NRL Seeks Research Partners

The Naval Research Laboratory (NRL) is looking for research partners for 87 long-range research projects described in NRL's Fiscal Year (FY) 1996 Broad Agency Announcement (BAA). The NRL 1996 BAA will be open for one year, from December 1, 1995, to November 30, 1996.

NRL encourages industry, educational institutions, small businesses, small disadvantaged business concerns, historically black colleges and universities, and minority institutions to submit proposals in response to BAAs. Proposals involving cooperative research arrangements are also welcome.

The typical range of funding for contracts under NRL BAAs is $1,000 to $2 million. However, circumstances may arise in which awards are made outside this general range.

To be eligible for a contract award, all prospective applicants, with the exception of other federal government activities, including state and local government agencies, must meet certain minimum standards pertaining to financial resources, adequacy of accounting systems, ability to comply with performance schedules, record of past performance, integrity, organizational structure, experience, operational controls, technical skills, facilities, and equipment.

The list of NRL 1996 BAA, including award considerations and instructions for submitting proposals, is available on the World Wide Web at http://www.nrl.navy.mil/BAA/baa.html. The fax address for requests is 202-767-6197 or 767-5896. For nongovernment personnel requesting BAA information, contact Pat Schaefer at 202-767-6263. For government personnel requesting BAA information, contact Jim Waldenfels at 202-767-2372. The address of the cognizant contracting activity is Commanding Officer, Naval Research Laboratory, 4555 Overlook Ave., SW, Attn: Code 3204, Washington, DC 20375-5326.

Artificial Skin Replaces Burnt Dermis

Ioannis V. Yannas, Massachusetts Institute of Technology professor of polymer science and engineering, and his colleagues have developed technology to replace damaged skin. Patients with severe burns have lost their dermis, a layer about 2 mm thick that lies beneath the epidermis and which does not regenerate when damaged. Yannas's technology involves chemically bonding collagen taken from animal tendons with glycosaminoglycan (GAG) molecules from animal cartilage to create a simple model of the extracellular matrix that provides the basis for a new dermis. Collagen is part of the structural scaffolding in mammals that allows tissues to maintain their shape. The collagen-GAG combination "makes a simple chemical analog of the matrices in our own tissues," Yannas said.

Surgeons can implant this material, temporarily covered by a thin layer of silicone that protects the area from infectious agents and excessive moisture loss. The collagen-GAG material has pores with carefully controlled diameters that permit cells to grow through the scaffold, which is eventually broken down and dissolved by enzymes. Cells synthesize a new dermis at the same time that the scaffold is being broken down. Epidermis then grows naturally over the new der-

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mis unless the wound area is especially large, in which case the surgeon does an autograft of epidermis.

The new skin also grows as the patients do, an important consideration for burned children. The only limitation is that patients with large grafts must avoid strenuous exercise in the sun, because the newly synthesized dermis does not have the original dermis's sweat glands and hair follicles.

Liquid Crystal Molecules Manipulated for Orientation-on-Demand Thin Films

Liquid crystal (LC) molecules can be manipulated to self-assemble in a desired direction into a robust network, making them useful for a variety of applications in the computer, medical, automotive, and aerospace industries. Scientists at Cornell University have built a network of LC molecules that are linked together while aligned in an electric field. The field makes them lie parallel or perpendicular, depending on the ac frequency, so they orient on-demand.

Christopher K. Ober, Cornell professor of materials science and engineering who led the work, said, "When you apply the electric field and crosslink [the molecules], you get controllable properties, so that it is possible to tailor these materials to possess specific optical, electronic, and mechanical properties."

With an ac electric field from 10 Hz to 10 kHz applied, LC molecules self-assemble into a wall and can be made to lie flat or stand up on demand by changing the frequency of the field. When cured, the molecules form bonds to create a network. The curing can take anywhere from five minutes to an hour, depending on the intended result.

The scientists used x-ray diffraction to observe the orientation-on-demand thin films in real time. The high-flux x-ray beam allowed them to monitor the curing process and alignment of the molecules, and to simultaneously adjust the electrical field. The network ensures that the molecules remain in the orientation and the bonds remain strong. The network can be used at temperatures above 100°C.

"Our goal was to create a molecular system where one could not only align the components in external fields to form networks, but also selectively control and lock-in the direction of alignment by network formation," the researchers write in their paper published in the April 12 issue of *Science*. "Such materials would possess physical and chemical properties that are very different along each orientation, and one could conceive of using photochemistry, for example, to form films with order and orientation set in specified regions."

Computer-Generated Hologram Positions Atoms

Researchers from NEC Fundamental Research Laboratories and the University of Tokyo have passed a beam of ultracold metastable atoms through a computer-generated hologram in order to reconstruct a desired atomic pattern. As reported in their article in the April 25 issue of *Nature*, the researchers used a Fourier hologram to prodcue an image of the letter F. Using a 100-nm-thick SiN membrane for the hologram,the researchers etched the letter F, then sent a beam of Ne atoms ultracooled with lasers through the pattern. After passing through the diffraction pattern as would a beam of light, the atoms were deflected, some detected by the microchannel plate (MCP) detector placed 45 cm below the hologram. The position of each atom detected by the MCP is recorded by the computer. The researchers concluded that "atomic holography is not limited to the generation of a fixed pattern with a fixed diffracting component. By combining it with other manipulation techniques, it should be possible to make a real-time moving pattern of atoms, or a device to investigate the three-dimensional phase and amplitude characteristics of an atomic de Broglie wave."

Plasma Process Vitrifies Waste

A technology known as the controlled plasma glassification process (CPG) uses electrically conductive gas, or plasma, to heat solid waste to the point that it becomes molten. The resulting solid glass or metal material prevents any contaminants from leaching into the environment. This technology is well-suited to treat most solid waste streams including hazardous, medical, radioactive, mixed industrial, and municipal solid waste. The CPG can process high volumes of waste in a relatively small unit while reducing environmental impacts.

Because solid byproducts of waste processing are converted to a glass-like product or a usable metal, the CPG process

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does not have a secondary disposal problem often associated with ash from incineration and other thermal technologies. The glass byproduct is durable and possibly could be recycled for other uses, such as construction materials.

The technology will soon be available commercially through a start-up company, Integrated Environmental Technologies, in Richland, Washington.

Bhakta Rath Receives 1996 TMS Leadership Award

Bhakta Rath, Associate Director of Research, Materials Science, and Component Technology Directorate at the Naval Research Laboratory (NRL), is the recipient of The Minerals, Metals, and Materials Society's (TMS) 1996 Leadership Award. The award, presented at the 1996 TMS Annual Meeting on February 5, in Anaheim, California, recognizes Rath for his "outstanding leadership in research planning and guidance and for promoting materials science and engineering for national security and society."

Rath received his BS degree in physics and mathematics from Utkal University in Cuttack, India, his MS degree in metallurgical engineering from Michigan Technology University, and his PhD degree from Illinois Institute of Technology.

Following several years of service as a tenured professor at Washington State University, Rath worked as a research scientist at the Edgar C. Bain Laboratory for Fundamental Research of U.S. Steel Corporation and the McDonnell Douglas Research Laboratory. He joined NRL in 1976 as Head of the Physical Metallurgy Branch and subsequently served as Superintendent of the Materials Science and Technology Division from 1982 until 1986, when he was selected Associate Director.

Rath has published over 140 technical papers and has edited books on materials science. He currently serves as a member of several planning, review, and advisory boards, which include boards from the Department of Defense, the Department of Energy, the National Science Foundation, the Materials Committee of the National Science and Technology Council, Carnegie-Mellon University, University of Connecticut, University of Florida, and Colorado School of Mines.

Surface Structure Prize 1996 Awarded to J.B. Pendry

J.B. Pendry has been awarded the Surface Structure Prize, presented in July during the International Conference on the Structure of Surfaces (ICSOS) in Aix en Provence, France. The award recognizes Pendry's far-reaching, diverse, fundamental, and practical contributions to the field of quantitative surface structure determination. He has introduced a series of theoretical and computational methods which have been widely adopted to interpret data measured with a variety of techniques sensitive to surface structure.

Due largely to Pendry's innovations, low-energy electron diffraction (LEED) has emerged as an effective and productive technique for surface crystallography, contributing over 60% of detailed surface structures. Pendry has introduced several critical methods that are in wide use within LEED computer codes, including renormalized forward scattering, used for computing multiple scattering between atomic layers of a surface. Pendry developed programs for computing phase shifts which have served LEED practitioners for many years, as well as scientists working in related fields such as photoelectron diffraction. He also pioneered methods to treat diffuse LEED, allowing the structure of locally ordered but long-range disordered overlayers to be determined by LEED.

The Surface Structure Prize will be sponsored by the International Conference on the Structure of Surfaces (ICSOS) every three years.

Gschneidner Elected Chair of Acta Metallurgica

Karl Gschneidner, Jr., an Anson Marston Distinguished Professor in Iowa State University's Department of Materials Science and Engineering, has been elected Chair of the Board of Governors of Acta Metallurgica, Inc. Gschneidner, a member of the board since 1967, is former director of ISU's Center for Rare Earths and Magnetics (formerly the Rare-Earth Information Center) and researches rare earth magnetic materials at Ames Laboratory. Acta Metallurgica owns and publishes three international journals in the materials field—*Acta Materialia, Scripta Materialia,* and *Nanostructured Materials*— and hosts international materials conferences every year.

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NAE Elects Members and Foreign Associates

The National Academy of Engineering (NAE) elected 78 engineers to membership in the Academy and eight as foreign associates. Election to the Academy is among the highest professional distinctions accorded an engineer. Academy membership honors those who have made "important contributions to engineering theory and practice" and those who have demonstrated "unusual accomplishment in the pioneering of new and developing fields of technology." Among the newly elected members and foreign associates are **Zdenek P. Bazant**, Walter P. Murphy Professor of Civil Engineering and Materials Science, Northwestern University, for contributions to solid mechanics, particularly structural stability and size effects in fracture; **Y. Austin Chang**, Wisconsin Distinguished Professor, Department of Materials Science and Engineering at the University of Wisconsin—Madison, for applications of thermodynamics, phase diagrams, and kinetics to the understanding of modern materials of technological significance; **Martin E. Glicksman**, John Tod Horton Distinguished Professor, Rensselaer Polytechnic Institute, Troy, New York, for contributions to the science and engineering of solidification and crystal growth processes; **Donald M. Smyth**, professor, Department of Materials Science and Engineering, Lehigh University, Bethlehem, Pennsylvania, for contributions to the solid-state chemistry of electronic components based on ceramic materials; and, as foreign associate, **Jacob N. Israelachvili**, professor, Department of Chemical Engineering, University of California—Santa Barbara, for contributions to the measurement and understanding of surface forces in liquids, and their application to colloidal, biological, and tribological systems.

1996 Acta Metallurgica Gold Medal Goes to Vitek

The 1996 Acta Metallurgica Gold Medal has been awarded to Vaclav Vitek of the Department of Materials Science and Engineering, University of Pennsylvania. The medal will be presented on October 8, 1996 at the Annual Awards Dinner of ASM International in Cincinnati, Ohio. Established in 1974, the medal is an international award recognizing outstanding ability and leadership in materials research. Vitek is one of the world leaders in the field of modeling the mechanical properties of metals and alloys in terms of the structure and behavior of defects on the atomic scale. He has also made many outstanding contributions to the atomistic modeling of grain boundary structure and of glassy materials.

Vitek was a pioneer in the development of an atomistic approach to understanding the role of crystal defects in mechanical properties. His early atomistic studies of the core structure of dislocations in bcc metals and the effects of stress on their motion paved the way for many other atomistic simulations, which provided evidence that the lattice friction stress in bcc metals is due to the complex extended core of the screw dislocations, and put on a firm basis an understanding of the temperature and orientation dependence of the yield stress in these metals. In the course of these studies, Vitek formulated the notion of the t-surface which is now commonly used in analyses of dislocation core structures. Subsequently, Vitek and his colleagues extended the simulations of dislocation cores to dislocations in $L1_2$ alloys, leading to the Paidar-Pope-

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Vitek theory for the anomolous temperature dependence of the yield stress in these alloys. More recently he has applied this approach to hcp metals and a variety of intermetallic compounds.

Vitek obtained his PhD degree from the Institute of Physics, Czechoslovak Academy of Sciences in Prague in 1966. He has received numerous awards and has served as editor or on the editorial board of several professional publications.

ULSAB Determines Materials and Processing Needs for Midsize Vehicle

In completing phase I of the American and International Iron and Steel Institutes (AISI and IISI) Ultralight Steel Auto Body (ULSAB) project, engineers have determined structural targets and conceptual design for a midsize, four-door vehicle. According to *High Strength Steel Bulletin*, published by the Auto/Steel Partnership (A/SP), an international organization of North American automotive companies and major sheet steel suppliers, the ULSAB indicates weight reductions of 25%, torsional rigidity improvements of 60%, and cost reductions of 14% with a design in conjunction with material optimization and use of near-reach technologies such as hydroforming and laser welding. The structure calls for high strength steel for 136 of the 205 kg mass, specifying bake hardenable steels, microalloyed steels, solution-strengthened rephosphorized steels, isotropic steels, high strength interstitial-free steels, and hot-formed ultra-high-strength steels. A stampable laminate material was selected for the dash panel insert, spare tire well, and front floor center. For more information on the materials and processes chosen, contact Bart DePompolo, HSS Awareness Task Force, c/o National Steel Product Applications Center, 12261 Market Street, Livonia, MI 48150; fax 313-591-5649.

Laser Zaps Graffiti into Powder

Dennis Matthews of Lawrence Livermore National Laboratory has used a laser to turn spray-painted graffiti into powder without damaging the underlying surface that has been defaced. When the laser hits the surface layer of paint, the beam converts into a sound wave. The sound wave transits the paint, strikes the underlying surface, and rebounds. The rebounded sound wave and the incoming beam collide and explode the paint into powder.

Matthews said, "After we turned the laser on a piece of graffiti-covered wood, the wood looked like it was fresh from the lumber yard." Lasers are efficient at removing paint from hard surfaces like marble and from porous surfaces like concrete and masonry. However, on painted metal street signs, the laser is unable to distinguish between the lettering on the sign and the graffiti and removes both.

Since laser light can be harmful if shone directly into the eye or can cause surface burns on skin, Matthews intends to design the optics so that the focused beam would extend a few inches out from the end of the application wand, but beyond that it would scatter. There would also be a proximity switch to disable the device if it was directed away from the target area. □

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