National Academy of Engineering Elects 77 Members and 8 Foreign Associates

Robert M. White, president of the National Academy of Engineering (NAE), announced the election of 77 engineers to membership in the Academy and eight as foreign associates. This brings the total U.S. membership to 1,790 and the number of foreign associates to 151. Academy membership honors those who have made important contributions to engineering theory and practice, including significant contributions to the literature of engineering theory and practice, and those who have demonstrated unusual accomplishment in the pioneering of new and developing fields of technology.

Among the elected members are John C. Angus (Case Western Reserve University) for contributions to the understanding of turbomachinery, particularly cavitation and rotordynamics; Federico Capasso (AT&T Bell Laboratories) for contributions to solid-state electronics and optoelectronics through semiconductor bandgap engineering; Wai-Fah Chen (Purdue University) for contributions to the theories of structural stability and plasticity and their application to structural design; Leland C. Clark, Jr. (Synthetic Blood International, Inc.) for inventions and contributions covering biosensors, artificial organs and blood, and their medical applications worldwide; Robert W. Deutsch (RWD Technologies, Inc.) for founding companies to improve human performance in high-technology industries; Nicholas M. Donofrio (IBM Corp.) for contributions in the development of semiconductor memory and technical leadership in computers; George J. Dvorak (Rensselaer Polytechnic Institute) for contributions to research on metal matrix composites and micromechanics of materials; Robert K. Grasselli (Mobil Research and Development Corp.) for the invention of catalysts and catalytic processes having commercial significance; Thomas J.R. Hughes (Stanford University) for contributions to the development of finite element methods for solid-structural and fluid mechanics; Stephen L. Matson (ARETE Technologies) for inventing new membrane technologies, including membrane reactors, and as an entrepreneur in the commercialization of these technologies; Jarold A. Meyer (Chevron Research and Technology Co.) for the development and commercialization of catalytic processes for lubricating oils and petrochemicals; Andrew R. Neureuther (University of California—Berkeley) for research and teaching in computer-aided modeling of semiconductor processing; Elsa Reichmenis (AT&T Bell Laboratories) for the discovery, development, and engineering leadership of new families of lithographic materials and processes that enable VLSI manufacturing; John M. Rowell (Conductus, Inc.) for experimental contributions to superconducting tunneling and leadership in the application of superconducting devices; Massoud T. Simnad (University of California—San Diego) for the development of materials and fuels for advanced nuclear energy systems and interdisciplinary activities bridging materials science and energy technologies; Philip C. Singer (University of North Carolina) for contributions to the treatment of public water supplies and to the education of environmental engineers; Vivian T. Stannett (North Carolina State University) for contributions to the understanding of transport processes and polymer radiation chemistry in polymers; Charles R. Steele (Stanford University) for contributions to the theory of thin shells, to understanding of human hearing, and to bioengineering; Simon M. Sze (National Chiao Tung University) for technical and educational contributions to semiconductor devices; Kathleen C. Taylor (General Motors Corp.) for the development of automotive-exhaust catalytic systems and leadership in materials battery and fuel cell research; and Robert H. Wagoner (Ohio State University) for contributions to the materials mechanics and manufacturing technologies aspects of industrial metal forming.

Among the Foreign Associates are John E. Ffowcs Williams (University of Cambridge) for contributions to the theory of jet noise and other aspects of aeroacoustics and hydroacoustics; Niels Hansen (Riso National Laboratory) for development of the science and technology of the strengthening of polycrystalline materials and for leadership of metallurgical research in Denmark; and David Tabor (University of Cambridge) for contributions to the theory of tribology, hardness, and surface physics.

Blue Light Emission Produced from GaN LED

EMCORE Corporation (Somerset, New Jersey) announced the achievement of blue light emission from light-emitting diodes (LED) fabricated from gallium nitride. The GaN was grown epitaxially on a sapphire substrate, using a 180 GaN MOCVD system capable of processing 6 × 2" or 3 × 3" wafer/run. Blue laser diodes are potentially useful for higher capacity optical disk drives and submicron semiconductor device manufacturing, among other applications.

Both p-type and n-type layers were grown. The p-type layers have shown carrier concentrations up to 5×10^{18} cm^{-3} with hole mobilities of 20 cm^{2}V^{-1}sec^{-1}. The room temperature light emission wavelength from the LED was close to 400 nm.

NSF Funds Microwave Research at Connecticut University

Steve Suib, professor of chemistry at the University of Connecticut, was awarded a $180,000 grant from the National Science Foundation for a three-year study of how microwave heating compares with conventional heating technology, including light energy, plasma heating, and furnace heating.

"Using microwaves in industry could be an especially effective way of changing the nature of the surface of materials," Suib said. Manufacturers want to know whether chemical changes occur unevenly in ceramic and metal objects, such as jet engine parts, when heated by microwaves. In an industrial setting, microwaves could be used to bake a protective coating of porous metal ions onto lightweight ceramic engine components, said Suib.

Microwaves are starting to be used instead of x-rays, light, and other high-energy sources to produce efficient superconducting materials and pharmaceutical drugs, Suib said. "We could see microwave technology extend to many other uses if we knew about what happens chemically to an object during its exposure to microwaves."

Theory Shows Microcircuit Heating Reduced by Energy Transfer Between Quantum Dots

Researchers at the University of Illinois and Keio University in Yokohama, Japan, theorize that heat can be transferred out of a microcircuit the same way sound is transferred between two tuning forks. The key to the application is removing circuit resistors that turn electrical energy into heat and replacing them with quantum dots that broadcast energy in waves, said Alfred Hubler, a physicist at the University of Illinois.

The quantum dots, which function as corrals for electrons, would have the same circuit resistance as the resistors they replace, so the electric current and voltage of the microcircuit would be unaffected, Hubler said. But because the stored, vibrating electrons would send out tunable electromagnetic waves instead of heat, the waves could be picked up and stored in a nearby circuit by another quantum dot pretuned to resonate with the first in the same way that a vibrating tuning fork will cause a second tuning fork to vibrate if they are in resonance. The second circuit either could store the beamed energy in a capacitor to power another microelectronic circuit, or discard the energy at a distance in the form of heat.

"It's an example of using resonance to achieve efficient energy transfer," Hubler said of the research described in the February issue of the *Japanese Journal of Applied Physics*. Other researchers working on the project were physicist Kiyoshi Kawamura and his student Fumiko Yamaguchi, both at Keio University.

Heat-induced failure of electronic components is a major problem in very small circuits. Researchers do not know how much energy harmonic transmission would dissipate, but Hubler estimates that the heat of circuits would be decreased by at least half.

One problem, Hubler said, is that the transmission resonances of the two quantum dots would be nonlinear. The decreasing energy of the transmitting circuit and increasing energy in the receiving circuit would quickly dissipate the initial resonance unless the sending and receiving materials were prepared carefully.

"In linear oscillations, one only needs to match frequencies, regardless of their amplitudes," Hubler said. "In nonlinear oscillations, frequency increases or decreases with changes in amplitude." The researchers proposed solving the problem by linking materials with opposite response qualities to counterbalance each other and preserve resonance.

Cooperative Agreement Signed for NASA's Finite Element Interface Technology

The MacNeal-Schwendler Corporation has signed a cooperative agreement with NASA-Langley Research Center for the inclusion of NASA's finite element interface technology into MSC/NASTRAN. NASA developed its finite element interface technology to overcome the difficulties that arose when attempting to connect different finite element analysis meshes. This technology makes it possible to interface the disparate sets of elements because the accuracy requirement that connected meshes have common mesh grid points has been removed. Applications include performing global/local analysis, connecting meshes built by different engineering organizations, and connecting meshes developed by solid modelers.

P/M Lab Announces Ben Franklin Center Collaboration

The Powder Metallurgy (P/M) Lab of The Pennsylvania State University and the Ben Franklin Technology Center (BFTC) have announced a new program for flexible, one-on-one collaborations with the Pennsylvania powder metallurgy industry. The newly funded project entitled "Industrial Collaboration in Powder Metallurgy" is directed by Randall M. German, Brush Chair Professor in materials at Penn State's University Park campus. This program puts into place a mechanism to foster small company, short-term research and development activities at P/M Lab. Through the BFTC program, several projects can be accommodated at Penn State's University Park campus for collaboration with powder metallurgy companies.

The P/M Lab is fully equipped with tools for powder fabrication, mixing, milling, blending, and characterization, and has great flexibility in compaction and sintering (including temperature capabilities up to 3000°C and a continuous pusher furnace operable to 1650°C) with tools for assessment of sintered products including dimensions, microstructures, mechanical properties, thermal properties, and other physical attributes.

Collaboration Announced on Ion-Projection Lithography

The Advanced Lithography Group (ALG) (Columbia, Maryland) and High Technology Organizations in the European Union agreed to explore joint collaborative efforts to develop ion-projection lithography (IPL) for application to advanced semiconductor manufacturing. The result is expected to lead to joint U.S.-European development of state-of-the-art tools that will enable manufacture of semiconductor devices having sub-0.20 μm feature sizes.

ORNL is Developing a Laboratory on a Microchip

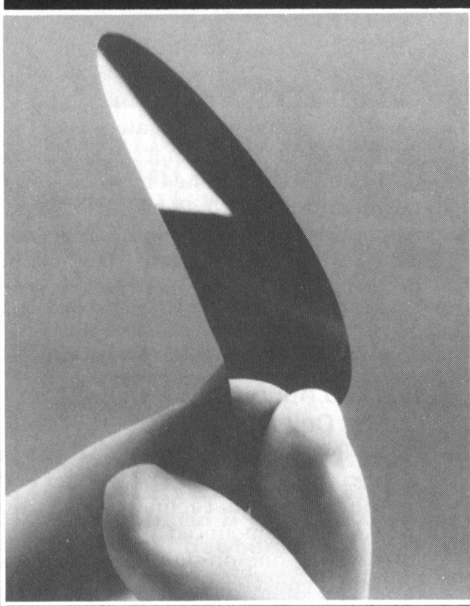
Researchers at the Department of Energy's Oak Ridge National Laboratory (ORNL) are developing a postage-stamp-size microchip for efficiently separating and identifying chemicals in liquids. Researchers have used the device to separate chemicals in a liquid drop in 150 ms. They expect such a device to have use in environmental, manufacturing, health care, and pharmaceutical industries.

The ORNL researchers have also shown that microscopic devices can be used to carry out chemical reactions. The work suggests that an entire chemistry laboratory, including chemical containers, beakers for mixing chemicals, and analysis instruments, could be placed on a microchip.

The chip is a glass plate as thin as a microscope slide. A winding, hairlike capillary channel, covering an area the size of a dime, is etched in the glass using standard micromachining techniques. The etched channels are closed by bonding a thin plate of glass over the top.

J. Michael Ramsey, one of the developers of the technology, said that a microchip laboratory could provide faster, cheaper, and more reliable chemical analyses for environmental monitoring, industrial process control, and medical diagnosis.

The laboratory on a chip offers several potential advantages over conventional approaches to chemical analysis. It would automate preparation of chemicals for analysis, saving labor and protecting scientists from unnecessary chemical exposure. The amount of chemical reagents on a chip would be one-millionth of the typical volume used in a laboratory setting, thus minimizing chemical waste requiring disposal.



A 3" diameter 2-4 μ membrane manufactured at Virginia Semiconductor, Inc.

The researchers said that the microchip laboratory could be incorporated into hand-held devices for surveying waste and could be part of a small sensor used in chemical process pipes to monitor and control production in a factory.

Along with Ramsey, the developers of the microchip include Stephen C. Jacobson, Roland Hergenroder, Lance B. Koutny, and Alvin W. Moore from ORNL's Chemical and Analytical Sciences Division.

Researchers Undertake Development of a Portable Ultrasonic Imager

Researchers at Pacific Northwest Laboratories are developing a portable ultrasonic imager that enables real-time imaging of flows of very dense opaque solid/liquid mixtures. The researchers' goal is to place the imager directly on pipes transporting opaque materials and provide a visual display of these mixtures. Real-time acoustic planar imaging of dense slurries will be useful in imaging flows of slurries, porous media, fibrous suspensions (pulp and paper), polymer melts, and other petroleum and chemical engineering applications that require real-time rheological and morphological measurements.

Chemist Converts Coal Ash into Impervious Glass

Joseph F. Chiang, professor of chemistry at the State University College at Oneonta, has patented a process that converts "fly ash" from coal-fired power plants into a useful, unbreakable ceramic glass. The glass could potentially be used to encapsulate toxic waste. Presently, it can be used for counter tops, boilers, tubing, glassware, sporting goods, sandpaper, and many other common products.

Chiang was experimenting with superconducting processes at Argonne National Laboratory when he came upon a new heat-treatment technology. He tested fly ash because it was readily available and it cannot be recycled. At first he heated the material to 1450°C until it melted. When it cooled, it formed a solid piece of glass, much like a rough rock. However, by experimenting with the heating and cooling treatment process, and introducing phosphorus oxide, he produced a shiny glass that could not be bent, broken, or scratched.

Chiang is now experimenting with ways to inject color into the ceramic glass. □

Correction:

The March 1995 issue of *MRS Bulletin*, page 68, should have included Frederick Seitz, The Rockefeller University, in the list of Von Hippel Award recipients.