M. Shayegan Receives Presidential Young Investigator Award

Monsour Shayegan was among the 100 engineers and scientists selected by the National Science Foundation (NSF) to receive Presidential Young Investigator Awards for fiscal year 1986. Shayegan, a member of the Materials Research Society, is in the Department of Electrical Engineering at Princeton University, New Jersey. His field of research is solid state physics and electronic materials.

The awards, which fund research by faculty near the beginning of their careers, are intended to help universities attract and retain outstanding young PhDs. Each recipient can receive up to $100,000 per year for five years in a combination of federal and matching private funds.

The awards also address the growing faculty shortages in the highly competitive fields of engineering and science. Erich Bloch, Director of NSF, said that the awards "represent the new spirit of cooperation among industry, academia, and government in addressing this problem." Of the 100 awards this year, more than three-fourths went to engineering and the physical sciences.

A brochure describing the awardees and their research interests is available from the National Science Foundation. Send a mailing label to PYI Brochure, Division of Research Career Development, Room 414, National Science Foundation, Washington, DC 20550.

Strained-Layers Identified in Catalysis

Clues to why chemical catalysts composed of two metals in combination function better than either metal alone have been uncovered in experiments at Sandia National Laboratories. The studies show that the bimetallic catalysts act almost as if an entirely new material has been formed. The atomic arrays of the two metals attempt to "fit" each other, causing strains on the outer one that change its properties. Electronic exchanges between the two metals also appear to affect their catalytic properties.

Catalysts are essential in virtually all major industrial chemical processes. "Many of these processes are so important that if you can improve them by even one-tenth of one percent it would be tremendously important," said D. Wayne Goodman, head of Sandia's Surface Science Division.

Bimetallic catalysts have generated increasing interest because they allow chemists to tailor a catalyst's composition, increasing control of catalytic activity and selectivity. Bimetallic catalysts are commercially succesful because they work, not because chemists understand why.

To study the problem, Goodman and a group of scientists chose the bimetallic catalyst of copper and ruthenium because it is a prototype. A special laboratory instrument that combines a high-pressure microcatalytic reactor with an ultrahigh-vacuum analysis chamber was used to prepare and study the copper-ruthenium catalyst.

The scientists began with a single crystal of ruthenium, evaporated a single atomic layer of copper onto it, and then observed the new material's properties. Additional layers of copper were added and observed. The analysis showed that the copper atoms sit in registry with the ruthenium atoms. But since the atoms of ruthenium (atomic number 44) are larger than the atoms of copper (atomic number 29), the array of copper atoms stretches by about 5% to maintain its fit with the array of ruthenium atoms. The copper becomes a "strained" lattice. This means many of its properties, including its reactivity, are different from those of pure copper.

These structural perturbations may not be the only contributor to the increased catalytic function of the two-element catalyst. The studies also indicated some electronic transfer between the copper atoms and the ruthenium atoms. This electronic modification of the copper by the ruthenium appears to be significant, and it has been calculated.

M.S. Dresselhaus

MIT Names M.S. Dresselhaus Institute Professor

Dr. Mildred S. Dresselhaus, Abby Rockefeller Mauze Professor of Electrical Engineering and Physics at the Massachusetts Institute of Technology (MIT), has been named an Institute Professor. The title of Institute Professor is an honor given by the MIT faculty and administration for distinguished accomplishments in scholarly, educational, service and leadership pursuits. There are usually no more than 12 active Institute Professors on the faculty. The appointment of Dresselhaus brings the active number to 12.

As a researcher, Dresselhaus has focused on electronic, optical and magneto-optical properties of semiconductors and semimetals. Her recent work has concentrated on graphite intercalation compounds, graphite fibers and the modification of electronic materials by intercalation and implantation.

Dresselhaus is a Fellow of the American Physical Society and was its president in 1984. She is also a Fellow of the American Association for the Advancement of Science and the Institute of Electrical and Electronics Engineers, and a member of the Society of Women Engineers. An active member of MRS, she served as Symposium Chair for the 1982 MRS symposium on Intercalated Graphite. Currently she is a Councillor for the Society.

Glass Crack Growth Rates Predicted

Researchers at Sandia National Laboratories can predict how rapidly glass or ceramic materials will crack when exposed to various stresses, humidity, and chemical environments. This ability is expected to help designers produce more reliable optical fibers, insulators for high-performance batteries, solar collector covers, underwater windows, and many other glass or ceramic items. Researchers hope to use this understanding to identify ways of treating glasses with thin coatings (possibly polymers) that slow or stop crack growth, or even to reliably heal cracks in glass.

This work received the 1985 Award for Outstanding Scientific Accomplishment in Metallurgy and Ceramics, presented by the U.S. Department of Energy's Office of Basic Energy Sciences.

The predictive ability is based on the use of model chemical compounds (small clusters of silicon and oxygen atoms) to understand the behavior of silicon-oxygen-silicon bonds that form glass, especially the bonds at a glass crack tip (the opening of a crack). Results from experiments with model chemical compounds and test pieces of glass were incorporated into a mathematical model that calculates the effects of different chemical reactions on glass strength.

The model chemical compounds were verified through molecular-orbital calculations. These computer calculations simulated a cluster of silicon and oxygen atoms with the same physical distortions as glass crack tip bonds. The calculations were then compared with the chemical behavior of the model chemical compounds. The mathe-

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matical model was confirmed by additional testing with glass samples. Researchers also recorded glass behavior over time and extrapolated future long-term behavior up to 10 years. Before verification of these model chemical compounds, the accuracy of glass behavior predictions for more than several months was questionable.

Studies of the model chemical compounds also predicted the formation of chemical compounds that will occur on glass crack surfaces while fractures grow. Experiments at the National Synchrotron Light Source, Brookhaven National Laboratory, confirmed these predictions. Glass test samples were fractured in controlled environments and the crack surfaces were exposed to an ultraviolet beam, causing the compounds formed during crack growth to pop off the surface for identification and comparison.

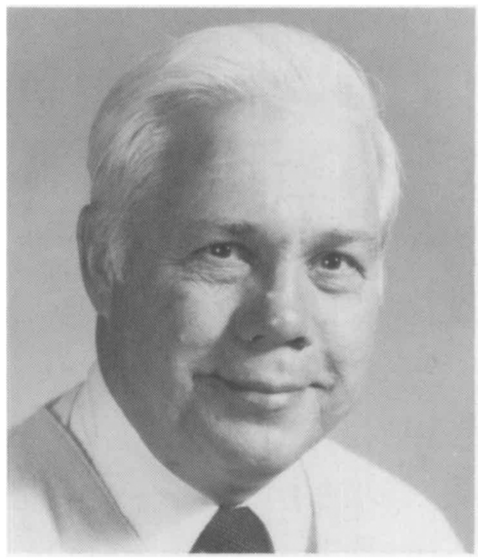
As a result of the glass crack studies, Sandia researchers believe they can reliably predict strains that glasses ought to survive without cracking, and predict whether certain glasses are likely to be crack resistant.

The research program is also providing ideas for limiting or preventing crack growth. For example, Sandia scientists learned that molecules larger than 0.4 nanometer (the size of the structural unit that forms silica glass) will not enter crack tips and react with silicon and oxygen. Placing large molecules on the glass surface, then, would block small, reactive molecules from entering crack tips where they would start the crack growth reaction. Sandia's glass crack growth models may also be useful for determining the long-term strength behavior of brittle materials such as aluminum oxide and magnesium fluoride.

AIP Executive Director to Retire

Dr. H. William Koch has announced his retirement as Executive Director of the American Institute of Physics (AIP), effective March 1987. In two decades at the helm, Koch oversaw the addition of three new member societies and a doubling in the number of pages published. Today the AIP is an industry leader in the use of electronic publishing techniques and services. Koch was instrumental in establishing *Journal of Materials Research*, the official journal of the Materials Research Society published through the AIP. A search committee, headed by W.W. Havens, Jr., Executive Secretary of the American Physical Society, is soliciting nominations for a successor to Koch.

Koch received a BS in physics from Queens College (NY) and an MS and a PhD from the University of Illinois. He worked at the University of Illinois from 1944 to 1949 on betatron research. A 4.5 MeV betatron that he constructed and delivered to England in 1944 was subsequently converted into the world's first high energy electron synchrotron. From 1949 to 1966 Koch worked as a research physicist in nuclear and high energy x-ray physics at the National Bureau of Standards (NBS). While there, Koch's group developed the world's first large-aperture 180 MeV circulator accelerator for synchrotron-light research and a high-power 100 MeV electron linear accelerator. He was Chief of the Radiation Physics Division of NBS from 1962 to 1966, when he was appointed Director of the AIP.



W.L. Brown

NAS and NAE Confer Dual Honor on W. Brown

Walter L. Brown, head of the Radiation Physics Research Department at AT&T Bell Laboratories (Murray Hill, NJ) was one of 59 new members elected to the National Academy of Sciences (NAS). He was also among 73 engineers and six foreign associates elected to the National Academy of Engineering (NAE), which cited him "for discovery of semiconductor surface channels crucial in field effect transistors, and for contributions to ion beam uses in semiconductor diagnostics and processing." Election to either Academy is the highest professional distinction that can be conferred on an American scientist or engineer.

The National Academy of Sciences is a private organization of scientists and engineers dedicated to the furtherance of science and its use for human welfare. It was established in 1863 by a congressional charter to serve as an official adviser to the U.S. federal government in matters of science and technology. The National Academy of Engineering, also a private organization, was established in 1964 to share in the responsibility given the National Academy of Sciences.

Brown's scientific accomplishments and personal dedication are well known to the materials research community worldwide. In 1984 he received the Materials Research Society's Von Hippel Award for his "seminal role in the development of semiconductor materials science and technology." (See the MRS BULLETIN, Vol. IX, No. 5, pp. 5-8 and Vol. X, No. 1, pp. 16-20). Brown is a Councillor for MRS. He also serves on the Awards Committee and was Meeting Chair for 1984 Fall Meeting.

G.C. Farlow Accepts Assistant Professorship

Gary C. Farlow accepted a position as assistant professor of physics at Wright State University (Dayton, OH) as of September 1, 1985. He shares the responsibility for developing an ion beam modification and analysis center at the university. The center's capabilities will include Rutherford backscattering analysis, proton-induced x-ray analysis, and ion implantation into temperature-controlled substrates. Farlow's research will emphasize ion beam mixing of metals on compound substrates, and ion beam modification of ferroelectric materials.

Farlow was previously with Oak Ridge National Laboratory, where he participated in projects on the ion beam modification of Al_2O_3 and the ion beam mixing of metals on insulators. He holds a PhD in solid-state physics from the University of North Carolina (Chapel Hill), and he is a member of the Materials Research Society, American Physical Society and the American Ceramic Society.

New Technique for Very Small Scale Magnetism Studies

A new tool for studying magnetic surfaces could lead to subminiature computers, television sets, and other electronic devices. Developed by the Department of Energy's Argonne National Laboratory, SMOKE (surface magneto-optic Kerr effect) allows the study of layers of magnetic materials one atom or less thick. "The ultimate size limit in miniature electronic circuits," said Samuel Bader of Argonne, "could be a layer of magnetic material one atom thick deposited on a supporting surface." This kind of ultrathin magnetic film might also be used in smaller, faster computer memories. "But before uses like that can be devised," Bader said, "we need to know more about thin magnetic films. This new technique gives us a new way to do that."

The technique relies on changes in the polarization of light reflected from magnetic surfaces. The Kerr effect has been used for years to study the magnetism of bulk materials but, said Bader, "this is the first time it has been used to study mag-

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netism on surfaces." Bader and the scientists working with him have used SMOKE to measure changes in magnetism in a layer of iron that averaged less than one-half an atom thick, and to measure the magnetic properties of a single layer of iron atoms deposited on a gold surface.

SMOKE will allow scientists to study magnetism within four ten-millionths of an inch of a material's surface—a distance smaller than the diameter of the average iron atom. It can also probe beneath surface atoms. By studying how magnetic characteristics vary for layers of different thicknesses, scientists will be able to learn more about what happens as the films are made. SMOKE could prove an important new probe for studies of magnetism on a very small scale.

Strategic Defense Education Act Introduced

The Strategic Defense Education Act of 1986 (S-2117) has been introduced by Senator Larry Pressler (R-SD). Patterned after the National Defense Education Act of 1958, enacted in response to the launching of Sputnik, S-2117 would provide support to college and university research programs. It includes a graduate fellowship program for talented students pursuing advanced degrees in areas of "national need," it and also offers tax incentives to encourage private industry to increase its involvement in university research.

A.W. Johnson and S.T. Picraux Coordinators for Project to Aid Crystal Growth

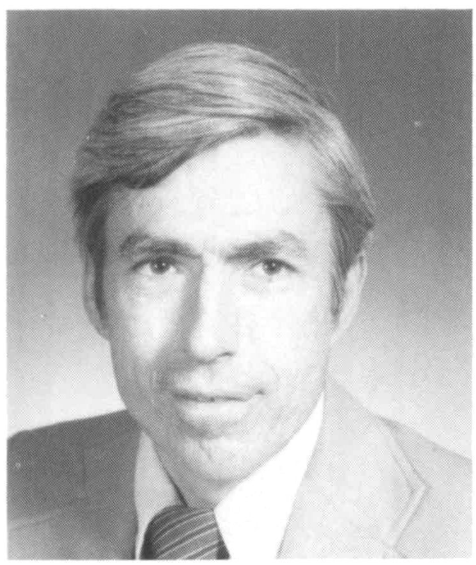
A. Wayne Johnson and S. Thomas Picraux, both of Sandia National Laboratories, are project coordinators for "Advanced Growth Techniques for Improved Semiconductor Structures." The project is one of three winners in a competition among all the national laboratories for FY87 special funding by the U.S. Department of Energy's Basic Energy Sciences/Materials Sciences Division (BES).

The project will use ion and laser beams to stimulate the growth of high quality, layered semiconductor materials. Such materials would have applications in several fields: opto-electronics, photonics, microwaves, photodetectors, perhaps even integrated opto-electronic circuits that could combine light emission, detection and signal processing in the same device.

Ion or laser beams will be used with molecular beam epitaxy (MBE) and chemical vapor deposition (CVD) to supply additional surface energy, which is expected to allow growth at lower temperatures (below 500 °C) or higher growth rates and still achieve the high quality crystalline materials necessary for high-performance devices.

Nearly 30 proposals, including three others from Sandia, were submitted to BES. The other two winners were Brookhaven's "Synthesis and Structure of New Conducting Polymers" and Oak Ridge's "Ion Beam Deposition." The three will share a $2 million budget in FY87; BES plans to continue funding the projects for three years.

Both Johnson and Picraux are members of the Materials Research Society. Johnson was Meeting Chair for the 1985 MRS Spring Meeting and Symposium Chair for the 1983 MRS Fall Meeting. Picraux is Symposium Chair for the 1986 MRS Fall Meeting and Meeting Chair for the 1987 MRS Fall Meeting.



S.T. Picraux

S.T. Picraux Named Department Manager at Sandia

S. Thomas Picraux has been named manager of the Ion Implantation and Radiation Physics Research Deprtment at Sandia National Laboratories (Albuquerque, NM) effective April 1, 1986. The department is part of the Solid State Sciences Directorate and conducts research in ion implantation, ion beam analysis, materials modification, radiation effects and structural studies of semiconductors, metals and insulators. Picraux joined the Sandia technical staff in 1969 and previously served as supervisor of the Ion-Solid Interactions Division. His research interests include ion, electron and laser beam modification of materials, ion channeling, metastable materials formation and epitaxial growth of heterostructures. (See related article on this page.)

Picraux is Co-chair of the MRS symposium on Beam-Solid Interactions and Transient Processes to be held at the upcoming Fall Meeting, and is a Meeting Chair for the 1987 MRS Fall Meeting. He served for several years on the MRS Publications Committee.

Physicists Vote on SDI

Physicists gave the Strategic Defense Initiative (SDI) a decisive "no" vote in a poll conducted by Peter D. Hart Research Associates, a nationally respected public opinion research firm. The nationwide poll was taken at the request of the Union of Concerned Scientists. By almost two-to-one, physicists viewed SDI as a step in the wrong direction for America's national security policy. Among those who professed a high level of familiarity with SDI, the ratio was even higher. Even among those who derive a majority of their funding from the Department of Defense, only 38% thought it was a step in the right direction. "The vote represents a stunning repudiation of the Star Wars concept by the group generally considered to be in the best position to judge its technical merits," according to Robert L. Park of the American Institute of Physics, Washington, DC office. Details of the poll are available from the Union of Concerned Scientists, 1616 P Street NW, Washington, DC 20036.

Editor's Note: See "Materials for SDI," in this issue.

National Academy of Engineering Elects Council Members

The members of the National Academy of Engineering (NAE) have elected a new chairman, treasurer and three members to serve on the NAE Council. The Council is the governing body of the NAE and is composed of 12 elected councillors and the six elected officers of the Academy.

The new NAE chairman is John F. Welch, Jr., chairman and chief executive officer, General Electric Co. (Fairfield, CT). He will serve a two-year term beginning July 1, 1986. Edward R. Kane, director and former president, E.I. du Pont de Nemours & Co. (Wilmington, DE), will serve a four-year term as treasurer. Roland W. Schmitt, senior vice president, corporate research and development, General Electric Co. (Schenectady, NY), was re-elected as a councillor for a second three-year term. The two newly elected councillors, who will also serve three-year terms, are Ralph E. Gomory, IBM senior vice president and director of research, IBM Corp., Thomas J. Watson Research Center (Yorktown Heights, NY), and Herbert H. Richardson, vice chancellor and dean of engineering, Texas A&M University (College Station, TX).

The National Academy of Engineering is

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a private organization established in 1964 to share in the responsibility given the National Academy of Sciences under its 1863 congressional charter to examine questions of science and technology at the request of the federal government. The NAE sponsors engineering programs aimed at meeting national needs, encourages engineering research, and recognizes distinguished engineers.

Secondary Battery Technology Progresses

The powerful secondary (rechargeable) batteries now being developed could be a boon to the electric vehicle industry, could prove valuable in utility load leveling, and could store electrical energy from solar cell arrays—an application that could be particularly useful in remote locations and in developing countries.

Dr. Nicholas Magnani of Sandia National Laboratories singled out two major projects—the sodium/sulfur and zinc/bromine battery systems—as examples of progress. Magnani, who directs the Sandia-based lead center for the Department of Energy's (DOE) Exploratory Battery Technology Development and Testing (ETD) Project, said both projects "are expected to lead to the production of large (50-kWh) advanced secondary battery modules" and eventual commercialization of these technologies.

Ford Aerospace and Communications Corporation recently built a 75-kWh stationary sodium/sulfur battery system. The system operated successfully for 675 cycles for 32 months. Chloride Silent Power Limited (CSPL) of Runcorn, England was recently awarded a DOE contract to continue developing this system, and to produce a 50-kWh battery module for stationary energy applications. This module will be the foundation for a 500-kWh stationary energy storage battery to be built under a complementary contract between CSPL and the Electric Power Research Institute (EPRI).

A zinc/bromine battery built by Exxon Research and Engineering Company successfully powered Ford Motor Company's ETX test vehicle last summer, the first advanced secondary battery to do so. A new contract with Energy Research Corporation (Danbury, CT) calls for production of a 50-kWh battery module that will be the basis for a 500-kWh stationary energy storage battery to be produced later under an EPRI contract.

"The hydrogen/nickel oxide battery also is of great interest," said Magnani. An aerospace version operated for more than 7,000 cycles without maintenance or other human intervention. Unfortunately, the aerospace version is produced at about $25,000 per kWh. Versions suitable for terrestrial applications need to be about 1/15th to 1/20th as expensive. Contractors working with Sandia (COMSAT Laboratories, Inc. and Johnson Controls, Inc.) have already generated workable designs that are expected to be about 1/12th as expensive as the aerospace version.

DOE-Supported Research Facilities Must Accept Classified Work

According to a new U.S. Department of Energy (DOE) policy, any major DOE facility with a unique research capability must accept contractual provisions for the possibility of classified research. DOE initially wanted to issue a regulation, but after protest from the universities DOE decided to use contract negotiations. The new policy could create a serious dilemma for universities with strict prohibitions against classified research and with aspirations for major new facilities.

In 1983 DOE attempted to use the Stanford Synchrotron Radiation Laboratory for classified work on detectors used in nuclear weapons testing. Two-hundred Stanford scientists signed a petition to bar that work.

Students to Use Synchrotron Light Source

This August, the Department of Energy will be giving high school honor students an opportunity to sample materials research during a two-week research session at the National Synchrotron Light Source (NSLS), at Brookhaven National Laboratory in Upton, NY. The program is patterned from a similar one, begun last summer, which sends about 50 students to get hands-on experience with supercomputers at Lawrence Livermore National Laboratory.

Through lectures and tutoring at NSLS, the world's brightest x-ray and ultraviolet source, the students will get a chance to study the surface properties of condensed matter, the mechanisms of corrosion and materials failures, problems in photochemistry and processes in photosynthesis. Working in groups of four or five, each student will also get a chance to participate in an experiment using the vacuum-ultraviolet and the x-ray ring—each experiment lasting about four hours. At the x-ray ring, for example, students might conduct a trace-element analysis. They'll learn how the devices on a particular beam line works, conduct experiments, write up their data and then make a presentation of their results. The ultimate goal, says Donald J. Metz, who will be coordinating the program at Brookhaven, is to stimulate an interest in a research career by giving students a taste of real experimental work.

J.R.

R.P.H. Chang

R.P.H. Chang Accepts Professorship

R.P.H. Chang of AT&T Bell Laboratories (Murray Hill, NJ) has accepted an appointment as a Professor in the Materials Science and Engineering Department at Northwestern University in Evanston, IL. Chang joined the research division of AT&T Bell Laboratories in 1971 to start research in experimental plasma physics, concentrating on nonlinear plasma wave phenomena. Since 1976 his research interest has shifted toward the study of plasma-solid surface interactions as a means of processing thin film electronic materials. He has recently been working on electronic materials for integrated opto-electronic devices, and he plans to continue his research in electronic materials and plasma processing at Northwestern University.

Chang has been very active in MRS in various capacities. In 1984 he organized the first symposium on Plasma Synthesis and Etching of Electronic Materials. Chang is a Councillor for MRS, a Meeting Chair for the 1986 MRS Fall Meeting, and Chairman of the Subcommittee on International Relations of the External Affairs Committee. He also serves on the Awards, Corporate Participation and Long Range Planning Committees.

S. Susman Honored for Patent

Sherman Susman was among 39 Argonne National Laboratory scientists honored recently at the laboratory's annual Patent Awards Banquet. Susman, a member of the Materials Research Society, and Kenneth Volin received a U.S. patent in 1985 for "glass capable of ionic conduction and its method of preparation."

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MIT Press Offers Materials and Processing Report

MIT Press recently began publishing *Materials and Processing Report: The Leading Edge of Technology Worldwide*, a monthly report edited by Renee G. Ford, in association with the Massachusetts Institute of Technology Materials Processing Center.

Materials and Processing Report (*MPR*) was developed by MIT Press to bring timely, interdisciplinary information to the materials community in industry, academia and government. *MPR* will focus on the "state of the art in advanced performance materials as they affect the drive for competitive advantage and leadership in technology," said Ford. The Report will feature technical summaries of significant developments in all advanced materials, including ceramics, metals, polymers and electronic materials, and all types of processing innovations. Articles will list follow-up sources for further information. Other regular features will include policy news from Washington, DC, international developments, patent reviews, conference highlights, publication notices, and a meetings/conference calendar section.

Contact MIT Press Journals, 28 Carleton Street, Cambridge, MA 02142; telephone (617) 253-2864.

International Journal of Optical Sensors

This new bi-monthly journal is dedicated to all aspects of the technology of optical sensors, including theoretical principles, signal processing, materials science, device fabrication, packaging, systems design, industrial and research applications and operational economics. *IJOS*, which began publishing in January 1986, will provide rapid publication of review articles and original papers refereed to the accepted standards of established international scientific and technical journals.

Papers for publication in *IJOS* should be sent to the editors A.J. Rogers or R.J. Weiss, IJOS, Department of Physics, King's College London, Strand, London WC2R 2LS; telephone (01) 836-5454, ext. 2155.

For subscription information, contact Newman-Hemisphere, 10 Bywater Street, London SW3.

Indian National Academy Elects J. Narayan Fellow

Jagdish Narayan, professor of electronic materials at North Carolina State University, has been elected a Fellow of the National Academy of Sciences (India). He was recognized for his pioneering contributions in the development and transient thermal processing of solid-state materials. Narayan, who became a naturalized citizen of the United States in 1981, is a Fellow of the American Physical Society and the American Association for the Advancement of Science. He has received a number of awards, including the U.S. Department of Energy's Outstanding Sustained Research Award and three IR-100 Awards from Industrial Research for novel materials and processing methods. MRS has benefited from his service as chairperson and as a Meeting Chair of the 1984 Fall Meeting in Boston. Narayan is now serving as a Councillor of the Materials Research Society.

First Radiation-Hardened Two-Level Metal Microchip Developed

New processing techniques have permitted researchers at Sandia National Laboratories to build a radiation-tolerant microchip that uses two levels of interconnects to make electrical connections between its more than 100,000 transistors. The resulting thumbnail-size memory chip is inherently faster at processing information and less susceptible to the effects of transient radiation than its one-level metal predecessor. (Exposure to transient radiation can cause permanent loss of a chip's entire memory.) Microelectronics experts at Sandia's Center for Radiation-Hardened Microelectronics (CRM) note that two-level metal interconnections will be essential for a new generation of microprocessors designed for use in extreme radiation environments like those in space and nuclear weapons.

"Development of a radiation-hardened two-level metal IC has been slowed because the additional process steps required to add a second layer of conducting lines have compromised the chip's ability to perform reliably in radiation environments," said Dr. Bob Gregory, Director of Microelectronics at Sandia. "The new low-temperature processing techniques identified at the CRM confirm that the second level can be added without degrading radiation hardness," he added.

The keys to the development of Sandia's new chip are threefold:

- Use of a new layered material (a 0.7 micron layer of pure aluminum capped by a thin layer of tantalum silicide) as first-level interconnects. The 0.1-micron-thick tantalum silicide cap primarily eliminates hillocks that form on aluminum lines during thermal cycling. Hillocks seriously increase the incidence of electrical shorts, thus increasing the number of unusable ICs on a wafer.
- Use of special deposition and etching techniques to ensure a flat silicon dioxide insulation layer between the device's bottom and top interconnect levels. The multistep plasma planarization process begins with the low-temperature deposition of silicon dioxide on the IC's aluminum/tantalum silicide interconnects, followed by deposition of photoresist on top of the silicon dioxide. A two-phase etching process then removes all the photoresist and precisely controls thicknesses of the insulation.
- Use of a versatile etching process to cut tailormade vias through the device's insulation layer. The new etching technique can produce either straight or sloped via walls, depending on the material (aluminum or tungsten) used in the vias.

Test versions of Sandia's new chip can read and write information about 30% faster than a one-layer part with equivalent radiation hardening. In addition, using two levels of metal interconnects will help scientists design chips so that excess photocurrents can be more efficiently routed to ground. Excess current not quickly removed from the chip can cause permanent loss of its entire memory. Test results have also encouraged designers about the device's tolerance against single event upset (SEU), a temporary memory loss that can occur when a high-energy particle or a cosmic ray passes directly through a transistor.

CRM researchers list additional advantages for the new conductor material, including:

(1) electrical resistivity almost as favorable as aluminum-only lines;

(2) simultaneous etching of the aluminum and tantalum silicide films;

(3) the presence of tantalum silicide at the bottom of a via hole, which enhances formation of a stable electrical contact between the two metal levels and facilitates selective deposition of tungsten into a via; and

(4) the ability of tantalum silicide to absorb the ultraviolet light that occurs during lithographic processes, a property that leads to extremely well-defined etching.

MRS