Good Science Makes Good Business

Twelve members of the Forum on Industrial and Applied Physics (FIAP) have been elected Fellows of the American Physical Society, an honor the society bestows annually on a select group of its members working in industry, academia, and government. The new Fellows, recognized for their outstanding contributions to physics, include Margaret Weiler of Lockheed Martin IR Imaging Systems, who is a member of the FIAP executive committee.

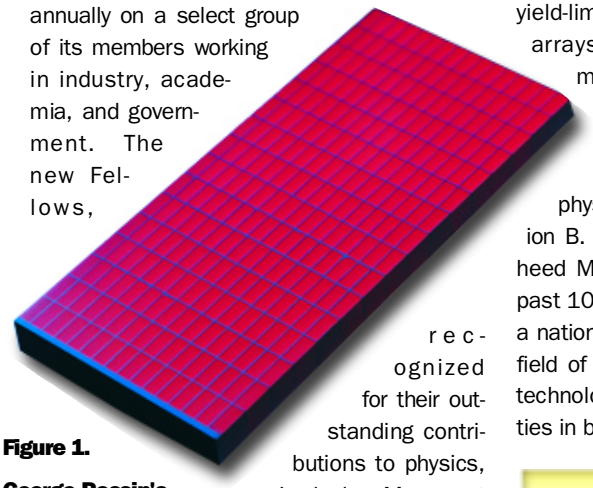

Figure 1. George Possin's research on silicon has contributed significantly to General Electric's X-ray flat-panel detector and multislice CT imaging technologies.

The FIAP members named as APS Fellows (see box) have contributed across a broad range of science, and their work has had a significant impact on many technologies vital to maintaining the nation's competitive strength. Their accomplishments include innovations and applications in microelectronics, electrophotography, imaging technology, and accelerator mass spectrometry; contributions to understanding the physics of xerography, organic light-emitting diodes (OLEDs), and nanoscale tribology; and the invention of ultrahigh-vacuum chemical vapor deposition.

Some of the new Fellows have produced a body of work that is as notable for its breadth as for its depth. Weiler's research interests, for example, have ranged from fundamental quantum theory of solids to applied work in solid-state optical and microwave devices. During the last 15 years, she has focused on gallium-arsenide (GaAs) and mercury-cadmium-tellurium (HgCdTe) semiconductor devices. Her accomplishments include developing and applying physics-based numerical computer models to the design of advanced HgCdTe photodiodes and explaining the origin of yield-limiting defects in HgCdTe photodiode arrays, which has resulted in improved manufacturing yields.

"Margie's career has been a series of successes, beginning with basic research in semiconductor physics and materials science," says Marion B. Reine, a colleague of Weiler at Lockheed Martin IR Imaging Systems. "Over the past 10 years, she has established herself as a nationally recognized technical leader in the field of HgCdTe infrared-detector physics and technology. She did this by applying her abilities in both experimental and theoretical solid-state physics to the challenging engineering problems that we were facing in developing advanced HgCdTe infrared detectors and in transitioning these products from development to manufacturing."

A bent for invention characterizes many industrial physicists. For C. Mathew Mate of the IBM Almaden Research Center, this led to pioneering a new field of surface science now called nanotribology. It began in 1987, when Mate and his coworkers announced the invention of the frictional force microscope, a form of atomic force microscope, and the discovery of atomic-scale friction. He went on to do groundbreaking investigations of nanoscale tribological problems, including measuring lubricant thickness on surfaces, studying the friction and adhesion properties

Why New APS Fellows Were Honored

Dan A. Hays
Xerox Corp.
For original contributions to the physics of xerography.

Rajinder P. Khosla
National Science Foundation
In recognition of exemplary leadership in developing innovative and creative applications of microelectronics in imaging technology.

Charles Mathew Mate
IBM Almaden Research Center
For pioneering contributions in establishing the field of nanoscale tribology, which has had a widespread impact on technology, particularly on lubrication in disk drives.

Bernard S. Meyerson
IBM T. J. Watson Research Center
For the invention of ultrahigh-vacuum chemical vapor deposition and its application to low-temperature silicon epitaxy, especially the fabrication of SiGe heterojunction bipolar integrated circuits for wireless telecommunications.

George Edward Possin
General Electric Corp. R&D
For sustained excellence in the science and technology of medical X-ray imaging equipment, flat-panel displays, and semiconductor physics.

Ivan David Proctor
Lawrence Livermore National Laboratory
For improvements in the accuracy, capacity, and capability of accelerator mass spectrometry that have contributed to archaeology, earth sciences, biological sciences, and also arms control.

Donald S. Rimai
Eastman Kodak Company
For contributions in the fields of particle adhesion and electrophotography.

George Anthony Sai-Halasz
IBM T. J. Watson Research Center
For applications of physics in seminal contributions to microelectronics.

Ching W. Tang
Eastman Kodak Company
For pioneering work in organic light-emitting diodes.

Gary George Tibbetts
General Motors R&D Center
For pioneering research that led to the discovery of vapor-phase growth of carbon fibers from natural gas, and for subsequent significant research on the properties and applications of these fibers.

Sandip Tiwari
IBM T. J. Watson Research Center
For contributions to the understanding of device physics and for innovations in small electronic and optical devices with strong quantum confinement.

Margaret Horton Weiler
Lockheed Martin IR Imaging Systems
For fundamental contributions to HgCdTe infrared-detector and GaAs microwave-device technologies, in the development and experimental validation of new physical models for semiconductor device properties and their influence on system applications.

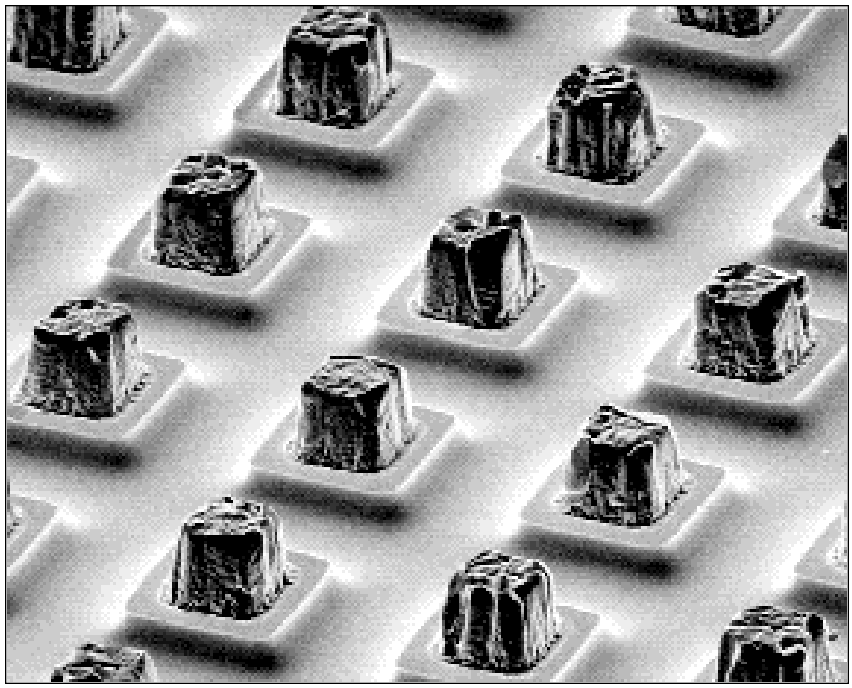

Figure 2. Margaret Weiler's research on mercury-cadmium-telluride photovoltaic detectors has helped Lockheed Martin IR Imaging Systems develop arrays such as this, in which each 60-µm-square mesa-delineated pixel is capable of detecting infrared light with wavelengths on the order of 10 µm.

of protective overcoats, and also determining the molecular functioning of lubrications.

Mate's seminal studies of lubricants at the molecular level at the slider–disk interface in disk drives dramatically improved the durability and reliability of these devices. He introduced the concepts of capillary and disjoining pressures on a lubricant film and showed how they could be used to determine many important tribological properties, says Andrew C. Tam, a project manager at the IBM Almaden Research Center. "These concepts are now being widely used in the disk-drive industry around the world to design slider–disk interfaces for a number of current and future disk-drive products."

Ingenuity and insights, two keys to innovation, underscore the pioneering work of Ching W. Tang of Eastman Kodak Co. and Dan A. Hays of Xerox Corp.

In 1987, following years of research, Tang reported the first organic light-emitting diode (OLED) with high efficiency and high brightness to operate at low voltages. His report stimulated the intense academic and industrial research that underpins today's OLEDs. Tang went on to invent a multilayer device structure for modulating carrier transport and recombination that is a major factor in the success of OLEDs.

"His work has revolutionized the field," says Yongli Gao, who is associate professor of physics at the University of Rochester. "The use of organic materials for electronic and optoelectronic applications has opened a new horizon in device physics and materials science. Recent advances have given indications that these OLEDs have the necessary attributes and competitive advantages to be considered seriously for efficient, large-area, full-color displays."

Hays, winner of the American Institute of Physics' 1997–1998 Prize for Industrial Applications of Physics (see The Industrial Physicist, 12/97, p. 47), has made three seminal contributions to the physics of xerography, says Charles B. Duke, Xerox vice president and senior research fellow. Hays introduced and validated models describing the effect of local electric fields on triboelectric charge transfer; identified the mechanism of two-component (carrier and toner) developer neutralization and used this knowledge to invent several new development technologies; and proposed and validated an electrostatic model of toner adhesion based on the nonuniform charging of toner particles.

In 1996, products containing development systems invented by Hays accounted for 47% of Xerox revenues. Last year, the Committee on Economic Development cited his achievements in its report America's Basic Research: Prosperity Through Discovery. The independent policy-research group used xerography and Hays' contributions to it as one of eight case studies illustrating the value of basic research to the U.S. economy.

Good science can be good for the bottom line. Over his career, George Edward Possin has made significant contributions to understanding the fundamental physics of amorphous and single-crystal silicon, including the effect of doping on band gap and recombination in single-crystal silicon. This work improved the understanding and modeling of bipolar devices and photovoltaic cells. He also developed a novel quantitative electron-beam-induced conductivity method for measuring structure and recombination in semiconductor devices, and co-invented and helped develop a new electron-beam computer memory and other electron- and ion-beam recording methods.

More recently, he made important improvements in two medical diagnostic X-ray imaging technologies: amorphous silicon flat-panel detectors and computed tomography. These "have already contributed to the quality of health care around the world and will totally change that market in the future," says Bruce F. Griffing, manager of General Electric's Industrial Electronics Laboratory. "As a business person, I see George's outstanding example of good science contributing to good business."

Fellow nominations come from each APS division, forum, and topical group. Nomination forms and additional information can be obtained by writing to the APS Fellowship Program, One Physics Ellipse, College Park, MD 20740-3844; by sending e-mail to fellowship@aps.org; by telephoning (301) 209-3268 or faxing (301) 209-0865; or by downloading an electronic version of the nomination form from the society's Web site (www.aps.org). Ω

The Forum department is initiated by the American Physical Society's Forum on Industrial and Applied Physics (FIAP). For further information on FIAP, please contact the chairperson, Galen B. Fisher (gfisher@ notes.gmr.com).