SYMPOSIUM X

Frontiers of Materials Research

April 22 – 24, 2003

Chairs

Terry J. Garino
Ceramic Materials Dept
Sandia Natl Laboratories
MS-1411
Albuquerque, NM 87185-1411
505-845-8762

Hans J. L. Gossmann
Axcelis Technologies
Beverly, MA 01915
978-787-9620

Lisa C. Klein
Dept of Ceramic & Materials Engr
Rutgers Univ
Piscataway, NJ 08854-8065
732-445-2096

Albert Polman
FOM - Inst AMOLF
Amsterdam, NL-1098 SJ NETHERLANDS
31-20-608-1234

* Invited paper

This symposium is the Society's principal vehicle to maintain the interdisciplinary and integrative nature of its mission within the materials community with invited reviews presented over the lunch hour. Leaders in various specialties represented by the topical symposia present reviews designed for materials researchers who are NOT specialists in the reviewed field.

SESSION X1:
Chairs: Terry J. Garino, Hans J. L. Gossmann,
Lisa C. Klein and Albert Polman
Tuesday Afternoon, April 22, 2003
Salon 7 (Marriott)

12:05 PM *X1.1
QUO VADIS, SILICON? Meikei Ieong[a,b], Bruce Doris[b], Kathryn Guarini[a], Wilfried Haensch[a], Jakub Kedzierski[a], Edward Nowak[b], Ken Rim[a], H-S Philip Wong[a], and Min Yang[a], IBM Semiconductor Research and Development Center (SRDC), [a]Research Division, T.J. Watson Research Center, Yorktown Heights, NY; [b]Microelectronics Division, Hopewell Junction, NY.

This talk will provide a brief overview of high-performance silicon device technology for a general audience. Transistor performance can be improved by device scaling, shrinking both the vertical and lateral dimensions. Key parameters to continue the conventional CMOS device scaling will be discussed.
Simple extrapolation of fundamental physical limits has led to pessimistic predictions for the end of device scaling. On the other hand, the race to fabricate the smallest transistor continues to show tremendous progress. Functional transistors with gate-length down to 6 nm were recently demonstrated using aggressive halo implant and ultrathin channels of 4 to 8 nm. An ultrathin silicon-on-insulator (SOI) layer can effectively reduce the short-channel-effect and eliminate most of the leakage paths. However, rapid degradation of mobility with the channel thickness will limit how far we can scale the SOI layer thickness. Novel device structures and new materials are needed to overcome these barriers. Further performance improvements can be achieved through three-dimensional (3D) integration of multiple layers of transistors. We argue that there is still plenty of room for continued advancement of silicon device technology.

12:45 PM *X1.2
WORKFORCE AND EDUCATION ISSUES IN MATERIALS SCIENCE AND ENGINEERING. Sylvia M. Johnson, NASA Ames Research Center, Moffett Field, CA.

A workshop entitled "Workforce and Education in Materials Science and Engineering: Is Action Needed?" was held at the Beckman Center, Irvine, California on October 21, 2002. Three sessions were scheduled, considering respectively "Defining Materials Science and Engineering", "Demand for Materials Scientists and Engineers" and "Supply of Materials Scientists and Engineers", each with invited speakers and discussions. Substantial audience participation took place throughout, with a final discussion period devoted to the question, "Is Action Needed?". The general theme revolved around the basic issue of whether the U.S. has the right number, mix and quality of materials scientists and engineers to meet current and future demands. At the outset, it was emphasized - and this was amply confirmed by the final discussion - that the workshop would not and could not provide complete answers to the questions posed, but would rather relate to the nominally simpler question, "Is There a Problem?".
This presentation will review some of the data and the discussions from this workshop.
Acknowledgement: The presentation will draw from the contributions of all the speakers and attendees at the workshop.

SESSION X2:
Chairs: Terry J. Garino, Hans J. L. Gossmann,
Lisa C. Klein and Albert Polman
Wednesday Afternoon, April 23, 2003
Salon 7 (Marriott)

12:05 PM *X2.1
NANOCRYSTALS: FROM SCALING LAWS TO APPLICATIONS. Paul Alivisatos, Department of Chemistry, University of California, Berkeley, CA.

This talk will provide a brief overview of the field of nanocrystal science and technology for the general audience. Nanometer size crystals of inorganic solids are the size of a protein of biological macromolecule. They exhibit strongly size dependent and very predictable physical and chemical properties. Recently, the ability to precisely control the sizes and shapes of nanocrystals has emerged. This has led to increased interest in using these nanocrystals in a wide range of applications from biological labeling to electro-optical sensing and detection.

12:45 PM *X2.2

OUTSTANDING YOUNG INVESTIGATOR ORAL PRESENTATION

SYNTHETIC POLYPEPTIDES: NEW DEVELOPMENTS IN AN OLD FIELD. Timothy Deming, University of California, Santa Barbara, CA.

The use of low-valent metal complexes for the polymerization of alpha-amino acid-N-carboxyanhydrides (NCAs) will be presented. Details of these polymerizations will be discussed in addition to studies on the initial reactions of NCA monomers with the various metals. These reactions will be analyzed to correlate how the chemistry of different metals, and different modes of monomer additions, affect the control of polypeptide formation. Using these initiators, we have prepared block copolypeptides containing a variety of both hydrophilic and hydrophobic domains. The hydrophilic chains are composed of either cationic, anionic, or custom non-ionic residues and the hydrophobic chains are composed of natural non-polar amino acid residues such as leucine, valine and phenylalanine. We have studied the self-assembly of these polymers in aqueous solution using a variety of techniques and will discuss the self-assembled structures that result as well as possible biomedical applications of these assemblies.

SESSION X3:
Chairs: Terry J. Garino, Hans J. L. Gossmann,
Lisa C. Klein and Albert Polman
Thursday Afternoon, April 24, 2003
Salon 7 (Marriott)

12:05 PM *X3.1
WHAT BIOLOGY HAS TO OFFER THE MATERIALS SCIENTIST. Mark Alper, Materails Science Div, Lawrence Berkeley National Laboratory and Dept of Molecular and Cell Biology, University of California, Berkeley, CA.

Mankind has made use of biological materials for millennia, most often as nature made them. Homes were built with wood, straw, leaves; ropes were fashioned from vines; tools were shaped from bone, antler, horn; bread and wine were produced catalytically using yeast.
Mankind has made use of biological materials for millennia, most often as nature made them. Homes were built with wood, straw, leaves; ropes were fashioned from vines; tools were shaped from bone, antler, horn; bread and wine were produced catalytically using yeast.
The more sophisticated use of biology was initially impeded by the view that nature's living systems are "special." It was not until relatively recently that the principle of the "vital force" was finally set aside and the concept of making biological molecules and using biological processes outside the living organism was accepted. Wohlers 1828 extracellular synthesis of the biological molecule urea was a first. Buchner's 1897 demonstration of the cell-free, 12 step conversion of glucose to ethanol nailed the vitalist coffin shut.
The potential impact of these discoveries on materials science is clear but only beginning to be exploited. Nature, through evolution, has learned to make thousands of extraordinarily sophisticated materials and to organize and regulate myriad processes and functions. Many of these would appear to be able to serve us well in our search for the advanced materials, devices and processes required to meet our demand for improvements in productivity, conservation, and health and safety. Biomedical applications have led the way but the time for applications to the physical sciences is now here, and the past few years have seen a burgeoning of our interest in pursuing this exciting field of endeavor.
We would like today to display the model: to discuss some of the awe inspiring molecules, structures, and processes of living organisms that are potentially available for our use, modification or mimicking. It is an impressive list, providing on the one hand, an "existence proof" of what can be done, and on the other hand a challenge to us to exploit it. The impact could be enormousin almost every imaginable area of application.

12:45 PM *X3.2
USING PATENTS TO PROTECT AND PROFIT FROM YOUR INVENTIONS. David M. Longo, Jonathan Hack and Timothy Hsieh, Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P., Washington, DC.

Everyone knows that patents are used protect inventions and allow innovators to profit from their insights and work. However these rights to exclude others or generate royalties can be lost or diminished in many unexpected ways. This talk will provide an overview of patents and how to avoid these pitfalls by following a hypothetical nanotechnology invention through the patenting process and addressing basic questions confronting the researcher and developer of technology from technical, financial and business perspectives when a discovery is made: how do I determine if my invention is eligible for patent protection, is it new, is it sufficiently inventive to be patentable, does it provide a sufficient advantage to be worth patenting, what aspects of the discovery should be patented, how do I get a patent, how much does this cost, how much time does it take, what can I do in the meantime (or not do).

PIZZA WILL BE PROVIDED COURTESY OF THE 2003 SPRING MEETING CHAIRS