R.J. Matyi Joins University of Wisconsin Engineering Faculty

Richard J. Matyi has joined the faculty of the University of Wisconsin at Madison as an assistant professor in the Department of Metallurgical and Mineral Engineering. Prior to accepting this position, Matyi had been a member of the technical staff at the Central Research Laboratories of Texas Instruments.

Matyi's research at Texas Instruments included the analysis of bulk and thin film semiconductor materials using x-ray diffraction, the growth of compound semiconductors with molecular beam epitaxy for microwave and ultrasmall electronics applications, and the patterned growth of GaAs-on-Si for the co-integration of silicon and GaAs device structures. A member of the Materials Research Society, Matyi received his PhD in materials science and engineering from Northwestern University in 1983.

Northeastern Group Announces 122 K with Four-Layer Superconductor Compound

A research group at Boston's Northeastern University recently announced the fabrication of a new superconducting compound containing four consecutive copper oxide layers separated by pairs of thallium oxide layers. The critical temperature, 122 K, is the second highest reported for any superconductor, and the group's findings support the belief that the greater the number of copper oxide layers, the greater the superconductivity.

Independently, Japanese researchers at MITI's Electrotechnical Laboratory reported a structurally similar compound with a T_c of 120 K.

The Northwestern team studied the resulting materials by x-ray powder diffraction and four-point-probe resistometric and SQUID susceptibility. To aid in x-ray identification of the new phase, they used an intense magnetic field to line up the layers of individual crystalline grains. The procedure greatly simplified phase identification.

The Northeastern University research group is headed by chemistry professor B.C. Giessen, physics professor R.S. Markiewicz, and P. Haldar, a chemistry student. All are members of the Barnett Institute for Chemical Analyses and Materials Science at Northeastern. A paper describing the group's findings was accepted for publication in the August 1988 issue of *Science*. Giessen, Markiewicz, and Haldar are members of the Materials Research Society.

Scientists Probe Earth's Crust

Researchers from Los Alamos and Sandia National Laboratories and from the University of Utah Research Institute have joined scientific and engineering forces to core drill a hole into the Earth's crust in the Valles Caldera crater in the Jemez Mountains of northern New Mexico. The final hole, which could reach a depth of 7,000 feet, will be the deepest and hottest continuously cored hole ever drilled in North America. At that level the temperature is expected to be nearly 600°F. →

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The scientific objectives of the project include greater understanding of how heat and mass are transferred in the Earth's crust through volcanic-geothermal processes. Rock and mineral samples and also hot hydrothermal fluids will be taken from the hole and analyzed. Other scientific goals include studying the development and evolution of a complex volcanic field and learning more about the dynamics of an active hydrothermal system. Drilling began in late July 1988 and is expected to be completed within four months.

Steel liners are being installed as the hole is being drilled. After about a year, the liner will be perforated at specified intervals for fluid sampling and flow testing. The fluids will be measured for characteristics (such as composition, acidity, temperature, and pressure) that exist when metals such as silver or molybdenum are precipitated out of solution and deposited within the hydrothermal system. The hole will remain open for about four years to permit more experiments and fluid sampling.

The project is being funded by the U.S. Department of Energy's Office of Basic Energy Sciences as part of the Continental Scientific Drilling Program, an effort jointly sponsored by the DOE, U.S. Geological Survey, and the National Science Foundation.

Advanced Technology Materials to Evaluate MOCVD for Superconducting Thin Films

Advanced Technology Materials (ATM), Inc., New Milford, Connecticut, was awarded a contract for $950,000 by the Defense Advanced Research Projects Agency (DARPA) to develop a process to manufacture thin films of high temperature superconductors. Under the contract, ATM will evaluate the potential of metalorganic chemical vapor deposition (MOCVD) as a cost-effective, reproducible process to make superconducting thin films.

Widely used in the electronics industry for epitaxial layer growth of semiconductors, MOCVD offers exact control of stoichiometry and morphology. The process also offers potentially significant advantages in versatility, step coverage, large area uniformity, microstructure control, and large-scale production capabilities.

Deposition of the new oxide superconductors by MOCVD is technically challenging. There are three or more metals to deposit as oxides, and since there is a lack of suitable source reagents, none have been routinely deposited, either as metals or as oxides.

Du Pont Gains Exclusive Rights to Houston High T_c Research

Following heated competition with the Japanese trading group Mitsui, the Du Pont Company signed an exclusive licensing agreement with the University of Houston, making Du Pont the major beneficiary for the next three years of high T_c research directed by Dr. Paul Chu.

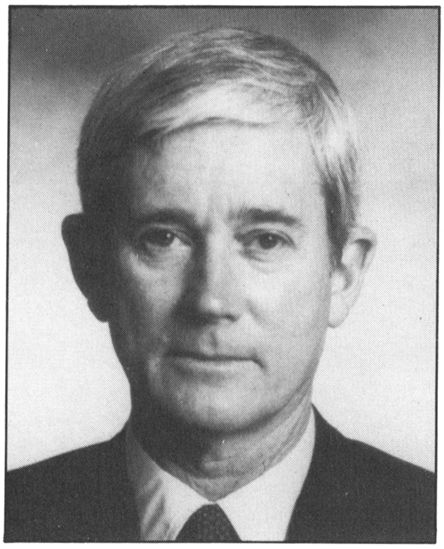
In exchange for receiving an exclusive, worldwide license right to make and sell products deriving from the high T_c work done at the university, Du Pont will give $4.5 million to the Texas Center on Superconductivity at the University of Houston (TCSUH).

In addition to rights for 1-2-3 materials and related yttrium substitutions, Du Pont will also have the right of first refusal for all other compounds developed by University of Houston, as well as processes involving the manufacture or use of such new compounds. This gives Du Pont potential access to a whole variety of new compounds and processes beyond 1-2-3. Some early Du Pont high T_c products expected to be marketed in a few years include smoke detectors and SQUIDs.

Even though Du Pont will gain the major licensing, University of Houston officials believe the agreement will help foster further attention on the TCSUH consortium. They note that members may gain licensing access to new patents that Du Pont is not interested in, receive advance notice of timely research information, gain regular technical reviews of the ongoing research program, and benefit from the exchange of industry and university research staff, as well as membership on the consortium's advisory board.

From *Superconductor Week*, Vol. 2, No. 33, p. 1.

A.W. Trivelpiece Appointed Oak Ridge Director



Martin Marietta Energy Systems, Inc., has announced the appointment of Alvin W. Trivelpiece as director of Oak Ridge National Laboratory (ORNL). He will also be a vice president of Martin Marietta Energy Systems, the Martin Marietta subsidiary that manages ORNL and four other energy-related facilities for the U.S. Department of Energy.

Trivelpiece, who has been executive officer of the American Association for the Advancement of Science (AAAS) since 1987, will oversee the laboratory's energy research and development operations, which include more than 5,000 staff members and have an annual budget of approximately $500 million.

Before becoming executive officer of AAAS, Trivelpiece served as director of DOE's Office of Energy Research from 1981 to 1987. Earlier he was corporate vice president for Science Applications, Inc.; vice president for engineering and research at Maxwell Laboratories, Inc.; and assistant director for research in the U.S. Atomic Energy Commission's Division of Controlled Thermonuclear Research.

Trivelpiece has been honored as a distinguished alumnus of both California Polytechnic State University and the California Institute of Technology. A Fulbright and a Guggenheim Fellow, he also received DOE's highest service recognition, a Secretarial Commendation, in 1987.

Trivelpiece holds four patents and is the author of numerous research publications. He is a Fellow of the American Physical Society, the Institute of Electrical and Electronics Engineers, and AAAS. He is a member of the American Nuclear Society, the American Association of Physics Teachers, and the American Association of University Professors.

COMAT Study Estimates FY 1989 Federal Superconductivity Funding at $205.4 Million

A comprehensive study developed by the White House Office of Science and Technology Policy's Committee on Materials (COMAT) estimates that federal funding for superconductivity research will increase from $84.6 million in fiscal 1987, to an estimated $205.4 million in fiscal 1989. Specific federal funding for high T_c superconductivity is expected to grow from $44.9 million to $135 million in that same two-year period. The report was developed by COMAT's Subcommittee on Superconductivity.

Five agencies are described as having substantial superconductivity efforts under way: Department of Energy, Department of Defense, National Science Foundation, National Institute of Standards and Technology (NIST), and National Aeronautics and Space Administration.

The report cites low temperature superconducting niobium digital electronics as being critical to ground-based air and space applications, also calling it an area that is not being adequately addressed in the United States. Citing its potential for relatively near-term application, the COMAT study claims that "those nations which most aggressively advance low temperature superconducting electronics, will be in the best position to carry the superconducting electronics revolution to its ultimate conclusion by eventually executing in high T_c materials the 'devices, circuits, and architecture' that come from low T_c materials."

According to the report, "DOD has the most interest in electronic devices for applications such as signal processing, sensors, and antennas." DOE focuses on electrical energy conversion, storage, and distribution as well as large magnets for acceleration and fusion plasma containment. NSF funds universities for basic research, and NIST is interested in superconductivity for standards and instrumentation. NASA is interested in aeronautical and space applications, particularly those involving weight and volume savings.

From *Superconductor Week*, Vol. 2, No. 27, p. 1.

Argonne Develops Sensor with Wide Manufacturing Potential

Using an electrically conductive glass, Argonne National Laboratory has developed a new instrument to measure impurities in high-temperature molten salts and liquid metals.

The instrument has attracted the attention of corporations interested in adapting it to their manufacturing processes, according to Argonne. Aluminum companies, for example, could use it to measure low levels of sodium impurities in their final product. Paper companies could use it to help monitor recovery of a paper-whitening agent. The instrument could also be useful in the battery industry or other industries that need to measure sodium concentrations in molten salts or liquid metals.

The device—a micromembrane electrode sensor—operates from room temperature to about 600°C. →

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The key to the instrument is a new glass (developed for use in advanced sodium-based batteries) that conducts sodium ions more efficiently than any other glass. The instrument is made by sealing the bottom of a narrow tube of alumina, or other suitable insulator, with a thin membrane of sodium-conducting glass. The tube is then filled with a liquid of known sodium concentration and inserted into the sample to be measured.

Differences in sodium concentrations inside and outside the tube produce a voltage across the membrane. The measured voltage, which is directly related to the difference in sodium concentrations, allows calculation of the sodium concentration in the sample.

Reflected Laser Light Measures Atomic Layers

Taking advantage of the unique characteristics of laser light as it reflects off a material, a Los Alamos National Laboratory team is investigating the chemistry and microscopic structure of surfaces.

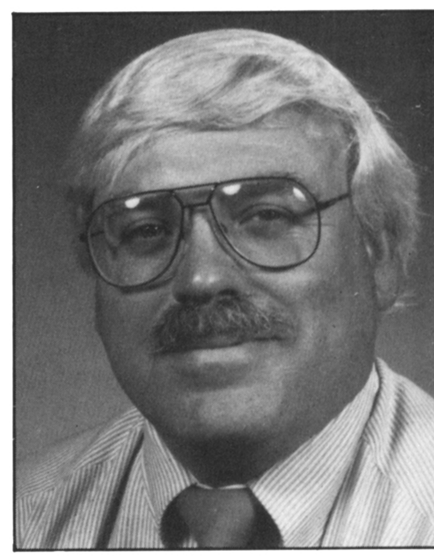
Mark Hoffbauer of Los Alamos' Physical Chemistry Group is leading the research on the technique of "second-harmonic generation" in which reflected laser light measures surface properties on an atomic scale. Collaborating on the work is Ross Muenchausen of the Materials Technology: Polymers and Coatings Group, and a member of the Materials Research Society.

The team's initial SHG experiments are being conducted on a copper-crystal surface housed in a special vacuum chamber. The copper is made "atomically clean" by bombarding it with ions to eliminate contamination, and then heating and cooling it to anneal the surface. Changes in the strength of the second-harmonic laser signal are then observed as the signal reflects from the copper surface. These changes help determine characteristics of the interface.

The researchers have observed, for example, that the SHG intensity can change dramatically with the addition of less than one part in 100 of silver on top of the copper. They have also found that the silver atoms can migrate to form tiny, three-dimensional crystals on the surface of the copper. These crystals, only seven atoms thick, serve as microscopic antennas, broadcasting light at the second-harmonic frequency more efficiently than the original smooth surface.

In addition to its sensitivity, SHG offers some important advantages over other surface analysis techniques, including the ability to make measurements remotely and in actual real-time, and the ability to operate without an elaborate experimental set-up.

R.J. Eagan Named Director of Materials and Process Sciences at Sandia



Robert J. Eagan has been promoted to Director of Materials and Process Sciences, Sandia National Laboratories, Albuquerque, New Mexico. In this position he will be responsible for several departments including the Organic and Electronic Materials, Metallurgy, Chemistry and Ceramics, and Materials Characterization departments. He was previously manager of the Chemistry and Ceramics Department at Sandia.

Eagan received his BS in ceramic engineering from Alfred University in 1966, and his MS (1968) and PhD (1971) in ceramic engineering from the University of Illinois. Since joining Sandia in 1971 he has primarily studied glass and glass ceramics.

Eagan is a past vice president of the American Ceramic Society and is currently its treasurer. He is president of the Ceramic Educational Council and was guest editor for the MRS BULLETIN's focus issue on

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ceramics research (Vol. XII, No. 7, 1987).

Eagan is replacing Richard L. Schwoebel, who has recently become Director of Components at Sandia. Schwoebel is an active member of the Materials Research Society and is a former secretary of the Society.

Record Efficiency Demonstrated for Photovoltaic Concentrator

Scientists at Sandia National Laboratories have achieved a 31% solar-to-electric conversion rate with a new photovoltaic concentrator cell. The rate is the highest efficiency ever recorded by any photovoltaic device.

By comparison, commercially available concentrator cells are currently 18-20% efficient. Recent experimental work with similar multijunction or compound crystalline cells had recorded results up to 26.6%.

The new cell, described as a mechanically stacked multijunction solar cell, takes advantage of advances in solid state technology from Varian Associates Inc. and Stanford University as well as from Sandia's own Photovoltaic Cell Research Division. It is made up of gallium arsenide and silicon crystalline cells (from Varian and Stanford, respectively) in a layered, or stacked, arrangement. Peak efficiency for the record-breaking cell came at a light intensity level of 35-50 W/cm2, the equivalent of 350-500 suns.

The new cell breaks the 30% barrier in efficiency, attaining a goal of the U.S. Department of Energy's (DOE) five-year research plan, calling for an experimental multijunction concentrator with 30% efficiency by this year. A subsequent program goal calls for the cells to be grouped and installed in a high efficiency module. Module efficiencies are expected to be less than those of the cell alone because of losses in the electrical and optical parts of the module. Later experimental cell efficiencies will be pushed to 35% under the DOE plan and ultimately to their expected limits of near 40%.

The significant increase in the interest in concentrator technology in recent years is partly attributed to economics, according to Eldon Boes, supervisor of Sandia's Photovoltaic Technology Division. The path to economical power generation with concentrator technology has become much clearer, he said, since modules with 20% efficiency appear to be at hand. Such modules are believed likely to attract the attention of utility companies as an alternative to conventional power generation.

Fiber-Optic Spark Plug Allows Researchers to "See" Inside Running Engines

A spark plug fitted with fiber-optic "eyes" is being used at Sandia National Laboratories' Combustion Research Facility (CRF) in Livermore, California, to probe combustion problems inside auto engines while they are running. All of the "big three" U.S. auto makers may soon be using a similar diagnostic tool in their engine research programs.

Sandia developed the fiber-optic plug as a result of an inquiry from Chrysler, which was interested in studying the causes of rough idling in automobile engines. Because the special plug was built using a standard 14-millimeter spark plug, it can be used to test unmodified, production-model automotive engines. The plug also allows the investigator to measure the way in which the flame of the explosion grows in the first moments following ignition.

Sandia researchers Peter Witze and Matthew Hall—working with visiting scientist James Wallace of the University of Toronto—devised the optical probe. It consists of a standard spark plug in which a ring of eight 1-millimeter (0.039-inch) holes have been drilled through the threaded metal housing that screws into the combustion chamber.

Each hole contains an optical fiber that is cut off flush with the base of the plug so that it "looks" down into the combustion chamber. Each fiber leads up through the plug to a separate light detector, in this case a photomultiplier tube located in an analyzer away from the engine.

Using the special spark plug, researchers are able to record the shape of the flame kernel by analyzing the outputs from the eight detectors. Because each optical fiber transmits the light it detects from moment to moment, the speed at which the flame grows in different directions can be plotted with the help of a computer program. The optically instrumented spark plug is particularly valuable because it can be installed without changing the geometry of the engine. □

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