

PLENARY SESSION

E-MRS 2002 SPRING MEETING

Plenary Session

Wednesday, June 19, 2002
Mercredi 19 juin 2002

Morning
Matin

	08:15-8:30	WELCOME ALLOCUTION
SESSION CHAIRS:		Giovanni MARLETTA , E-MRS President Mildred DRESSELHAUS , MIT, Cambridge, USA
PS-1	08:30-9:05	J.M. LEHN , ULP, Institut Le Bel, ISIS, Strasbourg, France (Nobel Prize 1987) " "
PS-2	09:05-9:40	W. ARDEN , INFINEON Technologies - Corporate Logic, München, Germany "The International Technology Roadmap for semiconductors -perspectives and challenges on silicon for the next 15 years" The paper will give an overview on the structure and the contents of the International Technology Roadmap for Semiconductors (ITRS) 2001, with special emphasis on future requirements on semiconductor materials for manufacturing technologies on silicon. The ITRS started in 1992 as a US-national roadmap and became a joint international effort in 1998 with all major five industrial global regions (US, Japan, Taiwan, Korea and Europe) participating in its definition. Its technical scope covers semiconductor technology from design & test, device architecture, manufacturing processes, factory integration and environmental issues. The time horizon extends to the following 15 years. Representatives from IC manufactures, equipment & material suppliers, research institutes and consortia totaling more than 800 experts are engaged in the definition of future requirements for the semiconductor industry. The outlook in semiconductor manufacturing expects the continuous application of silicon technology for the next 15 years where CMOS based devices will carry the development of the industry at least for one more decade. New device architectures and concepts based on silicon wafer material are being developed to support the development of the IC industry for another one or two decades. The talk will high-light the key issues of future semiconductor material requirements. These will cover material aspects for front end processing, interconnect, lithography, new memory concepts and new devices. Materials to be discussed are, for example, high permittivity gate dielectrics, low k insulating layers for interconnect, ferroelectrics for memory applications as well as new resist materials for very deep UV imaging processes.
PS-3	09:40-10:15	P. FROMHERZ , Max-Planck-Institute for Biochemistry, München, Germany "Semiconductors with brain" Assembling living matter and semiconductors may give rise to devices that combine analog biodynamics and digital electronics for information processing and medical prosthetics. We explore the fundamentals of such future hybrid devices and study silicon chips with ion channel molecules, nerve cells and brain tissue. Two directions are followed: On a nanoscopic level we analyze and optimize the interface of electronics and ionics. On a microscopic level we join neuronal networks with microelectronic circuits. In the first area, solid state physics and DNA technology are used to improve the cell-chip interaction; fluorescence methods elucidate the nature of the cell-chip contact. In the second area, small defined nets of snail neurons and tissue slices of rat brain are electronically interfaced to semiconductor chips. The approach relies on an integration of concepts and techniques in neurophysiology, molecular biology, electrochemistry, semiconductor physics and microelectronics.
	10:15-10:45	BREAK

- PS-4** 10:45-11:20 **D.B. GEOHEGAN**, A. A. Puzetky, C. H. Schittenhelm, M. A. Guillorn, P. F. Britt, M. Lance, D. Austin, H. Cui, G. Eres, M. L. Simpson, S. J. Pennycook, R. Buczco, L. Allard, J. Howe, A. Lupini, M. Chisholm and D. H. Lowndes, Oak-Ridge National Laboratory, USA
 "Laser synthesis and processing of single-wall carbon nanotubes for advanced electronics and composites"
 Single-wall carbon nanotubes (SWNTs) are just one example of a multitude of one-dimensional nanocrystals which are efficiently grown by catalytically-assisted laser-synthesis. SWNT show remarkable promise for the development of future generations of multifunctional electronic and structural materials. Individual SWNT exhibit metallic or semiconducting behaviors depending upon their atomic structure, and have an axial Young's modulus ~ 1 Tpa. Of the several methods to grow SWNT, the laser vaporization (LV) approach naturally yields: the narrowest distribution of nanotube diameters, exclusively single-walled nanotubes, at the fastest growth rate, from a wide distribution of catalyst nanoparticle diameters. The LV approach is also the most well-suited to time-resolved diagnostic investigation. In this talk, time-resolved *in situ* spectroscopic investigations of SWNT growth are described which are yielding some of the first direct determinations of carbon nanotube growth mechanisms and rates necessary to evaluate strategies for controllable synthesis and large-scale production. Results will be presented to show that SWNT grow over extended annealing times during the LV process by the conversion of *condensed phase* (cluster and nanoparticulate) feedstock. Methods to enhance the growth rate for faster SWNT production and the growth of SWNT by laser- annealing and other thermal treatments of condensed-phase precursors will be discussed. However, the synthesis conditions of SWNT can dramatically affect strategies for their subsequent chemical purification and functionalization. Resonant Raman scattering measurements are described for the monitoring and control of SWNT defect levels, a first step toward reproducible SWNT chemistry for composites and electronics. Results and strategies for the formation of nanotube-based electronic devices, composite materials, and multifunctional composites will be discussed.
- PS-5** 11:20-11:55 **S. KALBITZER**, Physics Department, University of Pretoria, South Africa
 "Semiconductors for optical memories"
 Optical nano-structures can be produced in semiconducting materials by irradiation with focused ion beams. Exposed target areas exhibit strong optical absorption in contrast with non-implanted regions. Geometrical limitations on pixel size are set by lateral straggling of the ion beam. By proper choice of implantation conditions pixel diameters of less than 100 nm can be produced with an estimated limit of about 10 nm. For digital recording the resulting pixel densities reach ultra-high values of $10^{10} - 10^{12}$ pix/cm². Hetero-epitaxial silicon on sapphire, commercially available as thin films, constitutes an excellent recording material with an optical working range up to photon energies of $h\nu \sim 3$ eV. Diamond layers with a useful optical range of up to $h\nu \sim 6$ eV have the promise of better resolution due to a lower Abbé limit. The life times of these optical memories greatly exceed those of all presently used storage techniques. The physical properties of this ionographic technique, i.e. of ultra-high pixel density and practically unlimited life time of the recorded information, provide a perfect tool for permanent mass storage of archival data.
- PS-6** 11:55-12:30 **Y. PETROFF**, ALS-LBNL, University of California-Berkeley, USA
 "Impact of synchrotron radiation in materials science"
 The brightness and the partial coherence of the beams produced by third generation S.R. sources have opened new possibilities, allowing the development of new techniques. This will be illustrated by describing very recent results in various areas: high pressure physics, magnetism, electronic properties of solids and imaging.