Linus Pauling to Receive NSF's Vannevar Bush Award

Linus Pauling, whose plenary address at the recent MRS Spring Meeting centered on metallic bonding, quasicrystals, and cold fusion, will receive the National Science Board's Vannevar Bush Award in acknowledgment of his outstanding contributions to science and society.

The award from the NSB, the policy-making body of the National Science Foundation (NSF), honors both the individual selected and the concept that science and technology are important to the future of humankind. It is named for the director of the Office of Scientific Research and Development during World War II, whose efforts to manage federal programs in scientific research led to the establishment of the NSF in 1950.

Pauling, twice winner of the Nobel Prize, is widely acknowledged to be a seminal figure in the history of chemistry. His first-year textbook, *General Chemistry*, is often credited with having revolutionized the teaching of chemistry by presenting the subject as one that can be understood rationally in terms of the laws of quantum mechanics applied to molecular structure. *The Nature of the Chemical Bond*, another Pauling work, is one of the most cited scientific books of the 20th century.

At April's MRS Meeting in San Diego, the 88-year-old chemist presented a paper in the high temperature superconductor symposium and delivered a plenary speech to more than 1,600 colleagues. Pauling discussed the evolution of his work from chemical bonding in metals to more recent work on quasicrystals. He also reasoned that a chemical reaction involving metal hydrides, not nuclear fusion, led to a substantial release of heat in now-famous experiments involving heavy water and palladium.

Editor's note: A summary of Pauling's plenary address will appear in an upcoming issue of the MRS BULLETIN. It is also available in its entirety from MRS on videotape.

Allied-Signal Starts Metglas Alloy Plant

Allied-Signal has opened the world's first commercial-scale amorphous metal casting plant in Conway, South Carolina. The plant will produce Metglas Transformer Core Alloy, used instead of conventional electrical steel by manufacturers of electrical distribution transformers, greatly increasing energy efficiency.

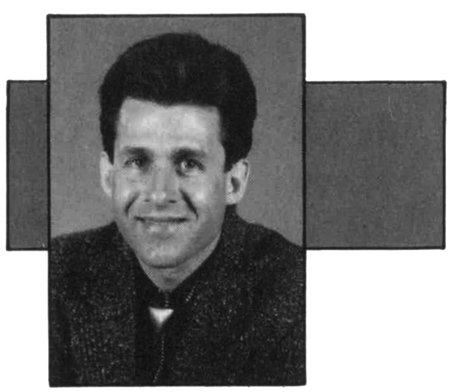
At full capacity, the Conway plant will produce 60,000 tons of Metglas alloy per year. About 240,000 tons of electrical steel is used annually in the United States in the manufacture of transformers, primarily for electric utilities.

About 6,000 MW of electric power are now lost annually in distribution transformer cores in the United States at a cost of $3 billion per year. By switching to transformers with Metglas alloy cores, utilities can reduce these losses by up to 70%, thus reducing fuel consumption and delaying the need for new power generation capacity.

Allied-Signal began research and development of amorphous metals in 1970 and has spent over $100 million to commercialize the product. Metglas alloy is a metal with a glasslike atomic structure. It is produced by cooling the molten metal alloy at over one million degrees per second, giving the resulting product unusual magnetic properties.

C.J. Brinker Wins Zachariasen Award in Glass Science

C. Jeffrey Brinker will receive the Zachariasen Award in Glass Science during the 10th University Conference on Glass Science, June 1989, at Pennsylvania State University.



Brinker, a member of the technical staff in the Inorganic Materials Chemistry Division at Sandia National Laboratories and co-chair of the "Better Ceramics Through Chemistry" symposium and meeting chair for the 1990 MRS Spring Meeting, is only the third recipient of the Zachariasen Award since it was established in the 1970s to recognize significant contributions to the glass science literature by young scientists.

Named in honor of W.H. Zachariasen for his pioneering work defining the criteria for oxide glass formation, the award is one of the most prestigious available to glass scientists. Recipients of the $1,000 prize are chosen by the advisory editorial board of the *Journal of Non-Crystalline Solids*.

Brinker was recognized for numerous publications on the physics and chemistry of sol-gel processing, particularly a series of papers co-authored with E.P. Roth, also of Sandia, and G.W. Scherer of E.I. duPont de Nemours and Company. The award also cites his published works on defects in gels co-authored with Roth and D.R. Tallant and C.S. Ashley, both of Sandia.

T. Michalske Receives Premier Glass Science Award

Terry Michalske, supervisor of the Surface Science Division at Sandia National Laboratories and a member of the Materials Research Society, has earned the Woldemar A. Weyl International Glass Science Award. Presented only once every three years, the award recognizes young scientists whose work has shown ingenuity, initiative, and innovative thinking.

Michalske was cited for work and publications (more than 30 to date) contributing to the scientific basis for understanding and predicting the mechanical properties of glass in corrosive environments (see "Glass Corrosion Studies" in this section).

Formal presentation of the Weyl Award will be made at the 15th International Congress on Glass to be held in Leningrad, USSR, July 2-7. Michalske will deliver the Weyl Lecture as part of the award ceremony.

The award was established in 1976 by Pennsylvania State University in collaboration with the International Commission on Glass as a memorial to Woldemar A. Weyl, who was Evan Pugh Research Professor in Physical Science and a member of the Penn State faculty from 1938 until his death in 1975. Weyl was known internationally as an imaginative and innovative scholar and teacher, whose pioneering studies of colored glass formed the basis for later research into the chemical constitution of glass.

Diamond Coatings Grown on Silicon Chips

Scientists at the University of Houston have discovered a way to grow diamond coatings on silicon wafers that may lead to a new generation of integrated circuits. According to Houston x-ray analysis reports, "the diamond layer consists essentially of a single crystal of diamond that is one or two atomic layers thick."

The Houston scientists adapted ion beam epitaxy to produce the diamond coatings. A beam of charged carbon atoms is shot at a silicon target with just enough energy to drive the carbon atoms a small

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distance into the silicon. There, the carbon atoms blend into the crystal structure of silicon atoms, forming electronic bonds with the silicon. As the carbon beam continues to irradiate the target, carbon atoms build up and begin to form a lattice of their own, a diamond crystal lattice that is intimately connected to the underlying silicon lattice.

For further information, contact: J.L. Robertson, Department of Physics, University of Houston, Texas 77204-5504.

From Electronic Materials Technology News, March 1989, p. 3.

Panel Discounts Immediate Need for Commercially Developed Space Facility

The nation has no compelling need for a separate, commercially developed space facility (CDSF) for conducting research at low or zero gravity before a proposed space station is expected to be operational in 1996, according to a report to NASA by a National Research Council (NRC) committee.

Some proponents of the CDSF say the facility could be used to manufacture special materials and pharmaceuticals in a microgravity environment. But the committee found no evidence to support this claim. Instead, says the report, information gleaned from such experiments would be used primarily to improve terrestrial manufacturing processes.

Although the committee acknowledged that important work can be done in an environment free from the influence of gravity, including growth of protein crystals and perfectly formed crystals for semiconductors, current shuttle flights provide the capability to perform such work. Current flight duration, for example, allows microgravity experiments to run for about one week. A new generation of shuttle missions with extended duration, anticipated to begin in 1992, will allow 16-day missions and possibly 28-day missions. More than 85% of planned experiments could be accommodated by the 16-day missions and virtually all the rest with 28-day missions, the committee said. Moreover, it found that fewer than 4% of planned projects would require more than 2 kW of power, which can be accommodated by existing shuttle power supplies.

The committee also countered arguments that a CDSF is needed in case all the currently planned shuttle missions don't materialize. It noted that the cost of having a CDSF as "insurance" for microgravity research (as much as $700 million over a five-year period) rivals the cost of the experimental projects themselves, which are budgeted at about $150 million per year.

A CDSF is not needed, the report concludes, to carry on meaningful microgravity research. However, it advises NASA to build a "contingency reserve" of about 20% into its mission-scheduling process to compensate for flights which are shortened or delayed.

EPRI Seeks Patent on ORNL Superconducting Motor Design

The Electric Power Research Institute (EPRI) has filed for a patent on a superconducting electric motor that was designed at Oak Ridge National Laboratory (ORNL) under a joint program.

The new design, described as an axial gap superconducting motor, makes the superconducting magnet stationary and eliminates the need to transfer the liquid refrigerant and high currents to a rotating component. This simplifies the design, decreases the cost, and could increase reliability. The design may also eliminate the need to form the superconducting materials into coils.

The invention grew out of a Department of Energy-EPRI assessment completed last year of future energy productivity applications of the new ceramic superconductors which superconduct above the temperature of liquid nitrogen.

In the ORNL design, a circular disk-shaped superconducting magnet assembly is bracketed by dual, normally conducting rotating armatures. This modular design allows use of a number of stator/armature pairs on the same shaft to increase power output. This design is also the first known superconducting motor with fully adjustable speed.

The developers say the motor's simple magnet design may allow early application of new high temperature ceramic superconductors. As a first step, a 180 hp prototype of the new motor using a conventional low-temperature (niobium-titanium) superconducting magnet is scheduled for testing this fall at ORNL.

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The prototype motor will generate 535 ft lb of torque at 1,800 rpm using a superconductor at 4 K.

The developers believe that the new design, eventually using liquid nitrogen as a coolant for the superconducting magnet, can contribute toward making smaller superconducting motors technically and economically sound in the future.

CEAM II to Continue Magnet Research Project in Europe

Phase two of the Concerted European Action on Magnets (CEAM II) was recently accepted by the Commission of European Communities within its European Research on Advanced Materials Program (EURAM). Funding of 250,000 ECU was authorized over the next two years of the program. The first meeting of CEAM II participants was held at the Irish College, Louvain on February 24-25, 1989 during which the next year of research was outlined and several future workshops were scheduled.

Phase one of CEAM was initiated in 1984-1985 and involved 58 European laboratories in the study of high performance permanent magnet materials. Phase one, under a 30-month 2.5 million ECU grant from the Commission of European Communities, addressed fundamental studies, magnet processing, innovative design, and novel applications. Over 450 scientific publications and eight patents resulted as a direct consequence of CEAM. The final results of phase one were reported at a meeting held in Madrid, April 1988 and will be published by Elsevier Applied Science Publishers in mid-1989.

Additional information on CEAM is available from J.M.D. Coey, Trinity College, Department of Physics, Dublin 2, Ireland; telephone 1-77.20.95.

NRC Panel Recommends Major Changes to NSF Surveys of Scientists and Engineerings

A National Research Council (NRC) panel has recommended major changes to improve the quality and usefulness of the NSF Scientific and Technical Personnel Data System.

Discrepancies between data collected by NSF and other organizations led the agency to invite the inquiry. For example, NSF in 1984 estimated the number of scientists and engineers in the United States at 3.7 million—a figure almost double the Bureau of Labor Statistics' estimate but only three-fifths of the Census Bureau estimate.

The NRC panel, chaired by Graham Kelton of the Institute for Social Research at the University of Michigan, concluded that much of the problem stems from the way NSF defines "scientist" and "engineer." The NSF count includes most people currently working as scientists or engineers, but excludes those without related training or prior experience. In addition, it includes many people with a degree in science or engineering who are working as managers or administrators or in some other occupation.

For the past 40 years, NSF has maintained current statistics on numbers of scientists and engineers, personnel movement into and out of disciplines, new graduates, and other pertinent information. The core of its data system is a survey of college graduates selected from the decennial census and followed up at two- to three-year intervals. This principal survey is supplemented with surveys of new graduates in science and engineering fields and of doctoral recipients. From the data collected in these surveys, NSF constructs "composite estimates" of the numbers of scientists and engineers in each field. To arrive at its figures, the agency uses a complicated definition that combines aspects of an individual's occupation, degree field, and professional self-identification. An individual who meets two of these three criteria is included in the science/engineering statistics. The final product is a single composite estimate for each field of science.

NSF could improve its data system, the panel advised, by discarding the complex definition and developing estimates of college graduates in science and engineering, identifying those who are working in fields for which they were trained and those working in other fields. NSF should also develop estimates of people currently employed as scientists or engineers, including those who were trained in other fields. The panel argued that by distinguishing between different types of scientists and engineers and by asking more detailed questions in its surveys, NSF would be able to provide better answers to policy questions and would improve the capability of the system to support in-depth research on the science and engineering labor pool.

The panel also urged NSF to improve its survey procedures, develop a vigorous program for evaluating the data and meeting quality standards, and expand its activities for disseminating the data and working with the user community. In order to achieve the necessary levels of data quality and relevance, the panel concluded that NSF must allocate additional resources to its survey program.

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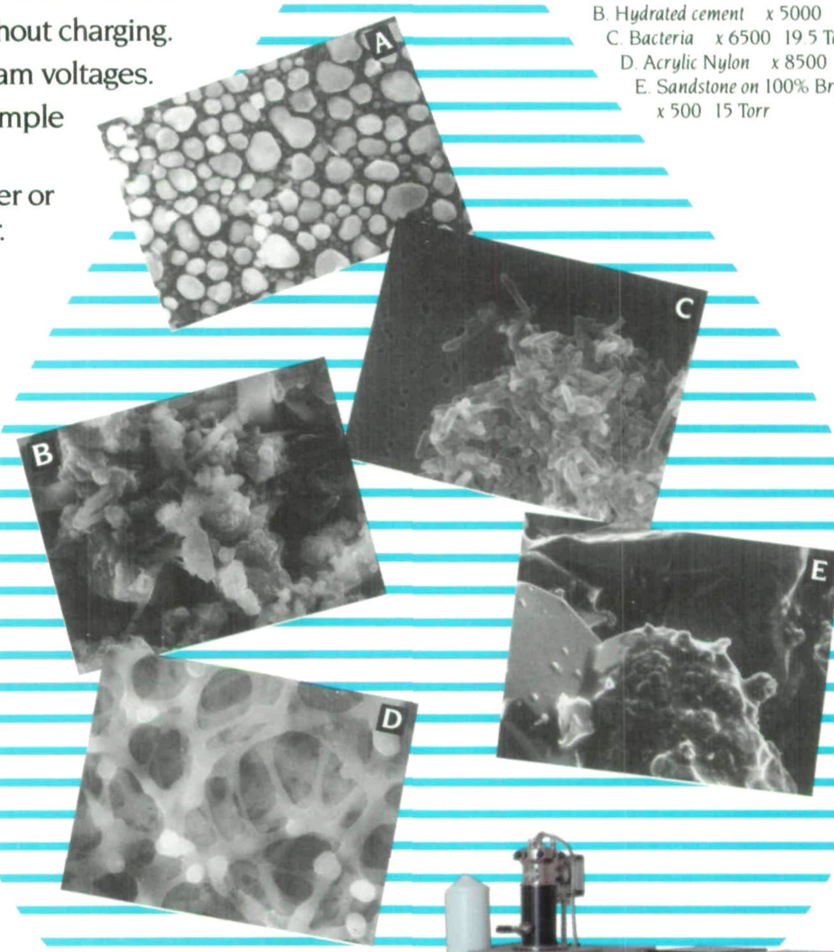

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Workshop on Tungsten and Other CVD Metals for ULSI/VLSI Applications

September 20-21, 1989, in San Mateo, California
October 19-20, 1989, in Tokyo, Japan

Announcement and Call for Papers

This workshop is the sixth in a series organized to bring together active researchers in the field of refractory CVD metals for advanced IC applications.

The 1989 workshop is in two sequential parts, the first in San Mateo, Calif., the second in Tokyo. Participation in either part or both is encouraged.

Papers are solicited on:

LPCVD modeling and deposition techniques
Selective, planarized horizontal interconnect/prepatterning techniques
Contact plug and via fill applications
Nucleation and compatibility studies
Adhesion to thermal and CVD oxides
Refractory metal gate development
Selective cladding of sources, drains, gates, interconnects
WAMO (tungsten-as-metal-one)
CVD reactor design enhancement
Deposition kinetics
Wafer temperature measurement and control
Effect of CVD gas chemistry and impurities on selectivity
CVD precursor development
Grain refinement/roughness control
Fundamental surface chemistry
Film properties (physical, chemical, electrical)
Selectivity enhancers and inhibitors
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New device structures
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Backside deposition prevention
Patterning and etching of refractory metals
Thermal stability/high temperature applications

Abstracts are due June 29, 1989

Send abstracts (300 to 500 words, typed, double-spaced) to S. Simon Wong, Center for Integrated Systems, CIS-202, MC 4070, Stanford University, Stanford, CA 94305. Include author's name, afiliation, mailing address, and phone number on abstract.

For an announcement:

Call (415) 642-4151 or write to Continuing Education in Engineering, University Extension, University of California, 2223 Fulton St., Berkeley, CA 94720.

Continuing Education in Engineering, University Extension,
University of California, Berkeley

The report, *Surveying the Nation's Scientists and Engineers: A Data System for the 1990s*, is available from the Committee on National Statistics at the NRC, 2101 Constitution Ave. NW, Washington, DC 20418; telephone (202) 334-3093.

Oak Ridge Initiates LPVD Thin-Film Growth Program

Oak Ridge National Laboratory (Tennessee) recently initiated a new program on the laser photochemical vapor deposition (LPVD) of thin films and artificially structured materials. UV photon-controlled deposition offers the potential advantages of low-temperature growth to minimize the disadvantages of conventional thermal chemical vapor deposition. The properties of many important thin-film materials are inevitably degraded at high growth temperatures because of the processes of thermal migration, vacancy generation, and diffusion.

Oak Ridge is working with Dow Corning to reach three principal goals:

1. To develop a fundamental, molecular-level understanding of photochemical reactions that result in low temperature epitaxial film growth. Techniques used to obtain this understanding will include *in-situ* optical and mass spectroscopy to identify the primary photo fragments produced in photon-controlled reactions, as well as to determine the products of subsequent collisional or surface reactions.

2. To identify and synthesize parent gaseous molecules that are specifically designed for efficient photon-controlled growth of technologically important materials.

3. To demonstrate low-temperature, photon-controlled growth and to determine the best growth conditions for epitaxial films of Si, Ge, and selected II-VI compound semiconductors.

Experiments at Oak Ridge have already demonstrated the high degree of control over film thickness that is possible using purely UV photon-controlled reactions, however very little is known about the photochemical reactions of parent molecules used for photon-controlled film deposition under typical growth conditions. For this reason Oak Ridge scientists have also initiated a program of basic research on the gas phase and surface processes that result in film growth.

The principal materials benefit from lower temperature, UV photon-controlled film growth is expected to be more perfect crystalline materials. Improved access to low-temperature and metastable crystalline phases, for practical applications, may also result. In addition, it may be unnecessary to use certain highly toxic parent molecules now used in conventional thermally driven CVD reactions.

From Electronic Materials Technology News, March 1989, p. 1.

J.T. Wrobleski Appointed Catalytica Project Leader

James L. Wrobleski, a member of the Materials Research Society, has been appointed project leader at the Catalytica Studies Division of Catalytica, Mountain View, California. Also appointed as project leader and marketing manager was John L. Cihonski. The two will direct the development of new Catalytica studies and will provide technical insight, author support, editing and analysis of findings, and publications coordination.

Before joining Catalytica, Wrobleski served in several positions with Monsanto Chemical Company. Most recently he was

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a senior research specialist in charge of identifying new products and technologies in the areas of advanced materials and ceramics. Previous responsibilities included synthesis and characterization, pilot-plant catalyst synthesis and testing, and commercial-scale catalyst manufacturing.

Wrobleski obtained his PhD and BS in chemistry from the University of Missouri-Rolla, and was a postdoctoral fellow at the University of Vermont.

Advanced Deposition Methods Used to Develop Thin-Film Solar Cells

Battelle-Columbus scientists are using advanced deposition methods to develop thin-film solar cells based on gallium arsenide and cadmium selenide. Ionized cluster beam deposition, which lowers the deposition temperature by reactive evaporation of gallium and arsenic, is being used for the GaAs films. Because of its favorable electronic properties, GaAs is expected to achieve new, higher levels of efficiency. Comprehensive work on the materials technology of thin-film Cd-Se films and the deposition technique has produced efficiencies of 7%, with 10% expected.

The work is being sponsored by the German Federal Government and the European Economic Community.

From Electronic Materials Technology News, March 1989, p. 5.

NAS President Calls for Modest Funding Increases, Better Facilities for U.S. Basic Research

National Academy of Sciences (NAS) President Frank Press has urged government leaders to double total federal support for basic science over the next five years and to pass special legislation to redress "two decades of neglect" in the funding of science buildings and laboratories.

At the same time, Press called for establishment of a National Economic Security Council to help improve federal coordination of policies affecting U.S. industrial competitiveness. To ensure that an adequate number of U.S. students pursues science careers, he also advocated a major effort to improve science education, the poor public image of science, and the support of science graduate students.

A five-year plan to double the current $10 billion federal budget for basic science would represent an annual growth rate of 14%, or about $2 billion per year in new funding. This compares with an increase in the FY 1989 basic science budget of 10% over the previous year.

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Press also requested that about $1.25 billion be provided per year for new construction, refurbishment, and repair of laboratories and other research facilities. This is equivalent, he said, to 50 new buildings a year at $25 million each. Legislation authorizing these new funds, he suggested, should include the following: participation in the process by all government agencies with science programs; allocation of funds by both "merit alone and on the basis of meritorious proposals from institutions aspiring to improve their standing"; local cost-sharing; facilities use charges that better reflect real costs; and an easing of restrictions on debt financing by nonprofit education and research institutions. Under this plan, peak spending would be delayed until the budget deficit is reduced.

Press also proposed the establishment of a National Economic Security Council, which would strive for enhanced international competitiveness by integrating the government's economic and technological policies. The council would have the same level of influence as the current National Security Council, dealing directly with the many factors affecting U.S. competitiveness including education; science and technology; and regulatory, economic, and trade policies.

O'Reilly Institute Established at Trinity College

The O'Reilly Institute for Communications and Advanced Technology was opened in February on the campus of Trinity College, Dublin. The Institute headquarters one of the leading university computer science departments in Europe and also several research groups in materials science. Included in the latter are the Magnetic Materials Group, which played a leading role in CEAM (the European Community program on magnetic materials); the Polymer Physics Group, which has extensive research interests with industry in Ireland, the United Kingdom, and the United States; and a group of computational physicists and mathematicians drawn from physics, chemistry, and mathematics.

The building also houses part of Op-

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tronics Ireland, the optical electronics initiative set up by the Irish government, and the Advanced Manufacturing Technology Group, also sponsored by the Irish government. Specializing in the industrial applications of computer-controlled inspection and monitoring devices, the Advanced Manufacturing Technology Group is a joint initiative of Trinity College's Departments of Microelectronics and Computer Science.

Adjacent to the O'Reilly Centre is the Innovation Centre, sponsored by the Industrial Development Authority of Ireland, which houses many of the 11 campus companies recently started in Trinity College, and the Innovation Services Department, which acts as the link with industry.

The $3 million gift made by Dr. A.J.F. O'Reilly, president and chief executive officer of the Heinz Corporation, Pittsburgh, Pennsylvania, was made to honor his parents, John P. and Aileen O'Reilly.

North Carolina Team Uses Low-Temperature Process to Make High-Current Superconducting Films

A novel process for depositing thin films of superconducting materials directly onto silicon and other substrates suggests new progress is being made toward the goal of using liquid-nitrogen-cooled superconductors in a new generation of ultrafast computers.

Jagdish Narayan and his graduate students at North Carolina State University have announced the development of a low-temperature (500°C) process that can be used to deposit superconducting films directly onto silicon. In addition, the group reports using the process to obtain current-carrying capacity that is higher than any other published reports. NCSU is applying for a patent for the new process, called biased laser deposition.

To make their thin films, a 45-nanosecond laser pulse is used to vaporize a pellet of the superconductor in a vacuum. Voltage is applied to control the movement of the ions toward the heated substrate, while the desired proportion of oxygen is added. The elements of the superconductor are deposited onto the substrate, where they crystallize in a layer-by-layer process.

Because it requires less heat during manufacture, resulting in less mixing between the crystallizing film and the substrate, the process allows direct deposition onto expensive strontium titanate as well as onto silicon. Researchers used a relatively low temperature—650°C—to make stable thin films on strontium titanate. The films of 1-2-3 yttrium-barium-copper oxide are epitaxial, carry a current of five million amperes per square centimeter without loss of superconductivity at 77 K, and lose all resistance to electricity at about 90 K. The films are 6.5 cm^2 and as thin as 0.000005 cm, and Narayan says the process can be scaled up for larger sized films.

At 500°C, the group succeeded in making films that were less defect-free, but which still carried currents of one million amperes per square centimeter.

While the team claims success in depositing the 1-2-3 superconductor directly onto silicon, and in obtaining zero resistance at liquid nitrogen temperatures, the crystal is imperfect and aligned in only one direction. Narayan says they expect to improve the epitaxial properties by optimizing the voltage, laser, and substrate variables.

Details of the experiment will be published in *Applied Physics Letters*.

CSAC Announces New Directors for 1989

The Council on Superconductivity for American Competitiveness recently announced five new directors for 1989: Charles D. Vollmer, vice president, General Dynamics Corporation; Walter L. Robb, senior vice president, General Electric Company; Herbert M. Dwight, chief executive officer, Superconductor Technologies, Inc.; Tom Long, vice president of technology, Tektronix; and Paul Chu, director, Texas Center for Superconductivity, University of Houston.

CSAC is a nonprofit association of 55 businesses, laboratories and universities established in 1987 to pursue commercial applications for traditional and high temperature superconductors. CSAC is headquartered in Washington, DC. □

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