Oregon Metals Initiative Formed

The Oregon Metals Initiative (OMI), a $4 million initiative supported by federal and state governments, research institutions, and Oregon metals companies, was recently formed to highlight and boost Oregon's metals industry, an industry that employs 40,000 workers. The Oregon Metals Industry Council, which represents 15 primary and fabricating companies, eight of them participants in the OMI, was also introduced.

Senator Mark Hatfield (R-Oregon) and Representative Les AuCoin (D-Oregon) were instrumental in securing $2 million in funding for the U.S. Bureau of Mines to support the OMI. Oregon Governor Neil Goldschmidt committed $1 million from the lottery-funded Strategic Reserve Fund, and $1 million is committed from the metals industry itself.

The initial $4 million will be used to: (1) find solutions to technical problems in metals processing, (2) increase the pool of Oregon research talent with expertise critical to the metals industry, and (3) improve the long-term competitive position of the industry. To implement this process, Oregon State University, the Oregon Graduate Institute, and the U.S. Bureau of Mines in Albany, Oregon, as well as Oregon's metals companies will submit research proposals to the OMI board and executive committee.

The $2 million in first-round research projects will be carried out by Oregon State University and the Oregon Graduate Institute, and a second round of $2 million in projects will be approved in the next funding cycle after October 1, 1990.

Some of the OMI research projects with the Oregon Graduate Institute of Science and Technology will involve: identifying the nature and source of contamination material in product cast parts; understanding the mechanisms of fatigue-caused crack growth in engine parts; improving weld design and practices used in manufacturing steel rail cars; and optimizing the chemistry, structure, and performance of zirconium-based alloys through experimental and theoretical studies.

Projects with Oregon State University will include: improving high-temperature strength properties of titanium alloys; increasing the quality of cast metal products through improving the flow of molten material into molds; enhancing aluminum alloy properties by novel processing; and investigating and developing advanced techniques for metal defect detection.

Picosecond RHEED Used to Measure Surface Temperatures

Hani E. Elsayed-Ali, a University of Rochester scientist, says he has found a way to measure the temperature of the top few atomic layers of a materials's surface in 100 picoseconds, suggesting important applications in the electronics industry, as well as help in the understanding of chemical and physical surface reactions.

Elsayed-Ali, who calls his technique picosecond reflection high-energy electronic diffraction (RHEED), says he can determine the temperature of a thin material without altering it, and make measurements of reactions that happen in less than 100 picoseconds.

For years scientists have bounced electrons off materials, creating unique identifying patterns for each substance and revealing the surface structure of materials in a process known as electron diffraction. But the technique has never been used to measure transient surface temperature.

"This isn't just a novel device; it has practical uses," says Elsayed-Ali. "One criticism of ultrafast research has been that the new techniques are novel but have no use. Materials scientists will definitely find this useful."

Elsayed-Ali begins by removing impurities from a material's surface, making sure the top atomic layers are completely clean. He splits a laser beam into two beams, each lasting about 100 picoseconds. One beam hits the sample, the other activates an electron gun. The electrons bombard the sample at an angle of only one to three degrees just a few trillionths of a second after the sample is heated by the laser. The electrons bounce off atoms in the material's surface, pass through an amplifier and form a reflection high-energy electron diffraction pattern (RHEED) on a phosphor screen.

As the material heats, its atoms vibrate more and more and become less ordered. By analyzing the angle at which the electrons are deflected, and their intensity as they hit the screen, Elsayed-Ali says he can determine the positions of surface atoms—and the temperature, within 10°C. (See photos.)

"A range of error of 10 degrees is pretty good when you remember that we take the temperature in less than a billionth of a second," Elsayed-Ali said. The "thermometer" works more than a thousand times faster than conventional devices.

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The speediness of the process makes it even more valuable. "Many reactions that happen at surfaces happen very fast," says Elsayed-Ali. "You initiate the reaction and then you look at the byproducts. Now, maybe we can look in between and intervene. It's possible that we'll be able to tailor things while they're happening."

Precisely understanding the thermal properties of surfaces and thin films would help prevent electronic devices from overheating and becoming damaged. This is particularly important for the new generation of high-speed integrated circuits in fast computers. Knowing the surface temperature is vital for other processes, such as the use of lasers in materials processing and in laser-induced surface chemical reactions, which are important in microchip production.

Elsayed-Ali is now building a laser and an electron gun he says will enable him to measure a surface's temperature within one degree in just one picosecond.

AIP Congressional Science Fellowship Applications Being Accepted for 1991-92

The American Institute of Physics is currently accepting applications for its 1991-92 Congressional Science Fellowship program. Fellows will serve for one year as special legislative assistants on the staff of either a member of Congress or a congressional committee. Science fellows will gain firsthand experience in the legislative branch of the federal government and the opportunity to explore science policy issues from the lawmaker's perspective. At the same time, the fellows will provide scientific and technical expertise to assist in the analysis of public policy issues.

Qualifications necessary for applicants include a strong interest in science and technology policy, a PhD in physics or a closely related field, and current membership in an AIP Member Society. The 1991-92 fellowship, which carries a stipend of up to $40,000 and provides relocation and in-service travel allotments, begins September 1, 1991.

The application deadline is **February 15, 1991**. For an application and further details, contact: George Shaw, American Institute of Physics, 2000 Florida Avenue NW, Washington, DC 20009; telephone (518) 370-6310.

Bush to Nominate Massey for NSF Directorship

President George Bush announced his intention to nominate Walter E. Massey to be director of the National Science Foundation (NSF). Massey would join Frederick M. Bernthal, who was sworn in as deputy director of NSF in March 1990 and has been acting director since Erich Block left in August 1990.

Massey is vice president for research of the University of Chicago and Argonne

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National Laboratory. As director of NSF, Massey, who has an extensive background in teaching, research, and administration, would head an agency that annually awards 12,000 to 14,000 grants for research in all fields of science, mathematics, and engineering, and which has a budget exceeding $2 billion. Massey became director of Argonne National Laboratory and physics professor at the University of Chicago, which manages the laboratory, in 1979. He relinquished the laboratory directorship to become a university vice president in 1984.

Massey is a member of the President's Council of Advisers on Science and Technology and a former member of the National Science Board. He is former president of the American Association for the Advancement of Science, and has been a member of the National Academy of Sciences Advisory Committee on Eastern Europe and the U.S.S.R.

Deputy Director Bernthal, a chemist, was previously with the Department of State as Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, a position he held since 1988. Bernthal served as a member of the U.S. Nuclear Regulatory Commission from 1983 to 1988. Prior to that, he was chief legislative assistant to then Senate Majority Leader Howard Baker.

ASTM Announces Standards Subcommittee for Sputter Metallization

ASTM standards-writing Committee F-1 on Electronics recently announced the organization of a new technical subcommittee, F01.17 on Sputter Metallization, chaired by Bruce Gehman of Degussa Electronics.

The group will cover sputtered thin film applications in semiconductor manufacture, computer disks, and flat panel displays. The subcommittee will develop voluntary consensus specifications and test methods relating to sputtering targets, production and characterization of thin films, and sputtering equipment. Meetings featuring a technical program on critical sputter metallization issues will be held three times a year and the objective is to promote sound film practice in high tech industrial environments.

For more information about the Sputter Metallization subcommittee's activities, contact: T. Mecholsky, ASTM Staff Manager, at (215) 299-5485; or Subcommittee Chair Bruce Gehman at Degussa Electronics, (408) 779-0636.

Donald R. Ulrich, an internationally recognized materials scientist who was instrumental in establishing and nurturing research in chemical synthesis of ceramics, died November 14, 1990 of cancer.

Ulrich was senior program manager and deputy director of the Chemical and Atmospheric Sciences Directorate in the Air Force Office of Scientific Research, which he joined in 1975. He received BS, MS, and PhD degrees from Rutgers University, conducted postdoctoral studies at the University of Minnesota and Massachusetts Institute of Technology, and later held research and management positions with NASA and General Electric Company.

A strong proponent of allied cooperation in science and technology, Ulrich established a major advanced opticals program involving leading scientists in the United States, United Kingdom, France, and Japan for the Strategic Defense Initiative Organization. His leadership played a critical role in the development and success of the MRS symposium series on Better Ceramics through Chemistry, which began in 1984. *Better Ceramics through Chemistry,* Volume 180 in the MRS Symposium Proceedings Series, has been dedicated to Ulrich.

His personal research and the programs he managed focused on achieving new processing methods and superior properties for high-performance materials, critical to emerging defense needs. This research has led to considerable scientific achievement and technological development in ceramics and ceramic composites, electrooptical materials, and multifunctional polymer materials. Much of the materials processing successes stem from the concept of ultrastructure, which Ulrich pioneered based on his inspirations from biological systems.

Honors earned by Ulrich include the American Chemical Society's Leo Friend Award and the American Defense Preparedness Association's Strategic Defense Award and Gold Medal.

Five Oak Ridge Developments Cited by R&D Magazine

Five developments from the Oak Ridge Department of Energy facilities were named among 1990's top 100 new technology advances by *Research and Development* magazine. These technologies include:

- A ductile iron aluminide (developed at ORNL) that is a possible substitute for many types of stainless steel and other iron alloys because of its corrosion resistance, improved strength and ductility, lower density, and low material cost. In several laboratory and in-plant tests, the iron aluminides appear to be more resistant to sulfidation than any other commercial or development alloys. (Researchers: Claudette G. McKamey, Vinod K. Sikka, and C.T. Liu).
- An ultrahigh-resolution scanning transmission electron microscope (developed jointly with VG Microscopes, Ltd.) that uses Z-contrast imaging to provide atomic-resolution images of the structure and composition of materials. (The Z-contrast imaging technique was developed by Stephen J. Pennycook.)
- A strong, ductile high-temperature structural material (an ORNL development) designed to provide the high-temperature strength and creep-rupture resistance normally found in many superalloys or nickel-aluminides in a lean austentic stainless steel. The new steel would be useful in applications involving fossil energy boilers, solar power towers, petrochemical process piping, aerospace, or automobiles. The steel is also resistant to radiation-induced swelling and helium embrittlement during exposure in advanced fusion or magnetic-fusion reactors. (Researchers: Philip J. Maziasz and Robert W. Swindeman).

Editor's Note: For more information about this steel, see "Using Analytical Electron Microscopy to Design Radiation Resistant Steels for Fusion Applications" by P.J. Maziasz, R.L. Klueh, and A.F. Rowcliffe in the July 1989 *MRS Bulletin,* p. 36-44.

- An automatic thermoluminescent dosimetry system (developed jointly with Engelhard Corporation) to measure the amount and type of ionizing radiation to which personnel are exposed and to analyze, store, and report this information.

- A radio-labeling reagent (developed at Oak Ridge National Laboratory) for tagging radioactive iodine to proteins and tumor-specific antibodies for use in cancer diagnosis and therapy. When linked with an antibody, the new chemical compound known as iodophenylmaleimide is attracted to tumors. (Researchers: Prem C. Srivastava and John F. Allred.)

Researchers Answer Fundamental Question About Amorphous Matter

A fundamental question concerning the atomic structure of amorphous materials—solids which are noncrystalline and have no symmetric order in their structure—has been answered by researchers in the Solid State Division of the Department of Energy's Oak Ridge National Laboratory (ORNL).

Using an analytical technique known as high-performance liquid chromatography (HPLC), researchers Brian C. Sales, Joanne O. Ramey, Lynn A. Boatner, and Jeffrey C. McCallum have quantitatively determined the relative concentration of each type of phosphate chain present in both lead pyrophosphate glass and an amorphous surface layer produced on lead pyrophosphate crystals by ion implantation.

Their studies show that the microscopic structure of pyrophosphate glass significantly differs from the structure produced by bombarding lead pyrophosphate crystals with ions, even though the elements are present in both materials in the same proportions. The structure produced by ion bombardment exhibits a higher degree of disorder than the glass.

The lead pyrophosphate glass was prepared by thermal quenching, which cooled the molten phosphate liquid quickly enough to prevent the growth of crystals.

Ion implantation involved injecting either oxygen or lead ions into lead pyrophosphate single crystals. The damage caused by the passage of the ions into the crystals extended to a depth of about 200 nanometers and induced a change from the ordered crystalline state to an amorphous or disordered state.

Prior to the research there was no consensus on how the structure of an amorphous material would vary depending on the method used to produce it.

The ORNL results show that the structure of the various amorphous states of lead pyrophosphate depends on the physical process used to produce the disordered material. The thermally quenched glass is characterized by a structure different from that of any of the lead pyrophosphate crystal surfaces that were made amorphous by ion bombardment. The researchers also found that ion-implanted glass has a structure different from both unimplanted glass and implanted crystals.

The HPLC analytical technique apparently produces such definitive structural results only for phosphates, although there are reports of attempts to apply a similar approach to the analysis of silicate glasses.

R.M. German Receives Distinguished Alumni Award in Engineering

The University of California at Davis awarded its 1990 Distinguished Engineering Alumni Award to Randall M. German, who received his doctorate in materials science from Davis in 1975. In addition, the board of trustees of Alpha Sigma Mu, the Materials Honor Society, awarded Honorary Membership to German in recognition of his research and international stature in the field of power metallurgy.

German is currently the Robert W. Hunt Professor in the materials engineering department at Rensselaer Polytechnic Institute. He joined the RPI faculty in 1980 and has written four books, and more than 250 research publications, and holds six patents.

Snyder Elected to National Committee on Crystallography

Robert Snyder, professor of ceramic science and director of Alfred University's Institute on Superconductivity, has been elected to the U.S. National Committee on Crystallography, a standing committee of the U.S. National Academy of Sciences and its administrative arm, the National Research Council.

The committee advises the president of the National Academy of Sciences on matters relating to the U.S. membership in the International Union of Crystallography, nominates delegates to the tri-annual meetings of the International Union, and takes actions to benefit and advance the science of crystallography throughout the world.

Snyder has also been named Distinguished Visiting Scientist at Siemens Central Research Laboratories, Munich, Germany, from January through July 1991 and will be on sabbatical from his duties at the New York State College of Ceramics at Alfred University during this time.

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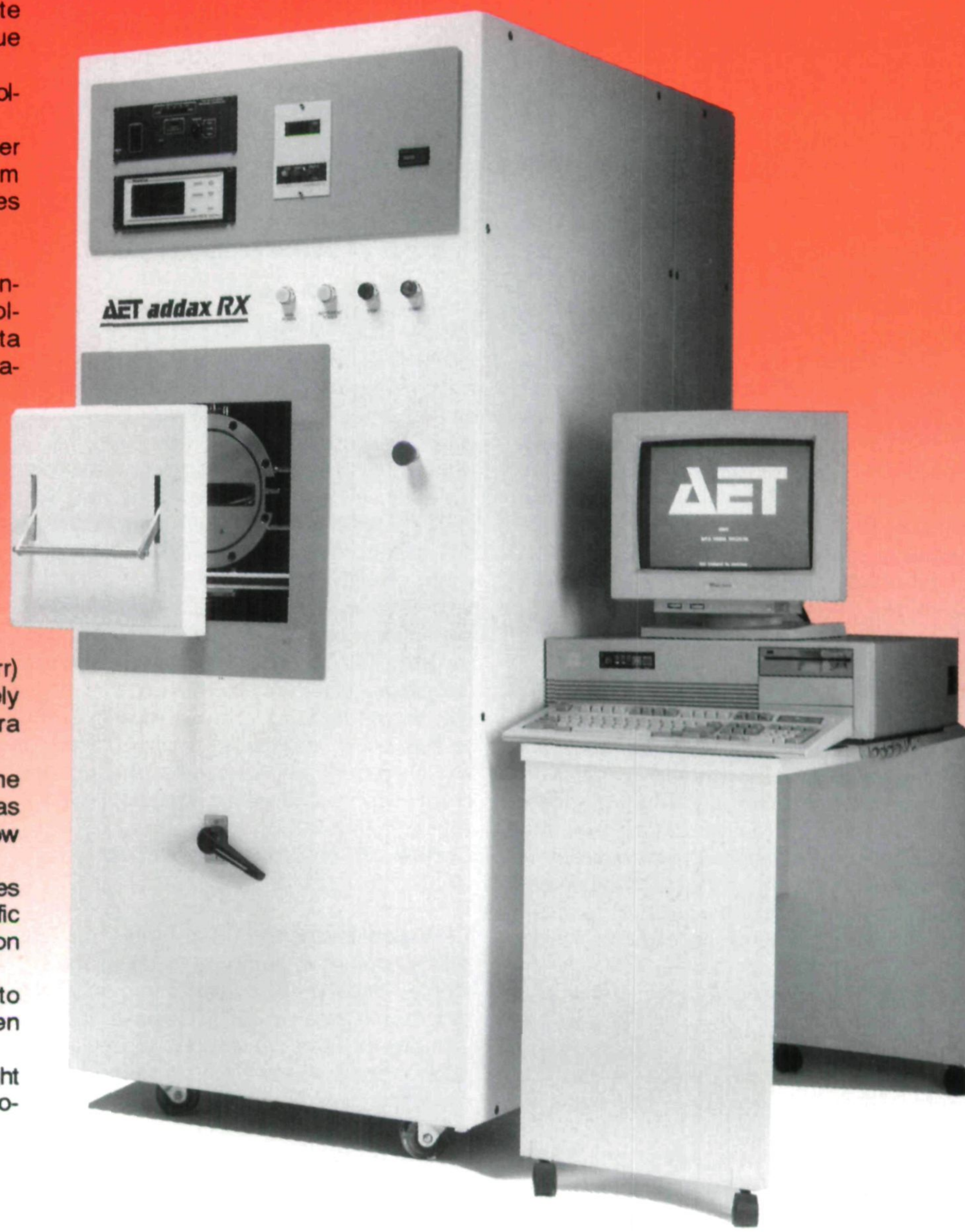

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