary mold. The demonstrated inter-step alignment accuracy of this tool was 500 nm. Results of these experiments revealed the polymer deformation that results when nanoimprint is used to further deform a previously structured surface. The molds used in these experiments consisted of 400-nm-period diffraction gratings, as well as of rectangular structures of varying aspect ratios, ranging from 150 to 300 nm wide. [C1957]

"Integration of Nanoscale Science and Technology into Undergraduate Curricula"

An interdisciplinary group at the University of Cincinnati was recently awarded an NSF Nanotechnology Undergraduate Education grant, Integration of Nanoscale Science and Engineering into Undergraduate Curricula. The faculty come from Engineering, Physics, Chemistry, and Philosophy departments. The overall goal of this project is to incorporate nanotechnology education into undergraduate curricula in the Colleges of Engineering and Arts & Sciences. This paper will discuss the material taught in the two courses and the reaction of the students to highly interdisciplinary team teaching of nanotechnology. The lectures provide an overview of nanoscale science and engineering, with applications in nanomaterials, nanophotonics, nanoelectronics, nanomechanics, and bionanosystems. We also include lectures on societal and ethical implications of the nanoscale. The laboratory modules give students hands-on experience including synthesis of nanoparticles and nanotubes, and subsequent characterization with multiple stations of atomic force microscopes and laser spectrometers. [C1958]

"Molecular Beam Epitaxy of GaAs Nanowires on Si Substrates"

Au-catalyzed GaAs nanowires were epitaxially grown on Si substrates by vapor-liquid-solid growth with the molecular beam epitaxy (MBE) method. The MBE growth could produce controlled crystalline orientation and uniform diameter along the wire axis of the GaAs nanowires by adjusting growth conditions such as growth temperature and V-III flux ratio. Growths of GaAs 001 as well as GaAs 111 nanowires were observed by transmission electron microscopy and scanning electron microscopy. Well-aligned GaAs 111 nanowires on a Si [C1959]

"Structural and Optical Characterization of InAs/GaSb nanoscale superlattices for mid-infrared detection"

Optimization of various growth parameters for Type-II GaSb(10MLs)/InAs(10MLs) nanoscale superlattices and GaSb layers, grown by solid molecular beam epitaxy, has been undertaken. These include the As/Sb soak times and substrate temperature during the growth. We present optical and structural characterization for these heterostructures, using high resolution X-ray diffraction (HRXRD), photoluminescence (PL) and atomic force microscopy (AFM). Optimized parameters were then used to grow a thick structure suitable for mid-infrared detection. [C1960]

"Engineering Exchange Interaction in Coupled Elongated Quantum Dots"

Coupled elongated quantum dots containing up to two electrons are studied with a model potential in magnetic fields. Single and two particle Schrцdinger equations are solved using numerical exact diagonolization to obtain the exchange energy and chemical potentials. Special emphasis is placed on the variation of the exchange interaction between the two electrons as the dot shape is modified. As the aspect ratio between the directions perpendicular and parallel to the coupling direction of the double dots increases, the exchange energy at zero magnetic field increases, while the magnetic field at the singlet-triplet transition decreases. By investigating the charge stability diagram, we obtain the inter-dot coupling strength for various configurations. We also show the onset of electron localization into one dot due to inter-dot detuning and increasing magnetic fields. [C1961]

"Optical Properties of Stranski-Krastanow and Strain-Free GaSb Quantum Dots on GaAs Substrates-Towards Sb-based Type-II Quantum Dot Emitters -"

We report the optical characteristics of type II GaSb quantum dot (QD) formation on GaAs by either Stranski-Krastanow (SK) or interfacial misfit (IMF) growth mode. The growth mode selection can be controlled by the gallium to antimony (III/V) ratio where a high III/V ratio produces IMF and a low III/V ratio establishes the SK growth mode. The IMF growth mode produces strain-free QDs emitting at 1.35 μm at room-temperature (RT), while the SK growth mode produces highly-strained QDs emitting at 1.18 μm at RT. We also demonstrate the fabrication of light-emitting diode (LED) structures containing five layers of GaSb/GaAs QDs using the IMF growth mode. Electroluminescence (EL) peak at 1.3 μm from the stacked QDs is observed at RT, which would be applicable to GaAs-based photonic devices for fiber-optic communication systems. [C1962]

"Dielectric Response of a Planar Periodic Array of Polarizable Wires Parallel to an Interface with a Nonlocal Dynamic Plasma-like Medium"

We examine the spatially inhomogeneous polarizability and dielectric function of the combined Coulomb-coupled system of a periodic lateral lattice array of polarizable 1D wire plasmas and a semi-infinite bulk plasma nearby. Furthermore, we carry out an exact closed form analytic solution of the spatially inhomogeneous random phase approximation integral equation for the dynamic nonlocal screening function, K(r,t;r′,t′) which is the space-time matrix inverse of the inhomogeneous dielectric function ε(r,t;r′,t′) in the sense ∫d3xdτK(r,t;x,τ)ε(x,τ;r′,t′) = δ3(r-r′)δ(t-t′). In this work we also determine the exact dispersion relation coupling the periodic wire lattice plasmons with the semi-infinite bulk plasmon, and the residues of the screening function at the coupled mode frequencies provide the relative excitation amplitudes (oscillator strengths) of the various plasmon roots that emerge. [C1963]

"Large-Area Nanophotonics Fabricated by Interferometric Lithography"

Large area (several cm2) mid- and near-infrared metamaterial samples including analogs to split-ring resonators and negative-index materials are fabricated using interferometric lithography and standard integrated circuit fabrication techniques. The split-ring resonators are vertical structures with the smallest dimensions defined by deposition rather than by lithography. The negative index material is an Au-Al2O3-Au stack structure perforated with a 2D hole pattern. Both the amplitude and phase of the transmission and reflectivity are measured with phase-mask, zero-path-length difference, interferometric techniques and the refractive index is deduced by inverting these measurements. A rigorous coupled wave analysis (RCWA) is in excellent agreement with the measurement. Improvements in the original structure to provide a lower loss and an improved transmission for the structure are presented. Prospects for continued reduction in the loss and an improved figure of merit, [|Re(n)|/Im(n)], are discussed. Interferometric lithography provides an inexpensive, facile, large-area technology for the fabrication of visible/infrared metamaterials with a 2D array patterning capability extending to as small as ~20-nm features. [C1964]

"Second Order Nonlinear Dielectric Response of a Dynamic, Nonlocal Plasma Subject to Terahertz Radiation"

We examine the nonlinear polarization of a solid state plasma in an incident terahertz (THz) field. In this, an iterated shielded potential approximation of the nonequilibrium Green’s function is employed to obtain the polarizability to second order in the THz field. This second order polarizability exhibits resonant behavior when the incident THz frequency matches the plasma frequency of the system, which can substantially reduce the effectiveness of screened impurity scattering potentials. [C1965]

"Engineering Tunnel Barriers in Hybrid Silicon/Molecular Memory Devices"

This paper discusses the role of asymmetric tunneling across oxide barriers in Hybrid Silicon/Molecular devices. Devices incorporating redox-active (ferrocene) molecules on silicon dioxide (SiO2) of varying thickness and Hafnium dioxide (HfO2)/SiO2stack on p-Si substrates were investigated as charge storage elements. The reduction (erase) process was found to be increasingly rate-limited as compared to oxidation (write) process with increasing SiO2thickness. This is attributed to asymmetric tunneling rates mainly due to a lower potential drop across the tunnel barrier for a given gate voltage during reduction process as compared to oxidation, resulting from higher surface potential drop in Si. Although increased SiO2thickness provides for improved retention, it severely retards write process. This can be overcome by employing asymmetric layered barrier of HfO2/SiO2which enhances effect of inherent asymmetric tunneling rates and also speeds up the write process due to higher relative permittivity and lower barrier offsets of HfO2/SiO2on Si as compared to SiO2. This behavior can be utilized to improve retention properties of these hybrid memory devices with minimal deterioration in write times. [C1966]

"Electrowetting on Arrayed Carbon Nanofibers"

Electrowetting on arrayed carbon nanofibers has been demonstrated. The testing structure consists of Si/carbon nanofibers/dielectric/fluoropolymer/liquid. Nanofibers were patterned on 5Ч5 μm pitch which resulted in superhydrophobic behavior for water (θ>150°). Via electrowetting, liquid contact angle was shown to be irreversibly reducible to θ 100°. Electrowetting using a competitive two-liquid (oil/water) system was shown to be reversible. The nanofibers terminate in a <25 nm radius tip. This small tip size results in effectively zero capacitance for water in the dewetted state. As electrowetting increased with applied voltage, the wetting state was confirmed by measuring the capacitance and stored energy density for the liquid/nanofiber system. [C1967]

"Overview of emerging technologies-nano"

The existence of a technology-based business is predicated on providing the customers with the technology that satisfies their needs. The tracking and application of similar technology developments is not a difficult proposition. However, it is very easy to overlook the emergence of alternate technological solutions. While there is not a single predicator that will provide an insight to key emerging technologies, the tracking of trends provides a beginning. Understanding these trends and being able to sort wheat from chaff is the most difficult task. A significant portion of being able to determine exactly what is being manufactured. If a manufactured item can not be measured and quantified, the device can not really be manufactured. [C1968]

"Temperature driven transport of gold nanoparticles physisorbed inside carbon nanotubes"

We use molecular dynamics simulations to demonstrate the temperature driven mass transport of solid gold nanoparticles, physisorbed inside carbon nanotubes (CNTs). Our results indicate that the nanoparticle experiences a guided motion, in the direction opposite to the direction of the temperature gradient applied to the carrier CNT. The force experienced by the nanoparticle is of thermophoretic character, scaling linearly with the applied temperature gradient. The present results prove that the surface corrugation of different types of CNTs and the magnitude of the temperature gradient strongly affects the nanoparticle motion along the carbon lattice. [C1969]

"Growth of Horizontally Aligned One-Dimensional Carbon Nanotubes Array on a Si Substrate"

A one-dimensional (1-D) array of carbon nanotubes horizontally aligned on silicon substrates was successfully grown using a flame synthesis method based on the template of a one-dimensional anodic aluminum oxide nanopore array. The diameter and length of nanotubes are controlled by the geometry of nanopores of the aluminum oxide template. This one-dimensional carbon nanotube array may have great potential for fabrication of nanoelectronic devices and nano-electromechanic systems (NEMS) compatible with the planar processing technology. [C1970]

"Mechanical Testing of Hydrated Collagen Nanofibrils Using MEMS Technology"

A novel technology has been developed to perform mechanical testing on nanoscale biological materials in a hydrated state. Microelectromechanical systems (MEMS) devices have been designed and fabricated specifically to test type I collagen nanofibrils. Fluorescent antibody labeling was used to visualize the fibrils in solution. Pulled glass micropipettes attached to micromanipulators were used to extract single fibrils from a solution droplet and to place them on the MEMS devices. An etched tungsten probe was used to place small drops of epoxy to fix the fibrils to the devices. Tensile testing was performed successfully on four isolated hydrated fibrils to generate stress-strain curves which produce the elastic moduli. In addition, cyclic loading was performed to investigate the fatigue properties of the fibrils. One fibril broke in the middle of the gauge length under tensile load after cycling indicating these nanofibrils are susceptible to fatigue. This technique can make quantitative reproducible mechanical measurements on specimens with characteristic dimensions in the range of 10-1000 nm, an experimental capability which has previously been lacking. With better understanding of the mechanical properties of collagen fibrils, investigators can develop more realistic multiscale computational models to predict bone fracture, put better design constraints on synthetic bone substitutes and help develop treatments for bone diseases. With minor modifications, the MEMS platform may be used to measure the mechanical properties of other nanoscale fibers and membrane structures. [C1971]

"Quantizing Parallel Magnetic Field Role in Statistical Thermodynamics of a Narrow Quantum Well"

We examine quantized-electron statistical thermodynamics in a narrow delta-function quantum-well system subject to a parallel magnetic field of arbitrary strength. In this, we employ an exact, analytical closed-form Green’s function for Landau-quantized electrons in skipping states of motion between the walls of the narrow quantum well coupled with in-plane translational motion and hybridized with the zero-field lowest subband energy eigenstate. The results are expressed entirely in terms of elementary function generators of the Landau eigenfunction series. In particular, we determine the (grand) thermodynamic potential of the system in the quantum strong field limit, in which only the lowest Landau eigenstate is occupied. [C1972]

"Industrial Production of Multiwalled Carbon Nanotubes"

First Page of the Article [C1973]

"Molecular Cognitive Information Processing and Computing Platforms"

Molecular cognitive systems are envisioned to be designed to accomplishing information processing integrating knowledge generation, perception, learning, etc. By introducing interactive cognition tasks, one attempts to expand signal processing which includes data coding, manipulation, mining, storing and computing. The information theory has been utilized to evaluate communication and coding, and there is a need to develop methods to measure and estimate knowledge generation, perception and learning. We initiate the developments of information-theoretic model of information representation and processing. Approaches in synthesis of molecular cognitive information processing platforms (MCIPP) are reported. ForMCIPP, synthesis of novel architectures and organizations can be performed utilizing aggregated neuronal hypercells. It is documented that the signal processing at the system and device levels can be evaluated and optimized using the performance measures. The objective is to examine how systems represent and process the information utilizing information-theoretic estimates. Signal and information processing depends on the statistical structure of data. We examine these statistics to attain statistical knowledge generation, learning, reconfiguration, adaptation, robustness and self-awareness. The information-theoretic limits of cognition (knowledge generation, perception and learning) should be examined using the information-centered estimates. Baseline cognition characteristics should be analyzed in order to approach fundamental limits and benchmarks of cognitive information processing. One faces with a significant mathematical complexity and technology dependence. Though fundamentals results may be technology-independent, the implementation leads to specific technologies. The proposed results uniquely suit emerging and gradually maturing molecular technologies. [C1974]

"Three-Dimensional Metal Patterning over Nanostructures by Reversal Imprint"

Metal patterning is a key technology in semiconductor and biomedical devices fabrication. A simple process for patterning three-dimensional (3D) metal structures over nanostructures is developed. Metal patterns of 50/20 nm thick Au/Ti and 0.5 μm thick Al have been transferred to SU-8 and Si structures by reversal imprint. 3D structures in metal have also been demonstrated. [C1975]

"Nanocomputing with Probabilistic Logic"

This presentation considers the impact on logic design and computing of the fundamental unreliability of nanoscale device technologies. In general, these technologies will provide implementations of logic gates and circuits where logic levels are "0" or "1" with some probability related to the error rates of gates and interconnect. In this context, reliable circuit design becomes a problem of maximizing the probability of the correct logic levels of the output of the function implemented by the circuit for the relevant inputs. This presentation reviews some recent results and proposes new ideas for the characterization and design of probabilistic logic. Since the early days of computing it has been well known that the design of reliable arbitrary logic circuits is only possible if individual gates have error rates below some threshold which varies with gate functionality. Using bifurcation analysis of probabilistic gate models, thresholds for different types of gates are derived and their implications for logic design are revisited. Similar techniques are used to analyze multi-gate circuits and the functions they implement. The resulting thresholds provide reliability bounds for the circuits. Also considered are several proposed models for either analyzing reliability or maximizing it. Reference is also made to circuits designed to implement probabilistic computations. [C1976]

"Information-Theoretic Analysis of Three-Dimensional Molecular Integrated Circuits"

For three-dimensional (3D) molecular integrated circuits (MICs), an information-theoretic model of signal processing is under developments in order. The objective is to estimate and examine the information-theoretic measures in order to perform optimization and carry out optimal design. Distinct information measures, such as entropy, capacity, complexity and other are analyzed. There is a need to derive baseline information estimates for 3DMICs to optimize molecular hardware and ensure a technology-centric co-design. This will allow us to approach fundamental limits and benchmarks. Three-dimensionalMICs are envisioned to implement datapath, memory and other subsystems. For information measures, different quantitative and qualitative estimates can be utilized. The information-theoretic analysis imposes significant challenges due to mathematical complexity and technology dependence. The information analysis to correctly compute switching functions and maximize the mutual information examining channel input and output can be performed. However, digital versus analog solutions, switching frequency, thresholds, switching energy, power losses and other characteristics depend on logic design as well as dynamic and steady-state characteristics of molecular devices. Hence, the information-theoretic analysis should integrate hardware, software and fabrication technology. It is shown that critical information measures depend on data structures, and, the information content of channels are technology-dependent. Different molecular gates, comprised from multi-terminal primitives (molecular electronic devices), can be used to implement neuronal hypercells ([unk]hypercells). The aggregated[unk]hypercells form 3DMICs. This paper focuses on further developments of molecular electronics and molecular signal processing platforms by utilizing quantifying and qualifying information measures and optimizing information estimates. [C1977]

"On Practical Multiplexing Issues"

This paper investigates the behavior of multiplexing schemes in combination with elementary gates. The two schemes under investigation are MAJORITY- and NAND-multiplexing. The simulation results are for single-electron technology (SET), where the elementary components of the gates (capacitors in the case of capacitive-SET) are subjected to geometric variations. First, the elementary gates are compared in terms of their intrinsic probability of failure with respect to variations. Secondly, the two multiplexing schemes are weighted against the reliability enhancements they are able to bring into the system. This study gives insights into the behavior of fault-tolerant multiplexing schemes and shows how the logic styles, as well as the technology, could affect the overall reliability of a multiplexed system. Such aspects should be carefully weighted for the design of future nano-architectures. [C1978]

"Using Super Cut-off Carbon Nanotube Sleep Transistors in Silicon Based Low Power Digital Circuits"

In this paper, we have explored the use of super cut-off tunneling carbon nanotube FETs for ultralow power digital logic. The use of such FETs in conjunction with the existing Si technology yields more than 1000X (10X) savings in leakage power in random logic (SRAM) [C1979]

"Small-World Power-Law Interconnects for Nanoscale Computing Architectures"

Interconnects on today's chips have become more important than transistors and this trend is predicted to continue with ongoing miniaturization and forthcoming beyond-silicon technologies. Current ad hoc interconnect technology is not suitable for multi-billion-transistor chip integration and we argue that radically new approaches potentially offer better performance for a lower price. The goal of this paper is to explore certain design and performance tradeoffs of both regular and irregular interconnect fabrics for self-assembled nanoscale electronics in a realistic framework. We show that fabrics with small-world-like properties have major advantages in terms of performance and robustness over purely regular fabrics. Our findings support the unconventional approach of self-assembling nanoscale electronics in a mostly random manner, which is believed to be more fabrication friendly and thus cheaper to realize. [C1980]

"Multidisciplinary Undergraduate Nano-Science, Engineering and Technology Course"

Using basic fundamentals, engineering and science encompass continuously evolving technologies. In response to these changes and emerging opportunities, engineering and science curricula evolve revisiting program objectives, goals and outcomes. By integrating various disciplines and tools, nanotechnology-centered engineering and science provides a multidisciplinary approach to these needed curricula changes needed to meet societal challenges and industry needs. Extensive advances in biotechnology, electronics, energy sources, information technology and nanosystems, have brought new challenges to academia. As a result, many engineering and science schools have revised their curricula to offer relevant courses. At the RIT, a cross-listed (Electrical Engineering and Physics) multidisciplinary sophomore-level Nano-Science, Engineering and Technology (NanoSET) course has been developed and offered with support from the National Science Foundation. This course is offered as a restricted science elective within the Electrical Engineering curriculum, while students from various science and engineering departments can take the course as a science or free elective. This paper reports the course goals, objectives, emphasis, coverage, accomplishments, dissemination and assessment. Strategies for interactive team-teaching, material delivery and coverage are reported. We articulate our innovative practice and strategies for teaching nanotechnology inside and outside of the classroom through lectures, workshops and laboratories. We emphasize the need for large-scale coherent efforts in defining and developing nanotechnology at the college, institutional and multi-institutional levels. To pursue the nanotechnology-centered developments and educational innovations, a number of obstacles and impediments should need to be overcome, and serious long-term commitments are needed. [C1981]

"Methods and Tools for Reliability Driven Defect-and Fault-tolerant Design of Nanosystems"

In the recent past, CMOS manufacturing technology has been downscaled successfully to create feature sizes below 100 nm. But with the predicted demise of Moore's law, continued success of the electronic industry will increasingly depend on emerging non-silicon nanotechnologies. CMOS or not, affordable manufacturing of defect-free nanosystems seems unlikely. Besides manufacturing defects, various transient faults will affect these systems. Therefore, there is a need for developing computing systems that are tolerant to defects and faults. Although several methodologies have been published in the literature to design defect-and fault-tolerant nanoscale systems, there is a severe lack of CAD tools to aid the design and analysis of such systems. In this paper, we develop multiple methodologies and tools to (i) design fault-tolerant nanosystems on architectures based on different nanotechnologies, and (ii) quantitatively analyze the performance of such nanosystems in terms of reliability, area and delay. [C1982]

"Modular Design of Conditional Sum Adders Using Quantum-dot Cellular Automata"

Quantum-dot cellular automata (QCA) is an emerging technology for electronic circuits. Its promising advantages such as a faster speed and a small size give us a good milestone of future technologies. Nanoscale devices, quantum-dot cells, are key components of QCA technologies as gates, wires, and memories. Its simple and unique structure allows the circuit designer to concentrate on the structural level of the circuit instead of the physical level. Currently the exploitation of the adder characteristics are not sufficient. This paper proposes a modular design of a conditional sum adder (CSA) in QCA for comparisons. Using the QCADesigner, the layouts are simulated with several different operand sizes. Those designs are compared with ripple carry adders and carry lookahead adders on the basis of the complexity, area, and timing. Rather complex designs of CSA give a very good indication of tradeoffs between the speed and complexity. The final design shows a modular and expandable design for CSA. [C1983]

"Information Acquisition at the Nanoscale: Fundamental Considerations"

Reliable extraction of information from a physical system requires some combination of redundancy, state distinguishability, and access time. This has obvious implications for any prospective nanoelectronic technology that would require rapid extraction of information from small numbers of electrons through nanoscale access volumes. In this work, we explore this issue through consideration of fundamental physical limits on information acquisition from electronic systems. We outline our approach and present model calculations that illustrate loss of accessible information at nanoscale access volumes and low particle densities in a simple tight-binding molecular wire. This approach, fully developed, could provide both useful physical insight and practical tools for the assessment of emerging electronic information processing technologies. [C1984]

"Realization of a carbon nanotube-based triode"

We report the design and realization of a carbon nanotube-based integrated triode. Patterned Si/SiO2/Nb/Nb2O5multilayer was successfully realized by means of a photolithographic process. Such structure constitutes the patterned substrate of the successive Hot Filament Chemical Vapour Deposition (HFCVD) process. Selective growth of highly oriented SWCNT arrays was obtained in the predefined locations while survival of the entire structure was achieved. Field emission measurements of such materials were carried out both on a diode and in a triode configuration. Good and reproducible field emission behaviour has been observed in several realized structures. In order to validate the experimental data a first simulation of the behaviour of the integrated vacuum triode with a single field emission CNT was also simulated. [C1985]

"The RTM/NEGF Method for ab initio Calculations of Electron Transport through Nano-Structures"

We develop a first-principles calculation method for the quantum transport through nanostructures between electrodes by using the recursion-transfer-matrix (RTM) method combined with the nonequilibrium Green function (NEGF) method. This RTM/NEGF method is applied to the electronic states and current-voltage (I-V) characteristics of atomic-scale nanocontact system. We observe a non-linear behavior in the I-V characteristics and correspondingly a gap structure appears in the differential conductance. We find that such a non-linear behavior emerges when the transport properties change from tunneling to ballistic regimes. [C1986]

"Energy Analysis of QCA Circuits for Reversible Computing"

Quantum-dot Cellular Automata (QCA) is a promising nanochnology that offers significant improvements in diverse areas (such as power dissipation) over CMOS. Recently, QCA has been advocated as a potential candidate technology for implementing reversible computing. However, existing tools for QCA design and evaluation have limited capabilities. A simple but versatile mechanical-based model has been proposed in the past for computing in QCA. This paper presents a thermodynamic analysis using this mechnical QCA model. Different circuits are analyzed for reversible computing. As applicable to QCA, two clocking schemes, namely Landauer clocking and Bennett clocking, are analyzed for energy dissipation and performance. [C1987]

"A Nanoscale Memory Interface Scheme based on Hierarchical Memory Mapping"

This paper presents a nanoscale to microscale interface for crossbar based memory architectures based on multi-stage memory mappers. By designing each stage carefully and by adding sufficient number of stages the total interface module size can be reduced to a size that is 3% to 5% the size of a one-stage mapper implemented in microscale. Thus most of the area advantage in using nanoscale memories can be retained. This architecture is also technology-independent and fault-tolerant. We have developed a model which relates the various design parameters to the size of the interface module and examined these design issues in depth. [C1988]

"Dual-Phase Line-Based QCA Memory Design"

This paper describes a line-based, parallel-access QCA memory design that is synchronized by a dual-phase clocking scheme. In line-based QCA memories, data bits are stored propagating along acyclic QCA lines and additional clock generators are used to create the clocking zones of the memory regions. The memory design proposed in this paper requires an easy-to-implement, dual-phase clocking scheme. Dual-phase clocking is implemented with two clock phases which have the same duty cycle and are phase-shifted by half a clock cycle, thus, requiring only one additional clock generator. The number of clock zones per memory cell is reduced to a minimum of two, permitting denser memory implementations. [C1989]

"A Novel Dual-Walled CNT Bus Architecture with Reduced Cross-Coupling Features"

Carbon Nano Tubes (CNTs) have been widely proposed as interconnect fabric for nano and very deep sub-micron (silicon-based) technologies due to their robustness to electromigration. In this paper, a novel bus architecture with low crosstalk features is proposed. It is made of dual-walled nanotubes (DWNTs) arranged in parallel. It achieves reductions up to 72% of the crosstalk-induced delay, and up to 76% for the crosstalk-induced peak voltage, at a modest area increase. Therefore, the proposed bus arrangement significantly improves performance and provides reliable operation in an interconnect. [C1990]

"Carbon Nanotube Soldering with Gold Nanoink by the Fountain-Pen Technique"

A novel method for soldering carbon nanotubes on electronic pads is presented. We deposited a gold nanoparticle suspension (nanoink) film on the contact area between the carbon nanotube and metal pad employing the fountain-pen principle. The nanoink is deposited by using capillary tubes that have been pulled into micro pipettes with outer diameters of 2-3 μm. The nanoink pattern was then annealed on a hotplate, so that good conductance of the contact could be achieved. The metal pads were prepared by utilizing the standard microfabrication technology. The carbon nanotubes were deposited across the two metal pads by employing the principle of dielectrophoresis. [C1991]

"Conductive Microstructures and Connections for Microelectronics Made by Ink-Jet Technology"

Production of modern microelectronic devices needs printing technologies with the highest level of resolution and repeatability. Ink-jet technology with micro-dimensions nozzle is year by year wider used for this purpose. It makes possible to dispense small volumes of a material in the range of tens picolitres. As a result the printed matrix of dots, lines and more complicated shapes have tens to hundreds micrometers scale. The printing of electrically conductive microstructures requires dispensed materials containing conductive particles as filler. On the other hand, the nozzle diameter of a few tens micrometers and extremely high acceleration during "shots" needs liquid formulations with as low as possible viscosity and highly homogeneous structure. Such demands are fulfilled by ink containing silver particles with size dimensions less than 10 nm. Only this types of fluids work very stable during extremely long time. In the first part of the paper the background of nano silver production and its properties are presented. Just after ink-jet printing process structures have the form of molecular fluid with no electrical conductivity. The main part of the paper is devoted to technologies which are necessary for obtaining the printed microstructures and connections with very high conductance. As a result it is possible to make lines and complicated shapes with resistivity in range 10-5 Omegacm [C1992]

"Flip-Chip Interconnection Using Anisotropic Conductive Adhesive with Lead Free Nano-Solder Particles"

The flip-chip interconnections obtained using anisotropic conductive adhesives (ACA) containing nanoparticles of Sn-4.0Ag-0.5Cu and Sn-0.4Co-0.7Cu (wt% composition) lead free solder alloys as fillers were studied in order to make use of the nanosize effect in flip-chip interconnection applications. The ACAs were formulated using epoxy resin, curing agent, coupling agent and lead free solder nanoparticles. The filler content used in this study was 1wt%. The silicon chips with electroless nickel and immersion gold platted bumps, and FR-4 test boards with copper, nickel and gold platted pads were used in this work. The average contact resistances of the flip chip joints, measured by means of four probe measurement method were 7.08 mOmega and 6.69 mOmega for joints with Sn-4.0Ag-0.5Cu & Sn-0.4Co-0.7Cu nanoparticles respectively. As epoxy resins are hygroscopic in nature and they absorb water, pressure cooker test was carried out in order to study the effect of severe humidity and temperature on the integrity and reliability of nanointerconnects formed in flip chip packages. It was observed that after 24 hours of pressure cooker testing, there was a slight increase in contact resistance due to moisture absorption causing hygroscopic swelling which induced residual stresses in the package. The measured contact resistance values after the pressure cooker test were 10mOmega~32mOmega [C1993]

"New Nano-Thermal Interface Material for Heat Removal in Electronics Packaging"

The need for faster, smaller, and more reliable and efficient products has resulted in increase of heat generated in microelectronic components. The removal of the heat generated is an important issue in electronic packaging. The present research work aims at developing a new class of nano-thermal interface material (nanoTIM) that has low thermal resistance, high thermal conductivity and mechanical strength using the electrospinning process. With the electrospinning process, polymer nano-fibers with nano-scale diameter are formed. Nano-particles such as nano-silver particles, nano-carbon nanotubes (CNT) and nano-silicon carbide particles were embedded into the nano-fibers to enhance the thermal conductivity and to reduce the thermal resistivity. Optical and scanning electron microscopy (SEM) analysis techniques were used to determine the morphology of the nano-composite fibers obtained. Thermal resistivity, conductivity and mechanical strength of the nano-composite materials formed were measured. In addition, the manufactured nano-materials were characterized using the thermo gravimetric analyzer (TGA) and the differential scanning calorimetric (DSC) analysis techniques to study the softening, melting as well as degradation behavior. The mechanical strength was also studied using a multi-functional mechanical tester. The results show that the nano-fiber based composite nano-TIMs have similar thermal conductivity, 3 to 9 times lower thermal resistivity, similar operation temperature range and degradation behavior, 2 to 5 times higher ultimate tensile strength, in comparison with commercially available TIMs. By adding adhesive functions into the process, a new class of nano-TIM tape has been produced [C1994]

"Development of Functional Ceramic Films for Nano and Microsystems Technology"

Ceramic films are considered as key functional material in nano and microsystems technology. IKTS has built the experimental basis for the development of functional films using screen printing, CSD, CVD, PVD, RIE and CMP, covering a wide range of chemical composition, film thickness and processing windows. Substrates of interest are those, forming the integration basis of microsystems, like Silicon (Si) wafers and glass ceramics (LTCC). The present paper is going to discuss the availability of various ceramics films for the design, development and fabrication of advanced nano and microsystems [C1995]

"An agent-based tetrahedral walker"

ANTS (autonomous nano technology swarm) SMART (super miniaturized addressable reconfigurable technology) architectures were initiated at the Goddard Space Flight Center (GSFC) to develop new kinds of robotic structures capable of: goal-oriented motion, changing its form to optimize its function, adapting to new environmental demands, and/or repairing itself. To begin to explore the possibilities of these concepts and the possible application of multi-agent control, a series of increasingly complex roving shapes leading up to the tetrahedron were considered. The goal is to have the structure move from an initial location to a specified goal location. The tetrahedron has six struts that can be reversibly deployed or stowed. More complex structures will be formed by interconnecting these reconfigurable tetrahedra, making structures that are scalable and massively parallel systems. The full functionality of such a complex system requires fully autonomous operations. This paper will address this innovative use of multi-agent system technology that is being used to achieve the desired autonomous behaviors as well as the increasingly complex staged approach in the development of the multi-agent tet [C1996]

"Evaluation of Metallic Nano-Lawn Structures for Application in Microelectronic Packaging"

New applications of template-generated structures and surfaces are foreseen in microelectronic joining, photonics, and analytical chemistry. They require a special tuning of morphological and topological parameters. High-resolution imaging techniques allow for optimising surface properties and grain size of metal-rod decorated surfaces. Submicron wires and more complex "lawn"-structures with diameters of 600-50 nm have been produced by galvanic deposition at porous polymer templates. Their application for low-temperature interconnect formation is under evaluation. First results indicate that single-metal and layered "nano-lawn" can be attractive for microsystem technology in general, but also in analytical chemistry and related fields. Template techniques are discussed and experimental approaches to use gold nano-lawn are presented. The development of new materials and appropriate techniques will be useful for future packaging technologies of (micro-) electronics to come [C1997]

"Deformation Property Measurement for Single Anisotropic Conductive Adhesive Particles"

Anisotropic conductive adhesives (ACAs) consist of a polymer adhesive matrix containing fine conductive particles. The primary objective of this experimental research was to establish a clearer understanding of the effects of the bonding force and load rate on the deformation of individual ACA particles. This has been achieved through measurements of the deformation against force using a specially configured nano-indenter machine, where the "indenters", instead of being a point, had a flat tip 30 mum in diameter. The merit of using this machine is that very small forces, of the order of 100 mN, can be accurately applied to the particles to a resolution of 100 nN and the resulting deformations, of less than 6 mum, can then be recorded to a resolution of 0.1 nm. The results showed that the ACA particle deformation was not linear and the force/deformation at which particle crushing occurs could be determined from the profile of the force versus deformation. The crush points and the deformation processes were affected by the load rate [C1998]

"Environment-Adaptive Antipersonnel Mine Detection System-Advanced Mine Sweeper"

In this paper, we propose an environment-adaptive antipersonnel mine detection system called Advanced Mine Sweeper. Advanced Mine Sweeper is developed based on sensing technologies, access-control technologies and system integration technologies for safe and effective demining procedure after the Level II survey. Advanced Mine Sweeper consists of a sensing vehicle/unit, an access vehicle, and an assist vehicle. The sensing vehicle/unit is composed of an integrated sensor and a small-reaction sensor head manipulator. The access vehicle is parked facing a mine field in order to control the sensing unit position in a global area using its boom. The assist vehicle is parked keeping some distance from a mine field. It controls the sensing vehicle/unit and access vehicle and then displays the processed sensing information for landmine detection, receiving sensing information and sensing position. By using this system, experiments in the field buried dummy landmines were carried out for the utility and performance evaluation [C1999]

"Sub-Lithographic Atomic-build Nanowire Gate Structure for Improved FET Performance."

Many nanowire or nanotube FET structures have been reported on over the past years, as possible replacements for conventional logic devices, because of their improved frequency performance. These nano-structures are built using various assembly techniques, some even derived from traditional lithographic methods. Many of these techniques involve the use of scanning tunneling microscopes (STM) to measure the electrical performance of the nanowires or nanotubes as logic or analog devices. However, this paper is a proposal on how such STM techniques can be applied to the construction of sub-lithographic gates on otherwise conventional III-V gate structures, in order to reduce the physical gate length to about 1nm. Use of the STM for atomic-level construction was first reported in 1989 at IBM Almaden, and this work has continued, delivering advanced molecular cascade logic structures built atom-by-atom. This technology has been demonstrated to be capable of building a nanowire of length about 100nm and width about 1nm which is ideally suited to the construction of a high-performance III-V FET gate. Projected FTof such a MHEMT (metamorphic high electron mobility transistor: higher Indium doping is used to improve the electron mobility in the channel) based structure is 0.5THz, and follow-on work would be done in conjunction with NIST to measure the performance of such a nanowire gate structure, as precursor to the construction of such a FET [C2000]

"Gap Analyses of Environmental Management Frameworks for Nanotechnology"

Nanotechnology is a rapidly growing field fraught with uncertainty due to the still nascent efforts to understand its potential health risks and ecosystem dynamics. Yet, nanotechnology, like other still-emerging technologies, provides fertile territory for establishing an "upstream" management system that minimizes future risks while still in research and design. Thus, to identify the characteristics of such a proactive nano management system, gap analyses were performed on the sustainable engineering frameworks: Twelve Principles of Green Engineering, Earth Systems Engineering and Management, Life Cycle Assessment, and Cradle to Cradle, with economic, socio-cultural, environmental, and technical criteria, using buckyballs (endohedral metallofullerenes), as a case study nanomaterial. It was determined that, partly due to the unavailability of most quantitative life cycle data, and the need for modifications of these frameworks to function both as proactive as well as nano-specific, it is premature to identify a specific optimal framework. Thus, a "hybrid" framework made partly from the tools, principles, and values of the existing methods like the ones analyzed here is proposed [C2001]

"Development of a Human Airbag System for Fall Protection Using MEMS Motion Sensing Technology"

This paper describes the development of a human airbag system which is designed to reduce the impact force from falls. A micro inertial measurement unit (muIMU), based on MEMS accelerometers and gyro sensors is developed as the motion sensing part of the system. A recognition algorithm is used for real-time fall determination. With the algorithm, a microcontroller integrated with the muIMU can discriminate falling-down motion from normal human motions and trigger an airbag system when a fall occurs. Our airbag system is designed to have fast response with moderate input pressure, i.e., the experimental response time is less than 0.3 second under 0.4 MPa. In addition, we present our progress on using support vector machine (SVM) training together with the muIMU to better distinguish falling and normal motions. Experimental results show that selected eigenvector sets generated from 200 experimental data sets can be accurately separated into falling and other motions [C2002]

"POSSГ,В® Coatings as Replacements for Solar Cell Cover Glasses"

Presently, solar cells are covered with Ce-doped microsheet cover glasses that are attached with Dow Corning DC 93500 silicone adhesive. This general approach has been used from the beginning of space exploration, however, it is expensive and time consuming. Furthermore, as the voltage of solar arrays increases, significant arcing has occurred in solar arrays, leading to loss of satellite power. This problem could be ameliorated if the cover glass extended over the edges of the cell, but this would impact packing density. An alternative idea that might solve these issues and be less expensive and more protective is to develop a coating that could be applied over the entire array. Such a coating must be resistant to atomic oxygen for low earth orbits below about 700 km, it must be resistant to ultraviolet radiation for all earth and near-sun orbits and it must withstand the damaging effects of space radiation. Coating flexibility would be an additional advantage. We have been exploring the use of newly discovered polyoligomericsilsesquioxane (POSSreg) materials with metallic additives for these applications. This technology has several significant advantages: the glass-like composition of POSSreg provides excellent resistance to radiation and VUV and the POSS nano-building blocks can be incorporated into all known plastics using conventional polymerization or compounding techniques that can lead to tailored optically transparent materials with entirely new performance levels. We will report on the results of POSS coatings containing various additives (e.g. organic and metallic). Thick samples (150 mum) are being applied to various substrates and have been exposed to 2 MeV protons up to 10 15P+/cm2and UV/VUV irradiation up to 1000 hrs. The 2 MeV protons are absorbed within about 85 mum depth with ~2 mum straggle so the damage is contained entirely within the layer. Results of these tests with several POSSreg matrices will be presente- d [C2003]

"Dye Sensitized Solar Cells with High Photo-Energy Conversion-Controll of Nano-Particle Surfaces"

Some of factors affecting photo-conversion efficiency of dye sensitized solar cells (DSCs) are discussed in terms of TiO2electrodes. The first topic is on the surface modification of TiO2 nano-particles, which is associated with electron traps on the surface of TiO2nano-particles. The surface is modified with dye molecules under pressurized CO2atmosphere to increase the surface coverage of TiO2nano-particles with dye molecules. This increases Jsc because of an increase in the amount of dye molecules and a decrease in the amount of trapping sites on TiO2nano-particles. In addition, the decrease in the amount of trap sites increases Voc because decreases in Voc are brought about by the recombination of I2molecules with electrons trapped on the TiO2surfaces. Selective staining for tandem cells is proposed. The second topic is on the contact between a SnO2/F transparent conductive layer (TCL) and nano-particles. Polishing the TCL surfaces with silica nano-particles increases the contact, resulting in Jsc increases [C2004]

"Fututre of Packaging and packaging materials"

Summary form only given. Systems packaging is moving from the bulky and discrete systems of the past to integrated systems of the future with embedded functions from thin film functional component, thin core or coreless packaging substrates and fine pitch interconnections in organic package. Together with SiP modules nano IC devices, embedded power sources and user interface, this is expected to lead to multi-functional systems in the short term and mega-function systems in the long run. Some examples of emerging packaging materials are advanced dielectrics for coreless packaging and low CTE thin core, advanced polymers such as LCP with low loss, near hermeticity and thermal stability, nanocomposite and nanoscale thin films for embedded capacitors, magnetic nanomaterials based inductors/antennas. MEMS/nanomaterial based chemical and biological sensors, nanostructured materials for high-density chip-package interconnects, self assembled monolayers for improved electron and heat transport at the interfaces, nanocomposite underfills for high reliability and high electrical performance chip-package electrical connections. Migrating the packaging technologies to nanoscale can lead to integration of the entire bio-wireless-computing system, including active and passive components, into a single package leading to reduced sized, reduced interconnect loss due to embedded nature of the active components, increased reliability, reduced power due to lower parasitics and lower cost due to large area processing. This presentation will focus on the status and challenges in materials and ultra thin-film processes for multiple-function fabrication and integration of RF, optical, digital and sensor components for tomorrow's mega-function systems [C2005]

"A micro high-temperature superconductor system: fabrication and operation"

This paper presents the development of an integrated micro high-temperature superconductor system for energy storage and attitude control of three-axis stabilized nano satellites. The micro high-temperature superconductor system consists of a flywheel/rotor, motor/generator, motor electronics, and a cooling system. The flywheel/rotor has been fabricated by using sintered NdFeB and the stator for motor/generator has been fabricated by micro fabrication technology. An alternative stator has been fabricated by cutting a 50 micron-thick copper film for comparison. A servo amplifier to drive the DC brushless motor of the integrated high-temperature superconductor system has been developed and successfully tested. A cooling system has been developed to test the system. It has been observed that the micro fabricated stator can make the flywheel rotate at a constant velocity of up to 12,000 rpm whereas the other stator generates a constant velocity of up to 2,500 rpm. Experiments show that the micro fabricated stator can significantly reduce the motor/generator losses [C2006]

"High Mobility Nano-Scaled CMOS: Some Opportunities and Challenges"

The scaling of some today's high mobility MOSFETs solutions was discussed. The enhancement (between 10-25% for sub-40nm devices) is often lower than the natural mobility decrease due to high short-channel doping (for bulk) or border S/D effects (on SOI). Further understanding of the short channel scattering effects is necessary to engineer next generation high mobility channels [C2007]

"Enhancement of Hole Mobility and Carrier Density in Ge Quantum Well SiGe Heterostructure via Implementation of Double-Sides Doping"

In this paper we report on experimentally obtained enhancement of hole mobility and sheet carrier density in Ge QW modulation doped (MOD) SiGe heterostructure via implementation of symmetric double-sides modulation doping [C2008]

"Nano nickel-tin interconnects and electrodes for next generation 15 micron pitch embedded bio fluidic sensors in FR4 substrates"

Lead free solder bumping requirements have challenged researchers to develop technologies to achieve fine pitch interconnects. ITRS has predicts that by 2017 the industry require 70 micron pitch area array lead free interconnects for flip chips. This paper describes bumping, assembly and reliability evaluation of a nano composite 15 micron pitch interconnect technology. Nanoparticles are the most common building blocks in several applications of nanotechnology. Beside, the enormous increase of their surface area, the high surface to volume ratio of the nano particles results in extraordinary high reactivity, and unusual physical properties (optical, magnetic, etc.). Several types of nanostructures (nano particles, nano-wires and nano-rods) can be fabricated. Dispersed nano particles are used in several important applications, e.g., catalysis, biomedical applications, nano coatings and nanocomposites. Nanostructured materials, prepared by consolidating nanoparticles with a very high density of grain boundary, have been shown to lead to dramatically improved mechanical and physical properties. Lead free interconnect reliability has been a concern due tin pest (whiskers), intermetallics and high temperature reflow problems. This problem becomes even more pronounced when the pitch of the flip chip reduces to 100 microns or lesser. This paper proposes a nano metal composite for fine pitch lead free interconnect as an alternative to solder for fine pitch flip chip interconnect as presented in R. R. Tummala (2001) and W. D. Brown (1999). This paper describes design, process, fabrication and reliability test for composite interconnects fabricated using Ni nano particles distributed in a tin core. A wafer level process is developed for flip chip having 15 micron pitch composite nano structured interconnect. The composition and intermetallics formed at the chip-to- interconnect-interface are evaluated when sent through 4 reflow cycles. Composition of the intermetallics is eva--luated to study the distribution Ni3Sn4, Cu6Sn5 and Cu3Sn. Shear test on interconnects provide bump adhesion strength and fatigue resistance information. The failure mode associated with shear test is also presented. The chip is thermally cycled in a oven from -55degC to 125degC and after every 100 cycles is evaluated for defects using x-ray and Sonoscan techniques. A cross section is made and the composition at interface is also evaluated for intermetalic diffusion. The paper provides optimized data for next generation nano composite interconnect for fine pitch flip chip to achieve high reliability. The paper also describes a process to fabricate substrates with nano lines and embedded fluidic channels [C2009]

"Model to Hardware Matching; For nano-meter Scale Technologies"

Our ability to reliably predict the outcome of a semiconductor manufacturing process has been steadily deteriorating. This is happening because of two important factors. First, the overall CMOS technology slowdown has led to rapidly increasing complexity in the process and in its interaction with design. This has in turn caused an increase in the number and magnitude of systematic sources of mismatch between simulation models (both at the technology-CAD and at the circuit simulation levels) and hardware measurements. Second, manufacturing variability resulting from random as well as systematic phenomena -long a source of concern only for analog design- is becoming important for digital design as well and thus its prediction is now a first order priority. Process complexity and the challenges of accurately modeling variability have conspired to increase the error in performance predictions, leading to a gap in model to hardware matching. In this paper, we will review these issues and show examples of potential solutions to this problem some of which are currently being developed in IBM, and some which are longer term and would benefit greatly from the attention of the academic community [C2010]

"Study on Dielectric Characteristics of Nano-Al2O3 Composite Polyimide Film"

The dielectric characteristics of nano-Al2O3 composite polyimide film with Al2O3 content of 5%, 10%, 12.5%, 15% and 20% in weight ratio were measured, respectively. The permittivity, dissipation factor and TSC peak temperature increase with increasing of the inorganic content. A percolation threshold corresponding to the content between 12.5% and 15% was discovered. With increasing the Al2O3 content, breakdown strength decrease and conductivity increases. The active energy of composite films with different inorganic content, ranging from 0.58 to 0.89, was calculated by auto-separating technology. [C2011]

"Synthesis and Characterization of Corona-resistant Polyimide/AluminaHybrid Films"

A new class of polyimide hybrid films with various amounts of alumina has been synthesized by the sol-gel reaction and characterized. The hybrid films were obtained by the hydrolysis and polycondensation of heteropropyl-alumina in polyamic acid (PAA) solution of N, NГ,Вї-dimethylacetamide (DMAc), followed by heating to 350Г,В°C. The chemical structure, surface morphology of the composites films were characterized by Atomic Forced Microscope (AFM) and Fourier Transform Infrared Spectroscope (FTIR). The thermal stability of the composites films was tested on Perkin-Elmer TGA7. With nano scale inorganic oxides adding, thermal stability of hybrid film was increased. The PI hybrid films showed improved electrical aging performance as compared with pure PI film.. [C2012]

"Space Charge Formation in LDPE/MgO Nano-composite Thin Film under Ultra-high DC Electric Stress"

Nano-composite technology makes it possible to improve dielectric properties, such as resistivity, breakdown strength and so on, under high DC stress. However, the mechanism of the improvement in MgO nano-composite LDPE (LDPE/MgO) has not been clear, yet. We attempted to clarify the mechanism of the improvement on the electrical properties focused on the space charge formation. To investigate the influence of MgO nano-filler on space charge profiles, we measured the space charge distributions using PEA system under DC electric field of 50 to 250 kV/mm. In the case of LDPE without nano-filler, a positive packet-like charge injection with peak charge density of more than several hundred C/m3were measured under more than 150 kV/mm. In the case of LDPE/MgO with MgO content of 0.2 phr, an oscillating behavior of packet-like charge was observed when the DC electric field of more than 200 kV/mm was applied to it. On the other hand, in the case of LDPE/MgO with MgO content of more than 0.5 phr, there is no remarkable charge injection. It is thought that space charge behavior is drastically changed by adding only more than 0.5 phr of MgO to LDPE. The nano-composite including more than 0.5 phr shows a superior property to prevent the injection of space charge into bulk [C2013]

"Thermal properties of oxide free nano non noble metal for low temperature interconnect technology"

Tin (Sn) nanoparticles with various sizes were synthesized from a chemical reduction method. Their morphological and thermal characterizations were studied. The high resolution transmission electron microscopy (HRTEM) study showed that significantly low level of oxides was formed. The thermal characterization by differential scanning calorimetry (DSC) exhibited the size dependency of the melting points [C2014]

"On Silicon Timing Validation of Digital Logic Gates "A Study of Two Generic Methods""

The world of electronic industry, is working with nano-seconds domain of timings, so it's always a challenge for the electronic designers to know the exact, if not exact, then at least 99% accurate of on-silicon-delay values of their design components. By component, means, the smallest possible element for circuit designing. These components are a part of standard library, known as standard cell library. The technology trends are almost following the Moore's law and thus every year we see the technology shrinks by roughly a factor of 1.5. This trend will go on as predicted by the experts. With the increasing complexity in designs, the need for a better silicon evaluation of our building blocks is also increasing. The ASIC design flows use characterized-data for sign off, so to be aware of its accuracy is a must. As flip-flops are very important part of ASIC Design flow, the characterization of a flip flop of the ASIC library on silicon with a good accuracy is a challenge. Being a sequential element, FF's delays and power consumption are very important for ASIC designers. This study work deals with the basic understanding of these logic gates. The "two-methods" used for showing the techniques which can be readily used in the electronics industry for measuring/validating the silicon-timings for the digital gates. The methods are dummy path method and ring-oscillator method. The experimental work is performed to study the behavior of various sequential when observed under these two methods [C2015]

"New developments in the WAVE W-band mission"

In this paper, an overview of the evolution towards the second phase (A2) of the WAVE (W-band analysis and verification) project is made, and the timeline for the development of a future pre-operative space mission is defined. This includes the definition of a number of advanced preliminary W-band applications such as the utilization of the M-55 Geophysica manned stratospheric aircraft for a number of experiments on the channel propagation in W-band 94 GHz and 82 GHz; the introduction of the LEO nano-satellite mission IKNOW (in-orbit key-test and validation of W-band) which is used for a first uplink-downlink satellite channel characterization and in-orbit validation of W-band technology and space qualification processes. These applications are expected to provide the necessary elements towards the realization of the GEO pre-operative payload defined in the phase-A of the project [C2016]

"Reliability of a rapid package prototyping technology based on a data driven chip first approach"

To reduce manufacturing cost, lead time, process complexity, and enhance electrical and mechanical reliability performance, an embedded-active approach that targets rapid prototyping and low-volume production in micro-system packaging is being developed. The approach involves a rapid prototyping of micro-system packaging by a data-driven chip-first packaging process using direct printing of nano-particle metals. In the chip-first process, bare dice are first embedded into a copper or stainless steel carrier substrate, fixed by filling up the gap between the chips and the substrate with thermoplastic adhesives, and planarized to a common planar surface. On the coplanar substrate, polyimide or liquid crystal polymer (LCP) film is laminated to form a dielectric layer. Through the dielectric layer to the chip metal pads, micro vias are drilled by laser ablation. The vias are filled with nano-particle silver (NPS), which has high conductivity and good adhesion to copper, polyimide, and LCP. The NPS is deposited by screen printing and a three dimensional electrical circuit is formed. This packaging approach is data-driven, so requires no masks and reduces packaging turn-around time from months to days. It is also less limited by substrate composition and morphology, eliminates the need for special chip processing such as the need required for flip chip solder bumps, and permits using any chip technology and any chip supplier allowing mixed devices. The embedded-active process with nano-particle metals avoids the extreme processing conditions required for standard IC fabrication such as wet chemistry processing and vacuum sputtering. The nano-particle conductors typically measure around 5 nm in diameter and can be sintered at plastic-compatible temperatures as low as 220 C to form material nearly indistinguishable from the bulk metal. The embedded-active packaging shows an excellent reliability performance in terms of thermal shock, which is performed in the range of -45 a--nd 125 degree Celsius. These results represent an important step to a system packaging characterized by high density, low cost, and data-driven fabrication for rapid package prototyping. This paper presents an electrical performance characterization of the nano-particle conductors, details of the rapid prototyping process sequence, an initial reliability characterization of the package architecture, and a failure mode analysis of the packages [C2017]

"A novel environmentally friendly and biocompatible curing agent for lead-free electronics"

In order to accommodate environmental considerations, the environmentally friendly and biocompatible materials become increasingly important and attract a lot of research interest in recent years, while application of biocompatible materials are still in its infancy. In this paper, the biochemical building blocks, amino acid is used as a novel environmentally benign and biologically compatible curing agent in epoxy system. Amino acids have both amine and carboxylic functional groups, both of which could participate in the reaction with epoxy. The curing capability of amino acid with epoxy is evaluated by measuring the heat flow and glass transition temperature using differential scanning calorimeter (DSC). In-situ Fourier transfer infrared (FTIR) spectra are used to determine the curing mechanism of amino acid with epoxy. The reaction of amino acid and epoxy is due to the lone pair electrons of the primary amine which provides high reactivity in curing the epoxy resin. The thermal stability of the cured epoxy was investigated by measuring the weight change with various temperatures. Novel lead-free, environmentally and biologically friendly electronic materials are developed for next generation nano bioelectronic packaging applications [C2018]

"Highly compliant bonding material and structure for micro- and opto-electronic applications"

Based on the developed analytical stress model, we demonstrate that the employment of highly compliant materials and structures as bonding layers in bi-material assemblies (joints) can lead to a significant stress relief. The model indicates that the interfacial shearing stress in an adhesively bonded or a soldered assembly is inversely proportional to the square root of the interfacial compliance, and that in "conventional" bi-material assemblies (characterized by moderately compliant bonding layers), the interfacial compliance is due to both the bonding layer and the bonded components. However, in assemblies with highly compliant bonds, it is the bonding material only that provides the high and favorable interfacial compliance. We suggest that an appropriate nano-wire array (NWA) fabricated on one or both bonded components be used as a suitable compliant bond. Based on the developed predictive model, we demonstrate that the application of the NWA as a compliant attachment can lead to a significant, about two orders of magnitude, increase in the interfacial compliance. This leads to a reduction in the interfacial shearing stress of about an order of magnitude (compared to the bonded joints using "conventional" adhesives or solders). We suggest that one of the modifications of the newly developed nano-particle material (NPM) be used in addition to, or instead of a NWA, to increase the compliance of the bonding layer. A suitable combination of both the NWA and NPM could be employed to provide a highly compliant and a highly reliable bonding material and structure. In this case the NPM is used as an embedding material for the NWA. Since the NPM has extraordinary mechanical and environmental properties, and, in combination with the appropriate NWA, can make an extremely highly compliant and a highly reliable bond, we expect that the NPM and NWA, used independently or in combination, find a wide application in various bi- and multi-material assemblies employed in micro---and optoelectronics, and well beyond the "high-tech" area [C2019]

"Development of novel silver nanoparticles/polymer composites as high K polymer matrix by in-situ photochemical method"

Conductive filler-polymer composite materials have been extensively investigated as conductor-insulator percolative system to achieve high dielectric constant (K). Additionally, the effective dielectric constant of conductive filler/polymer composite can be dramatically enhanced by increasing the dielectric constant of polymer matrix according to scaling theory. However, the high dielectric loss of this type material at high filler loading levels has been a challenging issue, which is originated from the high conductivity and excessive polarized interface induced by the fillers. In this study, an in-situ formed metal nanoparticles/polymer resin compound was developed as a high K polymer matrix by adopting a relatively low concentration of conductive filler to obtain high K retaining low dielectric loss simultaneously. Nano-sized metal particles are preferred because they achieve thinner dielectric films leading to a higher capacitance density. Compared to an ex-situ blending technique by incorporating and dispersing pre-synthesized nanoparticles into polymers, the in-situ synthesis method can offer more advantages such as much more uniform dispersion in polymers and easy size control of nanoparticles. This study explores the in-situ nanoparticle synthesis method by photochemical conduction of a metallic precursor within the polymer matrix. Crystal structure analysis and morphology characterization of the as-prepared nanocomposites by transmission electron microscopy (TEM) demonstrated the success of the in-situ formation of silver (Ag) nanoparticles in various polymer matrices by the photochemical method. Uniform dispersion of nano Ag particles with size of less than 10 nm in polymer matrices was observed. The effects of reducing agent types, concentrations of a metal precursor, epoxy matrix types and additives on the morphology of nanoparticles will be discussed. Based on the results of UV-Vis and FT-IR study, the proposed reaction mechanism of reduction of silver-- ion to silver will be presented. Aluminum particles were incorporated into the in-situ formed nano Ag/epoxy composite and the dielectric properties of the composite materials were also investigated. The composites showed a more than 50% increase in K values compared with an Al/neat epoxy composite with the same filler loading of Al. Moreover, the dielectric loss was maintained below 0.05. The results suggested that the in-situ formed Ag-polymer nanocomposites via photochemical approach can be employed as a high-K polymer matrix to host various fillers such as conductive metal or high dielectric constant ceramic fillers. The dielectric behavior of the composites materials at various frequency, their morphology, physical properties and their correlations will be discussed [C2020]

"Design and Simulation of an Agile, Fast and Broad-Angle Electronically Tunable Beam Steerer Based on Cascaded Photonic Crystals"

An agile, fast, and broad-angle electronically tunable beam steerer based on cascaded photonic crystal superprisms is designed. Firstly, an electronically tunable prism is used to expand the beam to have a divergence angle of a few decidegrees by its refraction index variation. The apex angle of the electronically tunable prism and the incident angle of beam are optimized to get an initial beam expansion. Then, a cascade photonic crystals (PCs) superprism system, consisted of two sets of PCs structures with an angle multiplication factor of about a hundred in total, steers the beam over 10° in angle of divergence. [C2021]

"High Thermal Conductivity Nanofluid Fabrication by Continuously Controlled Submerged Arc Nano Synthesis System (CC-SANSS)"

The purpose of this study is to innovative high thermal conductivity Cu-based nanofluid preparing method, the continuous control submerged arc nano synthesis system (CC-SANSS). The key parameters such as current, voltage, pulse-duration, electric resistance and temperature of the de-ionized liquid are investigated carefully in order to obtain more uniform nanoparticles suspension in nanofluids. The morphology of nanoparticles prepared in de-ionized liquid exhibits the needle-like shape, with an average width of 20nm and length of 80nm. In addition, transient hot-wire method is used to measure the thermal conductivity properties of nanofluids. It is found that improvement of thermal conductivity are 35.99%, 18.26%, 8.5%, 1.95%, respectively when ingredient of nanofluids are 2.0%, 1.0%, 0.5%, 0.1% Volume at 30°Cwater-based nanofluids containing copper oxide nanoparticle. Experimental result shows that better thermal properties are obtained when low concentration nanofluids produced by CC-SANSS are compared to the ones produced by other processes. [C2022]

"Electrochemical Characteristics of Self Assembled Monolayers of Oligothiophenes"

The properties of self assembled monolayers (SAMs) of 3-hexylthiophene, 2-mercapto 3-hexylthiophene and 2-mercapto 4-hexylthiophene on gold substrates have been evaluated by electrochemical techniques. It was observed that the 2-mercapto 4-hexylthiophene formed better packed films than the other molecules. As SAMs find potential applications in molecular electronics, the study, using tailored molecules, provides a better understanding of the film properties and the relation to the molecular structures. [C2023]

"Optimization of Grating Coupler Efficiency for Nanophotonic Device Integration"

A unique experimental apparatus has been developed for the optical characterization of nanophotonic devices. Grating couplers with nanoscale periodicity have been fabricated on silicon-on-insulator (SOI) substrates by electron beam lithography (EBL) and reactive ion etching (RIE). The coupling efficiency of these gratings has been measured as a function of grating depth and the angle and wavelength of incident radiation. A coupling efficiency of at least 5.2% is demonstrated for 1568 nm light incident at 40°. [C2024]

"Implementation of three Qubit Quantum Logic Gates in Ballistic Nanowires"

A scheme of implementation of one, two and three qubit quantum logic gates has been described in this paper. The three degrees of freedom of the electron in an intertwined nanowire setup have been used as the qubits. The qubits can be prepared and detected using a mesoscopic Stern Gerlach Apparatus (MSGA). The symmetric device can be coupled to create the Quantum Logic Processor (QLP). [C2025]

"Decoherence of Dynamically Manipulated Qubits"

We summarize our results on decoherence for short-to intermediate-time dynamics of an externally controlled two-state quantum system—a qubit—interacting with thermal bosonic environment. The developed approximation schemes are illustrated for an adiabatic model with time-dependent gate control, and for a model with rotating-wave gate function. [C2026]

"Nanophotonic traceable memory based on energy-localization and hierarchy of optical near-fields"

Optical near-field interactions allow energy localization at scales smaller than the diffraction limit of light. They also show hierarchical responses, meaning that optical near-fields exhibit different physical behavior at different scales. In this paper, by combining these properties of optical near-fields, that is, energy-localization and hierarchy, we present a novel traceable optical memory that records the event of memory access to each of the bits, which is useful in applications such as high-security information transfer. The basic principle is numerically demonstrated using a metal nanostructure. [C2027]

"SnO2 nanorods prepared by inductively coupled plasma-enhanced chemical vapor deposition"

SnO2nanorods were successfully deposited on SiO2/Si substrate by inductively coupled plasma-enhanced chemical vapor deposition (PECVD) using dibutyltin diacetate (DBTDA) as the precursor. The SnO2nanorods were in situ grown without additional substrate heating. These nanorods have an average diameter between 19 and 27 nm and a length of 190 to 600 nm depending on the deposition parameters. Substrate distance and RF power showed notable effects on the formation of SnO2nanorods. These high surface area SnO2nanorods showed sensing properties to reducing gases like CO. [C2028]

"Inner Trench Type Tungsten Nano Dot Arrays Patterned by Using Diblock Copolymer Templates and Selective Ion Etching"

Dense and periodic arrays of holes and nano dot were fabricated in silicon oxide and silicon. The holes were approximately 25 nanometers(nm) wide, 35 nm deep and 60nm apart. To access this length scale, self-assembling resists were used to produce a layer of hexagonally ordered parallel cylinders of polymethylmethacrylate(PMMA) in polystyrene(PS) matrix. The PMMA cylinders were deraded and removed with acetic acid rinse to produce a PS mask for pattern transfer. The silicon oxide was removed by fluorine-based reactive ion etching(RIE). Selective tungsten deposition was accomplished in nanoscale trench by using a low pressure chemical vapor deposition(LPCVD) method. Tungsten nano dot and trenched silicon size were 26nm and 30nm respectively. [C2029]

"Fabrication of OTFT Array on Plastic Substrate by using Nanocontact Printing and Low Temperature Process"

The flexible organic thin film transistor (OTFT) array to use as a switching device for an organic light emitting diode (OLED) was designed and fabricated in the microcontact printing and low-temperature processes. The gate, source, and drain electrode patterns of OTFT were fabricated by nanocontact printing which is high-resolution lithography technology using polydimethylsiloxane(PDMS) stamp. The OTFT array with dielectric layer and organic active semiconductor layers formed at room temperature or at a temperature lower than 40°C. The nanocontact printing process using SAM and PDMS stamp made it possible to fabricate OTFT arrays with channel lengths down to even nano size, and reduced the procedure by 10 steps compared with photolithography. Since the process was done in low temperature, there was no pattern transformation and bending problem appeared. Also, it was possible to increase close packing of molecules by SAM, to improve electric field mobility, to decrease contact resistance, and to reduce threshold voltage by using a big dielectric and fabricate nanopatterns. [C2030]

"Ge Nanowire Synthesis for Chip-Specific Application"

Nanoelectronic field-effect devices fabricated with 1-D semiconductor nanowires synthesized by bottom-up techniques are likely among those immediate successors of the top-down silicon CMOS technology, preserving the spirit of Moore's Law. The nanotechnology-embedded chip technology may emerge in the foreseeable future. However, there exists a gap between synthesis research and industrial application. Some of the critical integration issues need to be addressed before nanowire-based chip technology becomes truly impacting. In this paper, efforts are made in directing nanowire synthesis towards realistic implementation in future miniaturized chip. The research work include i) low-temperature and high-yield Ge nanowire synthesis, ii) Ge nanowires-on-insulator (GeNOI), iii) industry-benign metal catalysts, and iv) Ge quantum-wires synthesis. [C2031]

"Understanding the growth mechanisms of electron beam induced deposition via a Monte — Carlo based, 3D growth simulation"

Electron beam induced deposition (EBID) and etching (EBIE) is rapidly becoming the method of choice for nanoscale selective processing because is it a softer less damaging process relative to focused ion beam processing. Deposition with tungsten-hexafluoride (WF6) and tetra-ethyl-ortho-silicate (TEOS) sources have been shown to efficiently deposit tungsten and SiOx, respectively; however the distinct differences in material properties affect the final deposit morphology. Initial results from experiments show the distinct shapes formed from the two dissociation reactions have been reproduced using a Monte-Carlo based 3D algorithm which was designed specifically to predict such behavior. The effective Bethe stopping range determines the resultant nanopillar morphology under similar WF6 and TEOS EBID conditions. Simulations and experimental results show that the morphology is cylindrical when the fiber height is greater than the effective range and is conical when less than the effective range. [C2032]

"Controlled Lateral Growth of ZnO Nanowires Using a Growth Barrier"

We recently reported a technique to grow ZnO nanowires at predefined locations on a planar substrate. In this work, we report an improvement of this technique using a growth barrier to achieve better controlled lateral growth of ZnO nanowires. We evaluated two types of growth barrier, SiO2and Spin-On-Glass (SOG) dielectric, and show that both are effective in confining the growth of ZnO nanowires to a lateral direction. The simple fabrication processes and its compatibility with Si-based fabrication technology make this a viable processing technique for controlled growth of ZnO nanowires laterally across a planar substrate for future integrated nanocircuits. [C2033]

"Unusual Growth of InP Nanowires Grown on Silicon Surfaces"

Heteroepitaxial growth of III-V compound semiconductors on Si would enable the integration of high speed optoelectronic devices with mature Si technology. We report the growth of single-crystalline InP nanowires on [C2034]

"Effect of Oxygen Absorption on Contact Resistance between Metal and Carbon Nano Tubes (CNTs)"

Contact resistance (Rc) between metal and carbon nanotubes (CNTs) is studied extensively. Metal oxide formation at interface due to oxygen absorption plays very important role. Chemically inert metals such as Pt and Au results in the lowest Rc. Adding Ta into Pt can solve the adhesion issue while keeps low Rc . Those metals can break metal oxide and form metal carbide are also preferred [C2035]

"Quality and Reliability Evaluation for Nano-Scaled Devices"

In the next decade, reliability will be a key issue in nanofabrication due to the complex engineering and design of products along with the turbulent environment of change going on in nano-science. This research introduces adaptation of advanced statistical analysis toward nano-scaled display devices. This research will also catalyze further statistical modeling in nanofabrication outside of reliability. While currently there is little research on nano-science mentioned in the mainstream statistical literature, there is potential growth for design of experiments, robust estimation and statistical prediction within this framework [C2036]

"Bilateral Testing of Nano-scale Fault-tolerant Circuits"

As the technology enters the nano dimension, the inherent unreliability of nanoelectronics is making fault-tolerant architectures increasingly necessary in building nano systems. Because fault-tolerant hardwares help to mask the effects caused by increased levels of defects, testing the functionality of the chip together with the embedded fault-tolerance becomes a tremendous challenge. In this paper, a new bilateral testing framework for nano circuits is proposed, where multiple stuck-at faults across different modules in a triple module redundancy (TMR) architecture are considered. In addition, a new test generator is presented for the bilateral testing that takes into account the enormous number of bilateral stuck-at faults possible with new types of guidance in the search, and it can generate a set of vectors that can test the TMR-based nano circuit as a single entity. Experimental results reported for ISCAS'85 and ITC99 circuits demonstrate that the bilateral testing can help to capture many more defects which the single stuck-at fault misses [C2037]

"A Multi-Code Compression Technique for Reducing System-On-Chip Test Time"

With the nano-scale technology, a system-on-chip (SOC) design may consist of many reusable cores from multiple sources. This causes the complexity of SOC testing is much higher than testing conventional VLSI chips. One of the test challenges of SOCs is test data reduction. This paper presents a multi-code compression (MCC) technique to reduce the volume of test data and the test application time. A multi-code decompressor for recovering the compressed test data is also proposed. Experimental results show that the MCC scheme can achieve higher compression ratio than the single-code compression schemes. The area cost of the multi-code decompressor is small-only about 3498mum2based on TSMC 0.18mum standard cell technology [C2038]

"Waveguide Birefringence in Asymmetric Silicon-on-Insulator Nanowires"

A large group index birefringence of 0.6 is experimentally obtained by a polarisation beating technique in a silicon-on-insulator nano-waveguide. Using the Fabry-Perot resonance method we also determine the group index for two orthogonal polarisations [C2039]

"A New Transistor-Redundant Voter for Defect-Tolerant Digital Circuits"

As CMOS technology is being scaled down aggressively towards the nano-regime, digital circuits are becoming more and more prone to failure, not only because of transient faults, but more likely as a result of permanent defects. This paper presents a new technique for defect-tolerance at the transistor level called transistor redundancy (TR); targeting the voter design in fault-tolerant systems. This is the first time transistor redundancy is used to design the first defect-tolerant voter circuit. TR allows the masking of faults resulting from permanent defects, since it uses redundant transistors to implement the functionality of each transistor. Circuit simulations of n-bit TR-voter based triple modular redundancy (TMR) adder were conducted and the results were compared with conventional-voter based TMR adder. The use of the proposed TR-voter gives 100% fault masking capabilities (considering the single fault scenario) compared to fault-intolerant conventional-voter that does not mask any defect. There was no increase in the time delay but the total number of transistor, for each adder, increased by 25% compared to conventional TMR [C2040]

"Light Emission from Silicon-based Nano-materials"

This paper presents an overview of the research activities aimed at engineering novel, nanostructured-based materials solutions for CMOS-compatible electrically driven light sources. In particular, the state of the art of the optical and electrical properties of Si-nc nucleated within Si-rich nitride (SRN) matrices, and their large potential for energy sensitized, efficient 1.55mum electroluminescence under low injection fields are discussed [C2041]

"Highly Efficient Surface-Plasmon Antenna and its Application to Si Nano-Photodiode"

We report on a highly efficient surface plasmon (SP) antenna which consists of a nano-aperture surrounded by a concentric grating, and its application to a Si nano-photodiode. A very fast response of 20 ps was obtained for a nano-scale metal-semiconductor-metal photodiode combined with this SP antenna [C2042]

"Future of Nano-CMOS Technology and Its Production"

This paper focuses on the future semiconductor manufacturing challenges. Some background information regarding the possible limits of scaling and the problems appeared in the sub-100 nm devices will be discussed, respectively, in section 2 and 3. The impacts of the future semiconductor manufacturing will be discussed in section 4. We shall also look forward to the possible geographical redistribution of the manufacturing centers and the new role playing of the present leaders in IC technology. Paradigm of post-downsizing era will be described in section 5 [C2043]

"A New Series Resistance and Mobility Extraction Method by BSIM Model for Nano-Scale MOSFETs"

In this work, a simplified BSIM-based model has been proposed to solve the above issues contributed by halo implants [Goto, K, et al., 2003]. In this new methodology, Rsdand mueffcan be uniquely extracted in nano-scale devices. Furthermore, the extracted LGdependency of mueffmay serve as a good indicator for monitoring the relationship between geometry and stress parameters [C2044]

"Resistance Increase in Metal Nano-wires"

As the dimension of copper interconnect scales into the nano-meter regime, the resistivity of copper rapidly increases, primarily due to an electron scattering effect and other dimensional dependent factors, such as film quality. In this paper, we attempt to use a simplified parameter, dimension impact factor (DIF), which includes both surface and grain boundary scattering, to characterize the dimensional dependency of metal resistivity. Among the metal studied, silver has the largest DIF while aluminum has the lowest value. The chief reason is that aluminum has a short electron mean free path (MFP), meaning that it tends to be less affected by dimensional scaling, and has a higher electron specular ratio. In addition to the factor of MFP, resistivity can be affected by other dimensional dependent factors, such as film quality [C2045]

"A Study of Asymmetrical Behaviour in Advanced Nano SRAM Devices"

The importance of understanding asymmetrical behaviour in SRAM has increased as the technology node shrinks below 100 nm. Single bit failure can possibly be caused by the malfunction of any of the six transistors in a standard SRAM cell. In order to understand the asymmetrical behaviour in advanced nano SRAM devices, nanoprobing is introduced to perform transistor level fault isolation prior to attempting physical failure analysis (PFA) [C2046]

"Metal-Polymeric Nanostructured Materials"

The technology of making of metal-polymeric nanocomposites on the basis of the various polymeric matrixes was developed. The basic electrophysical characteristics of polythene-iron metal-polymeric nano-composites with content of iron nanoparticles up to 30 mass percents are investigated in various frequency ranges [C2047]

"Factorial Analysis of Chip-on-Metal WLCSP Technology with Fan-Out Capability"

In this study, a wafer level chip scaled packaging (WLCSP) having the capability of redistributing the electrical circuit is proposed to resolve the problem of assembling a fine-pitched chip to a coarse-pitched substrate. In the fan-out WLCSP, the solder bumps could be located on both the filler polymer and chip surface. The concept of the fan-out WLCSP and the processes of fabricating the novel fan-out WLCSP would be described. In addition, the reliability characteristic of the fan-out WLCSP in packaging level is described by using the two-dimensional finite element model. The 25factorial designs with the analysis of variance (ANOVA) are conducted to obtain the sensitivity information of the packaging [C2048]

"Local Strained Channel (LSC) nMOSFETs by Different Poly-Si Gate and SiN Capping Layer Thicknesses: Mobility Enhancement, Size Dependence, and Hot Carrier Stress"

In this study, we propose a LSC technique that using SiN capping layer deposition with high mechanical stress on single poly-Si gate. In addition, nMOSFETs with thicker poly-Si gate (220 nm) can also increase tensile strain in the channel region compared to that of the thinner (150nm) poly-Si gate structure. Furthermore, size dependence of nMOSFETs with SiN capping layer is also studied and compared the thickness of SiN and poly-Si gate simultaneously. In the final, reliability of hot carrier injection is studied for all splits (Songlp, 1992). The trend of degradation among the splits of SiN capping layer is abnormal to the tensile stress on the channel [C2049]

"Carbon Nano Tubes – Overview, Simulation of Single and Multilayer CNTs With it's synthesis and energy storage applications"

This paper examines the different methods of synthesis of Carbon nano tubes. The structures of SWNT, DWNT and MWNT are simulated and the structure related parameters are calculated The effect of various distortions on CNT are simulated using Nanotube Modeler. The CNT has a medium of hydrogen storage is analysed by doping CNT and in future it could also be in distortioned CNTs [C2050]

"Chemical Synthesis of ZnO Nanocrystals"

Nano-crystalline ZnO particles were synthesized using alcoholic solutions of zinc acetate dihydrate through a colloidal process. Five types of capping agents: 3-aminopropyl trimethoxysilane (Am), tetraethyl orthosilicate (TEOS), mercaptosuccinic acid (Ms), 3-mercaptopropyl trimethoxysilane (Mp) and polyvinylpyrrolidone (Pv) were added at the first ZnO precipitation time (1stPPT) to limit the particle growth. The first three capping agents effectively capped the ZnO nanoparticles and limited the growth of the particles, while the last two capping agents caused agglomeration or larger clusters in the solutions. Particles synthesized were in the size range of 10nm to 30nm after capping, and grew to 60nm and 100nm in 3 weeks and 6 weeks respectively during storage at ambient conditions. Refluxing time was found to only affect the 1stPPT time. Washing by methanol and water and slow drying are very important in converting Zn(OH)2into ZnO. XRD analyses revealed that single crystal ZnO nanoparticles were achieved with crystal size 53-55nm. Photoluminescence (PL) spectra showed high intensity in UV emission and very low intensity in the visible emission, which indicates a good surface morphology of the ZnO nanoparticles with little surface defect. Optical absorption spectra showed absorption at wavelength of 380nm from the uncapped ZnO, corresponding to the band-gap of bulk ZnO. While capped ZnO absorbed at shorter wavelength (350nm) indicating a much smaller particle size. [C2051]

"Sintering of Nano-sized Zirconia Powder Processed by Powder Injection Moulding"

The nano-sized Yttria Stabilized Zirconia (Nano YSZ) powder with an average particles size of 50nm is initially heat treated and then mixed with wax-based binder system. The prepared feedstock is then formed into a shape by powder injection moulding process. The green parts are then thermally debound and sintered. The sintering behavior of the nano-sized particles is presented and compared with those of BASF feedstock. It is found that Nano YSZ can achieve 98% of its theoretical density. Homogenous microstructure is obtained with an average grain size of 500nm. The hardness value of the sintered Nano YSZ is similar to those obtained from BASF feedstock. [C2052]

"Hybrid CMOS/molecular Electronic Circuits"

CMOS silicon technologies are likely to run out of steam in the next 10-15 years despite revolutionary advances in the past few decades. Molecular and other nano-scale technologies show significant promise but it is unlikely that they will completely replace CMOS, at least in the near term. This paper explores hybrid CMOS/molecular alternatives with an emphasis on better explaining the geometrical aspects of "angled" interfacing schemes between the CMOS substrate and the molecular layers on top. [C2053]

"Optical properties of Zn1-x Mgx O nano-particles obtained by low temperature method"

In this paper we report synthesis of Magnesium substituted Zinc Oxide (Zn1-xMgxO) nano-particles (~8-10nm) by low temperature solution route. We could reach upto x=0.075 without MgO getting segregated. Rietveld analysis of the XRD data confirms the Wurzite structure and a continuous compaction of the lattice as x increases. The bandgap also gets enhanced as x is increased and reaches a value of 4eV for x=0.075. The absorption also shows persistence of the excitoinc absorption on Mg substitution. The nanoparticles show near band edge photo luminescence (PL) at room temperature which shows blue shift on Mg incorporation. [C2054]

"Novel approach to low substrate temperature synthesis of carbon nanotubes"

We present a novel approach, which will potentially allow for low-temperature-substrate synthesis of carbon nanotubes using direct-current plasma-enhanced chemical vapour deposition. The approach utilizes top-down plasma heating rather than conventional heating from a conventional substrate heater under the electrode. In this work, a relatively thick titanium layer is used as a thermal barrier to create a temperature gradient between the Ni catalyst surface and the substrate. We describe the growth properties as a function of the bias voltage and the hydrocarbon concentrations. The heating during growth is provided solely by the plasma, which is dependent only on the process conditions, which dictate the power density and the cooling of the substrate, plus now the thermal properties of the "barrier layer". This novel approach of using plasma heating and thermal barrier allows for the synthesis of carbon nanotubes at low substrate temperature conditions to be attained with suitable cooling schemes. [C2055]

"Characterization of Thin Oxide using FIB-SIMS and FIB-TEM Techniques"

The use of SIMS for the characterization and study of biomaterial surfaces is fast gaining popularity in the development of bio-functional and bioactive tissue compatible interfaces. The presence of TiO2oxide in metallic Ti implants and its ability to promote bioactivity is still unclear. FIB-SIMS (Focused Ion Beam-Secondary Ion Mass Spectrometry) and FIB-TEM (FIB-Transmission Electron Microscopy) techniques represent powerful tools for characterizing the oxide layer. This paper investigates the oxygen transport mechanism of thermal barrier coating systems applied on nickel-base superalloy turbine blades. In this study, a two-stage oxidation experiment is used.18O2is used as a tracer during the second stage oxidation on previously oxidized Ni-base superalloys with a layer of bond coat material. The aluminium oxide grown in16O2during the first stage oxidation serves as a background oxide. Mass spectra collected by FIB-SIMS reveal the counter mass transportation by inward diffusion of oxygen and outward diffusion of aluminium. New oxide formation during the second stage oxidation under an18O2enriched environment is observed at both the gas/oxide interface as well as oxide/superalloy interface. Transmission Electron Microscopy (TEM) can be used to identify the very fine phases developed in both the inter-diffusion zone as well as the thermally grown oxide layer. The use of Focused Ion Beam (FIB) technique allows for selective nano-machining of areas of interest for the production of TEM samples. FIB-SIMS and TEM are carried out to determine the specific phase transformations occurring in the TBC system. [C2056]

"A New Route to Ultra-High Density Memory Using the Micro to Nano Addressing Block (MNAB)"

For the first time, we demonstrate sublithographic memory read/write operation using micro to nano addressing block (MNAB) decoders. Test structures are fabricated with integrated one-time programmable oxide ROM elements addressed using MNAB devices that have 4 sub-50 nm silicon fins at 140 nm period. Functional operation is obtained for all 4-bit ROM sequences and over different ROM cell areas [C2057]

"Trap Layer Engineered FinFET NAND Flash with Enhanced Memory Window"

This paper presents the trap layer engineered body-tied FinFET device for MLC NAND flash application. The device design parameters for high density NAND flash memory have been considered, and the advantages of FinFET structure and high-k blocking dielectric in such device have been demonstrated. Based on the WN nano-dot memory device, the trap layer engineering using nitride layer has been performed, and the results show that the memory window is improved from 2.6 V to 7.8 V by utilizing engineered trap layer at 14 MV/cm F-N programming, and it is proposed as a possible MLC NAND device structure [C2058]

"Analog VLSI design of an adaptive neuromorphic chip for olfactory systems"

In this paper, we present the analog circuit design and implementation of an adaptive neuromorphic olfaction chip. An analog VLSI device with on-chip chemosensor array, on-chip sensor interface circuitry and on-chip learning neuromorphic olfactory model has been fabricated in a single chip using Austria Microsystems 0.6 mum CMOS technology. Drawing inspiration from biological olfactory systems, the neuromorphic analog circuits used to process signals from the on-chip odour sensors make use of temporal "spiking" signals to act as carriers of odour information. An on-chip spike time dependent learning circuit is integrated to dynamically adapt weights for odour detection and classification. All the component subsystems implemented on chip have been successfully tested in silicon [C2059]

"Transport Characteristics of Si Nanowires in Bulk Silicon and SOI Wafers"

Silicon nanowires (SiNW) were fabricated on bulk Silicon and SOI wafers by means of conventional Si process technology. The nanowires were formed by stress-limited oxidation of Si beams pre-patterned on the wafer. Single or double vertically self-aligned wires were obtained depending on the bulk or SOI wafer used and also on the depth of silicon beam etched. The resulting nanowires exhibit triangular cross-section that can be converted to circular shape by annealing at high temperatures, exploiting the visco-elastic properties of SiO2and Si. Electrical measurements on single nanowire show that the resistance scales with length demonstrating consistent cross-sectional dimension in wires of different length. The nanowires formed on SOI wafers were also characterized as channels in FET configuration, using substrate as gate electrode. This technique can be exploited for realizing several nano-electronics, NEMS and biosensor applications in bulk silicon or SOI wafers, all in a CMOS compatible manner. [C2060]

"Carbon Nanotubes and Si Nanowires as an Alternative Route to Future Nanoelectronics"

Nowadays millions of elementary silicon transistors aggregated into microchips could be considered as a symbol of 20thcentury microelectronic technology which has become a spinal bone of postindustrial society propelling other areas of human life. Silicon technology has reached so high level of sophistication that the further evolutionary shrinking of the size of integrated circuits (IC) looks impossible giving way to the revolutionary ideas and new materials. There are obvious limiting factors which earlier have been considered as inevitable sequences of silicon choice: decrease of speed due to the low electron/channel mobility and great interconnect resistance; increase of power consumption due to the leakage currents, various tunneling effects in dense IC; sufficient rise of the manufacturing and IC design cost, rigid requirements on defects. Nevertheless "there is still enough space at the bottom" for new materials which could compete with silicon. Next decades IC industry should step into the post-Roadmap era when the long term anticipation of device parameters could be very difficult if possible at all. Presentation is devoted to the applications such new materials as Carbon NanoTubes (CNT) and silicon nanowires (SiNW) in modern micro and nano electronics. General aspects of hybrid silicon – carbon technologies and possible roadmaps will be considered and illustrated by the results obtained in new CNT center of STMicroelectronics recently established in Singapore. [C2061]

"Nanotube based Vertical Nano-devices for High Integration Density"

Various nano-devices based on vertical nanotubes were developed. Carbon nanotubes (CNTs) were employed as a functional part or a nano structure of a nanoelectromechanical (NEM) switch, nano-capacitor, and NEM-dynamic random access memory (DRAM). The unique vertical structure of nanotubes allows high integration density for devices. [C2062]

"Fabrication of Nanoscale Multilayer Device by Filtered Cathodic Vacuum Arc for Optical Application"

Multilayer device with 8 nano-layers consisting of alternate TiO2thin films (high refractive index) and Al2O3thin films (low refractive index) have been successfully fabricated by filtered cathodic vacuum arc (FCVA) with two separate cathodic sources. Microstructure and element distribution of multilayer coatings were examined by TEM and electron energy loss spectroscopy (EELS), respectively. The results show that the interfaces of the layers are well defined and exhibit smooth, sharp and flat properties. Each layer with nano-thickness keeps amorphous structure as determined by the electron diffraction pattern and XRD. The bond nature in respective TiO2and Al2O3layers is Ti4+-O2-and Al3+-O2-and no atoms diffuse into the nearby layer as concluded by EELS measurements. Good homogeneity in microstructure and element distribution indicates the potential deposition of multilayer by FCVA for advanced performances including optical application. [C2063]

"Reverse Hall-Petch Relationship of Metals in Nanometer Size"

The effect of melting temperature on Hall-Petch relationship has been studied. As grain size decreases, the melting temperature of the nano-structured crystals decreases, the Hall-Petch relationship is no longer sufficient. When the yield strength or hardness is taken as a function of reciprocal of the square root of the grain size, it has a numerical maximum whose location depends on the size of the bulk melting enthalpy of the crystals. Experimental results agree well with the modification induced by the size-dependence. [C2064]

"Parameter Investigation of Nano-Sized Etching in an ICP Silicon Etching System"

The effect of process parameters on the performance of silicon nano-sized etching in an Inductive-Coupled-Plasma Reactive-Ion-Etching (ICP-RIE) system is studied by the Taguchi experimental method. The Standard L9 orthogonal array is considered to evaluate the parameter effect and to obtain the optimum conditions. A total of 9 parameter settings are conducted to investigate the four parameters with three levels for each. The four parameters include the substrate temperature, bias power, gas cycle time and C4F8gas flow rate. The source power and the SF6gas flow rate are respectively fixed to a value of 500 W and 120 sccm. The etching bottom roughness and the etching rate are the quality characteristics to evaluate the parameter effect. The results show that both the C4F8flow rate and the bias power have the significant influence on the bottom roughness, while both the cycle time and the bias power play an important role on etching rate. And, the optimum conditions are obtained, of which the predicted quality has been confirmed by verification experiment. [C2065]

"Selective Deposition of Hafnium Oxide Nano-Thin Films on OTS Patterned Si"

The patterning of thin films is of considerable scientific and technological interest. Various ways to obtain micro/nano patterns of thin films have been thoroughly investigated. Soft lithography is the method to make micro/nano size patterns and structures simply using organic materials without involving high energy. In particular, microcontact printing (μCP) is a very convenient, nonphotolithographic technique that can generate patterned features of self-assembled monolayers (SAMs) on both planar and nonplanar surfaces. Moreover, the μCP technique shows that hydrophobic patterns with micro/nano dimensions can be formed on hydrophilic surfaces. In this study, we carried out the selective deposition of HfO2nano-thin films on Si [C2066]

"Nano Logic Circuits with Spin Wave Bus"

We propose and analyze logic circuits utilizing spin waves as a physical mechanism for information transmission and processing. The novelty of this approach is that information transmission is accomplished without charge transfer. A bit of information is encoded into the phase of spin wave propagating in a ferromagnetic film-spin wave bus. The communication between the spin wave bus and outer devices is performed in a wireless manner via a magnetic field. We describe an example of logic device using high frequency transmission lines to excite and detect spin waves. The performance is illustrated by numerical modeling based on the experimental data for spin wave excitation and propagation in NiFe film. We also propose an original scheme for output signal amplification based on the effect of hole-mediated ferromagnetism. Potentially, logic circuits with spin wave bus may be beneficial in terms of power consumption and resolve the interconnect problem. Another expected benefit is in the enhanced logic functionality. It is possible to achieve all advantages of the phase logic using spin waves for information processing. The shortcomings and limitations of circuits with spin wave bus are discussed [C2067]

"Study on bubble formation in rigid-flexible substrates bonding using anisotropic conductive films (ACFs) and their effects on the ACF joint reliability"

Because of downsizing of electronic products and cost effectiveness, rigid substrate-flexible substrate (RS-FS) bonding technology using ACFs becomes more important as an alternative to socket type connectors and rigid/flex substrates. However, formation of process related bubbles, entrapped inside the ACF layer during bonding processes, is strongly influenced by process variables, such as a bonding pressure and a bonding temperature. These bubbles can reduce adhesion strength of ACFs joints, and induce moisture penetration path and entrapment location during reliability tests in humid environments. However, the causes of bubbles formation during the ACF bonding process and the effect of bubbles on ACFs joints reliability have not been fully understood. Bonding process variables, such as bonding temperature, bonding pressure and flexible substrate (FS) types, were changed in order to investigate their effects on bubbles formation. According to the results, the tendency of bubbles formation was closely related to these three factors. The bubble area increased as the bonding temperature increased. Moreover, same tendency was observed against the bonding pressure changes at fixed bonding temperature conditions. Two different FSs, which have different surface roughness and energies, were used and the bubbles formed only at the FS with larger roughness and lower surface energy. According to the results from surface energy measurement of FSs by using goniometry, the FS with higher surface energy is favorable for bubble free assembly because higher surface energy provides better wettability. Therefore, Ar and O2plasma treatments were performed on the FS with lower surface energy to improve the wettability, and bubbles were significantly removed. Finally, two types of test vehicles (TVs), without (type 1) and with bubbles (type 2), were assembled to investigate the effects of bubbles on the ACFs joints reliability in humid environments, such as PCT (pressure coo--ker test). All type 2 TVs, with bubbles, were electrically failed after 72 hours of PCT because the process related bubbles acted as a moisture penetration path and entrapment sites. However, all type 1 TVs survived even after 120 hours of PCT [C2068]

"Wearable Health Systems and Applications: The Contribution of Information & Communication Technologies"

The interest for wearable health systems originates mainly from the need to extend health services out of the hospital and monitor patients over extensive periods of time. Smart wearable health systems (SWHS) are integrated systems in contact with or near to the body able to sense, (and/or act), process and communicate biomedical and physical parameters. Significant advances in biomedical technology, materials engineering, micro/nanotechnologies and information and communication technologies (ICT) lead to new possibilities for increasing miniaturisation, communication capabilities and system "intelligence". The new possibilities for wearable monitoring are mainly provided at the level of microsensors, wrist and other body worn devices, and smart biomedical clothing. Research and development in these areas has been strongly supported through public funding and private investments worldwide. In Europe the major R&D activities were promoted and supported by the European Commission, Information Society Technologies (IST) programme, mainly through health telematics (telemedicine, e-Health) and micro-nano technologies activities. The aim of these projects was the development and testing of innovative integrated user-friendly systems, environments and scenarios of use that could lead to market exploitation in a short to mid term future (3-5 years). This paper presents the rationale and the results of research on wearable health systems in Europe and comments on the current challenges and futures perspectives in the field [C2069]

"Constant impedance scaling paradigm for scaling LC transmission lines"

Reverse scaled LC transmission lines are an effective alternative to on-chip global interconnects which severely limit the chip performance in nano-CMOS technologies. However, the main disadvantage of the LC transmission line approach is their poor wiring density. The scaling of LC transmission lines is formally analyzed with the proposed constant impedance scaling paradigm that simultaneously maximize performance and wiring density. With this paradigm, we show that the LC transmission line implementation would need a minimum pitch of 8mum for line lengths in the range of 10 to 20 mm, considering a low-k dielectric of relative dielectric constant of 2.7 [C2070]

"Enhanced tensile ductility in an electrodeposited nanocrystalline Ni"

A sheet of fully dense nanocrystalline (nc) Ni with a thickness of 350 µm was obtained by a direct-current electrodeposition method. The nc Ni has an average grain size of 40 nm and an evident {200} texture as revealed by X-ray diffraction analysis. TEM observations show that the microstructure of the nc Ni consists of the grain clusters of about 150-300 nm surrounding by nano-grains of about 10-20 nm. Moreover, the clusters are also composed of the nano-grains of about 30-50 nm possessing the small misorientation angles. The room temperature tensile test performed at a strain rate of 1.04Ч10-3s-1indicates that the nc Ni has a combination of high tensile strength of 1220 MPa and enhanced elongation to failure of 7.2%. The optimized mechanical properties of our nc Ni is discussed by connected with its special micro-structures. [C2071]

"HfO2 Nano-thin Films Grown by Laser MBE for Gate Dielectric Application"

High-k hafnium oxide thin films with equivalent of thickness (EOT) to SiO2of about 1 – 2 nm were deposited on p-type [C2072]

"Nano-Forensics ---- Nanoparticles in Gun-Shot-Residue"

Analysis of Gun-Shot Residue (GSR) is a very critical step in Forensic studies of shooting and related criminal cases. However, the current techniques used for GSR analysis are not complete. Detailed information regarding the elemental and crystallographic signatures of the GSR are missing. Moreover the analysis requires a substantial amount of sample which is difficult to obtain and frequently might be contaminated. The current study on the GSR focuses on these deficiencies. Electron Microscopic studies of the metallic nanoparticles (10-100 nm in diameter) obtained from GSR at different target distances from a Winchester Super-X 9mm luger has been analyzed in detail. Perfectly spherical (diameter ~ 10 nm) and very crystalline Pb and Sb nanoparticles were observed. Theoretical studies explaining the formation of the nanoparticles is reported. The non-equilibrium thermodynamic processes leading to the synthesis of the nanoparticles was observed to be very similar to the artificial chemical synthesis methods (e. g. CVD, Laser Ablation etc.). A simplified model will be proposed to explain the nanoparticle synthesis process in the GSR. This additional information obtained from the nanoparticle synthesis model will provide valuable forensic evidence in solving criminal cases. Forensic benefits of this information will be discussed. This ingenious synthesis mechanism has been demonstrated in synthesizing pure crystalline form of other popular nanomaterials.. [C2073]

"A STEP-and-GROW Technique – An Economic and Environmentally Safe Manufacturing Approach for Fabricating Ordered Nano Structures"

A new variant of our "grow-in-place" methodology termed "step-and-grow" is used to produce polyaniline nanowires. Three different widths (5µm, 1µm, and 0.5µm) of nanowires were grown for this demonstration. These "step-and-grow" polyaniline nanowires showed conductivities of ~10 S/cm. [C2074]

"Cubic SiC Nano-thin Films and Nano-wires: High Vacuum MOCVD, Surface Characterization, and Application Tests"

Singlecrystalline, epitaxial cubic silicon carbide (β-SiC) nano-thin films have been deposited on Si [C2075]

"A Nano-MOS Array: Metallic Carbon Nanostructure Connected with Nanoscale SiO2 Islands inside Insulated Alumina Nanochannels on Silicon Substrate"

A nano-MOS array consisting of metallic carbon nanostructures connected with nanoscale SiO2islands inside insulated alumina nanochannel on silicon substrate was fabricated via Si-based porous anodic alumina (PAA) template. The electrical properties of the nano-MOS array were studied by means of current-voltage (I-V) and frequency dependent capacitance-voltage (C-V) tests. This structure is important to the application of carbon nanostructures and PAA template and has high potential in future nanoelectronics applications. [C2076]

"Growth of tungsten oxide nanowires using simple thermal heating"

Tungsten oxide nanowires are grown directly on tungsten wires and plates using thermal heating in an acetylene and nitrogen mixture. By heating the tungsten in nitrogen ambient, single crystal tungsten oxide nanowires can be synthesized via a self-assembly mechanism. It was found that the yield can be significantly increased with the addition of acetylene, which also results in thinner nanowires, as compared to nanowires synthesized in an oxidizing ambient. The tungsten oxide nanowires are 5 to 15nm in diameter and hundreds of nanometers in length. In some cases, the use of acetylene and nitrogen process gas would result in tungsten oxide nanowires samples that appear visually transparent. Comparison of the growth using the acetylene/nitrogen or then air/nitrogen mixtures is carried out. A possible synthesis mechanism, taking into account the effect of hydrocarbon addition is proposed. [C2077]

"A single chip micro-DNA-array system based on CMOS image sensor technology"

A micro-DNA-array based on integrated CMOS active pixel sensor (APS) technology is demonstrated. This system utilizes gold nano-particle binding to a DNA sample, which subsequently absorbed to the chip surface through the hybridization process when a matching between the DNA samples and DNA probes on the chip surface is found. The degree of DNA matching is reflected by the opacity of a certain location on the chip, which can be detected by the underlying CMOS APS array. The chip has been fabricated with a 0.5mum CMOS process and contains on-chip timing control, dynamic range enhancement by pulse-width modulation and correlated sampling. The system can detect DNA sample with extremely low concentration under ordinary light source [C2078]

"Modeling and Characterization of The Mechanical Behavior of Nano-Sized Structural Elements"

Summary form only given. Steady technological progresses in all fields of nanoscale technology and probe technology have enabled the synthesis, the assembly, the development, the characterization and the improvement of nanostructured materials. The lack of understanding of their macroscopic behavior is a major roadblock for inserting these materials into engineering applications. Partially due to these rapid advances in nanoscale and nano-structured materials, there has been a resurgence of interest in surface elastic properties such as surface energy, surface stresses, and surface elastic stiffness. Because of the large surface-to-volume ratio in nano-materials, surface elastic properties become more prominent. They have strong influence on the overall thermo-mechanical behavior of the nano-materials. In this paper, an innovative approach combining continuum mechanics and atomistic simulation is conducted to develop a nanomechanics theory for modeling and predicting the macroscopic behavior of nanomaterials. We first develop a framework to incorporate the surface free energy into the continuum mechanics theory. Based on this approach, it is shown that the effective elastic properties of nano-size particles (including nano-wires and nano-films) become size-dependent. Parallel to this methodology, we then introduce a semi-analytical method to calculate the surface elastic properties of groups 10-11 transition metals using the interatomic potentials directly without extensive atomistic simulations. In terms of engineering applications, this approach prove to be a useful tool for multi-scale modeling of heterogeneous materials with nanometer scale microstructures and provide insights on surface properties for several material systems; these are very useful in many fields including surface science, tribology, fracture mechanics, adhesion science and engineering, and more. This accelerates the insertion of nano-size structural elements, nano-composite and nanocrystalline--materials into engineering applications [C2079]

"Parasitic Extraction of IC Interconnects in Consideration of Optical Distortion by Using Shape Sensitivity Modeling"

In the nano-scale IC design, the silicon print image of a layout could be very different from the drawn dimension due to the photolithography effect even with the resolution enhancement technology (RET). To accurately predict the interconnect parasitic resistances and capacitances, the impact of optical distortion needs to be considered. This paper proposes the use of the shape sensitivity analysis to model the optical distortion. The shape sensitivity models are developed with the help of the field solver and can be associated with a pattern match based extraction tool for fast parasitic extraction in consideration of optical effect [C2080]

"Nanometer Scale InGaAs HEMT Technology for Ultra High Speed IC"

We have successfully fabricated various nanometer scale InGaAs HEMTs based on novel nano-patterning techniques, including sidewall-gate process and e-beam resist flowing method. The sidewall-gate process was developed to lessen the final line length, by means of the sequential procedure of dielectric re-deposition and etch-back. The e-beam resist flowing was effective to obtain fine line length, simply by applying thermal excitation to the semiconductor so that the achievable final line could be reduced by the dimension of the laterally migrated e-beam resist profile. Applying these methods to the device fabrication, we were able to succeed in making 30 nm InGaAs HEMTs with excellent fT exceeding 400 GHz. Based on nanometer scale InGaAs HEMT technology, several high performance integrated circuits have been successfully fabricated, such as 77 GHz MMIC chipsets for automotive car radar application and 40 Gb/s digital circuits [C2081]

"Hybrid CMOS/Molecular Electronic Circuits"

CMOS silicon technologies are likely to run out of steam in the next 10-15 years despite revolutionary advances in the past few decades. Molecular and other nano-scale technologies show significant promise but it is unlikely that they will completely replace CMOS, at least in the near term. This paper explores opportunities for CMOS and nanotechnologies to enhance and complement each other in hybrid circuits, in order to sustain the historical advances in the semiconductor industry while addressing manufacturability, yield, power, cost and performance challenges. [C2082]

"Dependability analysis of nano-scale FinFET circuits"

FinFET technology has been proposed as a promising alternative for deep sub-micro bulk CMOS technology, because of its better scalability. Previous works have studied the performance or power advantages of FinFET circuits over bulk CMOS circuits. This paper provides the dependability analysis of FinFET circuits, studying the soft error vulnerability of FinFET circuits and the impact of process variation. Our experiments compare FinFET circuits against bulk CMOS circuits in both 32 nm and 45 nm technologies, showing that FinFET circuits have better dependability and scalability, which is indicated by better soft error immunity and less impact of process variation. It is concluded that FinFET-based circuit design is more robust than the bulk CMOS based circuit design [C2083]

"PLAs in quantum-dot cellular automata"

Research in the fields of physics, chemistry and electronics has demonstrated that quantum-dot cellular automata (QCA) is a viable alternative for nano-scale computing. However, little work on QCA has studied designing implementation-friendly programmable QCA circuits. This paper fills this gap by presenting a novel QCA-based programmable logic array (PLA) structure. In addition to being compact, the proposed PLA structure exploits some unique properties of QCA cells to achieve ease of implementation, programming and defect detection. These features are indispensable to the successful adoption of any nano-scale circuits [C2084]

"Nano sensory device utilizing intermolecular communication on lipid membrane"

We have constructed a nano sensory device for detection of biologically important molecules through intermolecular communication between a synthetic receptor and a natural enzyme. The sensory device was fabricated on a liposome as an artificial cell membrane by self-organization of each component. Selective recognition of the biologically important amines by the receptor having a pyridoxal moiety was clarified by means of electronic absorption spectroscopy. The selectivity was mainly depending on the hydrophobicity of the amine signals. The signal recognition event was transmitted to the enzyme by a metal ion as a signal mediator, and followed by amplification of the signal output as the catalytic activity of the enzyme [C2085]

"Interfacial strength assessment of Cu-epoxy system by atomic force microscope"

This paper presents a novel nano-scale interfacial covalent bond measurement method by atomic force microscopy (AFM) with reference to the adhesion of self-assembly monolayer on epoxy/copper systems. Covalent bond strength measurements were conducted using AFM for self assembly monolayer (SAM) coated copper (Cu) tips on epoxy after epoxy has been cured at its curing temperature. In-situ curing of Cu-epoxy force measurement simulates situation of epoxy molding compound (EMC) curing inside conventional transfer molding process. The Cu-SAM-epoxy system testing provides a good testing platform for evaluating the performance of various SAM materials as an adhesion promoter. Adhesion enhancement at the interface has been achieved by surface modification of Cu surface with thiol solution. Normalized adhesion strength was reported as measured adhesion force divided by tip epoxy contact area. It illustrated that with thiol treatment, Cu-epoxy interfacial adhesion strength has been enhanced from 2.83plusmn0.07times 10-5 nN/nm2 and 5.38plusmn2.48times10-5 nN/nm2 [C2086]

"A novel method for bonding of ionic wafers"

A novel method for bonding sapphire, LiNbO3, quartz and glass wafers with silicon using the modified surface activated bonding (SAB) method is described. In this method, the mating surfaces were cleaned and nano-adhesion Fe layers were deposited using a low energy argon ion beam simultaneously. The optical images show that the entire area of 4-inch wafers of LiNbO3/Si was bonded. Such images for other samples show particle induced voids across the interface. The average tensile strength for all of the mating pairs was much higher than 10 MPa. Prolonged irradiation reduces polarization in LiNbO3, sapphire, quartz and Al-silicate glasses. Fe and Ar ions induced charge deposition may have resulted in electric field, which was responsible for the depolarization. The lattice mismatch induced local strain was found in LiNbO3/Si. No such strain was observed in the Al-silicate glass/Si interface probably because of annealing at 573 K for 8 h. The Al-silicate glass/Si interface showed a layer of 2-nm thick. An amorphous layer of 5-nm thick was observed with a layer across the LiNbO3/Si interface. The EELS spectra confirmed the presence of nano-adhesion Fe layers across the interface. These Fe layers associated with the electric filed induced by ion beam irradiation for prolonged period of time, particularly in Si/LiNbO3, might be responsible for the high bonding strength between Si/ionic wafers at low temperature [C2087]

"A novel non-migration nano-Ag conductive adhesive with enhanced electrical and thermal properties via self-assembled monolayers modification"

Silver migration has long been one of the most critical issues in semiconductor electronic industry, while no effective approaches have been developed to control silver migration and maintain its excellent electrical and thermal properties. In this paper, we report a novel approach of using molecular self-assembled monolayers (SAMs) to dramatically reduce silver migration in the nano-Ag conductive adhesives. The protection of silver nano particles with molecular monolayers reduced the silver migration dramatically and no migration was observed upon application of high voltages (up to 500 V) due to the formation of surface chelating compounds between the SAM and nano silver fillers. The migration behavior of SAM passivated nano-Ag conductive adhesives was investigated by analyzing the results with DiGiacomo's model. In addition to a controlled migration, the SAM passivated nano Ag fillers also enhanced the electrical conductivity and current carrying capability of ACA joints significantly due to the improved interfacial properties and high current density of those molecular monolayers. Unlike typical anisotropic conductive adhesive (ACA) joints which showed high joint resistance and limited current carrying capability, the joint resistance of the SAM incorporated nano-Ag conductive adhesive could be achieved as low as 10-5Ohm (the contact area is 100 times 100 mum) and the maximum allowable current was higher than 3500 mA. Furthermore, the improved electrical performance of SAM treated nano Ag ACAs was also achieved with the increased thermal conductivity. As such, a fine pitch, high performance, non-migration and high reliability adhesives are developed for potential solder replacement in high voltage, high power device applications. The novel approach for silver migration control and electrical properties enhancement can also be applied in next generation high performance semiconductor devices to replace aluminum and copper metallization with the bett--er performance silver [C2088]

"A novel 20-100/spl mu/m pitch IC-to-package interconnect and assembly process for Pb-free solder, copper or gold stud bumps"

This paper presents an IC-to-package interconnect and assembly process for ultra fine pitch flip chip with Pb-free solders, copper, nickel or gold stud bumps and other low-standoff interconnects. Current flip-chip technology is capable of 130-150 mum bump pitch and ITRS, iNEMI and other roadmaps identify the need for less than 50-100 mum peripheral pitch flip-chip interconnections in the next few years. Several interconnect methods are being pursued as alternative to current lead-free solders due to concerns with interconnect fatigue reliability as the pitch decreases to 20mum. These include copper posts/pillars, nickel or other nano-structured interconnects, and gold stud bumps. For any of these interconnects, it is anticipated that an underfill material is necessary to handle the CTE mismatch between the IC and the organic substrate. One of major challenges for ultra-fine pitch (20-100 mum) flip-chip attach is the ability to dispense underfill effectively without voids and defects over large ICs with low stand-off height (10-40 mum) interconnects. The need for highly tilled low CTE and high modulus underfill materials to absorb strains in the ultra-fine pitch interconnects places additional demands on underfill processing. The innovative interconnect and assembly process presented here overcomes these challenges and also has the potential to solve the yield problems associated with current no-flow underfill processes. Initial process development was performed using lead-free solder interconnect and details of the assembly process, bonding conditions, and new underfill material is discussed. Based on extensive process parameter optimization, defect-free interconnect assembly with underfill at 100 mum pitch for a 20 mm times 20 mm IC has been demonstrated with excellent solder wetting to the substrate pads. The novel approach in this paper is also applicable to copper, nickel, gold or other types of interconnects and enables the use of underfill materials with optim--um combination of thermo-mechanical properties [C2089]

"Electrical conductivity and reliability of nano- and micro-filled conducting adhesives for z-axis interconnections"

This paper discusses epoxy-based conducting adhesives for z-axis interconnections. Recent work on adhesives formulated using controlled-sized particles to fill small diameter holes is highlighted, particularly with respect to their integration in laminate chip carrier substrates, and the reliability of the electrically conductive joints formed between the adhesive and metal surfaces. A variety of conductive adhesives with particle sizes ranging from 80 nm to 15 mum were laminated into printed wiring board substrates. SEM and optical microscopy were used to investigate the micro-structures, conducting mechanism and path. Volume resistivity of Cu, Ag and low melting point (LMP) alloy based paste were 5 times 10-4ohm-cm, 5 times 10-5ohm-cm, and 2 times 10-5ohm-cm, respectively. Volume resistivity decreased with increasing curing temperature. The mechanical strength of the various adhesives was characterized by 90 degree peel test and measurement of tensile strength. Adhesives exhibited peel strength with Gould's JTC-treated Cu as high as 2.75 lbs/inch for silver, and as low as 1.00 lb/inch for LMP alloy. Similarly, tensile strength for silver, Cu and LMP alloy was 3370, 2056 and 600 psi, respectively. Reliability of the adhesives was ascertained by IR-reflow, thermal cycling, pressure cooker test (PCT), and solder shock. Change in tensile strength of adhesives was within 10 % after 1000 cycles of deep thermal cycling (DTC) between -55 degC and 125 degC. There was no delamination for silver, copper and LMP alloy samples after 3X IR-reflow, PCT, and solder shock. Among all, silver-based adhesives showed the lowest volume resistivity and highest mechanical strength. It was found that with increasing curing temperature, the volume resistivity of the silver-tilled paste decreased due to sintering of metal particles. Sinterability of silver adhesive was further evaluated using high temperature/pressure lamination, and shows a continuous m--etallic network when laminated at 365 degC. As a case study, an example of silver-filled conductive adhesives as a z-axis interconnect construction for a flip-chip plastic ball grid array package with a 150 mum die pad pitch is given. This effort is an integrated approach centering on three interrelated fronts: (1) materials development and characterization; (2) fabrication, and (3) integration at the device level [C2090]

"Nano bio embedded fludic substrates: system level integration for food safety"

This abstract describes an on-going research to develop bio compactable food sensor to separate mycotoxin infected barley and wheat seeds from non-infected seeds. Since 1999 research has focused on preventing and/or eliminating mycotoxin contamination in barley and wheat seeds with limited success. The mycotoxin, deoxynivalenol (DON), produced by the fungus, Fusarium graminearum, pose serious health hazards such as vomiting, dermatitis, and hemorrhagic septicemia in humans and livestock that limit the utilization of the infected grains containing high toxin concentrations. The US Food and Drug Administration have set the wheat advisory concentrations of 1 mug/g and 5 mug/g of DON in food for human and livestock consumption, respectively. DON-free or low DON grain is required for malting barley as DON carries through malting and brewing into finished beer. The farmers of upper Midwest greatly suffer because of fungal infection and toxin contamination as the brewing industry refuses to accept such toxin contaminated seeds. Rather the brewing industry import seeds from Canada. This research develops a solution to separate toxin contaminated seeds from non-toxin healthy seeds using biosensor technology. Over the years sensing technologies relied on silicon based inorganic substrates and electrodes to sense the presence of toxins. Toxins can be identified by understanding the required marker and interface proteins for the sensor. This research for the first time presents a method of embedding capacitor based sensor to detect DON. The capacitors uses shape memory polymers as the dielectric. The sensor process used for fabrication and data acquired from the biosensor application is presented in detail [C2091]

"Sn-Ag-Cu lead-free composite solders for ultra-fine-pitch wafer-level packaging"

SAC (SAC) based composite solders functionalized with single-wall carbon nanotubes (SWCNTs), nano particles such as nano-Ni, nano-Mo with various weight proportions ranging from 0.01 wt% to 5 wt% were successfully produced The composite solders with different wt% of nano particle and nanotube addition were synthesized using the sintering technique The microstructural, melting and mechanical properties of the SAC-based composite solders were evaluated as a function of different wt% of SWCNT, nano-Ni, and nano-Mo. It is observed that SWCNTs are homogeneously distributed at the edges of Ag3Sn compounds that are distributed evenly in the p-Sn solder matrix. Microstructure analysis revealed that the nano Ni and nano Mo particles were transformed to the intermetallic compounds during processing and distributed uniformly throughout the beta-Sn solder matrix. The different wt% addition of SWCNTs to SAC engendered a higher tensile strength, higher hardness and better melting characteristics. The nano particle reinforced solders are harder and stronger than the unreinforced counterparts. FE-SEM observations of fractured surfaces revealed that the failure is ductile in nature [C2092]

"Thermal Stability improvement of Nickel Germanosilicide Utilizing Ni-Ta Alloy and Co/TiN Cappling layer for Nano-scale CMOS Technology"

In this paper, highly thermal stable nickel germanosilicide utilizing Ni-Ta alloy and Co/TiN capping layer (Ni-Ta/Co/TiN tri-layer) is proposed for high performance strained Si CMOS technology. The proposed Nickel Germanosilicide utilizing Ni-Ta/Co/ TiN structure exhibits low temperature silicidation and wide range of rapid thermal process (RTP) process window. Moreover, sheet resistance shows stable characteristics up to 700degC for 30 min high temperature annealing and the surface of Ni-Ta/Co/TiN structure is much smoother than that of Ni/Co/TiN structure both after RTP and post-silicidation annealing. Therefore, the thermal immune nickel germanosilicide using the Ni-Ta/Co/TiN tri-layer is highly promising for future SiGe based nano-scale CMOS technology [C2093]

"A Study of Nickel Silicide Formed on SOI Substrate with Different Ni/Co Thicknesses for Nano-scale CMOSFET"

In this paper, a study of Ni suicide formed on SOI substrate that has different Si thickness (Tsi= 27, 50 nm) is performed in depth. The dependence of Ni silicide on the thickness of Ni/Co is also characterized. Ni silicide on SOI film exhibits quite different characteristics compared to that on bulk silicon. That is, Ni silicide on SOI showed 'V' shape as a function of deposited Ni/Co thickness while Ni silicide on bulk-Si showed linear dependence. Moreover, sheet resistance showed strong dependence on the SOI film thickness. Conclusively, Ni thickness adjustment is very important as the SOI Si-film thickness becomes thinner for nano-scale CMOS technology [C2094]

"Thermal Immune NiSi Technology for Nano-scale CMOSFETs"

In this paper, thermally stable nickel silicide (NiSi) technologies are investigated for nano-scale CMOS technology. Co/TiN double capping layer is investigated first. Co/TiN double capping is highly efficient in retarding Ni diffusion during high temperature post silicidation annealing by forming CoNiSi ternary layer at the top region of silicide. Then, hydrogen plasma implantation before Ni/Co/TiN deposition is shown to be desirable for nano-scale CMOS technology [C2095]

"Influence of the Annealing Ambient on the Thermal Stability of Ni Silicide for nano-scale CMOSFETs"

The thermal stability of Ni silicide was evaluated using post-silicidation annealing ambient such O2, N2, and 30 mTorr vacuum. Among the conditions, the thermal stability of NiSi was improved in 30 mTorr vacuum condition due to the maintenance of stable phases after post-silicidation annealing without combining oxygen. Moreover, abnormal oxidation on the As-doped Si was also suppressed in vacuum condition [C2096]

"Self-calibration technique for reduction of hold failures in low-power nano-scaled SRAM"

Increasing source voltage (source-biasing) is an efficient technique for reducing gate and sub-threshold leakage of SRAM arrays. However, due to process variation, a higher source voltage can significantly increase data flipping in standby mode (hold failures) resulting in faulty memories. This imposes serious concerns in reducing standby power with source-bias. In this paper, we analyze the effect of source bias on hold failures under both inter-die and intra-die variations. We propose a self-calibrating SRAM for aggressively reducing leakage while maintaining the hold failures under control [C2097]

"Electronics beyond nano-scale CMOS"

This paper presents nano-scale CMOS outlook, discusses the three tenets that have made electronics successful in the past, and using these tenets conclude that there is nothing on the horizon yet that has promise to replace CMOS. Therefore, we will make CMOS work for a foreseeable future [C2098]

"Elimination of Floating body Effect and Thermal Instability in a Nano Quasi-SOI MOSFET with π-shaped Semiconductor Layer"

In this paper, a new device structure called the quasi-SOI MOSFET with pi-shaped semiconductor conductive layer is proposed and demonstrated. In this structure, the pi-shaped source/drain layer is formed by the block oxide which consists of three separate oxide islands under the source, the drain, and the body regions, respectively. In other words, due to the three separate oxide islands forming two paths from source/drain to substrate, the generated holes and heat can be eliminated from this source/drain-tied scheme, thus, the proposed quasi-SOI structure shows to improve the kink effect and the self-heating problem as compared with that of conventional SOI structures. Moreover, owing to that the block oxide is utilized to restrict the electric field built between body and source/drain region, the ultra-short-channel effect is also diminished. Besides, our structure is based on the bulk wafer, thus, the cost can be cheaper than the SOI wafer [C2099]

"New Nanometric Opportunities with High Mobility Semiconductors such as InAs"

One-dimensioned electron gas (1DEG) structures can be fabricated from suitable hetero-structure sandwiches by using nano-technology Schottky- or MOS lithography. We have grown by MBE InAs sandwiched nearly lattice matched between AlSb and GaSb layers and obtained for InAs thicknesses of around 15 nm a room temperature mobility of up to 32000cm2/Vs, provided that the heterojunction was of InSb type. At 77K the electron gas has a mobility of up to 225000 cm2/Vs. Si-Nanowires are found to have an interesting band structure, which is different from Si bulk material. The InAs 1DEG exhibits a quantum-physical behaviour at low temperatures of a reasonable well defined quantized staircase conductance of a ballistic electron wave with increasing applied voltage. InAs is a material where such behaviour is expected to occur at not too low temperature. If two such 1DEG structures of slightly different geometry in parallel are applied with a triangular voltage, the difference potential between each of these two 1DEG's is a pulse sequence. The number of pulses obtained then depends on the amplitude of the triangular voltage. This can be considered as a basic unit for an Analogue-Digital Converter. These concepts were initially outlined by us at one of the European workshops, intended for discussion of new ideas. Such nano-conductance lines and zero-DEG quantum dot electronic structures can be interconnected in such a manner that various types of signal processing can be achieved. [C2100]

"Commercialization of Nanotechnology-Taiwan Experiences"

Taiwan National Nanoscience & Nanotechnology Program started in 2003. The budget is about US$ 600 million for six years. Compared to some countries, this is not a big number. Our strategy is to focus on industrilization. 65% of the budget was for industrialization nanotechnology. Our National Program is an industrialization driven program. Stumbling blocks to commercializing nanotechnology and Taiwan strategic initiatives to industrializing nanotechnology will be described in this paper. The stumbling blocks will be analyzed in two different phases. The first one is from science to industry. The other one is from nanoproducts to users. Taiwan strategy initiatives including government commitment, positioning of different players and infrastructure built for nanotechnology will be discussed in this paper. To industrialize nanotechnology, linking nano novel properties to applications is essential. The first approach to be presented is novel material-driven approach, which is to derive application concepts from the unique properties of a novel material. Carbon nanocapsule and tetrapod-like zinc oxide will be used as examples to illustrate our experiences. The other approach is need-driven approach. To maintain competitiveness in some products, nanotechnology could be quite helpful. Several examples, including CNT-backlight unit (BLU) and nanoclay in PU synthetic leather will be described. Nanotechnology is a hot R& D area globally. Differentiation strategy is very important. Self-cleaning paint is cited as an example to be differentiated from others. Through nanotechnology development, we believe that our daily life will be improved dramatically. [C2101]

"Investigation of Nano-Scale Single Crystal Silicon Using the Atomistic-Continuum Mechanics with Stillinger-Weber Potential Function"

This research proposes a novel atomistic-continuum method (ACM) based on the finite element method (FEM) to investigation the mechanical behavior of nano-scale single crystal silicon under uniaxial tensile loading. The FEM is widely used to model and simulate the mechanical behaviors of solid structure, it is a mature technology after decades of development. The ACM could be reduced efficiently the computational time and maintained the simulation accuracy. Since, the ACM developed the bonding force between the two silicon atoms to the two kinds of the nonlinear spring element. Moreover, due to the FEM considered the minimization of the total potential energy, which includes strain energy and the potential energy possessed by applied loads of SCS, a robust FEM is applied to solve the numerical model based on ACM. Therefore, this study combines FEM and interatomic potential function to explore the mechanical properties of nano-scale single crystal silicon. A general form of Stillinger-Weber potential function was used for interaction between the silicon atoms in the simulations. Simulation results showed that the Young's modulus of single crystal silicon were 121.8, 153 and 174.6 GPa along the [C2102]

"Studies on nano silver oxide thin films for optical memories"

In the present work, a novel proof oc concept for rewritable ultra high density nano optical data storage devices has been discussed. Nano silver films are prepared on glass substrates by DC Magnetron sputtering technique at lower temperature (T= 150 K). When these films are oxidised and are irradiated with blue light (λ= 485 nm), a fluorescence emission is observed in the red region (μ ~ 650 nm) . These films are analysed by XRD and AFM. Emission spectrum was recorded using fluorometer. Films of thicknesses 50E to 600E are prepared and compared the fluorescence properties. It is observed that the fluorescence emission from the silver clusters depends on growth parameters in sputtering (like substrate temperature or deposition rate) and on the oxidation temperature. [C2103]

"Nanoscale Metal Silicides"

Metal silicide thin films are integral parts of all microelectronics devices. They have been used as ohmic contact, Schottky barrier contact, gate electrode, local interconnect and diffusion barrier. Silicides of nanoscale are named nanosilicides. As the IC industry moves into the nano era, metal silicide contacts are naturally falling into this category. In this paper, we present an overview of the recent progresses on the study of nanoscale silicides [C2104]

"A Novel FDSOI MOSFET with Block Oxide Enclosed Body"

In this paper, we propose a novel fully depleted silicon-on-insulator MOSFET with block oxide enclosed body (bFDSOI). To differ with the conventional FDSOI MOSFET, the proposed SOI structure shows enhanced performance by exploiting sidewall spacer process. For this new bFDSOI device, the electric field between the body and the source/drain (S/D) region is restrained by the block oxide resulting in that the ultra-short-channel effects (USCEs) are suppressed. Thus, the simulation results of bFDSOI exhibit reduced drain-induced barrier lowering (DIBL), excellent subthreshold swing (SS), good roll-off characteristics and high drain output resistance for 40 nm thick enough body. In order to eliminate the floating-body problem, the bFDSOI device must not be operated under the partially depleted (PD) regime. Although this is the limit of device design, as the gate length is scaled down, the requirement of the ultra-thin body (UTB) structure is not needed to maintain its ultra-short-channel characteristics control over the channel due to the block oxide serves as isolation between the body and the S/D region. Moreover, owing to that the sufficient thick body is used; the bFDSOI device results in good amelioration of self-heating effects (SHEs), which is very important in a nano-scale SOI MOSFET design [C2105]

"Well-Aligned Carbon Nanotubes for Device and Assembly Applications"

The remarkable properties of carbon nanotubes (CNTs) with ballistic electrical transport and ultra high thermal conductivity have made them very attractive for microelectronic interconnects, thermal management and nanoscale device applications. This seminar discusses our recently developed CVD growth of well-aligned CNT films/arrays, their characterizations and applications related to microelectronics packaging. However, the high CNT growth temperature (>600 degC) and poor substrate adhesion impede the CNT implementation in microelectronics. To circumvent these obstacles for a successful CNT application, we propose using a CNT transfer technology process. The process is featured with a separation of the CNT growth and CNT to device assembly, which is enabled by an in-situ formed open-ended CNT structures that we have recently developed. This technique is similar to a flip-chip process and is compatible with current microelectronic device fabrication sequences and surface mount component assembly technology. Field emission testing of the as-assembled CNT devices indicates good field emission characteristics, with a field enhancement factor of 4540. In addition, we also demonstrate the creation of hierarchic structures (micro and nano-scaled) by controlled growth of CNTs for lotus effect (superhydrophobic) surfaces coatings and its geometric design and optimization are discussed. Aligned CNT prototypes for thermal management and electrical interconnect are also illustrated [C2106]

"Hybrid nanorobotic approaches for fabricating NEMS from 3D helical nanostructures"

Robotic manipulation at the nanometer scale is a promising technology for structuring, characterizing and assembling nano building blocks into nanoelectromechanical systems (NEMS). Combined with recently developed nanofabrication processes, a hybrid approach to building NEMS from SiGe/Si/Cr nanocoils and Si/Cr nanospirals is presented. Nanosensors and nanoactuators are investigated from experimental, theoretical, and design perspectives [C2107]

"Microfluidic end effector for manufacturing of nano devices"

In this paper, a new pneumatic end effector system for micro/nano fluidic handling, nanomanufacturing, and micro/nano manipulation is presented. The new micro pneumatic end-effector system consists of a DC micro-diaphragm pump and compressor, one region of flexible latex tube, a Polyvinylidene Fluoride (PVDF) sensor for in-situ measurement of micro force, and a micro steel tip. The micro steel tip of the new pneumatic end effector system has an internal diameter (ID) of 20 mum used for handling nano entities such as carbon nanotubes, DNA, micro/nano particles as well as for microfluidic handling and droplet control. The DC micro-diaphragm pump is automatically controlled via a voltage driver interfaced with a computer in order to effectively and efficiently control suction force and pressure during microfluidic handling and droplet control in nano manufacturing. The new pneumatic end effector system with force sensing can significantly improve the success rate for handling/depositing micro/nano entities in the case of carbon nanotubes. The experimental results show the success rate of placing carbon nanotubes between electrodes can reach close to 80%. Ultimately, the technology will provide a critical and major step towards the development of automated manufacturing process for batch assembly of micro devices, manufacturing of nano devices, microfluidic droplet control, and drug delivery [C2108]

"L methodology for high precision fabrication"

In this paper a neural interface has been designed, in terms of materials, layout and surface morphology. A methodology for its fabrication and characterization has been provided. This methodology is based on the use of focused ion beam (FIB), atomic force microscope (AFM) and micromanipulators, respectively for nano-modification, topographical characterization and nano-dispensing of liquid biological sample. The proposed design and methodology satisfy all the constraints, specifications and requirements coming from neurophysiology issues. Analytical techniques and in vitro testing (with PC 12 cell line) provided the criteria for the validation of the proposed solutions. Preliminary in vitro testing allows to conclude that the developed neural interface satisfies the elementary issues of biocompatibility. Further studies will be performed via AFM to investigate how biological matter interacts with nano-modified electrodes. The influence of topographical modifications of the electrode will be studied on neural cells as well as on proteins or other macromolecules which mediate the cell adhesion on an implantable surface [C2109]

"Strategic Research Agenda of "More than Moore""

In the past decades, the main stream of microelectronics progresses is mainly powered by Moore's law, with two focused development arenas, namely, IC miniaturization down to nano dimension, and SoC based system integration. While microelectronics community continues to invent new solutions around the world to keep Moore's law alive, there are ever-increasing awareness, R&D effort and business drivers to push the development and application of "more than Moore" (MtM) that are based upon or derived from silicon technologies but do not scale with Moore's law (with typical examples as RF, Power/HV, sensor/actuator/MEMS, SiP, SSL, etc.). Starting from a short overview about the motivation and activities of Eniac (European Nanoelectronics Initiative Advisory Council), this paper highlights part of the strategic research subjects for the technology domain of "more than Moore" [C2110]

"Efficient On-line Interconnect Testing in FPGAs with Provable Detectability for Multiple Faults"

We present a very effective on-line interconnect built-in-self-test (BIST) method I-BIST for FPGAs that uses a combination of the following novel techniques: a track-adjacent and a switch-adjacent (also called "mirror adjacent") pairwise net comparison mechanism that achieves high detectability, a carefully designed set of only five net-configurations that cover all types and locations of wire-segment and switch faults, a 2-phase global-detailed testing approach, and a divide-and-conquer technique used in detailed testing to quickly narrow down the set of potential suspect interconnects that are then detail-diagnosed. These techniques result in I-BIST having provable detectability in the presence of an unbounded number of multiple faults, very high diagnosability of 99-100% even for high fault densities of up to 10% that are expected in emerging nano-scale technologies, and much lower test times or fault latencies than the previous best interconnect BIST techniques. In particular, for application to on-line testing, our method requires 2n roving-tester (ROTE) configurations to test an entire n times n FPGA, while the previous best online interconnect BIST technique requires n2configurations. Thus, I-BIST is an order of magnitude more time- as well as power-efficient, and scale well with rapidly increasing FPGA device sizes that are expected in emerging technologies [C2111]

"SRAM Design Techniques for Sub-nano CMOS Technology"

The scaling of CMOS technology has significant impacts on SRAM cell – random fluctuation of electrical characteristics and substantial leakage current. The random fluctuation of electrical property causes the symmetrical 6T cell to have huge mismatch in transistor threshold voltage. Consequently, the static noise margin (Read Margin) and the write margin are degraded dramatically. The SRAM cell tends to be unstable and the low power supply operation becomes hard to achieve. Besides that, the large leakage current caused by the low threshold voltage and thin gate oxide let the sub-nano SRAM design have huge static power. This makes portable electronics applications become difficult. In this talk, several design techniques used to minimize the static power consumption will be addressed and compared first. Second, in order to increase the read/write margins of SRAM cell, the VDC (Voltage Down Converter) approach will be discussed. It is founded that by using a simple VDC design, the RM (Read Margin) and WM (Write Margin) can be significantly improved and let the SRAM design be functional in the 0.7V range. The yield of the SRAM chip can also be dramatically improved. Incorporated with a resistor-less BGR (Bandgap Reference) design, this VDC can be used for static power reduction, read margin and write margin improvement, programmable voltage and voltage clamping. [C2112]

"Challenges in using nano-textured surfaces to reduce pressure drop through microchannels"

Advances in silicon processing and micro-machining now allow the consistent manufacture of micro- and nanoscale features necessary for the production of controlled roughness superhydrophobic surfaces. Superhydrophobic surfaces combine roughness features with low surface energy to create materials with substantially decreased wettability and, subsequently, reduced hydrodynamic drag. Thus, they represent a promising technology for reducing microchannel flow resistance; a major technical issue in microfluidic systems. In there, however, limits to the pressure a superhydrophobic surface can support before irreversible wetting transition occurs, leading to a loss of the drag-reducing effect. Of greater importance are preliminary observations that, even before a superhydrophobic surface wets irreversibly, the drag reduction over a superhydrophobic surface may be compromised by subtle changes in the three-phase contact line position. The positive impact of micro-geometries on heat transfer is well known. Coupling this phenomenon with superhydrophobic surfaces to reduce flow resistance, could represent a significant step forward in areas such as electronics cooling. However, theoretical models of superhydrophobic surfaces are complex due to the requirement for high resolution on multiple scales. This paper aims to present current results and discuss issues in implementing superhydrophobic surfaces, specifically nano-structured posts, in a microchannel [C2113]

"A Monolithic Surface Micromachined Half-Coaxial Transmission Line Filter"

In this paper, a novel monolithic surface micromachined half-coaxial transmission line filter was designed, fabricated and measured. The band pass filter presented here has a unique ground structure compared to the other research groups -the suspended ground plane is 100 ptm over the center conductor. The high Q0results from this large gap and an additional reduction of loss is obtained by using quartz substrates. The filter is a 3-pole, 500 fractional bandwidth, bandpass filter centered at 31.75 GHz, consisting of three capacitively coupled resonators composed of half coaxial transmission lines, which are connected to input and output transitions designed to interface with external CPW probes for measurement. The spacing between resonators and the input and output coupling to the filter were calculated from a low pass filter prototype. The fabricated filter has a length of 13 mm and width of 1 mm. A 100-ptm-thick sacrificial layer was made by JSR THB-15IN photoresist. Suspended Au ground plane was supported at the substrate by electroplating process. The pass band return and insertion loss were -10.07 dB at 31.1 GHz and -2.83 dB at 32.0 GHz, respectively. In order to extract total losses of the proposed half coaxial transmission line, we fabricated and measured single resonators. A maximum Q0value of 153 was obtained and these Q values showed the potential of this filter structure, because much higher air gap can be obtained with the same process, resulting in further increase of Q0. Measured loss from the transition was around -0. [C2114]

"Photonic Crystal Attenuator with a Flexible Waveguide and Nano-Rods"

We propose a mechanical tuning method for a two-dimensional photonic crystal (2D-PC) attenuator with a flexible waveguide and double-layered nano-rods. The 2D-PCs have a triangular lattice of air holes in a silicon slab waveguide. PCs act as optical attenuators because of their photonic band gaps. By inserting nano-rods (500 nm in diameter) into PC's air holes (650 nm in diameter), the refractive index in the holes changes. Therefore transmittance can be tuned by insertion depth. We fabricated the device by an alignment-free simple process with direct EB lithography and demonstrated 7 dB attenuation at 1500 nm of incident wavelength. [C2115]

"3-Axes Flexible Tactile Sensor Fabricated by Si Micromachining and Packaging Technology"

We present the fabrication process and characteristics of a 3-axes flexible tactile sensor available for normal and shear mode fabricated using Si micromachining and packaging technologies. The fabrication processes for the 3 axes flexible tactile sensor were classified in the fabrication of sensor chips and their packaging on the flexible PCB. The variation rate of resistance was about 2.1%/N and 0.5%/N in applying normal and shear force, respectively. Because this tactile sensor can measure the variations of resistance of the semiconductor strain gauge for normal and shear force, it can be used to sense touch, pressure, hardness, and slip. [C2116]

"Exploring the Benefits of Using Motes to Monitor Health: An Acceptance Survey"

Motes which are tiny, wireless sensor devices (Smart Dust) have the potential for transforming the biomedical and healthcare industry sector. Researchers consider motes as prototypes for nano-devices (built from off-the-shelf technology also known as commodity based hardware), which will become a reality in 10 years time. The bio-medical and healthcare market is among the fastest growing markets for WiFi and other Wireless LAN Technologies. Motes are being trialed for emergency triaging, patient profiling and monitoring and education. This paper reports on the findings of a second anonymous web survey of over 100 participants from Australia, Europe and North America, aimed at investigating the possible acceptance of Motes as a reliable and efficient health monitoring tool. An acceptance model, Unified Theory of Acceptance and Use of Technology (UTAUT) has been applied to determine how viable this technology will be in medical institutions and patients' homes. This paper reports specifically on the subjective comments made by the survey participants in an effort to measure the acceptance or non-acceptance of motes for monitoring health. [C2117]

"A 6000 Hz Computer Vision System for Real-Time Wing Beat Analysis of Drosophila"

This paper reports the design and application of a novel high speed computer vision system for real-time analysis of the wing kinematics of tethered flying fruit flies (D. melanogaster). The system uses a camera with dynamic regions of interest (ROI) to increase temporal resolution from localized sampling, without loss of spatial resolution. An extended Kalman filter is employed to fit an a priori kinematic model to past wing position measurements, allowing the position of the next ROI to be predicted and providing a real-time readout of kinematic data. Using this approach, we sampled the wing position at 6250 Hz with a precision of 1deg, using a ROI of approximately 3600 pixels. This is more than four times faster than other computer vision based tracking system to date. Beyond the study of insect flight control, this paper demonstrates a novel approach to track complex and fast moving structures in real time applications, a challenge often faced in micro and nano technologies [C2118]

"When sensor Webs start being taken seriously"

The art and science of sensing and responding to dynamic data over vast areas through distributed network of assets has long been in existence for centuries. Much of the current and emerging developments in sensor-networks and trusted computing have their metaphorical counterparts seen in history. Clear insights into the architecture and effective practices in command, control, communication, computation, collaboration and coordination (C*) have much to offer to the way we design and deploy new and innovative sensors as we continue to exploit latest developments in micro- and nano-scale sensors and systems. This paper presents a brief overview of how a complex Web of intelligent autonomous and heterogeneous sensors might be used in a dynamic environment. The key elements of enabling technologies and required capabilities are identified to facilitate a paradigm for sensors, driven by system level considerations [C2119]

"Micromagnetic modeling simulations and applications"

The advancement in micro and nano-scale technologies demands in depth understanding of magnetic behaviors. For example, as the ever increasing need for high capacity data storage continuously pushes the boundaries of magnetic recording technology to the physical limits, detailed analysis of the magnetic properties becomes necessary. It is expected that finite element micromagnetics can predict the magnetic behavior with high accuracy taking complex microstructure of magnetic materials into account. In practice, however, the tradeoff is speed and accuracy. This paper reviews the numerical methods used in micromagnetic simulations and presents practical examples in the field of nanotechnology and magnetic recording [C2120]

"Atomic layer etching of silicon by using a low-angle forward reflected ar neutral beam"

Summary form only given. Atomic layer etching (ALET) can be an indispensable method in the fabrication of future devices such as nano-scale devices, quantum devices et al., because current etch technology utilizing reactive ion etching does not have precise etch rate controllability and tends to damage the surface of the devices physically and electrically due to the use of energetic reactive ions to achieve vertical etch profiles. Therefore, many studies on ALET of Si have been reported in recent years to develop a technique to etch materials layer-by-layer. But, these previous methods may show charging due to the charged particles such as positive ions and photons generated in the plasma. Therefore, in this study, the ALET of Si was carried out for the first time using an Ar neutral beam instead of the Ar+ion beam to avoid charge-related damage during the desorption of halide and its ALET characteristics of Si by Cl2were investigated. Especially, the ALET of Si having different orientation of (100) and (111) were investigated to understand the silicon etch rate per cycle. Also, the study of ALET mechanisms, variation of surface roughness has been investigated. By supplying Cl 2and Ar neutrals higher than critical doses, the constant etch rate of a monolayer per cycle (1.36 and 1.57 Aring/cycle for Si (100) and Si (111), respectively) and the lowest surface roughness of 1.45 Aring close to the reference sample could be obtained regardless of Cl2pressure and Ar neutral beam irradiation time. The step height divided by the total number of ALET cycles yielded the etch rate per cycle. An atomic force microscope (AFM) was used to measure the surface roughness. Also, a scanning electron microscope (SEM) was used to observe as-etched Si profiles [C2121]

"Industrial CFRP large part fabrication with the innovative hephaistos-CA2 microwave processing

system"

Summary form only given. A novel industrial microwave system HEPHAISTOS-CA2 (high electromagnetic power heating automated injected structures oven system) for curing of carbon fibre reinforced plastics (CFRP) has been developed at Forschungszentrum Karlsruhe (FZK). The system is based on the HEPHAISTOS-CA1 prototype system at FZK which has been evaluated for the application in composite manufacturing together with EADS Corporate Research Centre and the Institute of Aircraft Design (University of Stuttgart). The system, which has been taken successfully in operation at the end of 2005 integrates advantageously the basic processing steps such as tooling, tempering of the resin and lay up, the impregnation of the fibres, pre-forming techniques as well as finally the process curing of the composite structures. The growth of composites applications is especially based in part on the greater design space provided by the anisotropic nature of fibre-reinforced laminates. In the same way the design degrees of freedom can be further expanded by the application of nano-particle modifications. It is a basic research field, to understand the structural enhancements obtained using the HEPHAISTOS-CA2 system and to optimize selectively these properties by specific nanomodifiers. Blending of nano-additives to get an optimized suite of properties can be applied to thermoplastics, thermosets, adhesives, elastomers, fibre precursors, sealants, coatings, foam, etc. to achieve new designable properties. The challenge in the next years will be the combination of novel industrial microwave processing technology with nano-scaled modifiers. Basic challenges such as functionalization and dispersion of nano particles have to be solved as well as the production insertion of nano-enhanced composite materials which will involve focused use of technology, high quality, speed, lower costs, and innovative business development for both the industry and the customers. The addition of very small amount--s of nano-particles can have a significant effect on the material properties (e.g. ferrites, carbon-nanotubes (CNT), coated graphite etc.) and will enhance the material quality of large parts for aeronautical industries [C2122]

"Deposition uniformity of ultra nano crystalline diamond on 6" and 8" wafer substrates using a 915MHz plasma assisted CVD diamond reactor"

Summary form only given. Due the combination of diamond's mechanical properties with minimal intrinsic surface roughness ultrananocrystalline diamond (UNCD) is a very promising engineered material for microelectromechanical systems applications. To minimize production costs it is desirable to synthesize the material over large substrate areas with very good thickness uniformity. In this paper we discuss the results of experiments to maximize the thickness uniformity of the UNCD material over 150 mm (6") and 200 mm (8") wafers. The experiments were performed using a plasma-assisted chemical vapor deposition reactor based on a single mode cavity applicator design operating at 915 MHz. The system technology is now commercially available through Lambda Technologies Inc. The thickness variation across the wafer has been determined by cross sectioning and scanning electron microscopy. The initial uniformity results across 6" wafers of plusmn13% for 4 mum thick films are very promising. The experiments are being continued for 8" wafers [C2123]

"Multi-Probe SPM using Fringe Patterns for a Parallel Nano Imaging"

This paper proposes a multi-probe SPM using fringe patterns which is able to measure the large area. The composition of the chip accumulates 50,000 probes in the area of 5 mmtimes5 mm. We fabricated the multi probes, and by using the chip the fringe patterns image could be taken with the CCD camera [C2124]

"The Key Role of Flexible, Low-Cost, Maskless Lithography in Nanoscale Science and Engineering"

First Page of the Article [C2125]

"Electrospray Wings for Nanoscale Elephants"

First Page of the Article [C2126]

"Automated design of microfluidics-based biochips: connecting biochemistry to electronics CAD"

Microfluidics-based biochips are soon expected to revolutionize laboratory procedures involving molecular biology. Advances in microfluidics technology offer exciting possibilities in the realm of enzymatic analysis, DNA analysis, proteomic analysis involving proteins and peptides, immuno-assays, and environmental toxicity monitoring. Another emerging application area for microfluidics-based biochips is clinical diagnostics, especially the immediate point-of-care diagnosis of diseases. As the use of microfluidics-based biochips increases, their complexity is expected to become significant due to the need for multiple and concurrent assays on the chip. There is a need to deliver the same level of computer-aided design (CAD) support to the biochip designer that the semiconductor industry now takes for granted. These CAD tools allow designers to harness the new technology that is rapidly emerging for integrated biofluidics. This paper presents early work on CAD tools that allow biochip users to describe bioassays at a sufficiently high level of abstraction. It describes synthesis tools that can map behavioral descriptions to a droplet-based microfluidic biochip and generate an optimized schedule of bioassay operations, the binding of assay operations to functional units, and the layout and droplet flow-paths for the biochip. Cost-effective testing techniques are presented to detect faults after manufacture and during field operation. It is shown how on-line and off-line reconfiguration techniques can be used to easily bypass faults once they are detected. Thus the biochip user can concentrate on the development of the nano- and micro-scale bioassays, leaving implementation details to design automation tools [C2127]

"Integrated Porous Silicon Nano-Explosive Devices"

The explosive properties of porous-silicon, impregnated with an oxidant, were researched. A porous layer structural model is proposed to model the pore and crystallite dimensions as a result of the electrochemical etching of porous silicon layers. A gravimetric experimental technique is described whereby the pore dimensions and specific surface area of porous regions can be determined, resulting in a new relationship between pore size and specific surface area. The properties of different oxidants, were investigated. The filling of the pores by the oxidant is a strong function of pore size and the type of oxidant used. The experimentally observed nano-explosive figure of merit (FOM) is a function of the effective surface area in the porous region covered by the oxidant. It was found that there is an optimum pore size for the most energetic explosion. Future applications for this new technology are proposed [C2128]

"What is "nano" in the context of a filled dielectric?"

Some evidence in the literature suggests that nano fillers in a polymer matrix can provide beneficial dielectric properties. The obvious question is "What is `nano'?" Where and based on what criteria is a system nanofilled or microfilled? A statistical approach is applied to this problem to develop criteria based on worst case field conditions over critical distances. The criteria are based on previous work related to electrical tree initiation and insight gained from large scale 3-D field simulations of filled systems [C2129]

"Building EWOD Microfluidic Array Technology on Top of Foundry CMOS"

This paper discusses the main issues associated with integrating electrode controlled droplet motion using electro wetting on dielectric (EWOD) with IC foundry technology. The motivation behind this approach is based upon the desire to increase the number of control electrodes, which requires the implementation of on-chip line-column microelectronics. Increasing the number of electrodes is attractive as it provides the opportunity to finely adjust droplet size, and also increases the number of droplets that can be individually moved simultaneously. The tradeoffs associated with minimising the drive voltage by appropriate choice of dielectric thickness, strength and permittivity, are discussed and examples presented of systems with the ability to move liquid droplets using voltages between 27 and 70V. A small electrode array has been designed using transistors with high voltage shields using a 100V CMOS process. This circuitry has been fabricated and can successfully apply 90V to the electrodes. The paper presents the considerations related to the chip design and the issues associated with EWOD post-processing and the microfluidic packaging requirements. [C2130]

"Panel: Nano-computing-do we need new formal approaches ?"

First Page of the Article [C2131]

"Particle coating low-pressure Ch/sub 4/H/sub 2/ plasma: The effect of particle size"

Summary form only given. In recent years, material processing technologies have been remarkably improved by the ever-growing research interest and efforts in nano-science along with plasma processing techniques. In particular, low-pressure plasma has been widely employed in the coating industry due to its capability of efficiently generating active species, responsible for layer deposition, in a low temperature environment (300 K to 600 K). These physical conditions are particularly suitable for surface modification of micron/sub-micron size particles, which are the important constituents of different classes of materials. The possibility of many combinations of particle and coating materials, and range of operating conditions, make the physico-chemical phenomena of coating complex. Consequently, a great deal of efforts has to be invested in developing predictive models capable of defining the optimum conditions for coating of such particles. In the present work, a hybrid model of kinetic theory and continuum theory for predicting coating of particles by plasma enhanced chemical vapor deposition in low-pressure conditions is used to study the effect of particle size on the physical processes occurring during deposition (i.e. particle charging, distribution of species in the particle surrounding, and layer deposition). In particular, we focus our interest on large particles. The chemical reaction model considers a CH4/H2plasma consisting of 31 reactions that accounts for ionization and dissociation reactions, namely electron-neutral, ion-neutral, and neutral-neutral reactions. Ions and electrons are responsible for particle charging and for generation of self-bias electric field, whereas radicals account for particle layer growth. In a spherical symmetric geometry, up to a distance longer than one mean free path from the surface of the particle, reactive-diffusive phenomena occur and continuum theory is implemented to solve for species transpor--t. Whereas, inside the so-called vacuum sphere around the particle no collisions occur and kinetic theory is applied [C2132]

"Thyristor-Based Volatile Memory in Nano-Scale CMOS"

A thyristor-based memory cell technology provides SRAM-like performance at 2times to 3times the density of conventional 6T SRAM. The technology is readily embedded into conventional nano-scale CMOS and scales into future SOI and FinFET technologies. A 19mm20.13mum 9Mb SOI test chip has a 0.562mum2cell with a cell-R/W time <2ns [C2133]

"Optical interconnect technologies for high-speed VLSI chips using silicon nano-photonics"

Optoelectronic and electrooptic elements are integrated on VLSI chips. The junction capacitance of a nano-photodiode is extremely low (<10aF), which permits a high load resistance to be used, resulting in higher output voltage at high frequencies. A ceramic Pb(,ZrTi)O3 film with average crystallite diameter below 20nm has a high electro-optical coefficient (>150pm/V) suitable for on-chip modulators. This paper introduces a new approach for realizing high-speed optical interconnects on silicon chips. This concept uses nano-photodiodes on silicon with extremely low parasitic capacitance (less than 10aF) enabling robust communication at very high frequencies. The results demonstrate 5GHz clocking with the promise of up to 20GHz. The authors will also discuss how the silicon nano-photodiode can be used for wavelength-division multiplexing and low-voltage electro-optic modulators for on-chip and off-chip optical communications [C2134]

"Characteristics of On-Wall In-Tube Thermal Flexible Mass-Flow Sensors"

We developed a wall-mounted in-tube thermal flexible sensor for measuring mass flow that can measure the flow rate in both hydraulically developing and fully-developed regions. The flexible structure was achieved by using polymer MEMS technologies. It has high linearity with a TCR of 0.0026K-1, and a steady maximum value for the response time is reached within 7 μ s. The measuring distance from the tube entrance is 8.3D (D = inner diameter of tube). This is much shorter than 64D, the theoretically calculated distance necessary for the formation of a fully-developed flow condition. [C2135]

"Methods for molecular MRI"

Significant progress has been made in the field of molecular imaging. Guiding application of this technology has been the need to test, in vivo and in real time, hypotheses developed in multiple scientific fields. Because of the superb anatomical resolution already available with MR imaging several investigators have attempted to develop MR molecular imaging agents that would be useful to image gene expression and cellular biochemistry in vivo. Significant advances have been made and it is now possible to use MR for the detection and/or imaging of enzyme activity, protein and RNA levels, protein-protein interactions, pH changes, receptor activity, and calcium fluxes. The future for molecular MR imaging will include imaging based on information contained in complex molecular signatures and will render 3D images describing complex biochemical phenomena [C2136]

"High resolution clinical and preclinical SPECT-CT"

Dual modality preclinical and clinical SPECT/CT scanners have been under constant technological advance since the development of the first prototype dual modality clinical scanner in 1990. Dual modality SPECT/CT has rapidly become an established imaging tool in clinical and preclinical settings. In this article, we describe the present technology of dual modality SPECT/CT scanners used for clinical and preclinical imaging studies [C2137]

"Illuminating disease with fluorescence molecular tomography"

The combination of advanced macroscopic visualization methods with the ability to impart molecular contrast in-vivo in whole tissues offers an exciting new tool with large potential in basic research, drug discovery and clinical application. One of the most recent technological evolutions has been the development of fluorescence tomography for visualization at the whole animal or tissue level. This technology allows for three dimensional imaging of fluorescence bio-distribution in whole animals, is insensitive to optical tissue heterogeneity and offers great promise as a versatile platform for non-invasive fluorescence imaging. Key technological advances in the field are herein summarized [C2138]

"Silicon photodiodes"

A high-speed Si nano-photodiode with a surface plasmon antenna has been developed. The optical near-field technology used in this device will increase the feasibility of on-chip optical data transmission and optical clock distribution in LSIs [C2139]

"ZnO Nanobelts/wire for Electronic Detection of Enzymatic Hydrolysis of Starch"

The hydrolysis of starch converting into glucose, cyclodextrins and other monomer products is very critical in food and pharmaceutical industries. The conventional methods of testing the hydrolysis products are cumbersome and time consuming. The single-crystal zinc oxide (ZnO) structures are quasi-one dimensional semiconducting nanostrucrures, and open a new field of biosensor technology for fabricating highly sensitive biosensors for the detection of protein, peptide, DNA/RNA, and enzyme-catalyst events in real-time mode. We synthesized ZnO nanobelts/wires, and modified surfaces by coating with silicon nitride (Si3N4) to protect nanostructure from process treatment. The nanostrucrures were coated with dilute aqueous starch solution, and electrical impedance measurements were recorded for both control and test samples. The test samples were hydrolyzed using amyloglucosidase enzyme (AMG). The SEM analysis showed degradation of the starch on the surface of ZnO nano-belts, whereas the starch remained intact on the control samples. The electrical impedance measurements showed shift in electrical impedance on test samples, whereas in control samples it remained static. The details of experimental results of electronic sensing of hydrolysis and advantages of the lab-on chip are discussed. This is the first report of electronic detection of starch hydrolysis using ZnO nanobelts/wires [C2140]

"Neuromorphic Pattern Recognition Using SET Technology"

Based on the nano-scale devices subsume a profound understanding of the complex dynamics of small arrays of quantum structures, we propose a novel approach to signal pattern analysis using an array of quantum dots (QD) operating at single electron tunneling (SET) state. Such arrays produce bistable and multi-stable robust behavior, which can be harnessed for unconventional, yet powerful computational concepts. Our methodology combines an ultra fast neuromorphic learning algorithm with photon-assisted tunneling in the QD array. The latter enables emulation of the plasticity of neural synapses [C2141]

"VMOS, UMOS technology simulation"

VMOS, UMOS ("V"-groove-metal-oxide-silicon) transistors drain and gate are formed in the groove of "V" or "U" form. Expanding channel area, therefore VMOS and UMOS structures may use in the power chips. Using VMOS, UMOS is saving 40% free space than using NMOS technology. Nanostructures dimensions are very small, so it is important to keep pn junction in a right depth, in the all semiconductor manufacturing technological process. Analyzing influence to forming structure of each technological operation is used mathematical simulation program SUPREM IV. VMOS and UMOS technological operation was simulated in micro and nano level [C2142]

"Modulation of Nano-Selenium on Tetrodotoxin-Sensitive Voltage-Gated Sodium Currents in Rat Dorsal Root Ganglion Neurons"

Nano-selenium, a novel nano technology production, was demonstrated to be useful in medical and scientific researches. Here, we investigated the effects of nano-Selenium on tetrodotoxin-sensitive (TTX-S) voltage-dependent Na+channels in isolated rat dorsal root ganglion neurons, using whole-cell patch-clamp method. Nano-selenium irreversibly decreased TTX-S Na+current (INa) in a concentration-dependent manner and shifted the maximum of the current/voltage relationship from -67mV to -52mV, without modifying the threshold potential of the current. Nano-selenium shifted the steady-state activation and inactivation curves to the left. In the contrast of Na2SeO3, the inhibition effect of 1nM nano-Se was much stronger. The cell treated with 1nM Na2SeO 3firstly, still respond to further addition of 1nM nano-selenium. These results prove nano-selenium to be a novel antagonist, acted within the channel pore, not on or near the exterior surface of the channel protein where it would experience the membrane electric field, which possesses a distinct binding site from Na2 SeO3 [C2143]

"Simulation study of nanoparticle melting behavior for lead free nano solder application"

Summary form only given. Silver nanoparticle was used as model system for melting behavior study due to its wide application in the field of microelectronic packaging and the availability of force field. The embedded atom method (EAM) was employed in conjunction with molecular dynamics (MD) simulations to investigate the effect of particle size and temperature ramping up rate on nano silver melting behavior. Silver spheres with diameter of 10 nm and 4 nm were prepared, and the temperature was raised up to 1200 K at a ramping up rate of 0.1K/ps and 1K/ps respectively. [010] projection and pair correlation function (PCF) were applied to study the structural evolution of silver particles as temperature is ramping up. The melting point was derived by observing the abrupt increase in potential energy. The effect of particle size and temperature ramping up rate on melting point was investigated. Surface melting behavior was studied by comparing the micro-structure of silver atoms located in core/shell regions [C2144]

"Optimizing geometrical design of superhydrophobic surfaces for prevention of microelectromechanical system (MEMS) stiction"

Due to the surface smoothness of micromachined structures, strong adhesion forces between these fabricated structures and the substrate can be developed. The major adhesion mechanisms include capillary forces, hydrogen bonding, electrostatic forces and van der Waals forces. Once contact is made, the magnitude of these forces is in some cases sufficient to deform and pin these structures to the substrate, resulting in device failure. This type of failure is one of the dominant sources of yield loss in MEMS. The basic approaches to prevent stiction are increasing surface roughness and/or lowering solid surface energy by coating with low surface energy materials. Combination of micro- and nano-meter scale roughness can dramatically increase the surface roughness. However, in fabrication process, how to optimally design surface geometry with micro-/nano-meter roughness is still not clear. The objectives of this paper are to experimentally study the wetting and hydrophobicity of water droplets on two-tier rough surfaces for comparison with theoretical analyses, and to optimize the surface geometrical design for fabricating stable superhydrophobic surfaces. Two model systems are fabricated: carbon nanotube arrays on silicon wafers and carbon nanotube arrays on carbon nanotube films, to compare wetting on micro-patterned silicon surfaces with wetting on nano-scale roughness surfaces. All surfaces are coated with 20 nm thick fluorocarbon films to obtain low surface energies and to improve the stability of the superhydrophobic surface, formed by plasma enhanced chemical vapor deposition (PECVD). The results show that the microstructural characteristics must be optimized to achieve stable superhydrophobicity on micro-scale rough surfaces. However, the presence of nano-scale roughness allows a much broader range of surface design criteria, decreases the contact angle hysteresis to less than 1deg and establishes stable and robust superhydrophobicity, although nano-scale roughne--ss could not increase the apparent contact angle significantly if the micro-scale roughness dominates. The results of the research could guide the optimized designs of the surfaces for prevention of microelectromechanical (MEMS) stiction [C2145]

"Research progress of triptolide-loaded nanoparticles delivery systems"

Triptolide is one of the major active components of traditional Chinese medicine (TCM)-Tripterygium wilfordii Hook. f. (TWHf), which has been reported to be effective in the treatment of patients with a variety of inflammatory and autoimmune diseases, especially rheumatoid arthritis. However, its clinical use is restricted due to its scarce water solubility and some toxic effects. In order to find innovative ways for administering triptolide and alleviating its disadvantages, the novel types of delivery systems have been developed. This paper reviews the studies of triptolide-loaded nano drug delivery systems (NDDS) in our group during the past three years. The preparation, characterization, pharmacology and toxicity of triptolide-loaded solid lipid nanoparticles, microemulsions and polymeric nanoparticles were investigated. The results indicated that the NDDS presented more powerful activity and a lower toxicity in comparison with common drug carrier [C2146]

"Nanoshells as contrast agents for scatter-based optical imaging"

Optical properties of gold nanoshell-based contrast agents for optical coherence tomography (OCT) were determined using calculations based on concentric sphere Mie scattering theory. Nanoshells capable of optimal optical scattering in the near infrared (NIR) were subsequently fabricated. We show that scattering nanoshell possess higher backscattering efficiencies at longer wavelengths. Results show enhanced OCT signal intensities after addition of gold nanoshells to scattering tissue phantoms. In addition, in vivo mouse tumor model studies show clear evidence of enhancement of tumor scatter after nanoshell injection as compared to control (phosphate buffered saline, PBS) injections, further demonstrating the potential of gold nanoshells as NIR contrast agents to improve scattering-based optical imaging technologies. In addition to the data shown in this preliminary paper, the talk will present more recent data using immunotargeted nanoshells for molecular contrast OCT [C2147]

"Towards automated bioimage analysis: from features to semantics"

Recent advances in bio-molecular imaging have afforded biologists a more thorough understanding of cellular functions in complex tissue structures. For example, high resolution fluorescence images of the retina reveal details about tissue restructuring during detachment experiments. Time sequence imagery of microtubules provides insight into subcellular dynamics in response to cancer treatment drugs. However, technological progress is accompanied by a rapid proliferation of image data. Traditional analysis methods, namely manual measurements and qualitative assessments, become time consuming and are often nonreproducible. Computer vision tools can efficiently analyze these vast amounts of data with promising results. This paper provides an overview of several challenges faced in bioimage processing and our recent progress in addressing these issues [C2148]

"Joint estimation of image and coil sensitivities in parallel MRI"

Parallel magnetic resonance imaging (MRI) using multichannel receiver coils has emerged as an effective tool to reduce imaging time in various dynamic imaging applications. However, there are still a number of image reconstruction issues that have not been fully addressed, thereby limiting the level of speed enhancement achievable with the technology. This paper considers the inaccuracy of coil sensitivities in conventional reconstruction methods such as SENSE, and reformulates the image reconstruction problem as a joint estimation of the coil sensitivities and the desired image, which is solved by an iterative algorithm. Experimental results demonstrate the effectiveness of the proposed method especially when large acceleration factors are used [C2149]

"A Universal Parameter for Silicon Anisotropic Etching Inalkaline Solutions"

We propose a new explanation for the difference between the etching properties of potassium-hydroxide (KOH) and tetramethyl-ammonium-hydroxide (TMAH) by focusing on the volume fraction occupied by the corresponding cations, K+for KOH and TMA+(with molecular structure N(CH3)4+) for TMAH. We have found experimentally that the differences in the surface morphology of Si [C2150]

"Alow Temperature Vacuum Package Utilizing Porous Alumina Thin Film Encapsulation"

We report a monolithic thin-film encapsulation method that satisfies the most popular requirements for on-wafer packaging: low temperature, low cost, hermetic, and RF compatible. The key for this new nano-porous thin-film encapsulation method is the technique to produce a large free-standing porous alumina membrane on-chip by post-deposition anodization of aluminum at room temperature. A porous alumina membrane allows for the diffusion of gas or liquid etchants through the nano-pores into the cavity to etch the sacrificial material, freeing the movable structures encapsulated inside. Subsequent vacuum sealing was achieved by depositing a thin film over the nano-porous alumina shell in a vacuum deposition tool, with no detectable penetration of the sealing material owing to the nano-pores with a high aspect ratio (> 30). The process, done at a low temperature, produced a hermetic vacuum seal and demonstrated an exceptionally low RF insertion loss: < 0.1 dB up to 40 GHz. [C2151]

"CAS/sup 2/: context awareness service system based on wireless sensor networks"

In recent years, the appearance of ubiquitous computing provides a fair opportunity to access diverse information and service at anyplace, anytime for users. Furthermore, those services need system architecture and context-aware and, furthermore, location-aware technologies are essential. In this paper, we suggest that a system architecture (CAS2) for handling context information based on wireless sensor network (WSN) that can provide diverse and convenient services to user with only minimum actions by collecting context information of the user in real-time. CAS also provides optimized services to each user based on the context information [C2152]

"Carrying Target Molecules on Beads by Bio Molecular Motors"

A motor protein system, kinesin/microtubule, transported target molecules specifically attached on bead surfaces. The target molecule, biotin-4-fluorescein, was specifically immobilized on streptavidin-coated beads, on which kinesin molecules were also attached. The target molecules were successfully transported along microtubules immobilized on a glass surface. The activity of kinesin was not disturbed by co-existing target molecules. The result has significant implication to sort out any target molecule selectively from a sample solution by a nano-scale transport system driven by the kinesin/microtubule system. [C2153]

"Capacitive Absolute Pressure Sensor with Vacuum Cavity Formed by Bonding Silicon to Soiwafer for Upper Air Observations"

We present a capacitive absolute pressure sensor with a large deflected diaphragm that was fabricated with a sealed vacuum cavity formed by removing handling silicon wafer and oxide layers from a SOI wafer after eutectic bonding of a silicon wafer to the SOI wafer. The deflected displacements of the diaphragm formed by the vacuum cavity in the fabricated sensor were similar to simulation results. This result was estimated because of the dense interface produced between cavity-formed Si and the top Si layer of the SOI wafer by the Si-Au eutectic bonding process. Initial capacitance values were about 2.18pF and 3.65pF under normal atmosphere, where the thicknesses of the diaphragm used to fabricate the vacuum cavity were 20 μm and 30 μm, respectively. Also, it was confirmed that the differences of capacitance value from 1000hPa to 5hPa were about 2.57pF and 5.35pF, respectively. [C2154]

"Piezoresistive Cantilever for Nano-Newton Sensing in Two Dimensions"

This paper describes a novel two dimensional piezoresistive cantilever force sensor that is used to evaluate the impact force between micro-handling tools and microparticles in the nano-Newton range. Piezoresistor sensors are made from 500 nm-thick p-doped epitaxial silicon on a single crystal silicon substrate. The silicon cantilever is fabricated using bulk micromachining. Switching from the lateral mode to the vertical mode to monitor the lateral and vertical applied force is easily done by using two electronic switches. Force sensitivity of the implemented sensors up to 135 and 310 V/N for lateral and vertical configurations, respectively, is measured. The force resolution is estimated at 5 nN. [C2155]

"High Resolution and S/N Ratio Nano Probing System"

Recently, not only recording the neural activity, but also simultaneous measurement of ion concentration from a single cell is necessary for biological function analysis. We presented a nanoprobe with calcium ion measurement in a cell using fluorescence. We've improved the performance of the nanoprobe by coating the aluminum on the pipette. Our glass micropipette coated with aluminum can measure fluorescence from a smaller area. Using this nanoprobing system, the fluorescence response from a tissue was measured every 10 μ m in depth. [C2156]

"3-D tomographic reconstruction of the average propagator from MRI data"

The measurement of the 3-D "average propagator", P(r) from diffusion-weighted (DW) NMR or MRI data has been a "holy grail" in materials science and biomedicine, as P(r) provides detailed microstructural information, particularly about restriction, without assuming an underlying diffusion model. While Callaghan proposed a 3-D Fourier transform relationship between P(r) and the DW signal attenuation, E(q), using it to measure P(r) from E(q) data is not currently feasible biologically or clinically, owing to the staggering amount of DW data required. To address this problem, we propose that computed tomography principles can be applied to reconstruct P(r) from DW signals. Moreover, this reconstruction can be performed efficiently using many fewer DW E(q) data as compared to conventional 3-D q-space MRI or diffusion spectrum imaging (DSI) by employing a priori information about E(q) and P(r) [C2157]

"A framework for the detection of acute renal rejection with dynamic contrast enhanced magnetic resonance imaging"

Acute rejection is the most common reason of graft failure after kidney transplantation, and early detection is crucial to survive the transplanted kidney function. In this paper we introduce a new approach for the automatic classification of normal and acute rejection transplants from dynamic contrast enhanced magnetic resonance imaging (DCE-MRI). The proposed algorithm consists of three main steps; the first step isolates the kidney from the surrounding anatomical structures by evolving a deformable model based on two density functions; the first function describes the distribution of the gray level inside and outside the kidney region and the second function describes the prior shape of the kidney. In the second step, nonrigid-registration algorithms are employed to account for the motion of the kidney due to patient breathing, and finally, the perfusion curves that show the transportation of the contrast agent into the tissue are obtained from the cortex and used in the classification of normal and acute rejection transplants. Applications of the proposed approach yield promising results that would, in the near future, replace the use of current technologies such as nuclear imaging and ultrasonography, which are not specific enough to determine the type of kidney dysfunction [C2158]

"In-situ study of the effect of electromigration on strain evolution and mechanical property change in lead-free solder joints"

We report a localized mechanical property study by using the nano-indentation continuous stiffness measurement (CSM) technology on Pb-free solder joints with and without electromigration. The tensile test structure of a solder ball connected by two Cu wires of 300mum diameters was prepared and tested. At 100 degC, the applied current density was from 0 A/cm2to 5times103A/cm2 and the time from 3 to 144 hrs. An array of 500 nm indentations was created by the nano-indenter from the cathode area, across the bulk of the solder, to the anode area. The change of Young's modulus and the hardness at the cathode and the anode was calculated from the CSM. The results show that, the Young's modulus and the hardness of the anode were higher than the original values. And it increases with increasing electromigration time or higher current density. On the other hand, the Young's modulus and hardness at the cathode were lower than the original values and they decrease with increasing electromigration time or higher current density. Therefore, there is a change of mechanical properties at the cathode and the anode of the lead-free solder joints due to electromigration. Furthermore, an in-situ micro-DISC technology, digital image speckle correlation technology, was used to study the strain evolution at the lead-free solder joints during electromigration. It is found that, during electromigration, with the atoms moving from the cathode to the anode, a tensile strain was created at the cathode region; while a compressive strain was observed at the anode region. And the strain difference between the cathode and anode kept increasing with the time of electromigration. The localized mechanical property change in the lead-free solder joints due to electromigration will be discussed [C2159]

"The virtual physiological human: challenges and opportunities"

This paper summarises the current achievements and future developments of the virtual physiological human (VPH) technology. The VPH is an organised collection of computational frameworks and ICT-based tools for the multilevel modelling and simulation of the human anatomy and physiology. Once sufficiently developed, the VPH will provide an essential technological infrastructure to the Physiome Project, to pathology-specific initiatives in translational research, and to vertical solutions for the biomedical industry [C2160]

"A design and implementation of wireless sensor network routing on Nano-Qplus platform"

Recent advancement in wireless technologies has enabled the development of low-cost sensor networks. The wireless sensor networks can be used for various application areas such as home, health, and robotics. Sensor nodes are scattered densely in a field either close to or inside the phenomenon. Therefore, special multihop wireless routing protocols between the sensor nodes and the sink node are needed. Furthermore, wireless sensor network routing protocols are influenced by many challenging factors in terms of energy, processing, and storage capacities. We developed a wireless sensor network routing system based on the Nano-Qplus platform. The Nano-Qplus platform is composed of nano HAL, sensing and actuating, task management, power management, and message handling module. In addition, the Nano-Qplus platform includes a ATmega128 MCU and cc2420 IEEE802.15.4 RF communication module. In consideration of the functional and hardware limitation of the Nano-Qplus platform, we developed an energy efficient routing system based on the Nano-Qplus platform [C2161]

"A nano operating system for wireless sensor networks"

In recent years, the availability of cheap and small micro sensor node and low power wireless communication give a contribution of enhanced developments of wireless sensor network application in real society. Furthermore, middlewares and operating systems for convenience on development of sensor network application are essentially needed. In this paper, we introduce a sensor network operation system, Nano-Qplus platform, which is flexible, dynamic, and easy manageable for sensor network application programmer. Furthermore, for the purpose of performance evaluation, we compare Nano-Qplus to other sensor network operating systems related to memory read/write time and task creation latency. The results of performance analysis shows that Nano-Qplus offers enhanced advantages that other sensor network operating systems, so we can notice Nano-Qplus is easily applied to real sensor network application [C2162]

"Nasopharyngeal carcinoma lesion segmentation from MR images by support vector machine"

A two-class support vector machine (SVM)-based image segmentation approach has been developed for the extraction of nasopharyngeal carcinoma (NPC) lesion from magnetic resonance (MR) images. By exploring two-class SVM, the developed method can learn the actual distribution of image data without prior knowledge and draw an optimal hyperplane for class separation, via an SVM parameters training procedure and an implicit kernel mapping. After learning, segmentation task is performed by the trained SVM classifier. The proposed technique is evaluated by 39 MR images with NPC and the results suggest that the proposed query-based approach provides an effective method for NPC extraction from MR images with high accuracy [C2163]

"A Leakage Compensation Technique for Dynamic Latches and Flip-Flops in Nano-Scale CMOS"

This paper presents analysis and measurement of a leakage current compensation technique aimed to preserve traditional operation of dynamic flip-flops in nano-scale CMOS. Over 7.4X larger leakage tolerance was observed for a dynamic transmission-gate flip-flop utilizing the proposed technique. Furthermore, a conditional static keeper ensures robust operation at low-frequency/standby.. [C2164]

"Synthesis and Application of Novel Lead-Free Solders Derived from Sn-based Nanopowders"

Two kinds of lead-free solders derived from tin-based nanopowders were fabricated. One was the lead-free solders with Sn-Ag-Cu nanopowders, and the other was nano-sized Cu6Sn5doped Sn-Ag-Cu solders. The lead-free solders with Sn-Ag-Cu nanopowders were synthesized by chemical precipitation with NaBH4. The isolated particle exhibited a near spherical shape with particle sizes around 5 nm. The primary particle size of Sn-Ag-Cu nanopowders was in the range of 40 nm. Microstructural characteristics of particle growth were evaluated by TEM and FE-SEM. The primary particles after precipitation were (Ag,Cu)4Sn with a size of 4.9 nm. It was also revealed that (Ag,Cu)4Sn transformed into (Ag,Cu)3 Sn, when the total amount of Sn contributed from both (Ag,Cu)4Sn and Sn covering the (Ag,Cu)4Sn overtook that of (Ag,Cu)3Sn. The nano-sized Cu6Sn5 doped Sn-Ag-Cu solder paste was produced by mixing Cu6Sn5nanopowder into commercial SnAg solder paste. To realize the effect of Cu6Sn5nanopowder doping, the ball shear strength of the joint was further investigated. The fracture behavior of Sn-Ag-Cu solder joints was probed with respect to the fracture surfaces, interfacial morphologies, and ball shear strength. It was demonstrated that the creep strain rate sensitivity of nano-Cu6Sn5doped composite solder was higher than that of commercial Sn-Ag-Cu solder, although the creep hardness of both solders was nearly identical [C2165]

"Research on Nano-Imprint Microfabrication and Bonding of Polymer Microfluidic Chips"

Microfluidic chips based on MEMS technology have played significant roles in biomedicine, analytical chemistry and related fields. Polymer materials for microfluidic chips were proven to owe many advantages such as good insulation and optical properties, low price, easy production process, and so on. This paper documents the process of fabricating a silicon mold and the parameters on production of micro-channels by nano-imprinting technology. Study is reported on the bonding of microfluidic chips, including direct thermal bonding and vacuum thermal bonding. The nano-imprint processes are simulated by field limited method, and the corresponding optimization parameters of nano-imprint and bonding are also presented, providing a basis for the mass production of polymer microfluidic chips [C2166]

"Ultra Precision Polishing of GMR Hard-Disk Magnetic Head"

Though the material of substrate of magnetic head is very brittle, it can be removed in ductile way by controlling load and size of diamond in lapping. Different material removal mechanism can be produced by rolling grain and sliding grain. The material is removed in fatigue way by rolling grain but removed in micro-cutting way by sliding grain. For very brittle and hard reason, the substrate can be removed in fatigue way, while the pole tip can be removed by micro-cutting for the ductile reason. In theory, the pole tip is easy recessed when the grain mainly moved in sliding way. In this investigation, the ratio of rolling grains to sliding grains was adjusted by changing the pad roughness, diamond size, size distributing and lapping load to obtain an excellent magnetic head surface and high removal rate. The quality of magnetic head surface after nano-grinding will be better than that after lapping, but the removal rate in nano-grinding will be lower than that in lapping. So, nano-grinding was only used in the final process. The fabricating of nano-grinding pad is the main factor that influences the surface quality. Ultra-smooth magnetic head surface was achieved by integrated a serial of lapping and nano-grinding process [C2167]

"Controlled Propagation in Molecular Communication Using Tagged Liposome Containers"

Molecular communication is an emerging research area in the bio and nano science. Molecular communication uses molecules as a communication medium and allows nanomachines to communicate over a short distance. A key design challenge in molecular communication is controlling the propagation direction of information-carrying molecules towards their destination. This paper presents results of the experiment for transporting liposome containers to the designated receivers. In the experiments, molecular tags were used to identify the destination of the liposome containers [C2168]

"Logical Nano-Computation in Enzymatic Reaction Networks"

We propose a way to implement logical operations at the nanoscale by means of enzymatic reaction networks such as kinase-phosphatase networks. For this we suggest and analyze a small recurrent enzymatic reaction network with only four molecule species which contains a positive and a double negative feedback loop. The system is shown to have bistable regimes, the phase boundaries of which are analytically determined. We show that, by adjustment of the total concentrations of the species relative to the range of concentrations of the input substances, it is possible to flexibly implement logical AND, OR, and NOT gates with variable input sensitivity and output dynamic range. Finally, a realistic kinase-phosphatase implementation of the circuit is provided [C2169]

"A New Channel Coding Algorithm Based on Phosphorylation/dephosphorylation-proteins and GTPases"

Although molecular signaling of phosphorylation/dephosphorylation-proteins and GTPases has been extensively studied in molecular biology, it is still an open problem as to how information be coded in these molecules for molecular communication. In this paper, we propose a new channel coding algorithm based on signaling pathways in cells, extending our previous work on source codes to channel codes. The time complexity of the encoding/decoding algorithm we proposed is O(Qtimesm+Ltimes(P+zeta)) where Q refers to the number of the elements in the set of information vectors, m refers to the length of GTPase codeword, L refers to the number of the GTPase groups, P is the number of phosphorylation/dephosphorylation-proteins, zeta refers to the number of GTPases that are embedded in X'-codeword. This result shows the algorithm is theoretically realistic because the encoding/decoding process in a linear order time complexity is efficient. This benefits the studies on engineered cell communication in terms of information theory [C2170]

"1.5-V Linear CMOS OTA with -60dB IM3 for High Frequency Applications"

A novel configuration of linearized Operational Transconductance Amplifier (OTA) for low-voltage and high frequency applications is proposed. By using double differential pairs and the source degeneration structure under nano-scale CMOS technology, the nonlinearity caused by short channel effect from small feature size can be minimized. A robust common-mode control system is designed for input and output common-mode stability, and thus reduces distortion caused by common-mode voltage variation. Tuning ability can be achieved by using MOS transistors in the linear region. The linearity of the OTA is about -60dB third-order inter- modulation (IM3) distortion for up to 0.9 VPPat 40 MHz. Ths OTA was fabricated by the TSMC 180-nm Deep N-WELL CMOS process. It occupies a small area of 15.1 x 10-3mm2and the power consumption is 9.5 mW under a 1.5-V supply voltage. [C2171]

"Nano-hole Arrays in Thin Au/Pd Film on Glass, for High Speed Molecular Analysis"

We present an improved process technology based on e-beam lithography and lift-off technique, for fabrication of different nano-hole arrays in optically thick gold/palladium (Au/Pd=60/40) layers on transparent substrates. Every hole serves as a reaction chamber for bio-molecular analysis (e.g. antibody/antigen recognition), as part of a novel atto-liter titer plate device. The optical characterization of the hole-arrays is pursued, both for the transmission of the light and the fluorescence signal through the holes. Array structures with square and hexagonal holes' distribution, with the hole-diameters between 150 nm and 200 nm and periodicity of 600 nm and 900 nm are fabricated in 200 nm thick layer of gold/palladium alloy on glass. The spectrum of the transmitted light through the hexagonally distributed nano-holes compared to the one of the square distributed nano-holes shows a 20% of light enhancement. Applying Rhodamine G6 solution (0.05 mM) on top of the arrays reveals a nine time increased fluorescent signal. [C2172]

"New method for the detection of enzyme immobilized on Si-based glucose Biosensors"

Glucose oxidase molecular layers immobilized on planar and porous SiO2substrates were characterized with techniques commonly used in microelectronics technology. Both planar and porous SiO2were used as inorganic platforms for the enzyme bonding. The immobilization protocol on planar SiO2was characterized using contact angle, atomic force microscopy (AFM) and X-ray photoelectron spectroscopy (XPS), while energy dispersive X-ray analysis (EDX) coupled with scanning electron microscopy (SEM) were used on porous SiO2samples. A conclusive confirmation of the enzyme presence in the SiO2matrix was obtained by gold nano particles labeling. This last measurement technique could be implemented to determine the enzyme concentration in the porous SiO2layer. [C2173]

"Thin SQI NEMS accelerometers compatible with In-IC integration"

The paper presents thin SOI NEMS structures for accelerometers based on thin SOI technology and compatible with "In-IC" integration. The goal of this work is to demonstrate the feasibility in terms of concept and technological manufacturing. Modeling of Casimir force, development of hybrid e-beam/DUV lithography and FH-vapor release, specific AFM characterizations have allowed to design, fabricate and characterize first devices. [C2174]

"Single-walled carbon nanotube based gas sensor with nanoscale electrode interval using sacrificial oxide layer"

We developed a chemical gas sensor using SWCNT (single-walled carbon nanotubes) with nanoscale electrode-interval. To fabricate electrode pattern, we designed at first a continuous electrode pattern without any intervals. Then, the nanoscale interval was formed by a nanoscale trench using a sacrificial oxide layer located at the center of electrode. By this technique we obtained an electrode pattern with 100 nm interval. Though, the nanoscale interval can be realized by various nanolithography techniques including nanoimprint, nano-MEMS technology is not yet standardized and still requires great expense for even a stamp fabrication. Our method consisted of well developed processes for microscale semiconductor fabrication including trench formation, polysilicon deposition, and thermal oxidation. We expect that our method will induce high reproducibility and is closer to the commercialization of nanotube based gas sensor with higher sensitivity. [C2175]

"Ultra-high aspect ratio buried silicon nano-channels for biological applications"

It is reported for the first time a process technology to fabricate sub-100 nm silicon nano-channels with ultra high aspect ratio (~160) for micro fluidics, nano-filtration and pathogen detection applications. A novel double passivation deep reactive ion etching process has been developed to realize ultra high aspect ratio silicon nano-channels which is further narrowed by deposition of polysilicon and thermally oxidized to form sub-100 nm buried nano-channels. This technology further provides for in-situ capping of the nano channels which offers significant stress-relief at the top of the nano-channels during subsequent glass bonding and packaging process. By providing in-situ capping capability for the channels we also eliminate potential leakage issues due to poor bonding contact. This channel capping also helps in preventing breakage of the high aspect ratio structures under high anodic bonding pressure. Though the present work was targeted for biological applications, it can easily be used for mainstream MEMS and NEMS applications such a RF resonators, Sensors and Actuators. [C2176]

"MOSFET-Embedded Microcantilevers: An All-Electronic Label- and Optics-Free Signal Transduction Paradigm for Bio-Chem Sensing"

We recently introduced all-electronic label- and optics-free detection paradigm for biochemical binding events on metal-oxide semiconductor field-effect transistor (MOSFET)-embedded microcantilevers. Microcantilever bending as small as ~5 nm, leads to a measurable and reproducible change in the MOSFET drain current, which forms the basis for the microelectronics-based detection of molecular binding events. MOSFET-embedded microcantilevers are able to detect diverse probe-target binding events, ranging from DNA hybridization to protein-protein binding, at high sensitivity. Such label- and optics-free all-electronic MOSFET detection approach will bridge the current gap between integration of nano-bio nanostructures with microelectronics, and promises a universal and widely deployable bio-chem diagnosis platform, compatible with all the advantages of established CMOS technology for wide variety of biomolecular and chemical detection and diagnosis. [C2177]

"Research on intelligent CVC roll grinding and interpolation strategy"

These instructions give you the basic guidelines for preparing papers for conference proceedings. CVC system is an effective method for controlling the profile of strip. The key issue in the controlling facts of profile of strip is the accuracy of CVC roll shape. On the base of full analysis on CVC roll wear and describing characteristics of roll shape model, a new least square method is adapted to decrease the axis force of CVC roll so that the accuracy can be improved in contrast to traditional method. In this paper an intelligent grinding method based on STEP-NC is also created and STEP-NC is developed into CVC roll grinding field. By analysis of interpolation strategies, a spline interpolation method is made use of to meet the accuracy of roll shape. It proves that nano accuracy of CVC grinding can be obtained by means of the above mentioned intelligent method and strategy. [C2178]

"Detection Millimeter Waves Using Novel Electronic Nano-Devices"

THz spectrum lies between microwave and midinfrared, a region that remains largely unexplored mainly due to the bottleneck issue of lacking compact, room-temperature emitters and detectors. Here, we report on experiments using novel nanodevices as detectors at frequencies up to 2.5 THz, which are to our knowledge not only the simplest diodes but also the quickest electronic nanodevices reported so far. [C2179]

"Application of MMW/THz ESR for High Magnetic Field Spin Sciences-Physics, Chemistry, and Material Science"

Application of MMW/THz electron spin resonance for high magnetic field spin science will be presented. A MMW/THz electron spin resonance(ESR) is one of the most important spin probes in condensed matters. The applications to non-linear excitation in low dimensional magnetic systems, nano-magnetic molecules and hard magnetic material will be discussed. Furthermore, the activities in THz electron spin resonance in the priority area project "high magnetic spin science in 100 T" will be presented. [C2180]

"Ultrasonic-electrodeposited nano Ni-AlN composite layers and characterization"

Nanometer Ni-AlN composite layers were prepared by ultrasonic-electrodeposited technology. The optimum technological parameters of nanometer Ni-AlN composite layers were obtained by experiments and analysis. We observed surface morphology and metallurgical structure of composite layers with scanning electron microscope (SEM) and high respective transmission electron microscope (HRTEM). The test results showed that the nanometer Ni-AlN composite layers prepared by proper ultrasonic-electrodeposited technology have better wear resistance and corrosion resistance. And the composite layers consist of AlN particles and nickel grains both nanometer-sized. [C2181]

"Investigation of Nano-Phase Change for Phase Change Random Access Memory"

Understanding of the phase change in nano-scale, or so-called nano-phase change, and its related issues are important for its applications on both optical recording and phase change random access memory (PCRAM). Nano-phase change can be classified into thickness-dependent and structure dependent types. For PCRAM device performance, the film thickness-dependent thermal profile and materials' properties are the two important factors. In this work, the thickness dependence of nano-phase change for chalcogenide materials was studied by both simulation and experiments. A thermal model was built up to simulate the film thickness-dependent thermal profiles and its corresponding effects of line type PCRAM. The simulation results showed that the temperature profile, heating rate and cooling rate are strongly dependent on the thickness of phase change materials. Experiments had been conducted to investigate the thickness dependence of crystallization temperature for both nucleation-dominated and growth-dominated phase change material. It was found that the crystallization temperatures are function of the thickness for the both materials. Higher crystallization temperatures were obtained for thinner phase change films. The influence of above factors on the performance of PCRAM devices is discussed. [C2182]

"Ferroelectric Ultra High-Density Data Storage Based on Scanning Nonlinear Dielectric Microscopy"

Nano-sized inverted domain dots in ferroelectric materials have potential application in ultrahigh-density rewritable data storage systems. Herein, a data storage system is presented based on scanning non-linear dielectric microscopy and a thin film of ferroelectric single-crystal lithium tantalite. Through domain engineering, we succeeded to form an smallest artificial nano-domain single dot of 5.1 nm in diameter and artificial nano-domain dot-array with a memory density of 10.1 Tbit/inch2and a bit spacing of 8.0 nm, representing the highest memory density for rewritable data storage reported to date. Sub-nanosecond (500 psec) domain switching speed also has been achieved. Next, long term retention characteristic of data with inverted domain dots is investigated by conducting heat treatment test. Obtained life time of inverted dot with the radius of 50 nm was 16.9 years at 80degC. Finally, actual information storage with low bit error and high memory density was performed. A bit error ratio of less than 1times 10-4was achieved at an areal density of 258 Gbit/inch2. Moreover, actual information storage is demonstrated at a density of 1 Tbit/inch2. [C2183]

"Nano-scale Metamaterials: Fabrication and Optical Measurements from THz towards visible"

We have designed, fabricated, and optically measured several different nano-scale metamaterials. We employ e-beam nano-lithography technology at LBNL's CXRO for fabricating these structures on extremely thin SiN substrates so that they are close to free-standing. Optical properties were measured as a function of incidence angle and polarization using the ALS synchrotron IR beamlines. We directly observe strong magnetic resonances consistent with negative magnetic permeability in our samples at THz through near-IR optical frequencies. We will compare the results to detailed simulations. Finally, we will report on our progress towards constructing a negative index of refraction nano-scale metamaterial. [C2184]

"Research on Plastic Removal Mechanism of engineering ceramics grinding with ultrasonic assistance"

Plastic Removal Mechanism of engineering ceramics was discussed based on the method of micro-indentation, and the formula of critical wheel depth of cut and the model of material removal ratio were established. In comparison with traditional grinding, the experiment on the characteristics of ductile-regime grinding engineering ceramics with/without ultrasonic assistance were carried out using engineering ceramic Al2O3, zirconia-toughed alumina(ZTA) and nano-ZrO2workpiece respectively. Experimental results showed that the material removal ratio in machining engineering ceramics with ultrasonic assistance was increased by one time. Meanwhile, the ductile-regime critical wheel depth of cut was up to 9-12μm and the surface roughness on ground workpieces was improved 1-2 grades. According to analysis of surface topography, grinding-induced cracks on Al2O3workpiece were almost as a result of intercrystalline crack, while cracks on ZTA and ZrO2workpiece were mainly owing to transcrystalline crack. [C2185]

"Modeling and experimental analyses for Nano-Positioning Compliant Mechanisms"

There are non-linear errors, hysteresis errors and so on in the actuators made of piezoelectric ceramics. And these errors are especially conspicuous in the case of large range motion. In this paper, we gain nano-positioning accuracy of the conventional mechanical device by compliant mechanism for motion reduction. [C2186]

"Fabrication of nano-tips employing three different methods"

Fabrication of sharp tips with the diameter of nano-scale size is paramount important for the devices based on the electronic tunneling effect such as field emission vacuum microelectronic devices, tunneling accelerometer and micro-gyroscope etc. Three kinds of processes are developed and investigated to fabricate the nano-tip for our micromachined tunneling gyroscope, which are (1) Anisotropic wet etching combined with silicon-to-glass bonding; (2) Anisotropic wet etching combined with Ni electroplating; and (3) Reactive Ion Etching. It has been shown from the experimental results that the tip diameter of the nano-tips fabricated by using three processes is 23.44 nm, 58.77 nm and 69.3 nm respectively. Though the first method contains more process steps than others, all of the steps are simple and manageable relatively. The bonding process is not required in the second method, but the smoothness of the electroplated surface is influenced by the composition, temperature, stirring way and PH value of the bath solution and the parameters of pulsed power. [C2187]

"Square hole fabrication in micro nano scale by low energy ecr ion beam irradiation"

The importance of micro nano fabrication in nanotechnology world becoming greater and greater. Now a days several industries and technology especially IC industry, MEMS, solar cells, optoelectronics and flat panel display, depends on micro fabrication technologies. An easy method for square hole fabrication using highly charged ion (HCI) on Silicon surface is discussed. For several advantages and unique features including high reactivity and stopping power enhancement HCI was used during the experiment. [C2188]

"Optical measurement technology of nano-scale displacement"

A novel nano-degree micro-displacement measurement based on the optical lever principle and a micro-displacement measuring device with high-precision are introduced in this article. Traditional optical lever method for micro-displacement measurement is further investigated and improved. A pair of plane mirrors, one of which is movable and the other is fixed, are adopted instead of a single one in conventional optical-lever systems. The micro-displacement generated by the object is magnified by the improved optical-lever and results in corresponding displacement of the light point on the PSD (position sensitive detector), which can be examined by a signal processing circuit. The amplification coefficient of this improved optical lever can reach 102 103times, combined with a high resolving power to 10−10m. A new laser measure system, whose theoretical resolution is 4nm and less than 10nm in practical experiment, is developed using this method. The validity of this method is proved by practical experiments. The structure of the measuring device, having the advantages of miniaturization, good anti-interface ability and high reliability, can be integrated on a silicon slice with the technology of micro-optics and MEMS and further be made into a new-type high-precision micro-optical micro-displacement sensor. [C2189]

"Characterization of nanometer scale titanium film oxidation lines and mim tunneling junction structures"

In the novel photoconductive semiconductor switch (PCSS) used in ultra-high speed electric-opto sampling system (EOS), the nanometre scale metal-oxide-metal (MIM) junction is the basic structure of the PCSS. The substrate is LT-GaAs or oxygen ion implanted SOS material. Above it, there is a 3 5nm thick sputtered Ti film that are fabricated into MIM structure by the Atomic Force Microscope (AFM) using anodic induced oxidation method combined with photo lithography method. The chemical/physical characteristics of nano Ti film and nano oxidation line determine the operating property and reliability of such nano devices. In this paper, the characteristics of nano Ti film, nano oxidation lines and MIM junctions are measured by AFM, X-ray Photoelectron Spectroscopy (XPS) and semiconductor analyzer. The nano-oxidation lines are fabricated under air ambient, room temperature, the relative humidity is about 30%, oxygen density is about 20% and with tip scan speed is about 0.1μm/s during the fabrication process. The results indicate that with various bias voltages between AFM tip and Ti film during fabrication, different line width and different MIM's I-V characteristic can be obtained, and the methods mentioned above optimized the fabrication conditions further. [C2190]

"Novel approach to the dispersion of nano-sized particles with shock wave in liquid"

By now, nano technologies have been limited because of the dispersion of nano-sized particles. Due to the high surface energy and strong adsorptive states of nano-materials, a standing interest is observed in the study of high-energy method of dispersion. In this paper, shock wave, which is based on the high intensity of focused ultrasound (HIFU) technology, is successfully introduced to distribute and disperse nano-sized particles. Since the power density in the focused zone is up to 100W/mm2, the frequency of ultrasound is close to 1 MHz, and energy of shock wave is controllable, strong micro scale transient cavitations and acoustic streaming are dedicated to solve the problem of conglomeration. Therefore, three kinds of nano-materials, i.e., nano SiO2, montmorillonite (MMT) and carbon nanotube (CNT), which is a representative collection of different dimensions nano-sized particles, are dispersed in different liquid phase respectively by this method. Compared with the normal ultrasonic treatment, the dispersion stability and efficiency are remarkably improved, which are measured by absorption spectrometer, transmission electron microscopy (TEM) and the X-ray diffraction (XRD). It is demonstrated that ogano-MMT might be dispersed with no changes and the origin length of CNT could not be trimmed with good dispersion. [C2191]

"Hybrid Nanostructures: Organic Interconnections and Device Applications"

Silicon technology is rapidly progressing toward device sizes in the range of 10 nm. The evolution rate of silicon technology in next decades will require the use of new materials and processes to develop revolutionary CMOS devices. Organic nanostructures onto semiconductors or metals may provide interesting solutions to address the technological issues of nanoscale devices. In particular, technologies and devices based on organic nanostructures such as carbon nanotubes, semiconductor or metallic nanoparticles, DNA-templated nanowires may supply solutions for on-chip interconnections. The aim of this work is to present recent results on hybrid nanostructures based on gold nanoparticles stabilized by organic coating. Particular emphasis is devoted to the problem of the interconnections at the nanoscale. The resulting hybrid devices are suitable to develop single electron transistors and memories [C2192]

"Self-Assembled Networks: Control vs. Complexity"

DNA-based self-assembly of nanoelectronic devices is an emerging technology that has the potential to enable tera-to peta-scale device integration. However, self-assembly currently is limited to manufacturing small computing blocks (nodes) which must then be interconnected to build a larger computing system. In this paper, the authors study node networks created by varying control over three aspects of the self-assembly process (node placement, node orientation, and inter-node link creation). In particular, the authors examine the tradeoff between node complexity and control required during self-assembly to maximize the number of connected nodes in the network. As the level of control decreases, the authors find that node communication hardware needs to be augmented to allow link sharing between several transceivers. This also results in better network connectivity in the presence of defective nodes and links. Finally, the authors show that for a data parallel architecture with enough available nodes, the specific network topology has a negligible effect on performance [C2193]

"The State of ZettaRAM"

ZettaRAM is a nascent memory technology with roots in molecular electronics. ZettaRAM patents and papers are distilled and consolidated into a unified discussion. Various embodiments and key novel properties are discussed with a bias toward computer architecture and system design implications. Embodiments include transistor-free crossbar arrays and two hybrid molecule/silicon implementations, a flash-like cell and a 1T-1C DRAM cell. Key properties of the core technology include (1) flexibility and precision through molecular engineering, (2) self-assembly, (3) scalability through charge-voltage decoupling, (4) speed/energy tradeoff, (5) multiple discrete states, and (6) mixed molecules. Implications include inexpensive fabrication of high performance memory (by all metrics), practical mixed logic/DRAM, 3D memory, exceeding DRAM power scaling limits, intelligent power management, efficient multi-bit storage, memory hierarchies cohabiting the same space, and multiple virtual products in one physical product. Thus, molecular memory has qualities of a disruptive technology. Computer architects and system designers should play a central role in charting its use [C2194]

"A Theoretical Framework for On-chip Stochastic Communication Analysis"

One of the greatest challenges of the emerging VLSI technology is the shift from design determinism to design uncertainty. Indeed, at nanoscale, the chip manufacturability entails failure increase and unpredictable behavior and thus, in order to ensure system-level fault-tolerance, we need to consider alternative paradigms for on-chip communication. This paper investigates the theoretical foundations and the design implications of a biologically-inspired communication approach which can be used for on-chip multiprocessor communication [C2195]

"Predictive Technology Model for Nano-CMOS Design Exploration"

Predictive MOSFET model is critical for early circuit design research. In this work, a new generation of predictive technology model (PTM) is developed, covering emerging physical effects and alternative structures. Based on physical models and early stage silicon data, PTM of bulk and double-gate devices are successfully generated from 130nm to 32nm technology nodes, with effective channel length down to 13nm. By tuning only ten primary parameters, PTM can be easily customized to cover a wide range of process uncertainties. The accuracy of PTM predictions is comprehensively verified with published silicon data: the error of the current is below 10% for both NMOS and PMOS. Furthermore, the new PTM correctly captures process sensitivities in the nanometer regime [C2196]

"Novel Design of Three-Dimensional Crossbar for Future Network on Chip based on Post-Silicon Devices"

The authors present a novel 3D crossbar for future network-on-a-chip implementations. They introduce a routing algorithm for the 3D crossbar circuit and detail two specific 3D crossbar topologies. They evaluate the defect tolerance of the 3D crossbar and quantify the number of extra layers required to support arbitrary permutations as a function of the defect rate. Further, we estimate the circuit performance and advantages of the 3D crossbar circuit based on post-silicon devices [C2197]

"Electromigration effect on strain and mechanical property change in lead-free solder joints"

The effect of electromigration on the strain and mechanical properties change in SAC solder joint is reported. In-situ digital image speckle correlation technology was used to study the strain evolution at the lead-free solder joints during electromigration. The tensile test structure of a solder ball connected by two Cu wires of 300mum diameters was prepared and tested. It is found that, during electromigration, with the atoms moving from the cathode to the anode, a tensile strain was created at the cathode region; while a compressive strain was observed at the anode region. And the strain difference between the cathode and anode kept increasing with the time of electromigration. The mechanical property of Pb-free solder joints with and without electromigration is studied by the nano-indentation continuous stiffness measurement (CSM) technology. At 100 degC, the applied current density was from 0 A/cm2to 5 times 103A/cm2and the time from 3 to 144 hrs. An array of 500 nm indentations was created by the nanoindenter from the cathode area, across the bulk of the solder, to the anode area. The change of Young's modulus and the hardness at the cathode and the anode was calculated from the CSM nano-indentation test. The results show that, the Young's modulus and the hardness of the anode were higher than the original values. It increases with increasing electromigration time or higher current density. On the other hand, the Young's modulus and hardness at the cathode were lower than the original values and they decrease with increasing electromigration time or higher current density. Therefore, there is a change of mechanical properties at the cathode and the anode region of the lead-free SAC solder joints due to electromigration. [C2198]

"Force Distribution for Double-Walled Carbon Nanotubes"

Advances in technology have led to the creation of many nano-scale devices and carbon nanotubes are representative materials to construct these devices. Double-walled carbon nanotubes with the inner tube oscillating can be used as gigahertz oscillators and form the basis of possible nano-electronic devices. Such gigahertz oscillating devices made from carbon nanotubes might be instrumental in the micro-computer industry, which is predominantly based on electron transport phenomena. There are many experiments and molecular dynamics simulations which show that a wave is generated on the outer cylinder by the oscillation of the carbon nanotubes and that the frequency of this wave is also in the gigahertz range. However, conventional applied mathematical modelling techniques are generally lacking. In order to analyse and model such devices, it is necessary to estimate accurately the resultant force distribution due to the inter-atomic interactions. Here, we find the van der Waals force using the Lennard-Jones potential to calculate the oscillation frequency using Newton's second law for double-walled carbon nanotubes of any length of the inner and the outer tubes, 2L1and 2L2, respectively. These results are based on work by the present authors derived in (Baowan and Hill). [C2199]

"Creating Diamond-Like-Carbon (DLC) Templates Using Atomic Force Microscopy"

Pattern generation on the micro- and nano-scale is a vital ingredient in a vast variety of applications including biosensors and array devices. Current technologies are generally macroscopically-based, however a considerable increase in demand upon down-sizing must result in enabling meso/nanoscopic manipulation. Soft lithography is now routinely utilised in various applications with particular attention and importance placed on pattern transfer onto polymeric materials via the creation of masters. These are now fabricated using a number of techniques, all capable of producing well-defined surface topographies. The microelectronic industry utilises methods such as photolithography in order to fabricate such master templates at the micron scale. Various polymers can be used to transfer patterns. One of the most widely used is polydimethylsiloxane (PDMS). The elastomer is chemically resistant, has a low surface energy and readily conforms to different surface topographies. Obtaining a master is the limiting factor in the production of PDMS replicas. The use of diamond-like-carbon (DLC) as a master template is demonstrated in this study. PDMS micro/nano stamps and 3 dimensional PDMS structures have been created and routinely reproduced. Intricate surface relief patterns are formed on the DLC surface from lithographic techniques by atomic force microscopy (AFM) operated in the electrical conductivity mode. The mode induces oxidation on a DLC surface creating patterns in the tens of nm. An example of a lithographic pattern created on a DLC surface by this method is shown in the topographical image. The template shown was then coated with a layer of PDMS and thus used as a master. The resultant fabricated PDMS stamp is shown. The relief of the stamp correlates very well with the dimensions of the DLC master. [C2200]

"Performance Analysis of MISISFET"

The performance of nano MISISFET (metal insulator semiconductor insulator semiconductor field effect transistor) has been evaluated. The threshold voltage is same for MISISFET and a MOSFET of equivalent dielectric capacitance. The AC characteristics of MISISFET and MOSFET are also compared. No evidence of charge storage in the dielectric stack layer of MISISFET is found [C2201]

"Micro- and nano-DIC deformation analysis for electronic packaging applications"

This paper presents an automated digital image correlation (DIC) system for in-plane micro-deformation analysis. The system features microscale resolution, realtime thermal ramp and cycling loading, image auto-positioning and autofocus for image acquisition, and novel element-based DIC algorithm. The DIC tool is demonstrated to a micro-deformation measurement application of a solder joint in a plastic ball grid array (BGA) package. The solder joint deformation has been investigated under two loading cases, temperature ramp and temperature cycling. Finite element analysis was conducted and the U and V displacements, and calculated strain distribution in the solder joint is compared with the DIC measured result. The measured and predicted displacement fields under temperature ramp give good agreement. Research on nano-scale DIC measurements must employ an atomic force microscope (AFM) for in-situ digital imaging of in-plane deformation. It was discovered through calibration that AFM scanner drift is a intrinsic error and thus a correction methodology is required for DIC application. The application the AFM/DIC technique is used for deformation characterization of solder interconnection in a micro-thermoelectric cooler system subject to a small temperature gradient of +25C to -25C [C2202]

"Investigation of mechanical properties of black diamond tm (low-K) thin films for Cu/low-k interconnect applications"

The mechanical strength of the low-k dielectric thin films plays vital role in deciding the integrity and reliability of the interconnect structures and Cu/low-k packages. Present study focuses on the thickness dependence of mechanical behavior of BD (low-k, Black Diamondtrade) thin films of four different thicknesses, 100, 300, 500 and 700 nm. Nanoindentation and nanoscratch tests have been carried out on all samples using the Nano Indenterreg XP (MTS Corp., USA) system. Nanoindentation experiments with CSM (continuous stiffness measurement) attachment have been performed to assess the hardness (H) and elastic modulus (E) properties. The adhesion/cohesion strength of BD films is measured by using nanoscratch ramp loading technique and reported in terms of the critical load (Lc). Hardness and elastic modulus are found to vary with the BD film thickness (100-700 nm), in the range of 2.02-1.78 and 16.48-9.93 GPa respectively. The critical load (Lc) of the BD-100 nm film could not be determined and mainly expected due to limited resolution of the equipment. The critical loads for BD films (300-700 nm) are in the range of 13.02-18.52 mN [C2203]

"Cellular Nonlinear Nano-giga-scale Architectures (CNNA)- Converging Sensory Comnuting Hardware Platforms and Related Wave Logic Inferencing"

Summary form only given. In view of the latest technological developments, when billion transistor chips and million processor systems are being used, in many fields the cellular architectures are becoming prevailing. Moreover, bio-morphic and bio-inspired models are becoming available and being implemented in integrated cellular sensory microprocessors. In this review, the main trends and some new results are presented focusing on the following themes: 1. the technology scenario; 2. the converging architecture scenario; 3. the processing cell scenario motivated by physical implementations; 4. the algorithmic scenario exotic waves in action and multimodality; 5. bio-morphism and bio-inspiration: visual, auditory, and tactile systems; and 6. towards a non-Boolean wave logic with semantic embedding motivating examples [C2204]

"On Information Transmission Among Nanomachines"

In this paper, the authors review the fundamental issues arising when nanoscale devices are meant to be interconnected to transmit information. The possibility of manipulating and assembling objects at the atomic scale has paved the way for a future generation of computing machines, where nanoscale devices substitute silicon-based transistors. Interconnections, needed to perform complex operations, are expected to be the driving factor in terms of performance and costs of the resulting systems. In view of the current research on nanomachines, the authors are interested in understanding which may be the limits of communications at the nanoscale level. Our research stems from a few, simple and yet unanswered questions, like "what is the capacity of a nanowire/nanotube?", "what is the capacity of molecular-based communication systems?" etc. While we do not answer to such questions directly, we shed some light on possible approaches based on information-theoretical concepts [C2205]

"Transport in deca-nanometric MOSFETs: from bandstructure to on-currents"

This paper describes some of the most relevant challenges in the physically based modelling of transport in nano-MOSFETs. In particular, we start by discussing the determination of the band-structure in nano-scale devices. In fact, most of the device engineering options affect the device performance through the band-structure, which determines the carrier velocity and the scattering rates. We then emphasize the need for models able to link the improvements in the uniform transport regime, such as the mobility enhancement, to the on-current of nano-scale MOSFETs, where the carrier transport is strongly non-local and not yet ballistic. We also briefly discuss transport issues difficult to deal with in the semi-classical framework, for which a full quantum transport treatment is very attractive [C2206]

"High Speed Unipolar Switching Resistance RAM (RRAM) Technology"

We have successfully achieved high speed (~50 ns) unipolar operation in RRAM devices comprised of titanium oxynitride (TiON) combined with a control resistor connected in series. For unipolar switching, programming and erasing pulses can be the same width, typically, a few tens of nano-seconds. This enables high speed and high density cross-point RRAM memory arrays. In addition, we demonstrate how switching characteristics can be controlled by a series resistor [C2207]

"Full wafer integration of NEMS on CMOS by nanostencil lithography"

Wafer scale nanostencil lithography is used to define 200 nm scale mechanically resonating silicon cantilevers monolithically integrated into CMOS circuits. We demonstrate the simultaneous patterning of ~2000 nano-devices by post-processing standard CMOS wafers using one single metal evaporation, pattern transfer to silicon and subsequent etch of the sacrificial layer. Resonance frequencies around 1.5 MHz were measured in air and vacuum and tuned by applying dc voltages of 10V and 1V respectively [C2208]

"Nano Control Algorithm for Grinding and Polishing Aspherical Surface"

A position control method for interpolating aspherical grinding and polishing tool path was reviewed and experimented in a nano precision machine. The position-base algorithm was reformed from the time-base algorithm, proposed in the previous study. The characteristics of the algorithm were in the velocity control loop with position feedback. The aspherical surface was divided by an interval at which each velocity and acceleration were calculated. The theoretical velocity was corrected by position error during processing. In the experiment, a machine was constructed and nano-scale linear encoders were installed at each axis. Relation between process parameters and the variation of position error was monitored and discussed. The best result from optimized parameters showed that the accuracy was 150nm and improved from the previous report. [C2209]

"Fault Tolerant Signal Processing for Nano-scale VLSI Circuit Technology"

Adaptive fault tolerance (AFT) takes advantage of non-canonical adaptive filter architectures that use adaptive principles to achieve automatic fault recovery. Recent work has demonstrated the capability of AFT methods to mask single and multiple stuck-at bit errors in the filter coefficients, and also to demonstrate the capability of AFT filters to resist the effects of soft errors. This paper explores several approaches to fault tolerance that can be used in VLSI adaptive filters that are prone to soft errors caused by scaling down of feature dimensions and voltage thresholds. [C2210]

"SoC-what are our technology futures?"

Many of us discovered that we were working in System-on-Chip technology by default! The technology to put hundreds of millions of transistors on a monolithic CMOS digital chip became available over the past few years; we adopted it and became de facto SoC researchers. However, as SoC has come on stream we have also started to see cracks appearing in the technology. 3rd order effects ofjust a few years ago have become predominant problems, and previous performance predictions have been shown to be false. This talk will undoubtedly produce more questions than answers, but, as an interested observer of the technologies we play with in our sand box, I will try to ponder on some of the issues-and muse on how those amongst us, who normally only observe, can also play a role in defining and exploring promising future technologies. Brief Bio: Graham Jullien holds the iCORE Chair in Advanced Technology Information Processing Systems, and is the Director of the ATIPS Laboratories, in the Department of Electrical and Computer Engineering at the University of Calgary. His long-term research interests are in the areas of Integrated Circuits (including SoC), VLSI Signal Processing, Computer Arithmetic, High Performance Parallel Architectures, and Number Theoretic Techniques. Since taking up his chair position at Calgary in 2001, he has expanded his research interests to include security systems, nano-electronic technologies and biomedical systems. He is currently involved, along with his colleagues, in developing an Integration Laboratory cluster to explore next generation integrated microsystems. Dr. [C2211]

"Emerging Technologies -- Self-Assembling and Nanopatterning for Nano-CMOS"

First Page of the Article [C2212]

"Skew Insensitive Physical Links for Network on Chip"

The increasing complexity, in terms of both physical dimension and performance demand of current systems on chip (SoCs) led to the development of new suitable interconnect architecture, leveraging on computer network technology, called network on chip (NoC). This paper describes two architectures of advanced physical link for NoC, the former based on mesochronous technology, the latter based on asynchronous [C2213]

"3D on-chip networking technology based on post-silicon devices for future networks-on-chip"

We propose a 3D architecture using post-silicon devices, such as nano-mechanical electrical switches, carbon nanotube FETs, and nanowire FETs, for future networks-on-chip (NoC). Based on such a new 3D architecture, extremely high bandwidth with very low latency can be realized. These promising features are very useful for future NoCs [C2214]

"On-Chip Interconnects and Repeaters Based on NiSi Nanowires"

In this paper, a novel method is proposed fur building future nanoelectronic on-chip interconnects and repeaters using the newly invented nickel silicide (NiSi) nanowires. NiSi nanowires not only offer supreme interconnect performances but also open up the possibility of integrating both active devices and high-performance interconnects in a single nanoscale building block. Thus, it is particularly useful in the integration of interconnects and repeaters. The analyses show that this interconnect/repeater solution will operate in higher speed, compared with copper and carbon nanotube. This new interconnect/repeater technology is very promising for next-generation of nanoscale ICs [C2215]

"Optical Interconnects for Network on Chip"

This paper resumes some state-of-the-art results of research in view of the realization of optical interconnects as physical link for network on chip (NoC). Emphasis is given in particular to amorphous silicon technology for its actual technological compatibility with CMOS microchips [C2216]

"Modeling and Evaluating Carbon Nanotube Bundles for Future VLSI Interconnect Applications"

Single-walled carbon nanotube (SWCNT) bundles have the potential to provide an attractive solution for the resistivity and electromigration problems faced by copper interconnect as process technology scales. In this paper, we develop a scalable equivalent circuit model that captures the statistical distribution of metallic nanotubes, which can impact interconnect reliability, while accurately incorporating recent experimental and theoretical results. Leveraging the circuit model, we examine the performance and reliability of nanotube bundles for both individual signal lines and system-level designs. The results indicate that SWCNT interconnect bundles can provide significant improvement in delay over traditional copper interconnect depending on bundle geometry and process technology [C2217]

"Reliability Analysis for On-chip Networks under RC Interconnect Delay Variation"

Future integrated circuits are characterized by their high defect rates thereby necessitating certain degree of redundancy. In a typical network-on-chip (NoC), multiple paths exist between a source and a sink to provide the required level of fault tolerance. Consequently, a manufacturing fault on a single interconnect does not necessarily render the resulting integrated circuit useless. In this paper we quantify the fault tolerance offered by an NoC. Specifically, we (1) provide a model for determining the probability that an NoC link fails due to manufacturing variation, and (2) measure the impact of link failure on the number of cycles taken by the NoC to implement communication [C2218]

"Nanomaterial Based Room Temperature Hydrogen Gas Sensors"

Polyaniline (PANI) nanofiber and PANI/semi-conducting metal oxide nanofiber composites based layered surface acoustic wave (SAW) and conductometric sensors have been developed and investigated towards hydrogen (H2) gas. Chemical oxidative polymerization of aniline was employed to synthesize pure PANI nanofibers as well as PANI/semi-conducting metal oxide composites. The nano-materials were deposited onto layered ZnO/64deg YX LiNbO3SAW and conductometric transducers. The novel sensors were exposed to H2gas. Fast response and recovery with good repeatability were observed at room temperature. [C2219]

"Efficient transformation of water-soluble quantum dot to highly luminescent nanocomposite"

We report the efficient transformation of water-soluble amine-terminated CdSe/CdS core/shell quantum dots (QDs), QD-AET (AET=aminoethanethiol), to single QD containing and highly luminescent composite material QD-AET-PEF5000. The transformation was achieved by covalent conjugation of QD-AET to carboxy activated poly(ethylene glycol) (PEG5000, MW=5000) under the control of inter-particle attraction. [C2220]

"Nano accuracy elevation of ultra-precision machining using optical fiber laser encoder system"

The ultra-precision products which recently experienced high in demands had included the large areas of most updated technologies, for example, the semiconductor, the computer, the aerospace, the media information, the precision machining. For early 21st century, it was expected that the ultra-precision technologies would be distributed more throughout the market and required securing more nation-wise advancements. Furthermore, there seemed to be increasing in demand of the single crystal diamond tool which was capable of the ultra-precision machining for parts requiring a high degree of complicated details which were more than just simple wrapping and policing. Moreover, the highest degree of precision is currently at 50 nm for some precision parts but not in all. The machining system and technology should be at very high performed level in order to accomplish this degree of the ultra-precision. It was known that the products requiring the ultra-precision machining technology were applied only in some advance countries until 10 year ago as measuring instrument, satellite observing systems, airplane observing system, and national defense weapon system and other special areas which all included precision optics. In 70s, the aspheric lens were required their presence in limited areas, thus the products were manufactured individually by experienced engineers. However, there were increasing demands in the aspheric optic technology since there were dynamic developments in the electronics and the optics and increasing preferences in lightweight. There should be the improvement in machining technology since the degree of precision in the aspheric lens increased as the optical wavelength had shortened. The technological manipulation of the piezo electric actuator could compensate for the errors of the machining precision during the process of machining which lead to an elevation and enhancement in overall precisions. This manipulation is a very convenient method to advance-the precision for nations without the solid knowledge of the ultra-precision machining technology. Moreover, there is an increasing demand of the highly responsive ultra precision positioning control technology based on the piezo electric actuator for the non-axis symmetrical mirror machining as well as the delicate control of infeed rate application such as the ductile mode machining of the hardened-brittle materials. Due to the facts mentioned above, the ultra precision positioning technology being manipulated by the piezo electric actuator was regarded as the basis of this investigation. [C2221]

"Investigation of nano-porous silicon antireflection coatings for crystalline silicon solar cells"

Reflectance loss of crystalline Si causes low efficiency. The optical loss can reduce by antireflection coatings (AR coatings). The porous silicon (PSi) formed by anodization is well known as using good ARC because PSi can be obtained easily and economically. So, we investigated PSi as AR coating for silicon solar cells. The nano-PSi was obtained by electrochemical etching and has reflectance less than 20% in wavelength for 450-1000 nm. The porosity is about 60% and refractive index is 1.7. The obtained results point out that it would be possible to apply a Si solar cell by the proposed simple technology. [C2222]

"Nano-structured Interconnects for System Integration"

A collection of slides from author's conference presentation is given. [C2223]

"Compressible Placing of Dummy Elements in Nano-Scale VLSI Layout"

Multilevel discretization on quadtree base for dummy elements placing in nano-scale VLSI layout is proposed. The placing results are covered by simplest data type of GDSII and OASIS standard, which provides the data compression. The resulting placing of dummy elements is dense and uniform that improves the surface plain of dielectric. [C2224]

"Short course II-B Bio-nanoelectronics. Enabling a new paradigm of information technology: acquiring info and executing on info"

Information technology has been a great success, but also a narrow one -it has marched along the narrow path of processing and transmitting information. While there is still more room to continue the march along this same path, there appears to be much greater rooms in the space to the left -acquiring information, to the right -executing on information, and on the "inside" -acquiring and executing on information inside human body. This new paradigm of information technology can be well served by advances in bio-nano electronics. By way of presenting specific examples, this short course introduces a few basic concepts, methods and recent advances on three fronts of bio-nano electronics: (a) DNA directed self-assembly and growth of nanostructures (b) Real-time, scalable, reconfigurable, and direct read-out of bio-molecular signals (by nanoelectronic circuitry via programmable DNA wiring and addressing) (c) Intracellular probing, delivery, and exploration by nano-electrodes. [C2225]

"Rapid fabrication of functional CNT sensor arrays using micro-spotting and DEP technologies"

Our team has developed a systematic process to rapidly construct Carbon Nanotube (CNT) sensors by combining DEP and micro-robotics technologies. Arrays of CNT sensors were fabricated on MUMPs chips using this systematic process and the CNT sensor characteristics were found to be very consistent with individual CNT sensors fabricated using basic manual DEP manipulation process. We have shown that the average time to fabricate CNT sensor using this process is ~1 sec, which means that potentially 100,000 CNT components could be built in 24 hours . [C2226]

"Nanoelectronic materials and devices as new opportunity"

Present and future perspectives of nanoelectronic materials and devices are discussed both in evolutionary and revolutionary "nano " electronics spaces. It is likely that the evolutionary progress in all front of silicon based CMOS will keep its pace despite a variety of technical challenges. The revolutionary nanoelectronics, such as nanowires and nanotubes, would propose unique values when engineering break-through for control of growth comes real. [C2227]

"Perspective of nano technology in semiconductor industry"

First Page of the Article [C2228]

"The trends and future prospects of nano technology development and deployment in Korea"

This session will cover nanotechnology R&D trends and government's policies and infrastructure along with industrial trends in Korea through "Nano Korea Exhibition 2006." [C2229]

"Nano-CMOS scaling: Novel devices and materials"

This paper will review recent progress of innovative devices and materials for nano-CMOS technology. This paper will discuss (1) various mobility enhancement techniques for faster carrier, (2) new materials and structures for device scaling, and (3) novel contact and silicide technology for parasitic resistance reduction. [C2230]

"High performance CMOS device technologies in nano CMOS era"

This paper reviews the results on the development of these carrier-transport-enhanced CMOS structures based on global novel substrate technologies and the combination of local techniques with them. Here, there are two new directions for the development of the global substrate technologies including new materials such as Ge and

III-Vs. The other direction is the combination of any local formation technologies, allowing us to separately optimize the strain configuration and the channel materials for n-and p-MOSFETs for maximizing the CMOS performance. [C2231]

"3-D silicon technology for nano-electronics"

As the incumbent planar silicon technologies enter into deep nano scale dimension, it reveals many issues which are believed to be very difficult to be solved within incumbent technologies. Many exotic technologies seem to be not ready to take over the silicon technology. Thus the 3-D silicon technology is the only solution and fortunately in 3-D silicon technology the knowledge and experiences learned from 2-D planar technology over the 30 years can be fully utilized so that 3-D technology will be quickly established. Furthermore, when 3-D silicon technology facilitates with new materials and new concepts, 3-D silicon technology will be the center of technology in merging NT, BT, IT and others. [C2232]

"The use of MOS interfaces for GSI and TSI SET-based nanoelectronic processors"

Summary form only given. The realization of extremely dense integrated circuits, having from 109to beyond 1012devices per chip presents several challenges to current I.C. fabrication technologies. Among them, power dissipation seems to be one of the most difficult hurdles to overcome. Nowadays, nanoelectronic devices seem to be an attractive alternative to MOS devices for the implementation of these GSI to TSI integrated circuits. Single electron tunneling (SET)-based transistors are well-known for their extremely low power consumption and high-scale integration capability and should be an interesting option for the implementation of extremely dense I.C.s . However, their limited driving capabilities do not favor the interfacing of SET circuits and other non-SET modules in an electronic system. In this work, the present development of circuit solutions for a GSI/TSI processor (based on single-electron transistors) that is being developed at Universidade de Brasilia will be presented. The possibilities of interfacing these SET-based circuits via MOS devices, in order to overcome the limited SET driving capabilities, will be also discussed. [C2233]

"Challenges for sub-10 nm CMOS devices"

Scaling issues of nano-size MOSFETs will be discussed on the basis of sub-10 nm MOSFETs characteristics, which have been developed and confirmed switching characteristics. Understanding device limitations and developing new breakthrough technologies should be required to challenge sub-10-nm CMOS devices. [C2234]

"Reliability issues for high performance nanoscale CMOS technologies with channel mobility enhancing schemes"

In this talk, an overview of the mobility enhancing techniques for high performance/low power CMOS technologies will be introduced first. Two categories for mobility enhancing schemes, channel induced strain using Si/SiGe, and hybrid-substrate engineering, with (100) and (110) orientations, will be discussed next. In terms of the device reliability, different mechanisms.. are responsible for these two different technologies. While we have paid much more attention on the performance of these technologies, the device reliability has not been taken care of in the past studies. As a consequence, this talk will address several examples of these mobility enhancing schemes and their impact on the device reliability for advanced CMOS technologies for 65 nm and beyond. [C2235]

"CMOS technology-based spiral inductors for RF applications"

In this paper, a physics-based model applicable for CMOS technology-based inductors will be developed. Our model development will cover both the symmetrical and asymmetrical inductors. In addition, an octagonal spiral pattern will be considered, but the approach applies generally to other non-circular patterns. [C2236]

"Recent status on Nano CMOS and future direction"

Recently, CMOS downsizing has been accelerated very aggressively in both production and research level, and even transistor operation of a 5 nm gate length CMOS was reported in a conference. However, many serious problems are expected for implementing small-geometry MOSFETs into large scale integrated circuits even for 45 nm technology node, and it is still questionable if we can successfully introduce sub-10 nm CMOS LSIs into market, because the problems expected at this moment-such as Ion/Ioffratio, current drive, variation in the electrical characteristics, concerns for the yield, reliability and manufacturing cost. Considering the above situation, we formed a leading research group for future ultra-low power nano-CMOS technology in 2003-2006, by the Special Coordination Funds for Promoting Science and Technology sponsored by Ministry of Education, Culture, Sports, Science and Technology, Japan, in order to conduct nano-CMOS studies in advance to provide possible solutions to the future expected problems. The conclusion obtained by the group study was that, in the Nano-CMOS era, aggressive introduction of new materials, processes, structures, and operation concepts is required to solve the problems. Also, new physical analysis technique and physical model in order to predict and explain the atomic scale phenomena and properties at the new material interfaces are important. Unfortunately, there are no candidates among the so-called 'beyond CMOS' new devices, which are believed to really replace CMOS transistors usable for the products of highly integrated circuits within 20 years. Thus, our opinion is that we need to still continue CMOS based transistors-CMOS with FinFET, Nanowire FET, and even CNTFET-with 'More Moore' approach with combining that of 'More than Moore'. [C2237]

"32nm technology node Double-Gate SOI MOSFET using SiO2 gate stacks"

State of the art device simulation is applied to the analysis of possible scaling strategies for the future CMOS technology, adopting the Ultra-Thin Silicon Body Double-Gate (UTB-DG) MOSFET. n-MOSFETs designed according to an original scaling strategy are simulated and the main figures of merit of the high-performance MOS transistor for digital applications are evaluated and compared to the requirements of the International Technology Roadmap for Semiconductors.The results of our analysis confirm the potentials of UTB-DG MOSFETs. In particular, the possibility to control the short channel effects by thinning the silicon layer is fully exploited allowing to adopt almost undoped silicon channel, leading to reduced transversal field. [C2238]

"Hard and soft X-ray excited photoelectron spectroscopy study on high-κ gate insulators"

Hard and soft X-ray photoelectron spectroscopy study on the composition and the chemical structures of transition layers at La2O3/Si(100), Gd2O3/Si(100), Lu2O3/Si(100) and La2O3/Y2O3/Si(100) interfaces and their thermal stabilities are discussed. Soft X-ray photoelectron spectroscopy study on the distribution of nitrogen atomos in nearly 1-nm-thick oxynitride films and the chemical structures of the transition layer at SiO2/Si(100) interface are also discussed. [C2239]

"Influences of annealing conditions on flatband voltage properties using continuously workfunction-tuned metal electrodes"

This paper reports a systematic investigation of flatband voltage (Vfb), properties for HfO2-SiO2-Si capacitors using metal alloy electrodes of Pt-W alloy as a means of tuning work function (WF). It was found that the value of Vfb, for W (lower WF) is retained after forming gas annealing (FGA) and oxidizing gas annealing (OGA) processes, while that for Pt (higher WF) strongly depends on the annealing condition. The difference in Vfb, between Pt and W is 0.34 V at most, which is smaller compared with the WF difference of 0.8 eV. [C2240]

"Parasitics effects in multi gate MOSFETs"

The parasitics in multi-gate transistors (MugFETs or FinFETs) are expected to significantly degrade the device and circuit performance in scaled technologies. Using extensive 3-D device and circuit simulations, the impact of parasitics on the device and circuit performance is systematically investigated. The results clearly identify the issues in integrating high-K gate dielectrics in scaled multi-gate transistors. We show from 3-D simulations that, when a high-K gate dielectric (with a K ~ 15, similar to hafnium oxide) is integrated in a multi-gate transistor, a 5times increase (compared to the SiO2) in the off current occurs due to the fringing field induced barrier lowering effects. At the circuit level, our results show that, an order of magnitude degradation in the delay can take place, due to the unoptimized FinFET layouts. [C2241]

"Length, width and thickness effects in SOI transistors"

Without SOI, the future of the microelectronics would be hopeless and the CMOS technology would be useless. SOI does not mean Silicon On Insulator, it comprises any kind of semiconductor, strained or not, on any type of dielectric, with the stringent condition to have ultra-thin layers. This is why the scaling of MOS transistors is intrinsically easier in SOI than in bulk Si, where it is becoming a desperate issue. The nano-size MOS transistor stands as the perfect device for the natural transition from microelectronics to nanoelectronics. In addition, SOI is a most suitable substrate for the implementation of non-classic or pure nanoelectronic components. The dimensions of state-of-the-art SOI MOSFETs are already measurable in nanometers. The aim of this presentation is to illustrate, from an experimental viewpoint, a number of nano-size mechanisms and implications. The scaling beyond 10-nm channel-length is discussed by addressing the main effects: fringing fields, self-heating, transition from partial to full depletion, etc. A good electrostatic control requires nanometer-thick SOI films, where yet another family of mechanisms takes place: super-coupling, volume inversion, and quantization. Finally, the shrinking of the device width enables quantum wire operation and lateral strain or doping effects. A key aspect is that all dimensions need to be reduced concomitantly, not separately. An ultimate SOI MOSFET should be viewed and modelled as a transistor with a miniaturized volume. This is particularly true for innovative devices with multiple gates and/or non-planar configuration. Two, three or four gates can collaborate to bring enhanced performance, functionality, flexibility and scaling. Several device architectures will be evaluated by comparing their merits and ease of processing. Since the device operation is governed by 3-D effects, we will focus on the coupling between the longitudinal, lateral and vertical directions. [C2242]

"Characterization of plasma doped shallow junction"

Plasma doping technology has been expected to be an alternative method to beam line low energy ion implantation. First application will be shallow junction formation and doping for 3D structures. In this report, we tried to confirm the characterization methods for shallow junction, i.e., SIMS profiling for plasma doped layers shallower than 10 nm. This SIMS measurement method includes determining steepness of the profile tail. It is almost steeper than 2nm/decafe. Optical characteristics of the plasma doped layers were also investigated for optimizing optical annealing procedures. [C2243]

"Material and interface instabilities of high-к MOS gate dielectric films"

It is a general consensus that high-kappa dielectric films, transition metal oxides or rare earth oxides, have to be introduced for future generations of CMOS technology. However, high-kappa gate dielectric materials are found to have many inherent reliability problems because of their fundamental material properties and the instable Si/high-kappa interface. Particularly, the thermal instability, the poor interface properties with silicon, interface silicate layers formation, high interface and oxide trap density, low breakdown field and low mobility have become major concerns on the reliability of the MOS device. This work highlights the issues related to the thermal instability of high-k materials. The instabilities associated with high-kappa dielectric/Si interfaces will be also discussed. [C2244]

"New findings in nano-scale interface physics and their relations to nano-CMOS technologies"

We show the new findings in nano-scale interface physics and atomistic behaviors of defects in gate dielectric materials. In this paper, we first discuss the relation between defect behaviors and transistor characteristics. Next, we introduce our newly prosed mechanism of Fermi level pinning governed by the interface reaction. Further, we show that conventional charge neutrality level concept does not applicable to metal/high-k dielectric interfaces, and we propose a generalized charge neutrality level concept that includes both nano-scale interface structures and metal band structures. Finally, we discuss the atomistic investigation on the characteristics of conventional Si/SiO2nano interfaces. [C2245]

"Quo vadis nano-CMOS ?"

When I was a student, 25 years ago, one of the hypotheses was that intelligence would appear spontaneously once complexity and speed of a logic system exceed a given level. In the span of last 25 years the CMOS switching frequency has increased X50, the number of transistors per chip X1000, whereas the transistor feature size has decreased X32. In spite of that extraordinary progress, our computers seem all but intelligent. Does it mean that we are still below this magic complexity level? Maybe, but taking into account that CMOS is already today a genuine Nano-technology, there is little room left for improvement. Therefore, will intelligence appear within the remaining 3 or so generations before Nano-CMOS hits the atomic limit? Or maybe we should admit that transistor performance is no longer a key, and targets for CMOS technologies should be refined? If so, what is then THE nano-device we should seek? What is THE nano-technology we should target? In this paper we will deliberate on these and relevant questions (hardly answering ANY). [C2246]

"Dynamic PECT Effect for Nanotransducers and Hybrid Devices"

Recent advances in nanotechnology have opened the door to the use of hybrid devices in integrated system-on-a-chip. The Piezo Electrochemical Transducer (PECT) effect device uses nano-dimensioned graphite fibers, where the PECT effect can be effectively used to control current and voltage levels. The PECT effect, discovered (in early 1980's) and named by co-author F. L. Vogel, uses graphite fiber intercalated with sulfuric acid (H_2SO_4) to shrink parallel to the graphite planes (basal plane), whereas the reverse PECT effect causes the graphite fiber to expand. The reverse PECT effect appears by reversing the direction of the electrolysis current. This paper explores the physical properties of PECT and its applications to developing novel solid-state hybrid devices, including new kinds of transducers and transistors based on graphite that will have a significant impact on future bio-inspired integrated circuits and nano-technology. [C2247]

"Micro-Scale Structures and Nano-Scale Materials for Chemical and Biological Sensors"

Semiconductor and other materials with dimensions on the scale of micrometers or nanometers are being made into chemical and biological sensors. Besides being small, such devices are highly capable, low power and relatively inexpensive. They have many applications in personal health and safety, and for control of industrial processes. [C2248]

"Nano-thickness Stellar Defects"

New type defects which are nanometer-thickness stellar shape defects called as the stellar defects are reported. Since the stellar defects need the center particle and the water to form, we successfully have reduced the stellar defects by reducing the particles and humidity in the chamber. These very thin defects must be key issues in the processes that we have to control nanometer thickness. [C2249]

"An Artificial Nano-Drainage Implant (ANDI) for Glaucoma Treatment"

Glaucoma is the leading cause of irreversible blindness. The loss of sight in glaucoma is due to the permanent optic nerve damage which is the result of a chronic elevated intraocular pressure. In this paper, we report a completely new concept to treat glaucoma using a nano-drainage device fabricated through MEMS and nanofabrication technologies. This involves replacing the functionality of diseased drainage pathway for aqueous humor outflow (i.e., trabecular meshwork). By enhancing aqueous humor outflow, the artificial drainage implant will lead to a decrease in the intraocular pressure and a halt in the progression of glaucoma [C2250]

"SENSATION remote monitoring system for enabling the "anytime, anywhere" monitoring of patients with selected sleep disorders"

The SENSATION Integrated Project aims at promoting the health, safety and quality of life of people and protect the environment by reducing relevant accidents and thus the impact on environment through the application of novel micro and nano sensors and related technologies, of low-cost and high-efficiency, for physiological state monitoring. The focus of the work will be the brain activity, including the sleep and wakefulness states and their boundaries, stress, inattention and hypovigilance states, for hypovigilance detection, prediction and management as well as diagnosis, treatment and remote monitoring of sleep disorders. In this paper, a presentation of the application scenarios of the integrated medical system will be made [C2251]

"The wafer preparation technology with nano size particle contamination by using single spin processor"

In LSI manufacturing industry, design rule shrinkage is accelerated, also contamination control in cleaning process is required as nanometer order. Especially, wet cleaning process needs to solve two issues, one is PR stripping and lower film loss at particle removal[1,2]. As for such washing technology development, it was advanced a polluted wafer as a sample in a PSL (Poly Styrene Latex) particle historically. It is important for the washing evaluation using a particle forcible contamination wafer, and its development to carry out with the optimal sample for these issues. The particle containing Si is practical from the trend of a future device material and also in high temperature SPM process development. It is thermally stable compared with PSL in hot SPM, and excels as an index of future evaluation. This paper reports the Si3N4particle contaminating wafer preparation technology of controlling 65 nm order with sufficient linearity by using Single Spin processor. [C2252]

"Switched Polarity Charge Pump for NOR-type Flash Memories"

The era of nano technology and SOC's is driving the need for better and more compact design of embedded flash memories. This paper discusses circuit technique for a switched polarity 1.8 V charge pump based on Dickson's charge pump. The circuit can generate typical voltage levels for flash memories during both program and erase operations. The charge pump utilizes the same circuit elements to generate both positive and negative voltages using two non-overlapping clocks resulting in a very simple and compact design. Simulation studies comparing our design with a recent design of a charge pump show the advantages of our design in terms of rise time, charging characteristics, and area. [C2253]

"Delta-Sigma Modulators for Power-Efficient A/D Conversion in High-Speed Wireless Communications"

This paper describes how the signal path within a DeltaSigma modulator can be designed, independent of its noise-shaping characteristics, in order to significantly reduce the harmonic distortion due to opamp nonidealities and to lower the power dissipation. This paper then presents architectural approaches for designing high-resolution DeltaSigma modulators at low oversampling ratios (OSRs) and low supply voltages. Thus, analog-to-digital converters (ADCs) can be designed in low-voltage nano-scale digital CMOS technologies to achieve high-speed and high-resolution A/D conversion, with high power efficiency (energy dissipation less than lpj per conversion step). Such DeltaSigma ADCs are attractive for emerging broadband communication applications. [C2254]

"Asymmetric Magnetization Reversal in IrMn/CoFe/FeOX/CoFe Structures"

In this work, we investigate the mechanism of magnetization reversal in nano-oxide layers and explain the observed asymmetric hysteresis loops in the IrMn/CoFe/FeOx/CoFe system. [C2255]

"Discrete Sliding Mode Control of Piezo Actuator in Nano-Scale Range"

In this paper discrete sliding mode control (SMC) of Piezo actuator is demonstrated in order to achieve a very high accuracy in Nano-scale with the desired dynamics. In spite of the fast dynamics of the Piezo actuator the problem of chattering is eliminated with the SMC control structure. The Piezo actuator suffers from hysteresis loop which is the inherent property and it gives rise to the dominant non-linearity in the system. The proposed SMC control structure has been proved to deliver chattering free motion along with the compensation of the non linearity present due to hysteresis in the system. To further enhance the accuracy of the closed loop system and to be invariant to changes in the plant parameters a robust disturbance observer is designed on SMC framework by taking into consideration the lumped nominal plant parameters. Experimental results for closed loop position and micromanipulation applications are presented in order to verify the Nano-scale accuracy. [C2256]

"Compact Modeling and Applications of CNTFETs for Analog and Digital Circuit Design"

This paper presents some case-studies of an emerging nano-device, the carbon nanotube field-effect transistor (CNT-FET). First, we propose two design-oriented compact models, for both unipolar and ambipolar CNTFETs, i.e. devices with a classical behavior (MOSFET-like CNTFET) and an ambipolar behavior (Schottky-Barrier CNTFET). Models have been compared with exact numerical simulations and implemented in VHDL-AMS. Then we show some possible applications of CNTFETs in both digital and analog circuit design. In particular, an analog circuit based on the very particular ID-VGScharacteristic of the ambipolar CNTFET is demonstrated. [C2257]

"Arithmetic Reduction of the Static Power Consumption in Nanoscale CMOS"

The power consumption is becoming a major obstacle in future circuit design. Referring to Moore's law, by adding more functionality in an exponential way, we will also increase the total power consumption in the same pace. VLSI design has traditionally been concerning the dynamic power consumption as the limiting factor in low power system design. Today, when the feature sizes are in the nano-meter scale, the static power consumption is becoming a dominating factor. This paper indicates an arithmetic reduction of the static power consumption down to 20% by using bit-serial arithmetic instead of bit-parallel. [C2258]

"High Linear Voltage References for on-chip CMOS Temperature Sensor"

High linear voltage reference circuitry is designed and implemented in TSMC 0.13 mum and 0.18 mum CMOS technology. Previous research has proposed the use of MOS transistors operating in the weak inversion region to replace the bipolar devices in conventional PTAT (proportional to absolute temperature) circuits. However, such solutions often have linearity problem in high temperature region due to the current leaking devices in modern deep sub micron and nano-scale CMOS technology. The proposed circuit utilized temperature complementation technique on two voltage references, PTAT and IOAT (independent of absolute temperature) references, to enhance the linearity and produce a more stable IOAT voltage reference. Base on the simulation results, the R-squares of both circuitries are better than 0.999 in a considerable wider temperature range from -55degC to 170degC. Thus, a fully integrated temperature sensor with wider temperature range is designed and easily to integrate to modern system-on-chip designs with minimal efforts. [C2259]

""Nano-Technologies for Biomedical Applications""

My research in biomaterials and tissue engineering focuses on the synthesis development and application of novel biofunctional materials and on the use of biomaterials and engineering approaches to study biological problems. Several of the projects ongoing in my laboratory are described below. Tissue Engineered Vascular Grafts: There is tremendous need for materials for small diameter vascular grafts. Synthetic materials have not proved suitable, and tissue transplantation is limited. Tissue engineering may provide an answer. My laboratory is approaching this problem from two directions; synthesis of novel scaffold materials that mimic extracellular matrix and genetic manipulation of the cells seeded into these scaffolds. The scaffold materials under development provide signals to promote cell adhesion, to control synthesis of matrix proteins, to regulate cell growth, and to allow degradation of the polymer as new tissue forms. The goals for genetic engineering of smooth muscle and endothelial cells are to reduce thrombosis and improve the mechanical properties of the engineered arteries. Medical Applications of Metal Nanoshells: Nanoshells are a new type of nanoparticle with tunable optical properties. For medical applications, these particles can be designed to strongly absorb or scatter light in the near infrared where tissue and blood are relatively transparent. In a cancer therapy application, nanoshells are designed to absorb light and convert the energy to heat for tumor destruction. [C2260]

"Domain engineering in LiTaO3 by focused charge beam: From micro to nano scale"

In this study, 1-mum-dot domain by resist-assisted electron beam writing and 100-nm-wide line domain by focused ion beam domain patterning techniques have been demonstrated in LiNbO3and LiTaO3crystals thicker than tens of mum. [C2261]

"National NanoFab Center (NNFC): Nanofabrication Facility"

Nanotechnology predicts revolutionary changes in human civilization for its applicability to all science, engineering and technical fields, including electronics, materials, medicine, energy etc. It has recently emerged as a new strategic field following information technology and biotechnology. The Korean government has invested on the various national programs, such as nanoFab centers, tera-level nanodevices etc. since 2001 according to a basic plan it formulated for promoting nanotechnology development efforts. It has employed a focused investment strategy on such selected fields as nano electronic devices, especially for infrastructure. The National NanoFab Center was established to encourage and support nanotechnology R&D activities in the academic, research institutes and industry as a centralized public facility for nanofabrication service. In this paper, the overview of representative facilities in Korea, and equipments and activities of NanoFab centers were introduced. [C2262]

"Lithography Challenges toward Nano Scaled Device"

Lithography has been eagerly explored into nanoscale beyond sub-micrometer in the fields of leading-edge technology applications. NNFC (National NanoFab Center) has specially concentrated on direct electron beam lithography and nanoimprint which are flexible and effective methods to be applicable to sub-100 nm patterning. Nanoscaled FinFET and MRAM(magnetic RAM) were evaluated, using hybrid e-beam lithography (double masking method, mix & matching method), i.e. optical exposure tool used to reduce the total patterning time of direct electron beam. The results from these patterning methods were able to fabricate the world's smallest transistor, 5 nm FinFET and to adapt new material and device structure to magnetic device. Also 50 nm (line & space) fabrication capability of UV imprint template (stamp in UV nanoimprint) is demonstrated in this paper. [C2263]

"Falling Through the Cracks? Public Perception, Risk, and the Oversight of Emerging Nanotechnologies"

Nanotechnology is expected to be the key technology of the 21stcentury. Researchers are exploring ways to see and build at this scale, reengineering familiar substances like carbon and silver to create new materials with novel properties and functions. However, the emergence of nanotechnology also provides us with an opportunity to reshape how the public perceives the government's ability to manage risks posed by new technologies. As the first wave of nano-based products-including cosmetics, dietary supplements, food additives, and consumer products-enters the market, society will begin to ask questions about the health, environmental, and safety implications of these materials. The purpose of this paper is to connect the current state of such public perceptions-both with respect to nanotechnology, in particular, and to emerging technologies, in general-with the current state of nanotechnology product development and to analyze how well situated the public sector is to deal with these challenges. [C2264]

"Ferroelectric Gate on AlGaN/GaN Heterostructures"

A PZT, Pb(Zr,Ti)O3(40:60), ferroelectric layer has been successfully deposited onto a Al0.3Ga0.7N/GaN heterostructure with a 2DEG, two dimensional electron gas. Due to the chemical and temperature stability of AlGaN/GaN it was possible to implement the concept of field-effect transistor with ferroelectric gate. The high temperature perocessing conditions for PZT were optimised in order to grow highly textured (111) PZT on the heterostructure without destroying the 2DEG. However, it was imperative to measure the transport properties in the 2DEG before and after the PZT deposition process in order to detect any degradation of the 2DEG due to diffusion. Hall measurements also enabled the observation of the partial depletion of electrons in the 2DEG, confirming the functionality of the ferroelectric gate. This depletion was due to a change of the spontaneous polarisation in the PZT layer when poled with a negatively biased voltage. These results are encouraging for the use of PZT as a ferroelectric gate on AlGaN/GaN heterostructures and may open new possibilities for semiconductor heterostructure nano-patteming by polarisation domain engineering. [C2265]

"Innovations in light-emitting diodes"

This tutorial talk gives an overview of recent advances as well as future challenges in light-emitting diode technology for solid-state lighting applications. The discussion will include advanced nano-materials, packaging, and solid-state lighting systems. [C2266]

"Building the New Berkeley Microlab"

The University of California at Berkeley is proceeding with construction of a new nanofabrication laboratory-the CITRIS Nanolab. This new facility is a key component of the College of Engineering's CITRIS research center-the Center for Information Technology Research in the Interest of Society. The new lab will enable world class faculty research and stimulate creative partnerships with industry to address nanoscale CMOS electronics, nanoelectromechanical systems (NEMS), integration of opto and bioelectronics, and nano/micro/macro interface technologies. This laboratory will be the successor to The Berkeley Microlab and will continue and expand the Microlab tradition of a professionally managed, shared laboratory resource open to all academic researchers and supported on a recharge basis to insure the lowest possible barrier to entry. This presentation will provide an overview of the design and planning process with specific commentary on some of the challenges unique to the academic laboratory. Sample questions that will be addressed are as follows. How do you define facility and utility needs when future research requests are unknown? How do you efficiently translate the extensive industry experience of design consultants to a university situation? Is it possible to communicate directly with the architect and design team when working within the procedural confines of a large state university? Construction budget versus fit-up budget-are there strategies to take advantage of the Capital Projects process? Value engineering-does it provide either? And finally, is it possible to build a research laboratory this decade without including the word nano in the facility name? [C2267]

"A Micro-Fluidic Technique for the Evaluation of the Blood Compatibility of Nanostructured Polymer Surfaces"

We present a micro-fluidic technique for the evaluation of the blood compatibility of nano-structured surfaces under flow conditions. Micro-fluidic chips are coated with a polymer film. The demixing behavior of an immiscible polymer blend is used to create structured surfaces having typical feature sizes ranging from the nanometer to the micrometer length scale. Whole human blood is used to evaluate the blood interaction with these surfaces in terms of platelet adhesion, while platelet poor plasma is used to investigate protein adsorption. Our studies indicate that increasing the feature size of the surface nano-structures encourages von Willebrand factor adsorption and thus platelet adhesion and consequent thrombus formation [C2268]

"Intelligent H∞ Control of Nano-Positioning Systems"

This paper applies Hinfin control theory and evolution computing technology to design the optimally robust control system for a nano-positioning stage using piezoelectric actuators as driver components. After shaping the tracking errors and control energy through weighting function matrices, the Hinfin controller possesses the robust stability against the hysteresis effect. Furthermore, the hierarchical genetic algorithms are developed such that the control gene and coefficient gene evolve the structure of sensitivity function weighting and control energy weighting. The order and polynomial coefficients of the weighting function matrices do not need to be set in advance, but they will naturally evolve by artificial intelligence such that the optimal nano-positioning Hinfin controller is approached. [C2269]

"Model to Hardware Matching For nano-meter Scale Technologies"

With the semiconductor industry pushing past the 65nm node and forward to 45nm and beyond, a host of phenomena are becoming prominent. For some time now, manufacturing variability and its impact on power and performance has captured the attention of the CAD research community, and is now transitioning to the commercial EDA market. Simultaneously, however, our ability to reliably predict the outcome of a semiconductor manufacturing process has been steadily deteriorating. This is happening because the rapidly increasing process complexity which is introducing a host of systematic sources of variation, as well as a natural increase in core random variability due to scaling. These factors increase the error in our performance predictions, and thus lead to a gap in model to hardware matching. In this tutorial, we will review the sources and impacts of model to hardware mismatch, and show examples of potential solutions to currently under development [C2270]

"A Text Mining Framework to Support Nano Science and Technology Management"

This paper addresses how to inform nano science and technology management by mining a particularly rich information resource-the publicly accessible databases on nano fields. Empirical bibliometrics, technology forecast, technology assessment and competitive technical intelligence are not well utilized in technology management. Three factors could enhance managerial utilization: capability to exploit huge volumes of available information, ways to do so very quickly, and informative representations that help manage emerging technologies.In this paper, a framework based on text mining techniques is proposed to discover useful intelligence from the large body of nano's electronic text sources. This intelligence is a prime requirement for successful S&T management. After that the proposed method is applied to nano technology to give an empirical study. [C2271]

"Copyright page"

The following topics are dealt with: biological fluid pressure measurement using MEMS based micropressure transducer; nano-gap fabrication; polyacrylamide micro-pillar based DNA microarray; maskless direct cell patterning; silicon-based single-cell electroporation microchip; nanocytometer; biochip; microfabricated lab-on-a-chip devices; cell-based field effect devices; taste sensor chip fabrication; human assisted reproductive technology in embryo co-culture system; biosensor; micromachined nanotweezers; flexible microfabricated parylene multielectrode arrays; silicon nanotweezers; photovoltaically modulated MEMS optical scanner; microstencil lithographic application; human umbilical vein endothelial cell behaviour; controlled bacterial microactuation; genetic field effect transistor charged nanoparticle; microbioreactor with integrated magnetic stirrer pump; and transmembrane transport of Caco-2 cells [C2272]

"Nano-gap fabrication by focused ion beam for DNA trapping"

Micromachined tweezers is having nanometer sized gap was fabricated with a silicon etching method and a focussed ion beam technique. The gap of tweezer fabricated by this process was accomplished to be 15 nm-2 mum ranges. The validity of this tweezers was demonstrated by trapping DNA molecules. Trapping of bundle of lambda-DNA molecules between 100 mum gap was succeeded [C2273]

"Blood interaction with nano-topography"

The work concerns the study of blood behavior on nanostructured polymer surfaces under flow conditions. The authors use the demixing behavior of an immiscible polymer blend to create structured polymer films whose typical feature size ranging from the nanometer to the micrometer. Micro-fluidic chips are coated with these films. Blood interaction with these surfaces is evaluated in terms of platelet adhesion using human whole blood, while platelet poor plasma is used to investigate protein adsorption. The studies indicate that increasing the feature size of the surface nano-structures encourages von Willebrand factor adsorption and thus platelet adhesion and consequent thrombus formation. [C2274]

"VMOS, UMOS structures simulation in micro and nano scale"

VMOS, UMOS ("V"-groove-metal-oxide-silicon) transistors drain and gate are formed in the groove of "V" or "U" form. Expanding channel area, therefore VMOS and UMOS structures may be used in the power chips. Using VMOS, UMOS saves 40% free space than by using NMOS technology. Nanostructures dimensions are very small, so it is important to keep pn junction in a right depth, and in the all semiconductor manufacturing technological process. Analyzing influence to forming structure of each technological operation, mathematical simulation program SUPREM IV is used. VMOS and UMOS technological operation was simulated in micro and nano level [C2275]

"Lithography for the 32-nm Node and Beyond"

This review article presents, discusses and compares three emerging photo lithography techniques for use in future BiCMOS fabrication processes: EUV lithography, e-beam direct write, and nano imprint. Specific challenges are discussed and the state-of-the-art is illustrated with respect to bipolar device scaling [C2276]

"The New Scheme of the "Slicer" for Radiators of Powerful Nano-and Picosecond Pulses"

The new scheme of formation of the short pulses is suggested. This scheme allows us to receive a bipolar step pulse on an output and it is possible to radiate received pulse into free space without sizeable power losses [C2277]

"A Study of Intelligent Integrated Nano CNC System Based on Standard"

In order to meet increased demand of nano machining accuracy in modern manufacturing industries, intelligent nano computer numerically controlled (CNC) system will be the main development aim of the next generation CNC system. Because traditional G-codes (ISO6983) have been extensively used by the CNC machine tools for part programming and are now considered as a bottleneck for machine tools, a new standard known as STEP-NC is being developed to realize bi-directional transferred information flow between a CAD/CAM system and CNC controller. Although work has been carried out on traditional CNC system, there have been few papers which focus on intelligent nano CNC system. This paper presents a novel intelligent nano CNC system based on STEP-NC. Some related technologies and application principles were also studied [C2278]

"Thermal Packaging Challenges and Opportunities at the Micro and Nano Scales"

Microsystem technology is a key driver in the rapid migration of thermal science and technology towards the micro and nano scales. The deleterious effects of heat generation and thermally-induced failures of micro/nano electronic and photonic components have necessitated the development of thermal packaging solutions at progressively smaller scales. This lecture will define the emerging micro/nano thermal packaging challenges and explore solid state refrigeration and dielectric liquid cooling techniques for addressing on-chip hot spots in high heat flux chips, as well as the use of high conductivity polymer composites for cooling of notebook and portable computers. Thermo-optic issues in the use of polymer waveguides and gratings will also be considered [C2279]

"A Text Mining Framework to Support Nano Science and Technology Management"

This paper addresses how to inform nano science and technology management by mining a particularly rich information resource-the publicly accessible databases on nano fields. Empirical bibliometrics, technology forecast, technology assessment and competitive technical intelligence are not well utilized in technology management. Three factors could enhance managerial utilization: capability to exploit huge volumes of available information, ways to do so very quickly, and informative representations that help manage emerging technologies. In this paper, a framework based on text mining techniques is proposed to discover useful intelligence from the large body of nano's electronic text sources. This intelligence is a prime requirement for successful S&T management. After that the proposed method is applied to nano technology to give an empirical study. [C2280]

"Organizing for scientific performance: The impact of organizational affiliation on scientific productivity in Nano Science & Technology"

The relationship between scientific productivity and organizational structure has not been studied extensively to date and further research on this topic is needed to elucidate the role of this potentially important determinant of research productivity. This paper draws on a large and unique data set of more than 14,000 scientists in the multidisciplinary area of Nano Science & Technology (NST) and their publication behavior over a three-year period. The particular form of organization of interest is the specialized NSF-funded NSEC Centers, and it is shown that scientists affiliated with these research centers are more productive than their counterparts in academic departments, University Research Centers and Federal Laboratories [C2281]

"Flexible Workflows for Digital Design in the Nano Era"

This paper presents work in progress on an adaptive workflow management tool for digital design projects. The chip design follows standardized default processes which are adapted during an ongoing project by changing requirements from both design and application imponderabilities. Our approach focuses on flexible monitoring and authoring support of adaptive workflows in a real-world application [C2282]

"Overcoming research challenges for CMOS scaling: industry directions"

The development of silicon technology has been, and will continue to be, driven by system needs. The continuous and systematic increase in transistor density and performance, guided by CMOS scaling theory (Dennard et al., 1974) and described in "Moore's Law" (Moore, 1975), has been a highly successful process for the development of silicon technology for the past 40 years. As the silicon industry moves into the 45 nm node and beyond, significant technology challenges are imposed by silicon CMOS device scaling. Two of the most important challenges are the growing standby power dissipation and the increasing variability in device characteristics. These complaints are the embodiments of CMOS approaching atomistic and quantum-mechanical physics boundaries. They are frequently cited as the reason Moore's Law is "broken", or why CMOS scaling is coming to an end. Industry directions for addressing these challenges are developing along three primary extending silicon scaling through innovations in materials and device structure; expanding the level of integration through three-dimensional structures comprised of silicon through-via holes and chip stacking in order to enhance functionality and parallelism; and exploring post-silicon CMOS innovation with new nano-devices based on distinctly different principles of physics, new materials, and new processes, such as spintronics, carbon nanotubes, nanowires, or molecular systems [C2283]

"Nanoarchitectonics and nanoelectronics"

The paper discusses the mission and findings of our MARCO Focus Center on Functional Engineered Nano Architectonics (FENA) and the Western Institute of Nanoelectronics (WIN). In the Center and the Institute funded by SIA, we explore different logic state variables, such as the use of particle spin, molecular conformation and others in addition to today's charge based electronics, for resolving the most critical bottleneck-power dissipation towards to ultimate scaled CMOS and beyond. We investigate many different functional nanomaterials as building blocks and self assembly techniques as alternate fabrication methods for nanostructures and their integration. Examples of fabricating molecular structures, carbon nanotubes (CNT), and nano polymer wires, and their assembly using, for example, DNA and PNA conjugation are discussed for device and circuit applications. Likewise, oxide spintronic wires and dilute magnetic nanostructures for potential new power efficient devices are also highlighted. The work suggests the possibility of integrating a variety of these nano building blocks on a common platform, and further constructing future heterogeneous integrated nanosystems with potential new manufacturing methods. Towards these nanoelectronics systems, variability issues in device characteristics and in manufacturing tolerance demand the development of "nanometrology" and control tools sensitive to single atoms and molecules. An example of using a single wall CNT FET to study single interface defect and a single molecule in terms of fluctuation, or more specifically random telegraph signal are demonstrated [C2284]

"Nano-optoelectronics research in WNLO"

The research progress in nano optoelectronic devices and their integration at Wuhan National Laboratory for Optoelectronics are summarized. Integrations on different material platforms are described, but emphasis is given to new micro/nano scale emitters, detectors, and light beam controlling devices. The perspective of micro/nano scale monolithic integration of optical devices and electronic devices on a single chip by standard CMOS technologies is presented. The possibility of using these devices for communications, optical interconnections and bio-sensing, is also discussed [C2285]

"High impedance nano charger for on-chip 50nAH rated microbatteries"

Integrated microbatteries are being currently developed to act as a "micropower" source in microsatellites. They help provide localized current capacities or embedded power supplies at the chip level, for space exploration. The microbatteries are charged using these complementary algorithms based on constant current, constant voltage and pulsed current. The charging current is in the range of nano-amperes. A unique experimental setup is developed to implement the nano charging algorithms. This designed setup is completely automated for maximum efficiency. Laboratory results are shown as part of this paper to prove the validity of the designed work. The microbatteries used are rated at 50 nAH capacity and are solid state lithium electrolyte based [C2286]

"Possibility to read out 20-nm-sized pits using a near-field optical probe in an atomic force cantilevered snom"

We have studied a possibility to read small pits in electron beam (EB) resist layer using a near-field optical probe for ultrahigh density optical storage. For the reading, we used small near-field optical probe in prototype atomic force cantilevered SNOM, which has an ability to obtain both atomic force microscope (AFM) and scanning near-field microscope (SNOM) images simultaneously. We formed 20-nm sized pit arrays with a pitch of 60 nm using a conventional EB writing system based on a scanning electron microscope (SEM). Using the arrays and the prototype ANOM system, we have demonstrated the possibility to read-out 20-nm-sized pits using near-field optical probe [C2287]

"CMOS Integrated Electro-magnetic Force Actuator"

Minimizing the power consumed by transistors in numerous applications has been widely studied. This paper describes a digital approach to adjusting the output power of an RF circuit using 0.5 mum digital CMOS technology. A programmable power amplifier consists of an array of parallel NMOS transistors hooked up to an (all-on-chip) class E Power Amplifier (PA), and it functions as a direct digital to RF amplitude converter and filter. The results show that the maximum output power achieved is 8 dBm using a 3 V power supply and occupying 0.18 mum2. These programmable power sources can drive an on-chip small inductor so as to use it as an electromagnetic force generator. Several on these on-chip force generators can be used to drive a tiny probe, endowed with a similar generators, in imaging or manipulation applications in nano-technology-particularly atomic force microscopy (AFM). [C2288]

"Application-Independent Defect-Tolerant Crossbar Nano-Architectures"

Defect tolerance is a major issue in nano computing. In this paper, an application-independent defect tolerant scheme for reconfigurable crossbar nano-architectures is presented. Architectural features are developed to reliably connect local defect-free subsets of crossbars in order to generate a defect-free architecture. It is also shown how to further reduce the area overhead associated with this flow by relaxing some constraints on the defect-free subsets. Experimental results show more than 9times reduction in the area overhead without any negative impact on the usability of modified defect-free subsets [C2289]

"Automation in Mixed-Signal Design: Challenges and Solutions in the Wake of the Nano Era"

The use of CMOS nanometer technologies at 65 nm and below will pose serious challenges on the design of mixed-signal integrated systems in the very near future. Rising design complexities, tightening time-to-market constraints, leakage power, increasing technology tolerances, and reducing supply voltages are key challenges that designers face. Novel types of devices, new process materials and new reliability issues are next on the horizon. We discuss new design methodologies and EDA tools that are being or need to be developed to address the problems of designing such mixed-signal integrated systems [C2290]

"Information Processing in Nanoscale Arrays: DNA Assembly, Molecular Devices, Nano-Array Architectures"

Arrays of simple, nanoscale components are promising for future information processing circuitry. Large arrays could provide high functionality by exploiting the nonlinear dynamics of locally connected components, while circumventing nanoscale power dissipation and interconnect limits. To realize such a paradigm shift, however, many new physical design and system-level issues must be addressed. Here, I will describe 1) results on DNA-directed assembly of components in 2D arrays, 2) the search for electrically active molecular components and 3) schemes for information processing in arrays of simple nanoscale components [C2291]

"Manipulation of neuronal plasticity with strong magnetic fields and nano-technology"

Brain damages destroy neuronal network and impair motor and cognitive functions. However, it is difficult to reconstruct neuronal circuits damaged by brain diseases. Neuronal cell transplantation into damaged brain regions had been believed to be promising, grafted neurons can extend their neuronal processes less than 500 micron and few functioning connections between grafted neurons and host neurons could be achieved by using the current neuronal cell grafting techniques. To enhance innervation of grafted neurons in damaged brains, we use very strong magnetic field and nanowires-coated with neuronal cell adhesion molecules. Nanowires injected in the rat brain were observed not only at the site of injection but also near the site of the magnet. Interestingly, nanowires lined up from the injected site towards the magnet. The present study showed that strong magnet on the brain surface could move nanowires in the rat brain [C2292]

"Quartz tuning-fork type AFM probe operated in Anti-phase Vibration Mode"

This paper presents that quartz tuning fork shows excellent properties as atomic force microscopy (AFM) probe. We used focused ion beam (FIB) system to monolithically form a sharp tip at the side end of one beam. The fabricated probe can vibrate and detect the deformation itself because of piezoelectric property of crystal quartz. We evaluated the vibration characteristic and the self-detection ability of tuning fork. The tuning fork probe is actuated in two different vibration mode; in-phase and anti-phase mode, and clarified that high Q-factor of 5247 was obtained in anti-phase mode. We further applied this mode for AFM observation and images were successfully with dynamic AFM system [C2293]

"Impact Resilience Measurement of Elastic Materials by using Active Tactile Sensor"

This paper proposes an active tactile sensor driven by using piezo-electrical actuator. It consists of a silicon diaphragm having piezoresistive strain sensors for measuring displacement of the diaphragm, and a piezoelectric actuator for driving the sensing element. The proposed active tactile sensor has an advantage in that it can detect the multiple physical values, elasticity and impact resilience of a contact object, by analyzing the obtained step-response waveform. We fabricated the sensor element by using micro-electro-mechanical-systems (MEMS) technologies, and assembled it with a commercially available piezoelectric actuator in hybrid manners to produce the active tactile sensor. The sensor was 15 mm times 15 mm times 20 mm. Six different rubbers of different hardness ranging from A30 to A70 in Shore A, was used to evaluate the elasticity detection function of the sensor, and we confirmed that the output increased linearly with the increase in the rubber hardness (elasticity). We also evaluated two different rubber materials, urethane and damping rubbers, which had different values of impact resilience, and found that step responses of the sensor output were quite different between two (the damping rubber showed overshooting phenomena at the rise). We therefore concluded that the proposed sensor is capable of detecting two values, elasticity and impact resilience, of a contact object [C2294]

"Developing Dexterous Bilateral Nanomanipulation System using Haptic Interface"

To build complex 3D nano device such as nano scale force sensor or actuators, it requires dexterous 3D nanoassembly technology adding to 2D microfabrication or self-assembly of nano particles. We have two nanomanipulators which can be also setup either inside scanning electro microscope and optical microscope. Using multiple nanomanipulators, human-friendly haptic interface, and electro statically actuated MEMS micro gripper, 3D nanoassembly can be realized. By functionalizing tips in each nanomanipulator, a complex nanoassembly work can be done in a simplified manner. We adopt two nanomanipulators and electromagnetically functionalized probe tip and glue functionalized tip [C2295]

"A Study of Mechanical Dispersion of Ceramic Powder"

In order to develop the dispersion technique that produces ceramic nano-particles in non-aqueous liquid with the dispersant, we have considered 100 nm barium titanate in primary size experimentally and numerically. Dispersion in the wet batch was performed using the stirred bead mill. Static light scattering (SLS) and dynamic light scattering (DLS) method respectively characterized the particle diameters. Based on the results of characterizations, it can be concluded that the dispersion conditions leading to a given particle diameter distribution are influenced by operating parameters such as bead volume fraction, stirrer speed, bead size, flow rate, and dispersants. To understand the effective dispersion mechanism, we have performed the mechanical study at numerical viewpoint. This paper presents a new method that calculates the effects of beads by using Eulerian two-phase model. The results of the stress distribution obtained by computational fluid dynamics (CFD) are compared with experimental results about particle diameter [C2296]

"ECR Plasma-Enhanced Au/Al Bondability in Fine-Pad-Pitch BGA Assembly"

As the semiconductor IC process technology enters the deep-submicron or nano level, the pad area and space in bonding is gradually demanded to be shrunk. As a result, the smaller pad area and space, the worse bondability with the recent bonding technology. How to solve this challenge issue is an urgent task in assembly industry. In this paper, we propose an adequate plasma treatment to feasibly overcome this barrier in IC assembly concern. The plasma-enhanced chemical cleaning is employed to deterge the Al pads of IC products. Therefore, the surface pads exhibit the good clean efficiency and the micro roughness. Due to this application, the bondability performance in ball-grid-array (BGA) assembly experiment is obviously promoted. The reliability quality such as wire bonding strength, Al-Au eutectic ability, shear-pull force, and reduction of bonding parameters is effectively improved, too. Because of the good quality of surface pads, the ultrasonic output power and the bonding timing can be somewhat decreased to increase the throughput. In a short, the wafer crack probability and the pad oxide damage in bonding process can also be gradually deducted [C2297]

"Reliability Analysis of a New Soft Joint Protection Technology Using in WLCSP"

The coefficient of thermal expansion (CTE) mismatch between silicon and organic printed circuit board (PCB) causes a reliability issue for the ball grid array type electronic package. This makes it difficult for the conventional wafer level chip scaled packaging (WLCSP) with large die to satisfy the reliability requirement. Therefore, in this study a novel solder joint protection-WLCSP (SJP-WLCSP) structure is proposed to overcome the reliability issue. The SJP-WLCSP makes use of a delaminating layer to reduce the problem of CTE mismatch. In the SJP-WLCSP, a delaminating layer is interposed between the top layer of the chip and the bottom insulating layer of the redistribution copper metal traces. As a result, the stress on the solder joints can be released by allowing cracks to form in the delaminating layer. To elucidate the thermo-mechanical behavior of eutectic solder joints and copper trace, a nonlinear analysis based on the 3D finite element (FE) model under accelerated thermal test loadings was carried out. The crack of the SJP-WLCSP test vehicle after thermal cycling loadings exhibits a good agreement between the failure analysis experiments and the FE method predictions [C2298]

"Nano-Level 3-D Measurement Using Combination of Laser Lights Phase Shifts"

To improve the productivity of very large scale of LSIs and large LCD panels, the technologies to inspect the LSIs are required. To remove the less than one-micrometer contaminants on the LSIs, it is required to extract their 3-D shape and position, precisely. To meet with these requirements, a nano-level 3-D shape extraction method has been developed. Here, the basic idea of the method and the experimental result are described. To extract a nano-level 3-D shape, the method using some interference images is effective. Interference image is generated between reflected light on LSI surface and reference light. At this time, if the position of the mirror of a reference light is changed at regular intervals, the brightness change of same position on interference images shapes a sine wave. When heights of LSI differ between coordinates, the brightness of interference image differs. And the phases of brightness changes differ according to height of a viewing pixel. To meet with the requirement to measure longer than one wave-length, the combination method of multiple wavelength lasers has been introduced [C2299]

"From Micro to Nano: MEMS as an interface to the nano world"

Leveraging conventional microsystems technology, MEMS has become the technology of choice for a wide range of applications including inertial sensors for automotive, games, and consumer applications, projection displays or inkjet print heads. In support of recent efforts to shrink dimensions to the nanoscale, MEMS has established itself as a perfect technology for interaction with the nanoworld. We will describe initial results using MEMS to manipulate single molecules for medical diagnostics. This technology has the potential to turn complex laboratory procedures into procedures that are as simple as taking the temperature [C2300]

"A novel SPM probe with MOS transistor and nano tip for bio application"

In this paper, the novel SPM (scanning probe microscope) probe is designed and fabricated for the measurement of the surface electric properties of the biomaterials. The probe has two parts, the planar MOS (metal-oxide-semiconductor) transistor which is sensitive to the electric signal and the FIB (focused ion beam) nano tip. Since MOS transistor has high working frequency and high sensitivity, and the FIB nano tip has nanometer scale tip radius, the probe can rapidly detect small localized electric properties with high sensitivity and high resolution. The MOS transistor is fabricated with the common semiconductor process, and the nano tip is grown by the FIB system. The planar structure of the MOS transistor makes the fabrication process easier, which is the advantage on the commercial production. Various electric signals are applied using the function generator, and the measured data shows the promising aspect of the electric property detection of the biomaterials with high sensitivity and high resolution [C2301]

"The UV-Nanoimprint Lithography with Multi-head Nanoimprinting Unit for Sub-50nm Half-pitch Patterns"

Nanoimprint lithography is a promising technology to produce sub-50nm half-pitch features on silicon chips. The contact-based nano lithography, such as thermal and/or UV nano-imprint, is well-known as the next generation lithography. Especially, the UV nano-imprint lithography technology has advantages of the simple process, low cost, high replication fidelity, and relatively high throughput. To achieve nano-imprinting process, nano-imprinting lithography equipment must have required some multi-functional units which are imprinting head, self-alignment wafer stage, overlay and alignment system for multi-layer process, master with sub-50nm half-pitch patterns, and anti-vibration unit, etc [C2302]

"Evaluation of phosphorous pile-up at the Si/SiO/sub 2/ interface"

As we all know from the famous prediction for the micron order transistor era, which Gordon Moore predicted, the performance of transistors improved exponentially, but it doesn't quite follow his prediction, any more. The performance of transistor is now governed by bland new approaches, for example applying the new materials (high-k, metal gate, strain Si and etc.) and/or non-planar structures, not by the simple device shrinkage. Of those new technologies, SOI-CMOS is one of the best candidates for the next generation CMOS. At the time when SOI-CMOS technology is adopted, however, extensive thinning of the active layer is mandatory. The Si/SiO2interface effect obviously becomes significant, since the channel region has greater antenna ratio for peripheral insulator. Up until now, dopant loss at the Si/SiO2interface has been studied intensively. Macroscopic understanding of dopant diffusion is well achieved, but none has been reported on sub-100nm Si, where electrical inactivation due to the dopant trapping, Si/SiO2interface effect and strain from peripheral dielectric films has significant effects on the electrical properties compare to the one in bulk. The authors hereby discuss the electrical properties of the fabricated nano-Si wire devices to investigate the dopant diffusion by comparing the conductivities of those devices with different thermal histories [C2303]

"Influence of Gate-Electrode Fringing Capacitance on Threshold Voltage of Nano-MOSFET"

In this paper, the gate-electrode fringing capacitance of nano-MOSFET is derived by conformal mapping transformation. Threshold voltage including the fringing-capacitance effect is calculated and good agreement with experimental data is obtained. Factors impacting the threshold behaviors of nano-MOSFET are discussed in detail [C2304]

"Engineering of S/D Lateral Diffusion for DG-FETs Based on Full Quantum Analysis"

In this work, the dominant quantum effects in nano devices are investigated by the full quantum simulation based on the QDAME algorithm, which is suitable to analyze the quantum open system. Compared with the classical drift-diffusion mechanism, the full quantum simulation predicts that due to the carrier tunneling from source to drain in off-state, the control of source/drain (S/D) lateral diffusion becomes more crucial in nano devices to suppress the short-channel-effects (SCEs) and reduce the off-state leakage current. Considering the induced S/D-gate capacitance, a practical method is also proposed to optimize the lateral diffusion length [C2305]

"T-Shaped Body Silicon-on-Insulator (SOI) MOSFET"

A novel partially-depleted (PD) silicon-on-insulator (SOI) MOSFET with a T-shaped body (TSB) is proposed for the first time. Simulation results demonstrate that the proposed structure provides nano-scaled PD SOI devices with much better short channel effect immunity and sub-threshold characteristics than those of UTB SOI devices. It is also shown that the threshold voltage of proposed device can be adjusted over a wide range by changing the thickness of the low-doped channel region if a step-function channel doping profile is used. At the same time, the short channel effects of the TSB devices exhibit a week dependence on the channel thickness variation [C2306]

"Electrostatic Discharge Protection in the Nano-Technology-Will We be able to Provide ESD Protection in the Future?"

Electrostatic discharge (ESD) phenomenon will play a critical role in the introduction, manufacturing and implementation of present day semiconductor devices and future nano-structures as presented by Voldman (2002). In the future, the ability to produce nanostructures may be limited by the ESD sensitivity of these electronic and mechanical elements. The ESD technology roadmap has been shown, highlighting a decreasing ESD robustness with technology scaling. ESD technology scaling issues in advanced CMOS, RF CMOS, silicon germanium, to gallium arsenide will be reviewed. ESD issues from wafer-level charging, on-chip protection, to off-chip protection have been discussed. In addition trends in RF MEMs, FINFETs, magnetic recording, photo-masks to carbon nano-tubes (CNT) have been discussed. [C2307]

"Impact of Process variations on Leakage Power in CMOS Circuits in Nano Era (Invited paper)"

In sub 90 nm CMOS technology the process variations seriously affect the performance specification for leakage power and delay. In this paper, we have analyzed the techniques to improve the design quality for power and performance sensitivity to process variations. At gate level forced stacking not only reduces leakage but also improves the robustness of the gate to process variations. Logic style level the variation of leakage current with the Vthvariation for various logic styles is studied [C2308]

"Channel Engineering of Silicon Nanowire Field Effect Transistor: Non-Equilibrium Green's Function Study"

The device characteristics of Si-nanowire FET (Si-NWFET) are investigated with non-equilibrium Green's function (NEGF) method. In this study, we characterize the effect of channel modulation by engineering dopant profiles, oxide thickness, and corner rounding of nanowire cross section, and suggest how to enhance the performance of Si-NWFET. Our simulation shows that the engineering of dopant profiles in nanowire channel should differ from that in conventional planar MOSFET. It is also found that oxide thickness variation does not affect the performance of Si-NWFET, provided that it has high source/drain (S/D) resistance. Finally the effect of corner rounding in silicon nanowire channel is discussed [C2309]

"Nano-scale CMOS and Low Voltage Analog to Digital Converter Design Challenges"

This paper discusses the analog performance trend and the performance estimation of pipeline ADC in nano-scale CMOS era. The technology scaling is effective to increase the conversion rate, however it is not effective to increase the resolution, SNR, and decrease the power consumption at higher resolution. New converter design challenge is needed and one strong candidate must be the successive approximation ADC because it does not require operational amplifiers that consume power and become difficult to design with nano-scale CMOS [C2310]

"An ultra low-power low-cost gaussian impulse generator for uwb applications"

a new fully integrated ultra low-power pulse width adjustable Gaussian impulse generator using a low-cost 0.18

mum UMC CMOS process was designed and measured for ultra wideband (UWB) transmitter. The Gaussian impulse generator integrates a square-wave generator and an impulse-forming circuitry together in a single chip. The square-wave generator produces a square wave with sharp rising/falling edge, which is fed to the impulse-forming circuit. Simple CMOS inverter and NOR block are employed for the Gaussian impulse formation instead of a complex analog circuit formation, which must use resistor, capacitor and inductors (Zheng et al., 2002). Due to this CMOS Gaussian impulse generator all digital features, the generated pulse-width is easily adjustable from 50ps to several nano seconds and the power consumption is ultra small. We have measured a Gaussian impulse with pulse-width of 800ps, amplitude of 48mV, and average power of 200muW at 100MHz pulse repetition frequency. The impulse generator is a key component in both UWB transmitter and receiver. This developed Gaussian impulse generator building block can be further used to generate higher derivative order Gaussian monocycle pulses or another kind of pulse waveform needed for UWB systems [C2311]

"Technology Platform for IC Design in Nano-scale CMOS"

This paper discusses the technology platform development for IC design in nano-CMOS technologies. New effects and issues in nano-CMOS are reviewed before the discussion on the contents of the technology platform. Some key components are briefly discussed with the exploration of some further challenges to develop a RF SOC design technology platform. An advanced technology platform with strong links to process and device behavior and efficient simulation approaches is critical to a successful advanced IC design in nano-scale CMOS technologies [C2312]

"Investigation of SAWs Propagating on the Nano-porous Film"

This paper established a new layered model to calculate the theoretical dispersion curve of SAWs propagating on the periodic porous SiO2film on the Si substrate. In this model the periodic nanoporous SiO2film is treated as transversal isotropic structure. Based on this model the properties of SAWs propagating on the surface of periodic porous SiO2film in the directions of Si [110] and Si [100] are studied. The investigation on the characteristics of SAWs propagating on the periodic nanoporous film with different porosity, density as well as thickness is performed [C2313]

"Modeling of Nano-resonator Testing System by Lumped Parameter Method"

An electromechanical model for nano-beam resonator is proposed, considering simultaneously the residual stress, the nonlinear stretching effect and the fringing field effect. With some reasonable simplification, the analytical expression is derived from Euler equation. Based on the parameters extracted from the model, lumped parameter method is introduced to analyze the dynamic characterization of the whole testing system. The phase and amplitude of the output are detected from simulations and more precise resonance prediction is available. Based on the model and testing system, the influence of the parasitic effect is discussed [C2314]

"First-principles evaluations of dielectric properties from nano-scale points of view"

Dielectric properties of ultra-thin Si(111), SiO2, and La2O3(0001) films have been investigated using two methods, internal field method and dipole moment method, on the basis of the first-principles ground-states calculations in external electrostatic fields. With increasing thickness of the Si(111) film, the optical dielectric constant evaluated at the center of the slab converges to the experimental bulk dielectric constant, while the energy gap of the slabs is still larger than that of corresponding bulk. On the other hand, both the optical and the static dielectric constants of beta-SiO2(0001) films hardly depend on the film thickness and the spatial variation of the local dielectric constant is also very small. It has been found that both the surface effect and the quantum confinement effect are small on ultra-thin beta-SiO2(0001) films. Further, it has been revealed that ultra-thin La2O3(0001) film having a thickness of 1.1 nm possesses a large value of the static dielectric constant (29.2) equivalent to that of bulk [C2315]

"Local Model Analysis of Gate Insulator Oxides"

The authors have presented local analysis for modeling of gate insulator oxides in nano-CMOS devices based on the rigged QED theory. This analysis is effective to link the correlation between the chemical bonds and dielectric properties. The authors have adopted cluster models of SiO2, ZrO2, HfO2, La2O 3, Ce2O3, and Gd2O3 using ab initio methods for the electronic structure calculations. Careful treatment of valence electrons sheds new light on an important role of the 4f, 5s, 5p, 5d, and 65 orbitals in lanthanoid elements [C2316]

"Effect of surface roughness on quasi-ballistic transport in nano-scale Ge and Si double-gate MOSFETs"

Effect of surface roughness on quasi-ballistic transport in nano-scale Ge and Si double-gate (DG) MOSFETs are investigated using 2D full-band self-consistent ensemble Monte Carlo (MC) method based on solving quantum Boltzmann equation (QBE). Results show that the effect of the surface roughness on carrier quasi-ballistic transport in DG nMOSFETs is still significant even when the gate length scales down to 10 nm. Moreover, the influence of surface roughness can be suppressed by the non-local transport since the on-current of the Ge DG nMOSFETs decreasing less than that of Si DG nMOSFETs with increasing of surface roughness [C2317]

"Xe implantation in SiO/sub 2/: low-k applications"

SiO2samples were implanted with 300 keV xenon at various doses: 0.5 to 5 times 1016Xe/cm2. As-implanted samples show that nm-size precipitates are created for these doses while bubble formation needs doses higher than 1016 Xe/cm . Thermal annealing at 750degC results in the disappearance of nano-precipitates while bubbles/cavities remain stable even after annealing at 1100degC. Capacitance-voltage (C-V) measurements clearly indicate a strong decrease of the dielectric constant (k), consistent with bubble/cavity formation in SiO2 [C2318]

"Ultimate top-down etching processes for future nanoscale devices"

Our newly developed neutral beam (NB) etching could firstly accomplish the damage-free (defect-free and smooth surface) fabrication of high aspect rectangular Si-Fins. The fabricated FinFETs realize higher device performance (higher electron mobility) than that using a conventional reactive ion etching. The improved mobility is well explained by the atomically flatness of the neutral beam etched surfaces. Our new results strongly support the effectiveness of the NB technology for the nano-scale CMOS fabrication [C2319]

"Investigation of nanowire orientation and embedded Si1-x Gex source/drain influence on Twin Silicon Nano-Wire Field Effect Transistor (TSNWFET)"

This paper describes TSNWFET devices with embedded Si1-xGexsource/drain regions and different nanowire orientations. Thick Si1-xGexembedded source/drain and lang110rang channel orientation is found effective to enhance p-channel TSNWFET performance, while cause degradation for n-channel one. Thin Si1-xGexand lang100rang channel orientation is the preferred combination for keeping n-TSNWFET performance. With lang110rang channel orientation and thick Si1-xGexin source/drain, p-MOS current, for the first time, is even observed to exceed its n-type counterpart from the experiments [C2320]

"Silicon-on-nothing (SON) technology"

The "silicon on nothing" (SON) technology (Jurczak et al., 1999) and (Jurczak et al., 2000) is a promising candidate for the end-of-roadmap CMOS. In this paper we present the SON technology, show examples of sustained mono-Si nano-membranes over an empty tunnel, and deliberate on the suitability of this kind of 3-D nano-structures to build-up electronic devices. This technology opens a wide range of applications, in particular for the realization of localized single-gate fully depleted transistors on bulk substrates and of double-gate planar devices, co-integrable with bulk devices [C2321]

"Challenges for sub-10 nm CMOS devices"

Sub-10nm CMOS devices are the critical issue, because CMOS scaling is going to be sub-25nm regime. Scaling issues of nano-size MOSFETs can be discussed on the basis of sub-10 nm MOSFETs characteristics, which have been developed and confirmed switching characteristics and low-temperature characteristics. Studying device limitation issues and developing new breakthrough technologies are required to challenge sub-10-nm CMOS devices [C2322]

"Manufacturing considerations of lithography independent nano-MOS-transisters in the sub-25 nm-region"

The 2005 International Technology Roadmap for Semiconductors predicts a printed minimum MOS-transistor channel length of 9 nm for the year 2020, which results in a physical gate length of only 6 nm. The resolution of optical lithography still dramatically increases, but known and proved solutions for structure sizes significantly below 50 nm do not exist until now. Above these dimensions the known solutions are only affordable to a very diminutive group of manufactures due to the extraordinary mask costs. Therefore this paper presents and compares different methods of fabrication of MOS-transistors with a channel area smaller than W = 25 nm and L = 25 nm with low demands to the used lithography. They are all based on our deposition and etchback technique which was used in earlier research to produce transistors with very small channel lengths down to 30 nm, while the channel width was not scaled and stayed at the dimensions of the optical lithography (e.g. 0,8 mum). The used techniques are easily transferable to almost any other technology line and result in an excellent homogeneity and reproducibility of the generated structure size. By this means it is possible to examine the future nano-MOS-transistors regarding their electrical characteristics including low temperature measurements and statistical measurements at very low costs [C2323]

"The preparation of uniform Ag-TCNQ electrically bistable films with nano-grains for ultrahigh density data storage"

The Ag-TCNQ films with smooth surface and uniform tiny grains in nanometer scale were prepared by an improved vacuum evaporation method in which the deposition temperature of TCNQ films was increased from room temperature to 100degC. It is an ideal medium for ultrahigh density data storage with SPM-based techniques. Storage dots were recorded by applying voltage pulses between the tip of a scanning tunneling microscopy (STM) and the substrate under ambient condition. A recording pattern with six storage dots was obtained. The average diameter of recording dots was ~20nm, which corresponds to a data storage density of 0.5 Tbit/cm2 [C2324]

"The Study on Nanocontact Printing with Ink Aminosilane"

In this paper, a hydrogen silsequioxane (HSQ) stamp fabricated with low e-beam dose was used, and aminosilane was studied as an ink for nanocontact printing on a HSQ/Si substrate at room temperature. In order to find out the optimum conditions for the printing, ink composition, O 2plasma intensity, pressing force and pressing time were manipulated. The transferred patterns were examined by the utilization of AFM, SEM and 3M tape. Experimental results demonstrated that the nano-features on the HSQ stamp can be ideally transferred onto the substrate with strong adhesion under moderate O2plasma treatment and pressing force [C2325]

"Optical Characteristics of Nano-crystalline Diamond Films as X-ray Lithography Masks for Integrated Circuit Fabrication"

In this paper, the structure, morphology and optical properties of nano-crystalline diamond (NCD) films, deposited by hot-filament chemical vapor deposition (HFCVD) method under different carbon concentration, are investigated. With increasing the carbon concentration during the film deposition, the diamond grain size is reduced and thus a smooth diamond film can be obtained. According to the data on the absorption coefficient in the wavelength range from 200 to 1100 nm, the optical gap of the NCD films decreases from 4.3 eV to 3.2eV with increasing the carbon concentration from 2.0% to 3.0% [C2326]

"Instabilities in deep submicron SRAM"

Scaling to nano scale CMOS has provided high density SRAM. Reduced cell area and increased density has created problem of standby leakage. Scaled down SRAM cell has more leakage and at high temperature it creates serious power issues. Application of leakage reduction methods generally lowers rail-to-rail voltage and hence reducing the stability of the cell. Reduction in cell node capacitance further increases the problem of soft errors [C2327]

"Memory properties using nano-scale phase separation of HfO based dielectrics"

We investigated the phase separation of HfO based high dielectric constant (k) material for the application to non-volatile memory devices. We found that Hf0.5Si0.5O2underwent phase separation upon annealing in the temperature range of 900degC to 1000degC: Hf0.5Si0.5O2rarr (0.5-x)/(1-x) HfO2+ 0.5/(1-x) Hf2Si 1-xO2where 0 < x < 0.5. When an electric field was applied to the tunnel oxide, the programming of memory devices with the high-k trapping layer consisting of phases separated in nano-scale was faster than that using Si3N4, due to the higher electron capture efficiency of the phase separated structure. Also, the phase separated nano-structure resulted in better retention than pure HfO2. Furthermore, it was found that the phase separation of HfOxinto Hf-rich HfOy(y<x) crystals and O-rich amorphous matrix HfOz(z>x) was effective to suppress the lateral migration of charges trapped in HfOx. This article demonstrates the 2-bit memory property attained using the phase separation for the short channel devices with channel length down to 180nm [C2328]

"Fabrication and properties of nano-Si quantum dot flash memory"

We proposed a novel integration processes including multilayer CVD poly-Si deposition and post-annealing and thermal oxidation processes for nano-Si quantum dot flash memory devices have been fabricated. With increasing tunneling oxide thickness, the operation voltage increases, but retention properties are improved. With increasing nono-Si particle sizes and layer thickness the memory window increases from 6V to 12V. After programming to "on" or "off" states, the drain current read at 1V is about 5 times 10-4A and 5 times 10-12A respectively. The ratio of "on" current to "off" current is about 8 orders. The nano-Si quantum dot memory devices show very good properties [C2329]

"A Novel Multi-Channel Phase-Change Memory Cell for Multi-State Storage with High Controllability"

Lateral single-channel (SC) and multi-channel (MC) phase-change memory (PCM) cell structures are numerically analyzed for multi-state storage based on their temperature distributions and their programming characteristics. As studied by finite element modeling (FEM), shorter pulses lead to more gradual transition from the set to the reset state of these cells. Especially, for the MC-PCM cell with channels having different lengths, channels are sequentially melted with increasing pulse amplitude. Corresponding step-like programming characteristics of the cell indicate high performance for its application of multi-state storage [C2330]

"SRAMs in Scaled Technologies under Process Variations: Failure Mechanisms, Test & Variation Tolerant Design"

The inter-die and intra-die variations in process parameters (in particular, threshold voltage (Vt)) can lead to large number of failures in an SRAM array, thereby, degrading the design yield in nanometer technologies. To improve parametric yield of nano-scaled memories, different circuit and architectural level techniques can be used. In this paper, we first analyze and model different SRAM failures due to parameter variations, and discuss test methodologies to test for process variation induced failures. Next, we describe two different self-repairing techniques-at the circuit level, using adaptive body biasing and at the architecture level, using built-in-self-test (BIST), redundancy and address remapping. The discussed self-repair mechanisms can improve design yield much beyond what can be achieved using row/column redundancy and error correcting codes (ECC) alone [C2331]

"Fabricating Microelectrode with Nano Radius Tip by Electrochemical Micromachining"

A fabrication technology of microelectrode with nano radius of its tip was presented in electrochemical micromachining (EMM). The mechanism of pulses EMM was expatriated firstly. The shaping principle of microelectrode and micro probe was analyzed. Based on the fundamental experimental behavior of EMM current, a control strategy of current density was proposed with the gap variance. Then an experimental setup was constructed with pulses power supply and a control computer, which could detect the machining process and control the current density. After the experiments of technology analyzed, some microelectrodes were fabricated successfully by tungsten filament. This could provide the simple microelectrode for further electro-machining or micro probe for scanning probe microscopy. Preliminary experimental results show the feasibility of EMM and its potential capability for better machining accuracy and smaller machining size [C2332]

"Nano metamaterials and photonic gratings by nanoimprint and hot embossing"

This paper reviews our recent progress in nanoimprint lithography and hot embossing for the fabrications of planar photonic meta-materials and photonic gratings. With these technologies, dielectric, metallic chiral structures and dense gratings in sizes from sub micrometres down to sub-100 nm were successfully fabricated. Characterisations of these meta-materials and photonic structures indicate these materials and structures are functional. It can be concluded that nanoimporint lithography and hot embossing are capable of achieving large area planar optic meta-materials and photonic structures such as dense gratings. This progress suggests the great prospect of these techniques for fast speed patterning of important meta materials and photonic nanostructures with high throughput at low cost in mass production in the future. [C2333]

"Photonic Crystals and Quantum Dots: Towards Integrated Optics for Advanced Ultra-Fast All-Optical Signal Processing"

Nano-photonic technologies of GaAs-based two-dimensional photonic crystal (2DPC) slab waveguides and InAs-based quantum dots (QDs) are reviewed for a symmetric Mach-Zehnder type, ultra-small and ultra-fast all-optical switch (PC-SMZ) and new logic (PC-FF) device. [C2334]

"Photocatalysis and Luminescence of Nanometer-sized CdS"

Nanometer-sized CdS, as a typical II-VI semiconductor, has unique properties in luminescence and photocatalysis. In the experiment, nano-sized CdS embedded in PVA was prepared by coordination transformation method, and the luminescence property was determined. It could be found that the emission wavelength of the sample will be blue-shifted, and the extent of the blue-shift decreases gradually with the ratio of Cd/O increased. The photocatalyst of nano-sized CdS, which was used for photoreducing CO2, was prepared by the same method on the double-support superfine SiO2and PVA. The photocatalytic activity of photoreducing CO2was tested and the results show that with the ratio of Cd/O increased, the size of CdS particle becomes large and its activity becomes weak. So from the luminescence and photocatalytic results, it could be found that there exist corresponding relationships between them at some extent [C2335]

"A Single-Wafer-Processed XY-Stage Fabricated with Trench-sidewall Doping and Refilled-Trench Isolating Technology"

For nano-metric positioning and manipulation, a single-crystalline-silicon XY-stage is fabricated by using a double-sided bulk-micromachining technology. For defining different electrostatic actuators in one ordinary wafer (instead of SOI wafer), a trench-sidewall electric isolation method is developed. Previously insulator-refilled trench-bars are used to cut and isolate the different comb-drive actuating elements on the structural trench-sidewalls. Combined with the reverse-biasd isolation of p-n junctions along the boron-diffused trench- sidewall for comb-driving, individual actuators can be operated independently. For maximizing the actuating stroke that is limited by the fabricated minimal comb-gap, a two-segment comb with a gentle-curve transition is designed for both improving actuation-amplitude and avoiding side-instability of the stage. Under 23 V actuating voltage, the moving stroke is about 10 mum in each of the four directions. Compared with conventional comb structure, the new comb design contributes 70% improvement in driving amplitude. Nano pitches on PMMA film are recorded by an electric-heated SPM probe. Coated with PMMA film, the stage movement is precisely controlled, resulting in controllable nano recording. [C2336]

"Optics Correction Based on MOEMS and PDS"

According to the thermal-optical effect and the elasto-optical effect, the relationship of the refractive index with the temperature and the stress of the optical window in the aerodynamic environment is obtained. Based on building the model of grid, ray-tracing in optical window is carried out. Then a novel method to correct the wave-front and reduce the blurring caused by aero-optical effect is introduced. It combines the adaptive optics using the micro-opto-electro-mechanical system (MOEMS) and phase diversity speckle (PDS) technique. Now the development of the nano or micro fabrication technique offers the possibility for the real-time correction system using the combination of MEMS and the nano or micro optics technology. Furthermore, the method of phase diversity speckle is less susceptible to systematic errors introduced by optical hardware, and it also works well for extended objects. In this paper, the key technique of the wave-front correction under aero-optical condition is developed based on MOEMS and PDS, and the feasibility of this technique in the high-speed missile guide system is analyzed theoretically [C2337]

"Investigation into High Performance High current Ultra Low Dropout Regulator"

The investigation into high-performance high current ultra low dropout regulator (LDO) was described in the paper. In the circuit design, prereference is used as a method of controlling the power of circuit to minimize the effect of power variation on functional block parameter, thus achieving the goal of enhancing voltage regulation. In the layout design, trim design for bandgap reference source and output resistive sampling network is done to improve the circuit temperature performance and the output voltage accuracy; the vertical PNP transistor with higher gain is used as a regulating transistor to increase the output current. In the process technology, a unique SOI based high voltage complementary bipolar process is used which will most likely be a key to manufacturing the NEMS and nano devices we are currently developing. The maximum operational voltage of the LDO is 18V, the output voltage is 5.0V, and the accuracy is plusmn0.8%. The maximum output current is 3A. The difference between input and output voltages is less than 0.45V. The voltage regulation is less than 5mV. The current regulation is less than 25mV. The quiescent current is less than 3mA. The temperature coefficient is less than 50ppm/degree C. And the performance parameters of the LDO correspond to that of world's best LDO, and part of parameters such as voltage regulation is the best in the world [C2338]

"The Safety of Nanotechnology"

This article gives an assessment of the prospects and potential problems of nanotechnology. The two dominant areas of large-scale application for nanotechnology are likely to be in information and communications technologies (ICT) and in medicine. The most disturbing aspects of the nano area at present are (a) the rapidly increasing evidence that certain kinds of nanofibres and nanoparticles may be highly toxic to biological systems, coupled with (b) the lack of quantitative methods for the detection, identification and characterisation of nanoparticles, and for studying their interaction with the environment [C2339]

"Electron Emission Mechanism of Diamond"

Clarifying the electron emission mechanism of diamond is one of the remaining problems for the realization of diamond cold cathodes for vacuum nano-electronics applications. Diamond is well known to have negative electron affinity (NEA) and an electric field of less than 1 V/mum is required to extract electrons from the surface, whereas much higher field is needed for the conventional metal emitter tips. However, there have been only few reports attempting to clarify the mechanism based on the experimental results. In this study, a combined spectroscopy of XPS/UPS/FES was performed to characterise the electron emission mechanism of diamond. As a result, we have succeeded in drawing the energy band diagram to explain the electron emission from various types of diamond [C2340]

"The Dualbeam (FIB/SEM) and its Applications-Nanoscale Sample Preparation and Modification"

Summary form only given. The ability to modify samples and create structures at the `nano' level (<100 nm) is now a very well established science. However, the tools required to facilitate this technology are going through a constant evolution in order to keep up with the high demands of new applications. One such tool is the Dualbeam, which combines a field emission SEM column with a gallium source focussed ion beam (FIB) column. Previously used only in the semiconductor or `nano-electronics' industry, it is now a vital tool in creating, modifying, imaging and analysing structures at the nano scale. In fact Dualbeams systems are now used regularly in semiconductors, data-storage, research, industry and even biology. Having two beams offers tremendous advantages to the user. A SEM column is the ideal tool for sample inspection and for imaging at high resolution of specific features without the risk of sample damage. By aligning the SEM and FIB at a reference point the sample can be inspected non-destructively and a certain area of interest determined. Software patterns are used to control where and how the ion beam is scanning on the sample and therefore where material is being removed. The milled area can be imaged in real time by the electron beam while the milling is in progress. This `simultaneous patterning and imaging' can be very useful to carefully control the milling process, using the ion beam only for material removal and the electron beam for non-destructive observation. An extension of the imaging and milling capability is called Slice and View. This allows an image to be recorded each time a `slice' of material is removed by the ion beam. The result is a stack of images taken through a selected area of a sample, showing information in x, y and z dimensions. However, true 3D information can be seen if the images are processed using reconstruction software. One of the most important applications of a dualbeam is that of quality TEM sample prepara- tion. With the aid of the electron beam-the ion beam can be placed very accurately and site specific TEM sample preparation is possible. Recently the development of Cs corrected TEM systems has meant that TEM sample quality is now of high importance if quality data is to be gained. Using low kV ion beam energies the sample damage often associated with high kV preparation can be virtually eliminated. In situ lift out techniques, such as the Omniprobe, allow the sample to be removed and attached to a grid inside the chamber, allowing for further thinning and polishing of the sample wherever necessary. The ion beam can also be used to modify or produce tools for use in a variety of applications. Examples might be the production of super fine needles in the medical field, for producing micro-indenters for materials research, or for creating/modifying an AFM tip. In many cases the combination of beams may produce the best results. For example, the AFM tip may be further enhanced by depositing a super fine tip of material on the end with the electron beam. Similarly, emitters for field ion microscopes can be prepared at site specific locations using FIB milling. An important application in the field of semiconductor development is that of device modification. Electronic circuits are shrinking at an incredible rate and in order to test or modify these circuits FIB and Dualbeam systems are indispensable. Device edit makes use of all the Dualbeams capabilities, ion beam milling, etching, deposition and even circuit testing. The Dualbeam is proving an indispensable tool in many nanotechnology applications. With the flexibility to choose either the ion or electron beam and the different properties that these beams have, many applications can be achieved in a single tool. In fact the Dualbeam can be considered a true nano-laboratory [C2341]

"The Electric Field Inducing and Self-Assembly of Gold Nanoparticulates"

With the development of nano technology, as an adjustable macro-scale preparing technology, manipulating the nano particulates by dielectrophoresis has been concerned badly. The main work of this paper is to research on the manipulation and self-assembly of the gold nano particulates between the electrodes which work in the external AC field. This work realizes self-assembly of nano particulates using adjustable macro-scale conditions including the external force. It would lay a foundation for fabrication of functional structures and nano device using gold nano particulates as a building block [C2342]

"Two-dimensional Photonic Crystal Microcavity with Germanium Self-assembled Quantum Dots"

We fabricated two-dimensional photonic crystals on silicon-on-insulator substrate. Ge/Si self-assembled quantum dots were embedded in the PhC cavity as light emitters. The photoluminescence spectra of H1 cavity at room temperature showed strong optical resonance in the cavity. Significant enhancement of the luminescence was achieved and a main peak at 1.43 mum was seen to dominate the spectrum. Reasonable shift of the resonant peak wavelength was observed by changing the PhC parameters. The results prove that combination between photonic crystal and Ge quantum dots is a reasonable way to realize Si-based light source. [C2343]

"Photonic Crystal-/Quantum Dot-Based Nanophotonics for Ultra-Fast All-Optical Digital Signal Processors"

Nano-photonic technologies of GaAs-based two-dimensional photonic crystal (2DPC) slab waveguides and InAs-based quantum dots (QDs) are reviewed for symmetric Mach-Zehnder type, ultra-small and ultra-fast all-optical switch (PC-SMZ) and optical flip-flop device (PC-FF). In the 1st phase of this work, ultra-fast (~ps) and ultra-low energy (~100 fJ) switching has been demonstrated using the PC-SMZ chip with 600 Г‚Вїm ГѓВ— 300 Г‚Вї m in size. In the 2nd phase, the concept of the PC-FF based on the dual PC-SMZs for providing a latch function has been proposed for a future ultra-fast optical digital processor, as shown in Fig.1. One of the priority subjects is to establish a new design method, i.e., topology optimization method of the 2DPC waveguide with wide/flat bandwidth, high transmittance and low reflectivity. Another one is to develop a selective-area-MBE growth technique with a metal-mask method for high-density and highly uniform InAs QDs with large optical nonlinearity (ONL). Recent results regarding these subjects are shown in detail in the presentation. [C2344]

"Fabrication of Novel Magnetite Nano-Pyramid Field Electron Emitters"

Large scale crystalline Fe3O4nanopyramid arrays are fabricated by CH4and N2plasma sputtering of hematite [0001] wafer. The nanopyramid arrays are characterized using SEM, TEM and EELS and the possible growth mechanism is discussed [C2345]

"The Fabrication of Nano Structures on Wafer Surface by using Nano Island Lithography"

There are serial structuring methods invented or used for the fabrication of nano structures. However, there is an urgent need for innovative processing technologies, including hybrid methods across multiple energetic domains, and three-dimensional imaging and fabrication technologies such as ultrasonics. This paper shows a novel method of nano island lithography to shape hemispherically islands of cesium chloride with nano size. Nano island lithography was invented by Prof. Mino Green in Imperial College as a synthetic fabricating method (bottom-up). The method is the exposure of the CsCl thin film to water vapor for growth of CsCl islands (also called dots or hemispheres). Growth rate of CsCl islands is dominated by the kinetics of dissolution and deposition at the solid/solution boundary, rather than by inter island diffusion. The CsCl islands are translated to wafer or other material surface by RIE and lift-off technologies which are transformative (top-down) fabrication. And more, the island lithography can combine with UV lithography to create micro and nano scale hierarchical structures which induce super-hydrophobic surfaces with large CA and small alpha. [C2346]

"Occurrence of Virtual Entanglement in Nano-CMOS logic"

Using the theoretical framework of quantum mechanics we predict the possibility of occurrence of virtual entanglement in CMOS logic at nano-dimensions. Quantum mechanical properties such as superposition and entanglement are applied to CMOS logic and analysis is done using Dirac notation. The behavior of the n-type and p-type transistor during the computation phase is described. The parameter considered for analysis is state of the transistor and we obtain its behavior due to superposition and entanglement with other spatially separated transistors [C2347]

"Adhesive and Mechanical Properties of Nano-Particle Filled Thermoplastic Polyimide Dielectric Films for Microelectronics Packaging"

In this study the mechanical and adhesive properties of aluminum nitride (AlN) nano powder filled polyimide composite films (AlN-PI) are investigated to determine their usefulness as dielectric materials in microelectronic packaging. AlN nano powder was mixed in low wt% during synthesis at poly(amic acid) (PAA) stage. AlN-PI films were characterized using DMTA and tensile testing to determine viscoelastic behavior and mechanical properties. Adhesive strength of bonded samples was determined using single lap joint tests. The fractured surfaces were examined by scanning electron microscope (SEM) to determine failure patterns. The results showed that viscoelastic behavior of AlN-PI films changes from liquid-like to solid-like with increasing AlN content. Elastic modulus and strength at break of nano particle-composite films were found to increase with increase in AlN wt %. However, elongation at break and breaking energy of films and lap shear strength of bonded samples were found to initially increase with increase in nano particle wt%, but then after a critical value decreases [C2348]

"Low-Power and Process Variation Tolerant Memories in sub-90nm Technologies"

Inter-die and intra-die variation in process parameters increases parametric failures and leakage spread in nano-scale memories, leading to significant yield degradation. Design level optimization methods are not sufficient to address the leakage and parametric failures, particularly, under large variation. In this paper, we propose two post-silicon tuning techniques which can simultaneously reduce the leakage spread and improve parametric yield in memories. We show that, self- repairing and self-adaptive systems with post-silicon tuning are essential for designing low-power and robust memories in sub- 90 nm technologies. [C2349]

"Nano-CMOS Technology for Next Fifteen Years"

Complementary metal-oxide-semiconductor (CMOS) technology has been developed into the sub-100 nm range. It is expected that the nano-CMOS technology will govern the IC manufacturing for at least another couple of decades. Though there are many challenges ahead, further down-sizing the device to a few nanometers is still on the schedule of International Technology Roadmap for Semiconductors (ITRS). Several technological options for manufacturing nano-CMOS microchips are available or will soon be available. This paper reviews the challenges of nano-CMOS downsizing and manufacturing. We shall focus on the recent progresses on the key technologies for the nano-CMOS IC fabrication in the next fifteen years [C2350]

"A nano-sized catalytic architecture composed of SiO/sub 2/-TiO/sub 2/ particle and carbon nanofibers"

Amorphous SiO2-TiO2particles have been grown on the carbon nanofibers successfully via hydrothermal synthesis. SEM and TEM images revealed that the produced particles were in nano size (under 10 nm) and appeared to be distributed uniformly along the curvature of the nanofibers. This work also reveals the possibility of obtaining crystalline particles from amorphous phase via recrystallization. The synthesized composite material could be a potential candidate for catalytic reactions which utilize Ti centre as an active site and which require the particle size of the catalyst in nanometer scale. [C2351]

"Cluster Assembly: a Technology for Commercial Production of Nanowires"

Atomic clusters have been deposited from an inert gas aggregation source to form cluster-assembled nanowires with a view to electronic and chemical sensor applications. The fabrication methods employed make use of many of the desirable features of both bottom-up and top-down approaches to nanotechnology. We have produced electrically conducting nanowires through the deposition of atomic clusters onto lithographically prepared templates. These nanowires are being commercialized through a start-up company in collaboration with US-based partners. The application examples presented here are i) working hydrogen sensors based on Pd clusters and ii) trenches filled with copper clusters for use as interconnects. [C2352]

"3-Dimensional Integration for Interconnect Reduction in for Nano-CMOS Technologies"

This paper describes a method to integrate non-planar multi-gate CMOS devices in the third dimension. The technology is based on highly scalable multi-gate MOSFET structures which are promising for nano-scale integration. The extension to have active devices placed the third dimension allow significant reduction in the interconnect loading. We have demonstrated the potential of such technology though experimentally fabricated devices as well as detail system level analysis [C2353]

"Study on Atoms Diffusion of Vacuum Fusion Sintering WC-Co Composite Nano-coatings"

The WC-Co composite nano-coatings bonded strongly with steel substrate has been made by vacuum fusion sintering (VFS). Diffusion plays a crucial role in VFS processes, of which the atoms diffusion nearby interface is a vital variable which influences the interfacial bond strength. The atoms diffusion during the vacuum fusion sintering (VFS) process was firstly studied by molecular dynamics and by Fick second law of diffusion. The three-dimensional MD model was built, by which the atoms diffusion, atoms migration contrail and the VFS process were simulated. The concentration distribution of some components were measured by the electrical probe, and the microstructure and morphology of VFS nano-coatings were observed and analyzed by SEM, X-ray diffraction meter and micro-hardness instrument. Combined with the experimental results, diffusion coefficient of every element was calculated in diffusion dynamics [C2354]

"Silicon Nano Beam Fabricated by MEMS Technology and Its Electronic Properties"

In this paper, a MEMS method is developed to form suspended nano beams in 10 nm order width and thickness. The dimension of the nano beams is controlled precisely by employing traditional anisotropic self stopping etching instead of popular nano fabrication method such as e-beam lithography, which presents an opportunity for the future low cost batch product. The I-V measurements indicate that the resistance of the silicon nano beams has significant aging effect, which increases distinctly after released. The reason has been contributed to the oxidation of surface silicon. Besides, it is found that the resistance of the nano wire can vary with the gate voltage. As the gate voltage increases, a carrier depletion of the nano wire is observed. This may provide a new way to motivate and detect the resonation of the nano beam [C2355]

"The Novel and Effective Method of Removing of Trace Iron Impurity from Aluminum Isopropoxide for Nano-alumina"

Aluminum isopropoxide (AIP) is an important precursor in preparing high-purity and nano-alumina. The iron impurity in AIP has bad effect on the application of nano-alumina. In order to prepare the iron-free AIP, chelate organic ligand is added to this reaction system together with Al and isopropanol to form the high boiling point complex of the iron impurity in AIP by chelation. It has been revealed that phenolphthalein (P), an O-containing organic ligand, can form a stable, non-volatile chelate complex with iron element in the presence of AIP. By adding P into the reaction system and undergoing vacuum distillation after the reaction, 80% of the total product gives a high purity value with Fe content being less than 10 ppm (by $Al2O3$) that satisfies the need of luminous materials when mass ratio of P: Al is 1:500. A feasible mechanism about removal of trace iron impurity from AIP has been presented. [C2356]

"Complex Flow and Heat Transfer Behavior of Micro/nano Fluidics: Benard Convection Always Occurs in a NEMS World"

In recent years, interest in the thermal-hydraulics at micro/nano scale keeps increasingly growing owning to the rapid technology thus enabled. It was now accepted that the classical thermal or fluidic theories working well for "macro bulk systems" may become invalid for micro/nano scale geometry. On the contrary, some phenomena seldom occur in the large scale may frequently happen as a routine event in the small world. This study is aimed to theoretically predict a basic phenomenon that may always be encountered in the micro/nano fluidics devices, i.e. the previously well known Benard convection cell could easily be induced in a nano scale liquid film even by an extremely small temperature difference across such layer. It is this event that increases the complexity of the flow and heat transfer patterns in the MEMS/NEMS. Fundamental mechanisms related to this phenomenon will be interpreted and its implementations for developing useful tool will be suggested [C2357]

"Robust Sense Amplifier Design under Random Dopant Fluctuations in Nano-Scale CMOS Technologies"

Variation in transistor characteristics and particularly threshold voltage (Vt) has emerged as a major challenge for circuit design in scaled technologies. Process variations result in increased mismatch among neighboring transistors which can affect the correct functionality of circuits such as sense amplifiers. In this paper, we will analyze the impact of process variations on sense amplifier circuits in detail. We will explore statistical design and optimization techniques based on transistor sizing to improve the reliability of sense amplifiers under process variations. Furthermore, we will exploit dual Vt option to enhance the sense amplifier robustness. According to simulation results in a 70 nm process, by optimal transistor sizing and dual Vt assignment, failure probability of sense amplifiers can be greatly reduced (by more than 80%). [C2358]

"Polymer Micro-and Nano-scale Fabrication Technology Development for Bioinspired Sensing"

We report on the development of new elastomers and processes that utilize polymers such as PDMS, FSR (force sensitive resistor) polymer, MWCNT, and polyurethane to realize bioinspired sensors such as artificial haircells. In nature, haircell sensors are used by fish to sense flow, by spiders to sense vibration, and by some vertebrates for hearing and acoustics. An artificial haircell sensor is designed to mimic the ability of natural haircells to sense flow, vibration, and touch. However, in order to improve the sensitivity and robustness, the use of polymers is necessary. In this paper, we present the different generations of bioinspired artificial haircell sensors, along with the polymers and processes needed for their construction [C2359]

"Electrostatically Actuated Nano Tweezers Fabricated on Micro Processed Electrodes"

Nanoscale tweezers are integrated to deep reactive ion etching (DRIE)-processed microelectrodes by localized chemical vapor deposition using focused ion beam (FIB-CVD). The MEMS electrodes for electrostatic actuation of nano tweezers are fabricated on a heavily doped SOI wafer, which works as the interconnecting platform to control nanoscale device from macro-world. Unlike the carbon nano tube (CNT)-based nano tweezers, the dimension and gap between the pillars are well-controlled such that the designed range of motion and the operation voltage are easily achieved. Compared to repulsive nano tweezers, the actuation voltage is at least an order lower for the similar range of motion. Repeated electrostatic tweezing action for two sets of tweezers shapes has been successfully demonstrated. For bent type tweezers, short pillar is deposited on the edge of electrode to adjust the initial gap of tweezers which measures 17 mum in length and 300 nm in diameter. The threshold voltages that causes snap-down are dependent on the initial gap size of the unactuated pillars, and the measured value are 93 V for 3.5 mum and 30 V for 2.21 mum gaps. The dimension of straight type tweezers is 19.6 mum in length and 300 nm in diameter with 6.9 mum initial gap distance. Tweezing range is 3.4 mum and snap down voltage is 102 V. Young's modulus of the FIB-CVD carbon tweezers is estimated to be 377 GPa based on the experimental results. Tweezers with complicated 3-dimensional shapes are also presented [C2360]

"JEOL provides total solution and flexibility in the world of Electron Microscopy for the new era of Bio-Engineering and Nano-Technology"

{no data available} [C2361]

"A Low-Cost Microstrip UWB Pulse Generator with Integral Bi-Phase Switching Modulation"

We report on preliminary results from the development of a low-data rate, low-cost, Ultra-wideband (UWB) pulse generator which uses an RF Step Recovery Diode (SRD) on microstrip board. A circuit employing a single Skyworks CVB1031 SRD part on Rogers RT/Duroid 5870 RF board has been developed using HP Advanced Design System (ADS) software; initial simulation results show that sub nano-second (0.4-0.6 ns) monocycle wideband pulses with a repetition period of 2.5 ns (400 MHz) are achievable. While wideband pulse generators using SRD parts have been verified elsewhere [5, 7], the novelty in this work is that a six-finger, interdigitated Lange Coupler, employing an LC tank switching technique previously demonstrated at integrated circuit (IC) level [8], has been added to the pulse generator to yield a bi-phase pulse modulation technique. Pilot findings show a high degree of symmetry between the bi-phase output pulses, demonstrating how an RF pulse generator, designed with low-cost microstrip board and SMD techniques, has the potential to be used as a cost-effective pulse modulator solution in the physical layer of a wideband communication system. [C2362]

"Work in Progress: Micro-/Nano-technology `Lab-on-a-chip' Research Project for First-Year Honors Engineering Program"

The Fundamentals of Engineering for Honors (FEH) alternate group project (ENG H193A) uses micro-and nano-technology to involve students in research in their first year through development of and experimentation with a silicone rubber 'lab-on-a-chip'. Students seek to determine if a correlation exists between surface topology and cell adherence. They design and fabricate a lab-on-a-chip and use it to test the hypothesis. As part of the project, students use computational fluid dynamics (CFD) software to better understand and visualize the forces acting on the cells. Additionally, students create a three-dimensional computer-aided model of a theoretical nanofactory which would be used to alter the structure of DNA. At the end of the term, students submit a written report, project notebook, and laboratory notebook detailing their experimental work as well as their nanofactory model. Finally, they present the results of their experimental work orally to a panel who judge the students' results and understanding of the concepts involved [C2363]

"Nano- and Micrometric Structures for Cell and Tissue Engineering"

First Page of the Article [C2364]

"The Microflown, a Novel Approach to Helicopters Interior Noise Testing"

Noise levels recorded in the helicopter cabin are severely affected by the strength and vicinity of noise sources. Jet engines, the gearbox and the rotors can be considered as separated sources-whose spectral content is strongly tonal and rpm dependant-exciting simultaneously the cabin acoustic cavity. The total sound pressure level measurable in cabin can be then considered as a summation of partial contributions generated by each source acting separately. The energy transfer from each source to the cabin can be either structure borne, via the mechanical joints connecting the gearbox to the helicopter's ceiling, or airborne, via the sound propagation in the air from the rotors to the cabin. Analysis techniques such as transfer path analysis are largely applied in the automotive industry that allows identifying the main transmission paths and their relative contribution to the total sound pressure level in cabin. Several variants exist for TPA model to be realized, but all are eventually dependent on the experimental NVH data measure in operating conditions. However, measuring acoustic data on helicopters is a difficult matter because of the multiplicity of source, their high correlation (all sources are dependant on the rotational speed) and the high reflectivity of the acoustics field in cabin. Traditional testing techniques as acoustic intensity or near field acoustic holography fail correctly addressing the problem, as they cannot account for the "negative contribution" of reactive intensity or for the complexity of test set-up whose requirement are often colliding with the operating needs of a flight mission. An alternative testing technique that makes use of novel acoustic probes, the Microflown, proves able to deal with harsh environmental testing conditions while improving measurement accuracy and paves the way for a better understanding on how to reduce noise level in helicopter cabins. The Microflown probe couples a miniaturized microphone and a microscop--ic particle velocity probe. The latter is realized making use of nano-technologies (MEMS) and allows measuring accurately in-situ particle velocity providing a powerful tool to identify noise flow from the sources to the cabin. In the present paper a full description of the novel acoustic probe is provided and an application case is presented that allows realizing noise maps of a helicopter cabin in operating conditions. The noise maps measured with the Microflown point out critical areas that are susceptible of design modifications such as to improve cabin acoustic comfort [C2365]

"Molecular Nanotechnology Using Organic Nanofibers"

Light emitting single crystalline organic nanofibers with extraordinary morphologic properties are generated via molecular beam epitaxy from tailored molecular building blocks. The designed optoelectronic properties of the molecules are reflected in the properties of the resulting nanoaggregates and those aggregates are multiplied via bottom up self assembly. Via soft lift off the optimized nanofibers can be transferred to arbitrary new substrates and thus integrated into new advanced photonic devices. As an example for the feasibility of this new technology, custom-made nano frequency converters are discussed [C2366]

"Efficient Link Architecture for On-Chip Serial links and Networks"

Serial links are an effective solution to address the growing on-chip communication bottlenecks in nano-CMOS technologies. This paper proposes efficient link architecture for on-chip serial links and networks. The proposed solution consists of a pre-emphasized differential driver and receiver interconnected by LC transmission lines. The LC transmission lines are implemented in packaging layers post processed directly above a standard CMOS wafer. The link enables simple register-to-register style data transfer, well suited for on-chip IO. The proposed scheme can offer data rates as high as 12.5 Gbps per channel for less than 0.5pJ of energy per bit on the 0.13mum technology [C2367]

"A 0.8V 1.52MHz MSVC Relaxation Oscillator with Inverted Mirror Feedback Reference for UHF RFID"

A 0.8V nano-power relaxation oscillator for EPC standard UHF RFID transponder is presented. A low-voltage inverted mirror feedback VGS/R reference is proposed to provide correlated current and voltage references for the oscillator. As a result, the oscillator frequency is solely determined by the resistor in the reference and the timing capacitor to meet the frequency tolerance specification. Meanwhile, to minimize the power consumption, a minimum-supply-voltage-constraint (MSVC) design criterion is proposed to minimize the required supply voltage. The inverted mirror feedback technique reduces the headroom requirement of the traditional VGS /R to meet the MSVC. Measurement results show that the entire oscillator requires a minimum supply voltage of 0.8V in the prototype chip fabricated in CMOS 0.13mum technologies. The measured oscillation frequency is 1.52MHz with 400nA total current consumption. The chip area is 13400mum2 [C2368]

"Measurement of Inductive Coupling Effect on Timing in 90nm Global Interconnects"

Inductive coupling is becoming a design concern for global interconnects in nano-meter technology. This paper shows measurement results of inductive coupling effect on timing, and reveals that inductive coupling noise is a practical design issue in 90nm technology. The measured delay change curve is consistent with circuit simulation results with RLC interconnect model, and definitely different from those of conventional RC model. Long-range effect and noise reduction by ground insertion are clearly observed on silicon [C2369]

"EDA Challenges in Nano-scale Technology"

Since the onset of the 90 nm node the challenges associated with further transistor scaling while maintaining a consistently functional, reliable, and yielding design have increased substantially. While those challenges carry across the spectrum of the manufacturing, the EDA, and the design communities, we believe it is the responsibility and the goal of the EDA industry to deal with those issues as thoroughly and as seamlessly as possible to make those challenges transparent to the designer. In this paper we expose and analyze a plurality of those challenges and briefly go over the solutions EDA tools are offering for dealing with them. We also look forward and cover some of the future challenges associated with the integration of the emerging bottoms-up nano-materials flow with the traditional CMOS top-down process flow which has also entered the nano-era [C2370]

"Analysis and fabrication of sub micron scale directional coupler in high-index Silicon-On-Insulator"

In this paper we describe the design, fabrication and analysis of a directional coupler using sub micron SOI waveguides. Specifically, we focus on couplers featuring sub 100nm waveguide separation. Several phenomena that occur due to the ultra small gap are examined. We show that the etching rate at the waveguides gap is decreased and as a consequence the coupling between the waveguides is enhanced. Three dimensional numerical simulations are presented as well as fabrication results. [C2371]

"Reliable Interconnect Grid for Ultra Deep Submicron"

Reliability of the interconnects has become a challenge in deep submicron technology. In this paper, we propose grid communication strategy that establishes highly reliable interconnects with no length limitation. We show that using direct sequence spread spectrum and inexpensive transceivers we can transfer data with extremely low error rates. Such a highly reliable communication network is vital for future ultra deep submicron and nano systems. Experimental results are also reported to verify the concept, clarify the design procedure and measure the communication grid metrics [C2372]

"Development and Testing of a High Voltage Direct Converter for High Power RF Applications"

This paper is concerned with the development of a novel direct power converter for high energy physics CW applications. The converter consists of a direct (matrix) converter driving a high frequency resonant link. Operation at high frequency reduces transformer and filter size. The high frequency output is used to excite a resonant tank at its resonant frequency. Losses are minimised by switching at zero current. A high voltage, high frequency transformer is used to step up to the required voltage. The transformer is incorporated into the resonant circuit and uses the latest nano-crystalline materials to further reduce losses. Consequently design of this transformer to provide VA rating, dielectric strength and resonant operation is non-trivial. The RF supply generated is stable and predictable at 20 kV DC, whilst the reduced energy storage removes the need for crowbar circuits. Potential benefits of this converter when compared to conventional approaches are discussed. These include reduced energy storage, reduced size, and reduced turn on time. Simulation results are presented along with output practical results obtained from a prototype (16 kW) converter [C2373]

"Dielectric ageing: materials, measurements and modelling of nano to meso scale processes"

This paper considers ageing processes in polymeric dielectrics under the action of applied electric fields. Ageing can be thought of as occurring in two stages, initiation of damage and its subsequent evolution. Initially, charge carriers move through the material perturbing the local field (space charge) and inducing excited states. Such processes can result in the production of photons (electroluminescence) through carrier recombination processes or the relaxation of excited molecular states and consequent permanent chemical changes. Once local molecular damage has been initiated, growth commonly occurs through the development of fractal structures (electrical trees). All the above processes can be dependent upon both the molecular composition and microstructure of the dielectric concerned and we demonstrate the value of using material design, novel experimental techniques and modelling in concert to understand the underlying physics and chemistry of ageing [C2374]

"Microfabrication of nano-fractal electrodes for EEG application"

Electro-encephalography is the recording of bio-potentials in the brain. Generally, needle electrodes are used for EEG application. However, with the advancement of technology, fractal electrodes have been developed recently and are as dry electrodes that do not require the use of gel. These days, with the facilities of nanotechnology and micro fabrication, new types of nano-electrodes with new materials are possible. In the present paper, design and micro-fabrication of new fractally coated nano-electrodes are discussed. The fabrication aspects under different environments for different configurations are given in detail. The work on selection of materials for optimum performance has been pursued which is presented here in brief. The testing of these electrodes on the laboratory phantoms and in vivo objects is given. These nanosize electrodes are very useful in the study and diagnosis of brain activity, particularly, in the form of an array housed in a bundle wrapped around the head over the skull. The nano fractal electrodes technique is quick, reliable and successful. The system can be made in portable form and the data can be telemetered easily in remote areas [C2375]

"Bridging the imaging gap in nanobiology with three-dimensional electron microscopy"

Summary form only given. Emerging methods in three-dimensional biological electron microscopy provide powerful tools and great promise to bridge a critical gap in imaging in the biomedical size spectrum. This gap comprises a size range of great interest in biology and medicine that includes cellular protein machines, giant protein and nucleic acid assemblies, small subcellular organelles and small bacteria. In our laboratory at the National Cancer Institute, NIH, we are using a variety of approaches that utilize electron microscopic imaging to discover and analyze biological complexity within the size gap with linear dimensions of about 50-1000 nm. A key mission of our laboratory is to quantitatively describe the spatial and temporal architecture of key molecular machines that fall into this "nano gap". Areas of current interest include: (i) the development and application of novel technologies for three-dimensional electron microscopy of specimens ranging in size from small molecules to tissues, including automated approaches to analyze the molecular structure and sub-cellular location of a variety of nanoparticles, (ii) determination of the dynamic spatial and temporal architectures of cellular structures and molecular machines involved in fundamental process such as energy transduction, cell division and chemotaxis, and (iii) determination of molecular mechanisms underlying the neutralization and cellular entry of HIV [C2376]

"Nanotubes in NEMS -- Impact to the Marine Technology"

Advance of technology touches most surely the area of marine engineering. Nanotechnology, as at the top of research interest, has potential to change our lives. Nanocomputers, nanocontrollers or nanomechanical devices will impact every aspect of marine technology. One of the nanotechnological products are nano-electromechanical systems (NEMS). NEMS are manufactured and/or assembled by a lot of nanoelements. One of possible elements is carbon nanotubes. Cold emission of electrons is the characteristic of nanotubes. When in contact with metallic object, such as ship, it is possible that undesirable electric flow occurs. So, this article contributes to calculation of electrostatic charge of a nanotube in the proximity of ship's hall. The purpose of the research is to point out problems in application of nanotechnology on board [C2377]

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