

Fall 2002 FIAP Newsletter

FIAP visits Silicon Hills

By Stefan Zollner (Motorola) and Stephen Rosenblum, Senior Scientist, Advanced Energy Industries Inc.

The three largest semiconductor industry centers in the US are the Silicon Valley (San Jose, CA), the Silicon Desert (Phoenix, AZ), and the Silicon Hills in Austin, TX, where the next APS March Meeting will be held from March 2-7, 2003. Here, the The APS Forum on Industrial and Applied Physics (FIAP) will be offering an extensive program at this meeting (two tutorials, 18 focus sessions, and 12 invited symposia) that will strengthen the linkage between the local high-tech industry (computers, microelectronics, nanotechnology, equipment, and instrumentation) and the traditional March Meeting physics community. Major areas of interest this year are semiconductor heterostructures, nanoscale science and technology, and physics issues in silicon microelectronics. As always, In addition to these main dishes there will be a smorgasbord there is a broad range of other sessions as well.

Sessions on Heterostructures

On Sunday, March 2, FIAP will present a *piece de resistance* pre-meeting tutorial titled "Heterojunctions Everywhere." Nobel laureates Herbert Kroemer (University of California, Santa Barbara) and Horst Stormer (Columbia University and Lucent Technologies Bell Laboratories) will give an overview of heterojunction physics and its applications to semiconductor devices. and They will explain how heterostructures enable studying study of the physics of two-dimensional systems and as well as demonstrating fascinating phenomena such as the fractional quantum Hall effect. Federico Capasso will review the invention of the quantum cascade laser, an optoelectronic device based on heterostructures (the quantum cascade laser) and how it is being brought to the market. Finally, Chris van de Walle will describe what happens at the interface between two semiconductors, how structural changes and strain affect the electronic band alignment, at the interface between two and semiconductors, and how those effects can be used in commercial devices.

This tutorial is accompanied will be complemented by two invited sessions and one focus session (IR applications of Semiconductor Nano- and Microstructures) during the regular APS program. One symposium will describe commercial applications of semiconductor heterostructures. In this session, Motorola VP Karl Johnson, director of the Compound Semiconductor Technology Lab, will explain the advantages of an InGaP Heterojunction Bipolar Transistor (first proposed by Kroemer in 1983) as a high-frequency power amplifier in a cell phone and what the competing device technologies are. Other invited talks in this session describe column-IV semiconductor heterostructures devices, applications of the 6.1 Å lattice constant family of semiconductors (particularly antimonides for infrared detectors), and quantum cascade lasers. The role of "Nanostructured Interfaces," a critical aspect of heterostructures, is discussed in a related symposium, which includes topics ranging from *ab initio* theory and modeling of interfaces (Blöchl), atomic resolution imaging using transmission electron microscopy (Bonnell), and atomic layer deposition of high-k gate dielectrics for future Si CMOS devices (Nguyen). This

highly technical program will be augmented by a networking breakfast that the FIAP is currently working organizing with the Committee on the Status of Women in Physics (CSWP) to organize a networking breakfast with a keynote speaker from the local industry, possibly also with a heterojunctions theme.

Career Building

A second Sunday tutorial with the title "Things your professors will never tell you" is arranged jointly by FIAP and the APS Committee on Careers and Professional Development (CCPD), represented by Heather Galloway from Southwest Texas State University in San Marcos, TX, a small local institution committed to training undergraduate and M.S. students for careers in the high-tech industry. This tutorial is aimed at explaining career choices to younger physicists (graduate students, postdocs, and assistant professors without tenure) who need to choose between traditional academic positions (research and teaching) and jobs in industry. The instructors are experienced and successful physicists from industry and universities, who are familiar with these choices and can discuss these opportunities and how the consequences of early decisions do or do not have consequences later in one's career. In particular, there will be an emphasis on career transitions, from university to industry and back, from individual contributor into management, and on the influence of industrial experience on funding opportunities. Following up Continuing on this with this theme is a symposium entitled, "Training physics students for the semiconductor industry", and a focus session on "Career perspectives: How to get and hold a job in industry," jointly hosted by FIAP chair Gordon Thomas and FGSA (Forum on Graduate Student Affairs) chair Karsten Heeger. In the symposium, Mark Holtz from Texas Tech University will describe several successful interdisciplinary physics programs, which place M.S. physics degree students in industrial internships towards a M.S. physics degree. Two professors (Law from Florida and Lu from RPI) will discuss the role of funding from the semiconductor industry, (through the Semiconductor Research Corporation, SRC,) on physics and engineering education. Finally, two senior local industry scientists (Brad Melnick from Motorola and Larry Larson from International Sematech) tell about their own hands-on experience in this the semiconductor industry.

Nanostructures

Apart from heterostructures, a second major technical emphasis of the FIAP program at the APS meeting is on nanostructures. The National Science Foundation (NSF) and other funding agencies have recently made large investments in nanoscale science and technology. In particular, large Nanoscale Science and Engineering Centers (NSECs) have been formed at six major universities (Rice, Harvard, Cornell, Columbia, Northwestern, and Rensselaer Polytechnic Institute) 18 months ago. In a session organized by Ulrich Strom from NSF, the directors or other senior researchers from these centers (Stormer, Smalley Colvin, Hersam, Buhrman, Siegel, Westervelt) will present highlights of early research results from these centers and will discuss describe opportunities and challenges to translate scientific discovery into potential innovative technological innovations products. This symposium is accompanied complemented by a FIAP focus session, "Understanding Molecular and Nanoelectronics," organized by Alex Demkov from Motorola and Leonid Tsybeskov from New Jersey Institute of Technology. Continuing a very successful series of sessions from last year's APS meeting,

contributed papers will present progress in theoretical and experimental methods in this area. Particular topics are expected to be quantum size effects in the contact interaction, charging of the molecule, and scattering at the solid-molecule interface. One keynote speaker in this session is Tom Theis, Director of Physical Sciences at IBM Yorktown Heights. The Division of Materials Physics (DMP) is organizing a related focus session on transport in nanostructures and ultrathin ultra thin films.

Semiconductors

The third technical emphasis of the FIAP program is related to the examination of physics problems on the International Technology Roadmap for Semiconductors (ITRS). In an invited session organized jointly with the Group on Instrumentation and Measurements (GIMS) with the title "Frontiers in Si CMOS," Alain Diebold from International Sematech in Austin, TX, will introduce the ITRS roadmap and point out challenges, particularly in characterization and measurements, measurement, for high-k gate dielectrics, metal interconnects, and low-k interlayer dielectrics. Other speakers in this session include Allen Bowling from Texas Instruments ("R&D Strategies for the Semiconductor Industry"), Paul Ho from UT Austin ("Frontiers of Physics in low-k/interconnect Research"), Rich Matyi from NIST ("X-ray Measurements for the Semiconductor Industry"), and Peter Zeitzoff from International Sematech ("Beyond classical CMOS devices: A Wild West Physics Frontier"). A related symposium "Microelectronics Modeling and Simulation" describes the role of condensed matter theory and first-principles device modeling for the microelectronics industry. Speakers in this session include Sokrates Pantelides from Vanderbilt University and Max Fischetti from IBM Yorktown Heights. These two symposia form a miniconference, together along with several related focus session topics on "Measurements and Instrumentation for the Semiconductor Industry," "Mechanical Properties of Nanostructured Thin Films and Coatings," "Front-End Materials and Processes for Scaled Si CMOS," "Novel Complex Oxides," "Progress in Photovoltaic Technology," "Optical Telecommunications," "MEMS/NEMS Science and Technology," and "Physics of Silicon in Electronic Materials."

Smorgasbord

As always, there is a broad range of other topics included in the FIAP program. FIAP Chair-Elect Ken Hass from Ford has organized a symposium "Economic Value of Research," jointly with FPS, the Forum on Physics and Society. Together with the Division on Biological Physics, there is a symposium on "Advances in Medical Imaging for Early Cancer Detection." Fernando Ponce from Arizona State University has organized a symposium on "Nitride Semiconductors for Solid-State Nitrides and Other Applications." A particularly entertaining should be an evening session, has been organized by Robert Brown and Lawrence Rubin, on "Physics in the Entertainment Industry", including insightful comments on interstellar travel, alien life forms, and crop circles.

Attending and Submitting Abstracts

The deadline for submitting abstracts is December 6th. The FIAP focus session sorting categories are as follows:

- 2.9.4 IR applications of Semiconductor Nano- and Microstructures (FIAP/DLS)
- 7.9.3 Novel Thermoelectric Materials and Phenomena (FIAP/DMP)
- 7.9.4 Physics of Silicon in Electronic Materials (FIAP/DMP)
- 7.9.5 Novel and complex oxides and dielectrics (DMP/FIAP)
- 10.9.2 Physics of biosensors for high-throughput drug screening (FIAP/DBP)
- 12.10.8 Nonequilibrium quantum dynamics in electronic and magnetic systems (FIAP/DMP)
- 13.9.1 Quantum Information Science and its Applications (FIAP)
- 14.9.1 Mechanical properties of nanostructured thin films and coatings (FIAP/DMP)
- 15.9.1 Measurements and Instrumentation for the Semiconductor Industry (GIMS/FIAP)
- 15.9.2 Applications of Optical Spectroscopy (GIMS/FIAP)
- 16.9.1 Radiation Processing (FIAP/DBP)
- 16.9.2 Front-End Materials and Processes for Scaled Silicon CMOS (FIAP/DMP)
- 16.9.3 Progress in Photovoltaic Technology (FIAP/DMP)
- 16.9.4 Understanding molecular and nanoelectronics (FIAP)
- 16.9.5 Optical Telecommunications (FIAP/DLS)
- 16.9.6 MEMS/NEMS Science, Technology, Applications, and Measurements (GIMS/FIAP)
- 16.9.7 Nanotechnology for Display Applications (FIAP)
- 18.9.1 Career Perspectives: How to get and hold a job in industry (FGSA/FIAP)

The FIAP and the APS bid you a hearty welcome to the meeting and look forward to your participation at this exciting meeting in the Silicon Hills.

The complete FIAP program is accessible at the APS website <http://www.aps.org>, either by following the link to the FIAP homepage or to the APS March meeting pages. FIAP

appreciatively acknowledges the cooperation of several other APS units, with whom FIAP is holding joint sessions.

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Fellowship Nominations

By Ken Hass(Ford), FIAP Chair-Elect and outgoing chair of the FIAP Fellowship Committee

FIAP needs your help in proposing outstanding candidates for Fellowship in the American Physical Society. It is FIAP's particular pleasure and responsibility to identify deserving individuals who have distinguished themselves in areas related to industrial and applied physics. Please consider nominating a colleague or collaborator for this high honor.

Nominees must be APS members in good standing and should in some way epitomize the best of what FIAP represents to the broader APS community. If you know of "obvious" candidates, don't simply assume they're already APS Fellows; take the time to check, and if they're not, nominate them! FIAP has a particularly strong need for nominations for outstanding female and minority candidates. FIAP's prior Fellowship selections have been among the least diverse in the entire APS, but the primary reason for that is that very few female or minority candidates have ever been nominated through FIAP! The FIAP Fellowship committee is very much constrained by the nominations it receives. The committee does consider all nominations very seriously and accepts FIAP's relatively unique responsibility to recognize even non-traditional contributions that don't fit naturally into the APS mainstream and discipline-based Divisions. So please help the committee by bringing all deserving individuals to its attention. Fellowship selection is one of the greatest responsibilities that FIAP has, and a strong and diverse slate of honorees is a wonderful reflection on the entire organization and on the value of industrial and applied physics in general.

The deadline for fellowship nominations through FIAP is Feb. 21, 2003. Nominations require two APS member sponsors and a completed nomination packet (signed Nomination Form and Supporting Letters). Specific questions about FIAP's selection process may be directed to Ken Hass, FIAP Chair-Elect and outgoing chair of the FIAP Fellowship Committee, at khass1@ford.com.