develop organic diodes have resulted in devices with maximum frequency response of no more than 10 kHz and with output current densities of less than 1 A/cm^2 under an applied ac voltage. Since response speed is governed by the capacitance of a device, the researchers predict that reduced device areas will yield a 10-fold or more improvement in response time when scaling the device to micron-scale dimensions.

The scientists attribute the enhanced performance to the heat treatment, prior to which the performance was poor. They believe that the heat treatment causes the Cu to diffuse into the C_{60} layer, forming a stable metallic interface to the C_{60} layer. The device's strong electron acceptor properties lead to a conducting charge-transfer complex similar to the heavily doped interface in silicon technology to form a good ohmic contact. This situation allows for efficient electron injection from the Cu cathode into C_{60}, increasing by about three orders of magnitude after heat treatment. Atomic force microscopy revealed that the C_{60} recrystallized, enhancing carrier mobility. Al, on the other hand, forms covalent bonds to C_{60}, resulting in the observed work-function increase from 4.2 eV to 5.2 eV, which is consistent with the observed *I–V* curve reversal.

Organic diodes, with their response speed in ac mode below 10 kHz, are not stable in air. The C_{60}-based organic diode, however, did not show any noticeable performance decay, even after a 40 h stress test in air without encapsulation at 2.4 ac voltage and 1 MHz frequency, whereas normal organic diodes were found to have a reported lifetime of no more than 17 h even under current conditions that are three orders of magnitude less severe.

ALFRED A. ZINN

Protein Hydrogels Engineered to Promote Cell Growth

A research team at The Johns Hopkins University (JHU) has created a class of artificial proteins that self-assemble into a gel that can be tailored to send different biological signals stimulating the growth of selected types of cells. Tissue engineers use hydrogels to provide a framework or scaffold upon which to grow cells. The researchers hope to advance their technique to the point that it can be used to treat medical ailments by growing replacement cartilage, bones, organs, and other tissue in the laboratory or within a human body.

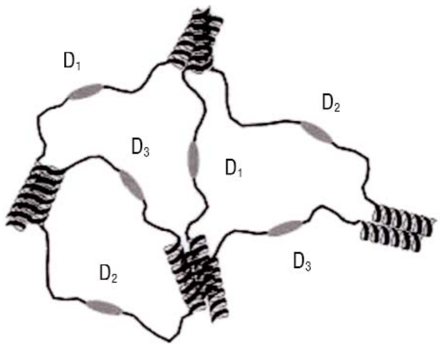

Figure 1. Schematic illustration depicting a hydrogel network with three distinct bioactive domains (D) formed by the self-assembly of modular proteins. Illustration by Will Kirk.

"We're trying to give an important new tool to tissue engineers to help them do their work more quickly and efficiently," said James L. Harden, whose laboratory team, L. Mi and S. Fischer, developed the biomaterial. Harden, an assistant professor in the Department of Chemical and Biomolecular Engineering at JHU, reported on his work at the 227th national meeting of the American Chemical Society in Anaheim, Calif., on March 28.

Harden's hydrogel is made by mixing specifically designed modular proteins in a buffered water solution. Each protein consists of a flexible central coil containing a bioactive peptide sequence and flanked by helical-associating end modules. The helical ends are based on the leucine zipper, a well-known motif in nature.

"We utilized three different types of these leucine zippers," said Harden, "an acidic helix A with glutamic acid residues in both the e and g positions, a basic helix B with lysine residues in both the e and g positions, and a mixed helix C with glutamic acid residues in the e positions and lysine residues in the g positions. The charge patterning of these helices supports the formation of very stable heterotrimer bundles of A+B+C due to favorable electrostatic interactions between the acidic and basic e and g residues on neighboring helices."

These end modules are designed to attract each other and form three-member bundles. This bundling leads to the formation of a regular network structure of proteins with three-member junctions linked together by the flexible coil modules (see Figure 1). In this way, the biomaterial assembles itself spontaneously when the protein elements are added to the solution.

"The helices have a hydrophobic strip of leucines along one face," said Harden. "When these proteins are put in water, they associate by overlapping these hydrophobic strips in order to keep water from coming into contact with the hydrophobic portions."

The assembly process involves three different "sticky" ends. But between any two ends, one or more bioactive sequences can be inserted, drawing from a large collection of known sequences. Once the gel has formed, each central bioactive module is capable of presenting a specific biological signal to the target cells. Certain signals are needed to stimulate the adhesion, proliferation, and differentiation of cells in order to form particular types of tissue.

Harden's goal is to provide a large combinatorial library of these genetically engineered proteins. A tissue engineer could then draw from this collection to create a hydrogel for a particular purpose.

"We want to let the end user mix and match the modules to produce different types of hydrogels for selected cell and tissue engineering projects," Harden said.

News of MRS Members/Materials Researchers

Diran Apelian of Worcester Polytechnic Institute has been named a fellow of the Metal Powder Industries Federation in recognition for his innovative work in metal processing and in building bridges between the industrial and academic communities.

Shefford P. Baker, of the Department of Materials Science and Engineering at Cornell University, was promoted to associate professor with tenure in November 2003.

Alexandre Blais, a postdoctoral fellow at Yale University, has received the 2004 **Howard Alper Postdoctoral Prize** from the Natural Sciences and Engineering Research Council of Canada in recognition of his research findings to improve the practical aspects of quantum-bit (qubit) construction and to offer a new way to maintain quantum coherence, the key to a successful quantum processor. The prize is one of Canada's premier awards for recent doctoral graduates. Blais received his PhD degree from Université de Sherbrooke in Canada.

Damon Canfield, president and CEO of New Product Innovations (NPI), has been named an **Ernst & Young Entrepreneur of the Year** for 2004. The award recognizes Canfield's leadership in transforming NPI from a technical services organization providing product engineering and materials

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expertise into a provider of turnkey business solutions for product design and manufacturing.

Emmanuel P. Giannelis, the Walter R. Read Professor of Engineering at Cornell University, was appointed director of the Department of Materials Science and Engineering for a five-year term that began on January 1.

Peter K. Jones, vice president of technology at Stackpole Ltd. in Oakville, Ontario, Canada, has received the Metal Powder Industries Federation's 2004 **Powder Metallurgy Pioneer Award** in recognition of his contributions to advances in the manufacture of high-strength and high-performance powder metallurgy parts by high-temperature sintering, proprietary alloying, and selective densification. The award recognizes that he was also instrumental in developing the first commercial process for manufacturing powder-forged connecting rods.

Chekesha Liddell has joined the faculty of the Department of Materials Science and Engineering at Cornell University as an assistant professor.

Nils Petersen, currently vice president of research at the University of Western Ontario, has been named director general of Canada's National Research Council's National Institute for Nanotechnology in Edmonton, Alberta. He term begins in November.

Tony Petric of McMaster University in Canada holds the NSERC Industrial Research Chair in Solid Oxide Fuel Cell Systems, which conducts research on fuel cells to respond to the global demand for cleaner and more efficient uses of energy. The Natural Sciences and Engineering Research Council (NSERC) award is \$775,000 (CAD) over five years.

Judit E. Puskas has joined the University of Akron as the Bayer Industrial Chair in the Department of Polymer Science.

Leslie L. Struble of the University of Illinois at Urbana-Champaign and **Claus Pade** of Concrete Experts International in Denmark have received the **Sanford E. Thompson Award**, which recognizes articles of outstanding merit published by ASTM International. Their article, "Proposed New Test Procedure for Measuring Alkali-Silica Expansion Produced by Hydraulic Cement," appeared in the journal *Cement, Concrete, and Aggregates* **22** (1) (2000) p. 48.

Donald Thomas has been named the new program scientist of the International Space Station.

Donald T. Whychell Sr. of CM Furnaces Inc. has been named a fellow of the Metal Powder Industries Federation in recognition of his 30-year career, during which he has advanced particulate materials processing. □

Raymond Smallman Receives 2004 *Acta Materialia* Gold Medal

The 2004 *Acta Materialia* Gold Medal has been awarded to Raymond Smallman, professor emeritus of metallurgy and materials science and honorary senior research fellow in the Department of Metallurgy and Materials within the School of Engineering at the University of Birmingham, England. Over a career spanning more than 50 years, Smallman has made many outstanding contributions to the field of metallurgy and materials science as a researcher, teacher, and administrator in the British and European spheres.

After gaining his PhD degree from the University of Birmingham in 1953, Smallman obtained an appointment as a scientific officer at the Atomic Energy Research Establishment in Harwell. There, he carried out research on the structure of liquid metals and then on textures in fcc metals and alloys, publishing a seminal article in 1955 on texture transition. He returned to this area of study on several occasions, publishing work in the 1960s on dependence on stacking-fault energy and in the 1990s on the role of deformation banding in deformation textures and recrystallization texture formation. As a senior scientific officer, he studied the structure of irradiated and quenched metals using small-angle x-ray scattering, and later introduced transmission electron microscopy (TEM) to Harwell when clustered point defects, 10–100 nm in size, were indicated. In a collaboration with Peter Hirsch, Smallman produced the first direct observation of dislocation loops in metals.

Always interested in teaching, Smallman accepted a lectureship at Birmingham in 1958, where he acquired an electron microscope for the university and introduced TEM studies to the undergraduate curriculum and into research. His team laid the foundation for climb-controlled annealing (e.g., radiation damage and recrystallization) and demonstrated the phenomena of oxidation-vacancy injection.

Smallman has published more than 300 articles and several books; served on professional and national committees, including terms as president of the Birmingham Metallurgical Association and of the Federation of European Materials Societies; and received numerous awards and honors in recognition of his achievements.

Siegfried Hecker Receives 2004 *Acta Materialia* J. Herbert Hollomon Award

The 2004 *Acta Materialia* J. Herbert Hollomon Award has been awarded to Siegfried S. Hecker, senior fellow at Los Alamos National Laboratory (LANL). Hecker has pursued a lifelong fascination with materials, beginning at General Motors, where he helped to identify the materials characteristics crucial for sheet-metal forming and developed key testing techniques to measure these characteristics. He helped to develop the fundamental scientific underpinnings for these applied technologies with pioneering work in large-strain plasticity and multiaxial deformation. At LANL, his principal interests have been to understand the unusual behavior of plutonium and the actinides. Hecker brought together the metallurgical and condensed-matter physics communities to help explain the notorious instability of plutonium metal and its alloys, and why plutonium defies conventional metallurgical wisdom. He has made seminal contributions to understanding phase instability and phase transformations in plutonium and put this knowledge to work to help ensure the safety of the nuclear weapons stockpile in the United States.

Hecker served as director of LANL from 1986 to 1997. In the early 1990s, he spearheaded U.S. efforts for cooperation between the nuclear weapons complexes of the United States and Russia and initiated what is now called the U.S. Department of Energy's lab-to-lab program between the nuclear institutes of the two countries. He serves on national and international committees, including the Nuclear Nonproliferation Committee and the Nuclear Threat Initiative.

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