University of Wisconsin-Madison College of Engineering

Research Review

Spring 2005

About This Newsletter

*Distributed quarterly, Research Review is an electronic newsletter of the University of Wisconsin-Madison College of Engineering. If you aren't a subscriber, **sign up** to receive each edition in PDF format via E-mail.*

Research News

DREAMING BIG

With inspiration from the integrated circuit, Electrical and Computer Engineering Professor Dan van der Weide is using an electrolyte-filled glass pipette to study the inner workings of the brain.
Read more.

GROWING, SMARTER

UW-Madison's Center for Quick Response Manufacturing helped a Madison-based company say "yes" to more growth by increasing its capacity—but within the constraints of its existing staff and manufacturing facilities.
Read more.

CAREER BUILDERS

Engineering faculty members will use prestigious NSF CAREER awards to design and optimize traction motors and study nanostructured polymer composites with electroactive molecular subunits.
Read more.

POSITIVE (RF)ID

A recently established UW-Madison workgroup enables corporate representatives to study radio-frequency ID tags in a campus lab and to learn ways to exploit the tags' potential for their own businesses.
Read more.

WEATHER BEHIND THE WHEEL

Civil and Environmental Engineering Assistant Professor David Noyce will develop a system that warns motorists of weather-related driving conditions that lie ahead.
Read more.

CLEAN LIVING

Via a donated Corbin Sparrow, engineering students gain hands-on experience researching advanced technologies that could address the world's growing need for energy.
Read more.

IN GOOD HEALTHCARE

A new suite of standardized tools will enable healthcare teams to assess patients' health—regardless of their country or care setting.
Read more.

New funding

General Motors and Delphi Corporations have awarded Biomedical Engineering Professor and Chair **Rob Radwin** (also Industrial and Systems Engineering) and colleagues a two-year, $670,000 grant to study the ergonomics and biomechanics of power hand tools used in automobile manufacturing. The study investigates how to minimize the risk of musculoskeletal injuries while maximizing the capacity to operate power hand tools with optimum performance.

Researchers from UW-Madison received three Nuclear Engineering Research Initiative Awards from the Department of Energy Office of Nuclear Energy, Science and Technology. The program provides U.S. universities the opportunity to participate directly in the agency's priority efforts to develop new economically feasible, environmentally friendly nuclear technologies. With $300,000 over three years, Engineering Physics Assistant Professor **Paul Wilson**'s group will study the adoption of advanced fuel cycle technology under a single repository policy. With $900,000 over three years, Engineering Physics Assistant Professor **Todd Allen**'s group will study candidate materials for the supercritical water-cooled reactor. With $650,000 over three years, a group under Engineering Physics Senior Scientist **Kumar Sridharan** and Associate Scientist **Mark Anderson** will study the materials corrosion and heat-transfer phenomena of a molten salt heat-transport loop.

Patents granted

Faculty and staff in the College of Engineering are among the leaders in creating new intellectual property at UW-Madison. For licensing or other information, contact the ***Wisconsin Alumni Research Foundation****.*

The ability to grow thin films of materials with special properties onto a base semiconductor, such as silicon, is critical to enhancing the utility of integrated circuits. But a major obstacle to growing thin films of one semiconductor on another is the lattice mismatch between materials, which can adversely affect the film's electrical and optical properties. Developed by Materials Science and Engineering Professor Max Lagally and colleagues, this invention provides a technique for controlled integration of different semiconductor materials, resulting in thin films of desired morphologies. It is applicable at both the wafer scale and die levels, is suitable for parallel, batch fabrication of multiple semiconductor devices, and can enable manufacturers to produce specific arrays of quantum dots with controlled size distributions, and flat, two-dimensional films of high germanium content. **Learn more**.

Scanning-force microscopy (SFM) is a powerful technique for studying surfaces that resolves surface topology at the atomic scale. Most commonly, SFM uses a vibrating cantilever system carrying a probe tip that oscillates above the sample without contacting it directly. As the probe tip scans across

In the news

UW-Madison engineers are cited worldwide. Here are a few mentions of note.

• NewsTarget.com and ScienceDaily.com carried news in January about Electrical and Computer Engineering Associate Professor Robert Blick's research demonstrating a nanoscale mechanism for field emission that could lead to a new type of energy-efficient flat-panel display. Blick and colleagues in Germany reported their findings in *Physical Review Letters*.
Read the story.

• A Feb. 17 *New York Times* story, "Demands Rise for Tighter Oversight on Use of Stun Guns," about the controversy surrounding police use of Tasers and many deaths that resulted, cited Biomedical Engineering Professor Emeritus John Webster's research of Tasers. Webster is conducting U.S. Department of Justice-funded studies of the health effects of the stun guns.
Read the story.

• The National Institutes of Health homepage highlighted research by Biomedical Engineering Assistant Professor Nimmi Ramanujam the week of Feb. 7. The story, "Optical probes may improve breast biopsies," discusses Ramanujam's fiber-optic probe, which slides through a hollow breast-biopsy needle to the tip, so that doctors can use light to help them identify the location of cancerous tissue.
Read the story.

In the news

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• The Jan. 28 Chicago Tribune quoted Robert Ratner Professor of Industrial and Systems Engineering Mike Smith in the story, "Look out below," about falling ice and its ramifications. In the story, Smith briefly discusses human factors engineering principles as they apply to "falling ice" warning sign wording, design, color and placement. **Read the story**.

Patents granted

Continued from previous page

the sample surface, changes in its vibration frequency, amplitude or phase are detected and used to produce a feedback signal that keeps the probe at a constant distance above the sample. High-frequency SFM cantilevers, with resonance frequencies in the MHz range, not only minimize tip and sample damage, but can achieve less noisy scans in liquids. However, they also require expensive, custom feedback systems because standard feedback systems are limited to frequencies below 500 kHz. Now, Electrical and Computer Engineering Professor Daniel W. van der Weide and a colleague have created a simple, inexpensive technique for down-converting the signal from high-frequency SFM probes so it can be sensed by standard detection electronics. The technique uses a heterodyne receiver to down-convert the signal, an approach that is well known in radio frequency engineering but has not been previously applied to measurement instrumentation. **Learn more**.

Liquid crystal displays (LCDs) are found in a wide range of consumer products, including laptop computers, digital clocks, microwave ovens and CD players. But LCDs currently are unsuitable for certain low-power, portable applications, such as electronic paper and electronic labels, because the mechanisms for switching the orientation of liquid crystals tend to require relatively high amounts of power. A team of UW-Madison chemical engineers, including Professor Nicholas Abbott, has created a device and mechanism for switching the orientation of liquid crystals in displays operating at low potentials. The device is an electro-optical cell consisting of a liquid crystal layer doped with a salt, which is sandwiched between a counter electrode and a working electrode supported by a substrate. **Learn more**.

Proteins change conformation in solution for a variety of reasons, including events such as ligand binding. Most researchers use simple and readily available optical means to measure protein conformational changes; however, these methods typically require large volumes of highly concentrated proteins. Other methods are time-consuming and complex. Developed by Electrical and Computer Engineering Professor Daniel van der Weide and a colleague, this invention uses dielectric spectroscopy to detect protein conformational changes. This alternative method relies on the fact that proteins in solution are surrounded by one or more shells of "bound" water. In response to changes in a protein's conformation, bound water is released or rearranged, causing a change in the solution's permittivity that can be easily measured by using this invention. In this invention, data analysis is as simple as in conventional optical spectroscopy. In addition, no labeling of receptor or ligand is required for detection. **Learn more**.

Developed by Biomedical Engineering Associate Professor David Beebe and a colleague, this invention uses a liquid-phase process to construct smooth, 3-D microstructures. Microstructures already show potential in transdermal drug delivery systems. Using these structures, drugs could be delivered through the skin in an essentially painless manner. In the new process, a solid is brought into contact with an air-liquid interface to form a shape in the liquid. The liquid, called Norland Optical Adhesive, No. 61, cures upon UV exposure. In this manner, the solid's 3-D shape is made permanent in the liquid. Several structures can be formed, including walls, cones, volcano structures and other diverse, curved 3-D microstructures. The method is less expensive, faster and yields better shapes than existing technologies do; in addition, it provides a good method for creating micro-needle arrays for transdermal drug delivery that is essentially painless. **Learn more**.