UNIVERSITY OF WISCONSIN-MADISON COLLEGE OF ENGINEERING

PERSPECTIVE

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1A

Fishing invention nets top creativity prize; pellet separator takes prototype award

As soon as the lakes freeze, legions of hardy fishermen drop lines through small holes in the ice. While some of them pursue little panfish, others look for more sizeable fish such as walleye and northern at the end of their lines. Once those heavier, stronger fish are hooked, however, there's not a good way to hoist them through the ice without cutting the line or injuring the fish, says engineering mechanics senior Nicholas Passint.

So he and classmates Bryan Wilson and Joe Cessna designed the Ice Net X, which folds up almost umbrella-style to fit through the hole in the ice. Once the net is in the water, they open it and lodge it against the underside of the ice, trapping the fish. Then they close the net and draw it—and the fish—through the hole.

The invention won top honors and $10,000 in the Schoofs Prize for Creativity, an annual innovation competition held on the UW-Madison campus. Ice Net X, which also took third place and $700 in the Tong Prototype Prize competition, could be used for warm-weather fishing because of its streamlined size, says Passint.

While his group pondered their winter woes, chemical and biological engineering student Aaron Wallander spent parts of two summer internships separating more than 400 pounds of different polymer pellets with a tweezers. "You sit there and you pick them apart long enough and you think of stuff," he says. "But the idea didn't come to me then—otherwise I wouldn't have been doing it all summer."

Companies need to separate different types of polymer pellets—the middle step in plastics manufacturing—for quality control or to test new machinery. And Wallander couldn't believe there wasn't an automated way to do it. His system flows the pellets from a hopper into a fluid-filled tank. Pellets lighter than the fluid float and flow into an adjacent tank, while pellets heavier than the fluid sink and remain in the initial tank. The invention and prototype won first place and $2,500 in the Tong Prototype Prize competition.

INSPIRATION TO INVENTION • INNOVATION Days • THE UNIVERSITY OF WISCONSIN-MADISON

Best Presentation

1B

The winners were chosen from a field of 22 ideas and inventions, including a portable computer-aided drug dispensing system, a method of storing liquid hydrogen in hybrid-electric vehicles, and a radio-frequency system for finding lost "disc-golf" discs, exhibited and displayed during Innovation Days, held Feb. 12 and 13 on the College of Engineering campus.

Judge David Smukowski, an alumnus with degrees in civil and environmental engineering, encouraged the contestants to pursue their passions regardless of whether they won or not. "I think you're all destined for success," he said.

Two students whose invention didn't receive an award plan to take Smukowski's advice. Their Cello Talon, which attaches to the endpiece of a cello and keeps the instrument firmly in one place, was easy to fabricate, said electrical and computer engineering student and cellist Daniel Springmann. "This is a part that we can sell out of our dorm room, so I think we're going to start making these and talk to some distributors," says his partner, John Weyers, a business student. (Continued on page 9)

1A First place and $10,000, Schoofs Prize; third place and $700, Tong Prize—(from left) Nick Passint, Joe Cessna and Bryan Wilson with Ice Net X, a net which ice fishermen can use to draw large fish through small holes.

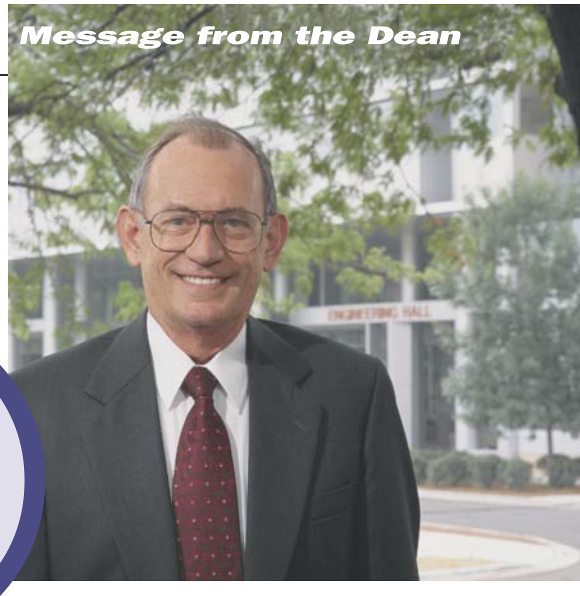
1B First place and $2,500, Tong Prototype Prize—Aaron Wallander, with a device companies can use to separate different polymer pellets via their density.

2 Second place and $7,000, Schoofs Prize—Mike Casper (rear) and Anthony Nichol with their Ice Light, which displays and controls illuminated images such as logos or advertising within ice sheets in ice arenas.

Best Presentation Best Presentation Award and $1,000—(from left) Mike Guthrie, Eric Schroeder, Aaron "Sonny" Nimityongskul and Luke Henke with the S-BMX Conversion Kit, a system that quickly transforms BMX-style bicycles into downhill skiing machines for the extreme sport ski-biking.

2

Message from the Dean



NSF program working to help women attain leadership in science and engineering

In late 2001, the National Science Foundation funded the Women in Engineering and Science Leadership Institute (WISELI) at UW-Madison. Housed in the College of Engineering, WISELI is intended not only to help broaden representation of women in science at all levels, but also to help them achieve a greater role in scientific leadership and enhance the culture of science as it affects women. Only about only 21 percent of UW-Madison faculty in science and engineering are women, and it's crucial that we draw more women into these fields if the United States is to stay competitive.

WISELI focuses on several areas. One of the most important is improving the climate. We define climate as the working and learning environment of the university, such that all feel valued and respected.

As a member of WISELI's leadership team, I am in a unique position to observe the effect of WISELI climate-enhancement activities in our college. I can point to three recent and important examples:

- The Department of Biomedical Engineering (BME) recently volunteered to be a pilot department for the WISELI climate survey project. BME faculty members filled out the survey and the composite results were shared and discussed at a faculty meeting. The results showed that the climate in the department was perceived as welcoming and inclusive. Even more important was the opportunity for the department chairs to discuss issues in the survey as a group in a workshop setting. According to BME Chair Rob Radwin, "I was pleased with the survey outcome but the workshop sensitized me as chair to potential problems that I will try to avoid as our department grows and matures. We will monitor the climate again in years to come." Professor Radwin has been sharing his positive assessment of this experience with other department chairs.
- We are crediting WISELI's influence with helping to create a lactation space in the college for women faculty, staff and students. While attending a WISELI leadership team meeting, one of our faculty members—Electrical and Computer Engineering Professor Amy Wendt—participated in a discussion of childcare needs and university space planning. Professor Wendt remembered that the college is planning a new Mechanical and Industrial Engineering Building, and that there was currently no lactation space for nursing mothers who need a private place to pump their breast milk while at school or work in the college. She suggested creating such a space in the new building, and the idea was enthusiastically embraced. Working with a group of interested students and employees that included Professor Vicki Bier, we have located a space in the new building that can meet the need. We are working on an interim space that can be used until the building project is completed in 2006. It's my firm belief that the WISELI setting gave women a forum to easily and comfortably bring up this topic.
- WISELI's effort to train search committees helped us create an immediate, impressive result in recruiting women faculty. The workshops sensitized our search committees to two factors of great concern to prospective faculty: spousal hires and the promptness of the offer after the interview. Before this training, our yield rate on offers to faculty was only about 50 percent and less than 35 percent for women. After the training, with attention to these issues, our latest round of faculty offers yielded 90 percent acceptances and allowed the college to add six women faculty members.

These examples are only three tangible instances of the success of WISELI's early efforts. It is clear to me that the group's presence on our engineering campus has been widely accepted as needed, effective and important. For more information on WISELI, see its website at **wiseli.engr.wisc.edu/**.

Sincerely, Paul S Peercy

FACULTY NEWS

The Graduate School Research Committee has awarded Associate Professor **David Beebe** of the biomedical engineering, electrical and computer engineering, and mechanical engineering departments an H.I. Romnes Faculty Fellowship. Funded by the Wisconsin Alumni Research Foundation in memory of the late WARF trustee H.I. Romnes, the award recognizes exceptional younger faculty members in the intermediate stage of their career and provides $50,000 WARF funding over five years to support their research.

Industrial Engineering Professor **Harry Steudel**, Electrical & Computer and Biomedical Engineering Assistant Professor **Susan Hagness**, Biomedical Engineering Professor **Willis Tompkins** and Mechanical and Biomedical Engineering Professor **Frank Fronczak** have been named fellows of the UW-Madison Teaching Academy. The Academy was founded in 1993 to promote effective teaching and learning on this campus and nationally. In support of this goal, fellows encourage learning innovation, experimentation and dialogue throughout the campus community and within their disciplines. The number of COE winners of the designation is now 15.

Chemical & Biological Engineering Professor Emeritus **Tom Chapman** has been elected a fellow of the American Institute of Chemical Engineers. He is also traveling frequently to Portugal as a State Department Embassy Science Fellow, promoting research collaboration between leading Portuguese research centers and related centers in the United States, and supporting innovation and technology transfer.

Chemical & Biological Engineering Associate Professor **Mike Graham** has been appointed to the editorial board of the Journal of Non-Newtonian Fluid Mechanics, the primary journal for publication of fundamental developments in the rheological sciences and applications on both the macroscopic and microscopic scale.

Chemical & Biological Engineering Milton J. and A. Maude Shoemaker Professor **Tom Kuech** won the 2003 Charles M.A. Stine Award in materials science and engineering from AIChE. The honor was given for his outstanding fundamental contributions to the understanding of the growth of compound semiconductors by organometallic chemical vapor deposition. Kuech is also serving as the new principal editor of the *Journal of Crystal Growth*, a leading journal that publishes research results on experimental and theoretical aspects of crystal growth and its applications.

Civil & Environmental Engineering Professor **Larry Bank** was elected a vice president of the recently incorporated International Institute for FRP in Construction, headquartered in Hong Kong.

Professor of Materials Science & Engineering **Chang-Beom Eom** has been elected a fellow of the American Physical Society. His citation is for his pioneering contributions in heteroepitaxy of novel complex oxide thin films and experimental material physics in superconductivity, magnetism and ferroelectricity.

Biomedical Engineering and Medical Physics Professor **Charles Mistretta** has been elected to the American Institute for Medical and Biological Engineering College of Fellows. The honor recognizes his many distinguished contributions to the field as well as his demonstrated interest, concern and involvement with critical issues affecting medical and biological engineering.

John T. and Magdalen L. Sobota Professor of Chemical & Biological Engineering **Nick Abbott** has received a Kellett Mid-Career Award from the UW-Madison Graduate School in recognition of his outstanding contributions to the understanding of intermolecular forces in systems that contain large interfacial areas, and to the design and engineering of organic interfaces. His research has contributed to the development of principles for active control of surfactant systems, to new methods for the synthesis and processing of ultra-thin polymers at surfaces, and to greater understanding of the fundamental relationship between the nanometer-scale structures of surfaces and the orientations of liquid crystals placed on these surfaces.

Wisconsin Distinguished Professor of Materials Science and Engineering **Y. Austin Chang** recently presented the 2003 Edward DeMille Campbell Memorial Lecture at the annual ASM International—The Materials Information Society meeting held in Pittsburgh. Chang's lecture highlighted the use of computational thermodynamics in teaching; the application of phase diagrams, particularly multi-component alloys, in materials and process design; and the current status on phase diagram calculations and future directions.

The NSF Directorate for Computer and Information Science and Engineering named Chemical & Biological Engineering Adjunct Professor **Sangtae Kim** as the new director for the Division of Shared Cyberinfrastructure. Kim is a member of the National Academy of Engineering and a fellow of the American Institute of Medical and Biological Engineers. He currently serves as the Donald W. Fedderson Distinguished Professor of Mechanical Engineering and Distinguished Professor of Chemical Engineering at Purdue University.

Civil & Environmental Engineering and Geological Engineering Professor **Craig Benson** has been appointed editor-in-chief of the *Journal of Geotechnical and Geoenvironmental Engineering* (JGGE) published by the American Society of Civil Engineers. JGGE is the leading international journal in geoengineering and publishes fundamental developments as well as practical advances in geoengineering.

Perepezko named to National Academy of Engineering

IBM Professor of Materials Science and Engineering John Perepezko has been named to the National Academy of Engineering (NAE), one of the highest honors accorded to engineers.

The academy cited Perepezko, a College of Engineering faculty member for 29 years, for his innovative work in solidification processing to obtain useful micro-structured, nano-structured, and amorphous materials. "John has made a number of leading contributions to the field of materials science and engineering, and we're proud the National Academy of Engineering has recognized his work," says Dean Paul Peercy.

In a series of papers he authored in the 1980s, Perepezko identified a unique perspective on nucleation behavior that the materials processing community has adopted as the benchmark for understanding nucleation and solidification in highly undercooled alloy systems. In addition, his research into high-temperature alloys such as superalloys, titanium aluminide intermetallics and refractory alloys has led to enhanced alloy designs in structural applications. He holds six patents and has authored or co-authored more than 200 publications.

Perepezko joined the college in 1975. He has won several teaching awards, and also received the college's 1997 Byron Bird Award for Excellence in a Research Publication. He is a member of The Minerals, Metals and Materials Society, the American Institute of Mining, Metallurgical & Petroleum Engineers, The Materials Information Society, the Electrochemical Society, the Materials Research Society, and the American Society of Engineering Education.

Perepezko becomes the fifth faculty member of the college's Materials Science and Engineering Department to be named to the NAE. "John's election the academy confirms our department's strength in assembling an outstanding team of faculty," says Chair Sindo Kou.

Fellow department faculty members in the NAE include Wisconsin Distinguished Professor Y. Austin Chang; Erwin W. Mueller Professor and Bascom Professor of Surface Science Max Lagally; Grainger Professor of Superconducting Materials and L.V. Shubnikov Professor of Materials Science and Engineering David Larbalestier; and Peercy, who holds a faculty appointment in the department.

Membership in the NAE is accorded to pioneers in the field who have made important contributions to engineering theory and practice. Founded in 1964, it advises the federal government on public policy issues involving technology and engineering, and conducts independent studies on technology and engineering matters.

Voyles receives NSF CAREER Award

Research aimed at figuring out the atomic structure of glass has earned Materials Science and Engineering Assistant Professor Paul Voyles a prestigious 2004 Faculty Early Career Development Award (CAREER) from the National Science Foundation.

Voyles, who joined the Materials Science and Engineering Department last year, plans to use a novel electron microscopy technique he helped develop to study the atomic structure of metallic glass—metals that do not crystallize, and therefore resemble glass, when cooled.

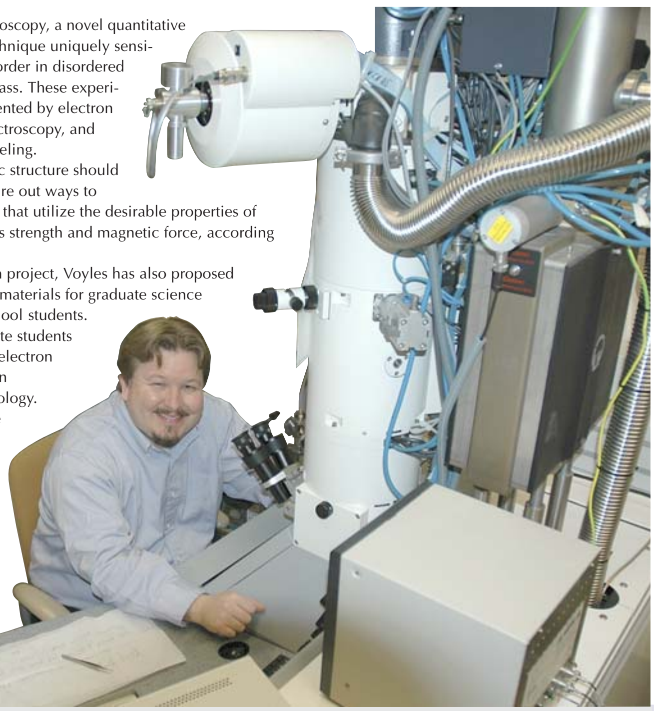
The NSF CAREER awards, among the most prestigious given to faculty members who are just beginning their academic careers, are granted to creative projects that effectively integrate research and education.

According to Voyles, the atomic structure of glass has long mystified scientists. Atoms in glass are jumbled together—resembling marbles in a jar, for example, as opposed to eggs in a carton. Beyond that, little is known about how atoms order themselves in glass. That's inhibited the development of new, glass-based materials.

Scientists have come to believe that useful properties of metallic glass can be attributed to some level of nanoscale atomic ordering. But such structures have been difficult to measure. Voyles has proposed using fluctuation electron microscopy, a novel quantitative electron microscopy technique uniquely sensitive to subtle structural order in disordered materials, on metallic glass. These experiments will be complemented by electron diffraction, electron spectroscopy, and atomistic structural modeling.

Insight into this atomic structure should allow researchers to figure out ways to develop better materials that utilize the desirable properties of metallic glass, such as its strength and magnetic force, according to Voyles.

As part of the research project, Voyles has also proposed developing educational materials for graduate science students and middle school students. The materials for graduate students will focus on advanced electron microscopy skills with an emphasis on nanotechnology. The materials for middle school students will focus on simple hands-on exercises introducing basic concepts in the atomic structure of materials, such as packing of hard spheres.



Civil & Environmental Engineering Assistant Professor **David Noyce** has received the 2003 Institute of Transportation Engineers' (ITE) Coordinating Council Award. The award recognizes Noyce's leadership as chairman of the 300-member Pedestrian and Bicycle Council, which developed the report, "Innovative Bicycle Treatments."

Electrical & Computer Engineering Professor **John Booske** has been appointed a Vilas Associate for the Physical Sciences Division by the Graduate School. Winners receive funding over the next two years to further research and scholarly efforts. Preference is given to professors with between five and 20 years of experience after tenure. Booske's research interests include electromagnetic field interactions with materials, microwave and rf processing of materials, and microwave vacuum electron devices and electron beams. He is also director of the Materials Science Program.

Industrial Engineering and Biomedical Engineering Professor **Gregg Vanderheiden** was one of 12 industry and policy experts testifying before the Federal Communications Commission at its Dec. 1, 2003 Forum on voice-over-Internet protocol (VoIP). VoIP enables people to use the Internet to make telephone calls. Director of the college's Trace Research & Development Center, Vanderheiden presented information and recommendations regarding accessibility of VoIP. He said the nature of the technology will make it easier and more commercially feasible than other technologies to implement accessibility features such as text communication for the deaf. A chapter based on his testimony was included in The New Millennium Research Council's December 2003 report, "The Future of Internet Phone Calling: Regulatory Imperatives to Protect the Promise of VoIP for Industry and Consumers." To read the chapter, visit the Trace homepage at trace.wisc.edu.

Robert Ratner Professor of Industrial Engineering **Michael J. Smith** has received a Chancellor's Distinguished Teaching Award. Smith is the recipient of numerous teaching awards, including the college's Benjamin Smith Reynolds Award for excellence in teaching in 2003. The industrial engineering undergraduate honor society, Alpha Pi Mu, named him 2002 instructor of the year and in 1991, the Wisconsin Student Association chose Smith as one of the University of Wisconsin-Madison's top-100 teachers.

Mechanical Engineering Assistant Professor **Tim Shedd** has received the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Young Investigator Award. The award is given to early career faculty members with interest in heating, ventilating and air-conditioning systems. Shedd will use the award, with funding of up to $45,000, for work in measuring heat-transfer coefficients simultaneously with measurement of liquid film thickness, bubbles and wave behavior in two-phase mixtures. The goal of Shedd's work in this area is to improve the modeling of two-phase heat transfer in pipes and tubes to make more accurate design equations for boiling and condensing of fluids in a pipe for a wider range of fluids and pipe sizes.

Engineering Physics Adjunct Professor **Harrison Schmitt**, along with Gene Cernan and Ron Evans, will receive the Laurel Legend Award from *Aviation Week and Space Technology* magazine. Laurel Legends are chosen for their long contributions to the global field of aerospace. The three were members of the Apollo 17 lunar mission in 1972. The honor states that while the three have achieved much since their moon mission, "the leadership, technical and scientific achievements and attitude displayed by NASA and the Apollo 17 crew are considered today as forming a model for future spaceflight."

Associate Professors of Civil & Environmental Engineering **Gregory W. Harrington** and **Daniel R. Noguera** received the 2004 Publications Award of the American Water Works Association (AWWA). The award honors the most notable scientific or practical contribution to the public water supply profession, as published in the Journal AWWA. The paper, "Pilot-Scale Evaluation of Nitrification Control Strategies," was best paper in the Engineering & Construction Division of AWWA in 2004. Co-authors were Alicia Kandou McMahon (MS '00) and David Van Hoven (MS '01).

Wisconsin Distinguished Professor of Engineering Physics **Michael Corradini** will serve on the National Academy of Nuclear Training Accreditation Board as a post-secondary representative. Members will review nuclear training programs and award, defer or withdraw accreditation, or place on them on probation. He will also chair the Nuclear Energy Research Advisory Committee's subcommittee on Advanced Generation IV Nuclear Reactors. This board will begin implementing the Generation IV Roadmap, a long-term plan to develop advanced nuclear reactor technologies and materials.

Biomedical Engineering Professor Emeritus **John Webster** and Professor **Willis Tompkins** are the most recent COE additions to a list that names the most-cited researchers in their fields. The citation survey by Thomson ISI, which includes work published between 1981 and 1999, is viewed as a key indicator of the influence of scholarly activity. Webster and Tompkins join three other COE faculty members on the list, bringing the UW-Madison total to 38. Visit isihighlycited.com and search for University of Wisconsin to view the entire list.

The 3M Corporation has given Engineering Physics Assistant Professor **Rob Carpick** a nontenured faculty award for the second year in a row. The award recognizes promising young faculty and promotes collaborations with 3M. Carpick also has been invited to become a funded member of the Department of Energy Synthesis and Processing Center project "Experimental and Computational Lubrication at the Nanoscale." The center provides funding to promote interactions among university researchers and DOE labs in specific focus areas.

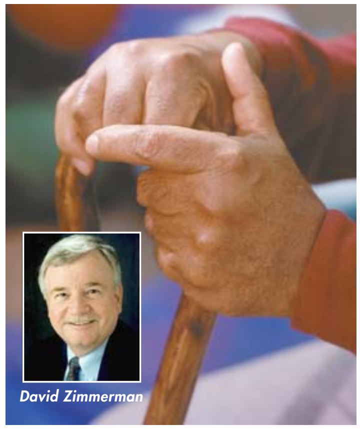
Taking care of care workers *Nursing home staff need greater job satisfaction*

In many nursing homes, turnover rates for certified nursing assistants (CNAs) exceed 100 percent, says Industrial Engineering Professor David Zimmerman. The retention rate for staff at all levels—including registered nurses (RNs) and administrators, is "terrible," he says.

CNAs, also known as direct-care workers, often leave their jobs because they are frustrated they can't do more to provide quality care to residents and are dissatisfied with their work environment, says Zimmerman. "Particularly, they're dissatisfied with the lack of meaningful input into how to care for residents," he says.

With a five-year, $640,000 grant from the Health Resources and Services Administration, Zimmerman is directing a project to implement and evaluate a team-based care model he hopes will increase worker job satisfaction, boost retention rates and improve the quality of care nursing-home staff deliver.

The model will open the lines of communication among nursing-home staff by laying out clear policies and procedures for providing care. A licensed health-care professional—usually an RN—will lead a team, and staff at all levels will play key roles. One aspect of the model will provide a systematic way of identifying a change, such as skin breakdown, in a resident's condition. It will enable staff to convey information about a resident's status more efficiently to people who can make decisions about his or her care. In addition, it will provide better mechanisms for making decisions based on changes in residents' health.


David Zimmerman

"You can think of this as a triaging step," Zimmerman says. "In some cases, the change may be subtle and not considered serious at the moment, so the intervention simply would be increasing the monitoring for that resident. On the other hand, it may be necessary to take some kind of action, and then you need a decision tree." The decision tree provides alternatives, such as undertaking an intervention within the facility or calling an outside medical provider to give care.

As an example, he cites skin conditions, which are common in nursing homes among bedridden residents. If a skin breakdown appears serious, the team may seek attention from an outside medical provider; however, nursing-home staff could resolve a less-serious problem by supplementing residents' diets or turning them more frequently to increase mobility.

Another area the model will address is correctly identifying and appropriately addressing resident behavior issues. "People are in nursing homes for a variety of reasons," says Zimmerman. "The common reason is that they have some type of impairment. It could be physical, it could be cognitive, it could be emotional, it could be clinical. But any one of these kinds of impairments can lead to disorientation or depression or confusion."

Consequently, he says, residents can be physically or verbally aggressive, emotionally abusive, or might behave self-destructively. "We do a fairly good job of identifying that something is happening, but the etiology of that particular change in behavior is oftentimes not investigated very systematically," he says.

Director of the college's Center for Health Systems Research and Analysis (CHSRA), Zimmerman is collaborating with Nursing Professor Barbara Bowers on the project. CHSRA Associate Scientist Allan Stegemann is project director; several CHSRA researchers are part of the project team and the Wisconsin Association of Homes and Services for the Aging is a partner in the project.

Initially, the researchers will develop, refine and test the model's feasibility. "We have to have an instrument that can be filled out by CNAs and can systematically get the information to the RN who will be the leader of the team," says Zimmerman. "And then we have to have a way of making sure the team has enough information when it goes through its triaging activities. We'll also want to have a better instrument and process to make sure that medical providers are notified on a timely basis."

To capture a range of social, cultural and ethnic diversity, they will implement the model in two urban and two rural nursing homes. Then the group will monitor the implementation, analyze the model quantitatively and qualitatively, and refine and possibly expand it into other care areas. Eventually, the researchers will transfer responsibility for education concerning the model to another organization but will monitor it and its implementation for two more years.

The model could mitigate the negative effects of a staff member's leaving, says Zimmerman. "One of the reasons care workers leave is frustration over the lack of some kind of consistent, systematic way of providing care—and therefore not providing quality care," he says. "The ones who remain can carry on in a more consistent fashion because they have a set of consistent policies and procedures." And staff easily can train new workers because everyone understands the same protocols.

Ultimately, he says, residents will receive better care.

FOSTER receives first Myers professorship


David Foster (left) with Jean and Phil Myers

Mechanical Engineering Professor David Foster has been named the Phil and Jean Myers Professor of Mechanical Engineering. Foster, a member of the college's Department of Mechanical Engineering faculty for more than two decades, has made significant contributions to the field of thermodynamics and kinetic processes of combustion and emission formation in internal combustion engines.

The Phil and Jean Myers Professorship was established by a gift from Emeritus Professor of Mechanical Engineering Phillip Myers and his wife, Jean, in 1999. Myers helped found the internationally known Engine Research Center (ERC) in the College of Engineering, and is credited with raising the stature of the Department of Mechanical Engineering nationally. He retired in 1986 after 44 years at the college, but continues to be a visible presence in the college's hallways and laboratories.

Myers created the professorship to help recruit and retain outstanding faculty members for the department. The professorship is for five years, and is available to any tenured member of the department or new faculty member granted tenure upon appointment. It can be awarded repeatedly, but not consecutively, to the same faculty member.

Foster is a former director of the ERC. His research group has successfully demonstrated combustion in a homogeneous charge compression ignition (HCCI) engine, believed to be a first in the field. Automobile manufacturers throughout the world are studying the use of HCCI engines because of their lowered emissions.

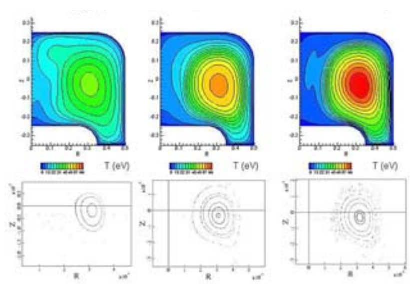
Foster received his BS (1973) and his MS (1975) in mechanical engineering from UW-Madison. He received his PhD (1979) from the Massachusetts Institute of Technology, and shortly after came to the college. His internal combustion engines class—ME469—is one of the most popular undergraduate student elective courses in the college.

Simulating spheromak behavior in 3-D

A new simulation code developed by Engineering Physics Assistant Professor Carl Sovinec and colleagues will enable plasma researchers to model more completely the behavior of a magnetic-confinement fusion experiment called a spheromak.

Unlike its toroidally shaped tokamak cousin, which drives the plasma via external magnets, a spheromak has no central column and relies on currents flowing within the plasma to generate magnetic fields that also confine the plasma. "You're sort of letting the plasma do as much as it possibly can," he says.

Although previous spheromak simulations generated lots of information about how the experiment's magnetic fields evolved, the results didn't paint the full picture and many researchers were skeptical of them, says Sovinec. "They thought that the magnetic fields wouldn't be consistent with the kinds of temperatures they see in the experiment," he says.


Sovenic's model gives researchers more information about spheromak behavior. During decay, closed flux surfaces form (bottom) and the peak temperature increases (top). (t=0.63 ms, 0.76 ms, and 0.91 ms after breakdown)

The new code incorporates temperature. "In particular, we can model thermal energy transport in our full three-dimensional simulations, including the ansiotropies and temperature-dependent coefficients that you would have in a collisional plasma," he says.

After running the new simulation, Sovinec's group showed that the experiment attains relatively low temperatures initially, but ensuing pulses, or transients, are critical to attaining high temperatures. "If we evolve the drive the way that they do in the experiment to take the transients into account, then you'll see that when the magnetic field starts decaying a lot of things come together," he says. "It actually makes a better configuration when it's decaying."

Normally, the experiment's magnetic configuration includes wiggles and fluctuations, which don't retain the plasma's temperature well. "But then when you stop driving it and let it decay a bit, those wiggles go away and it's that process that's critical for getting the high temperatures that they see in the experiment," says Sovinec.

The new simulation showed researchers there's a difference between the effects of the initial drive and those produced by subsequent drives.

Now researchers can learn more than what they did by looking just at experimental results or by applying earlier analytical theories, Sovinec says. "They don't tell you all of these details that are critical for really understanding things like how large the magnetic fluctuations are and what kind of temperatures you can get," he says. "We're able to do that with the three-dimensional calculations."

The group, which includes PhD student Giovanni Cone and collaborators from Science Applications International Corporation, San Diego; Utah State University; the University of Colorado; and Lawrence Livermore National Laboratory, ran many of the calculations on Sovinec's 25-PC cluster in the Engineering Research Building. Sovinec's three-year, $415,000 junior faculty award from the Department of Energy Office of Fusion Energy Science supports the research.

A CHEESE LASER

Precise, cost-effective—any way you slice it

Lasers do everything these days—from removing tattoos to playing music on compact discs. Now, in the great dairy state of Wisconsin, lasers have been harnessed for an entirely new purpose: slicing cheese.

Mechanical Engineering Assistant Professor Xiaochun Li, along with graduate student Hongseok Choi, adapted a so-called "cold laser machining" technique, primarily used in laser eye surgery, to the task of cutting Cheddar. Not just a cheesy idea, Li contends that the advance holds real promise as a clean, precise and cost-effective way to cut cheese commercially, especially into very thin slices.

"The fast-food industry wants cheese that is still nicely shaped, but is cut very thin so that customers consume less fat," says Li, who began the project at the request of a Wisconsin manufacturer of cheese-processing equipment. "But when you cut cheese thinner and thinner, mechanical systems have trouble. The cheese tears or sticks to the blade."

Li has applied for a patent on the technique through the Wisconsin Alumni Research Foundation (WARF), the patent and licensing organization for UW-Madison.

Lasers are devices that produce tight beams of light energy in units called photons, each of the same wavelength and traveling in the same direction. Laser light deposits large amounts of energy in a very small area; in most of today's commercial lasers, this causes extremely rapid, localized heating that cuts a material by melting or even evaporating it, Li says. But when he tried cutting through thin slabs of cheddar with a traditional laser, the cheese did what you might expect: it cooked. "The burning was severe and the smell was bad," Li says, with a laugh. "To make laser cheese processing acceptable to industry, we knew we had to find a cleaner process."

Li turned next to a relatively new class of lasers that emit light in the ultraviolet (UV) range. Unlike conventional lasers, which produce light of longer wavelengths and cut purely by heating, higher energy UV lasers cut using a process called photoablation.

Photoablation occurs when a laser produces photons whose energies exceed the energies of the bonds holding molecules together, Li explains, so that a photon striking one of these bonds immediately breaks it. The millions of photons emitted by a UV laser smash all the bonds in a material, obliterating it molecule by molecule with little or no heating.

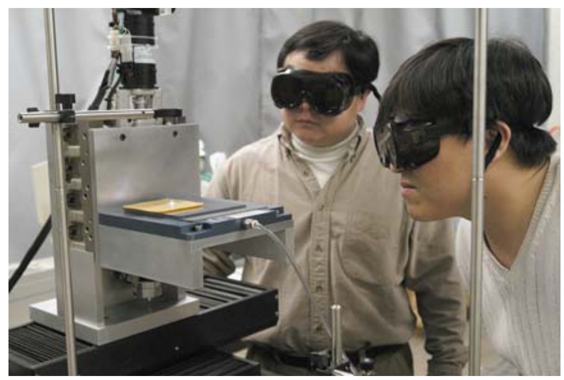
In a series of experiments, Li and Choi optimized the parameters of a 266-nanometer UV laser to make exceptionally smooth cuts in cheese without causing burning. To demonstrate the dexterity of the system, the pair has made CAD (computer-aided design) drawings and used them to guide the laser in creating intricate slices of mild Cheddar.

The main drawback of Li's laser technique is its speed; his current research laser cuts at a relatively slow pace of one inch every 25 seconds. So, although it can carve complicated shapes in thin cheese much more quickly than a mechanical system, the laser loses in a race with straight-up slicing.

At this point, the method is also limited to cutting cheese one-tenth of an inch or less in thickness. Both of these limitations can be addressed by employing faster and more powerful UV lasers, which, Li says, are already under development and should reach the marketplace in the near future.

Given their potential benefits—lasers are smaller, cleaner, more accurate, and possibly cheaper and easier to maintain than cutting systems fitted with mechanical blades—Li believes UV lasers eventually could assist in the processing of many other foods, such as meats and vegetables.

"Engineers usually only think about high-tech applications of lasers, such as semiconductors," he says. "One major point of this research is that the use of lasers is possible for processing food. I hope my work will help build a bridge between laser technology and the traditional food industry."



Xiaochun Li (left) and Hongseok Choi use a cold laser to cut slices of American cheese into computer-generated shapes.

Is bar coding the best medicine?

Study tracks how new technology affects health-care organizations

Ben-Tzion Karsh

In a large hospital, a nurse bustles into a patient's room and unclips a palm-sized computer and scanner from her waistband. She swipes the scanner across the patient's wristband, scans her own identification and then scans the vial of medicine in her hand. The computer beeps, warning her that this is the wrong drug for her patient—and alleviating what could have been a serious medical error.

Given the prospect of reducing the likelihood of such mistakes, a few hospitals have implemented bar-coded medication-administration systems and many more are considering installing them. "Theoretically, it sounds like a no-brainer," says Industrial Engineering Assistant Professor Ben-Tzion Karsh. "This obviously should reduce medication-administration errors, but in fact, we don't know that to be the case right now. There's been scant evidence."

Limited studies have examined how bar-coding technology affects medication-administration errors, he says. However, with a $1.36 million grant from the Agency for Healthcare Research and Quality, Karsh is leading an effort to study the technology's effect on an entire organization.

"Any technology change is tantamount to an organizational change," he says. "The way people do their work will change. And by not understanding people's jobs—how the different processes, including communication, supervision, auditing and quality control are all going to change—then by implementing the technology, we're putting a health-care organization and the patients and the employees at risk. This study is designed to fill that gap."

In addition, it is unique, he says, because it will be the first major study of the technology as it's applied in pediatric hospitals, which have their own set of potential medication errors. There are additional calculations for a dose based on a child's weight. Very young children can't say what's wrong when they don't feel well. And can you put a bar-coded wristband on a premature baby?

Working with similar pediatric hospitals in Wisconsin and Tennessee, Karsh's group will assess the technology's overall effect. One hospital is implementing a bar-coding system; the other will be a comparison group. Prior to the implementation, researchers will collect medication error data, conduct a work-system analysis, and interview employees about their perception of the way they currently work and of the safety and quality of the processes they use.

Once the bar-coding technology is in place, the researchers will gather the same data three more times. "We're expecting that maybe three months after the implementation, things may still be a little hectic and there'll be a lot of problems," says Karsh. "Maybe six months later, things will have calmed down and maybe a year later they'll have new problems."

When the study concludes, Karsh's team will establish guidelines to help health-care organizations prepare their entire facility to implement bar-coding technology and understand and navigate the changes and "bumps" that may occur afterward. "That will hopefully benefit the employees in terms of less wasted time, potentially even more satisfaction with their jobs because they feel that the care they're providing is safer and of higher quality, and certainly importantly, more safety and higher quality care for the patients," he says.

Clean snowmobile races to national championship

In only its third year of existence, the UW-Madison Clean Snowmobile Team has emerged as national champions. The nine-member team, comprised of College of Engineering students, beat 17 other teams at competition held March 15-20 in Houghton, Michigan. The Wisconsin team beat out the host Michigan Tech team, scoring 1,078 points to win by 78 points.

The Clean Snowmobile Challenge, sponsored by the Society of Automotive Engineers, is a collegiate design competition that calls for teams to create cleaner-running and quieter snowmobiles. Students re-engineer an existing snowmobile to make it run with cleaner emissions and less noise, while at the same time maintaining or improving the performance of the original snowmobile.

The Wisconsin team had finished last and next-to-last in its previous two appearances at the national snowmobile competition, largely due to poor engine performance. Team members did extensive testing this year to improve on their performance this year. But national champions?

"We figured we would do a lot better," said team leader Eric Schroeder, a fifth-year senior majoring in engineering mechanics. "We were real excited to win."

The Wisconsin snowmobile team was the only one to complete or pass the three major competition tests—one for beating the clean emissions standard, another for running quieter than a standard snowmobile, and a final 100-mile endurance race. The team also won a first-place award in the subcategory of best-designed snowmobile.

But team members and advisor Glenn Bower, faculty associate in the Department of Mechanical Engineering, said the key to the team's success this year was the development of a novel hybrid engine that used both traditional gasoline-powered components and an electric motor borrowed from a golf cart.

Team members say it's the first time a hybrid engine has been utilized in the snowmobile competition, and it proved to be more reliable and cleaner than traditional snowmobile engines. Snowmobile team members relied on advice from members of the university's national champion FutureTruck team, which has utilized hybrid engine technology.

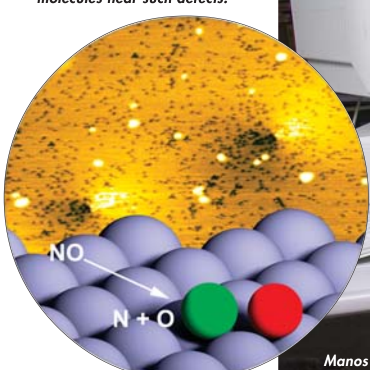
"This was a completely new design," Schroeder said. "It was something of a long shot. But we think that this is the world's first hybrid snowmobile."

Not only did the Wisconsin snowmobile run cleaner and quieter, it also avoided the fate of the team's previous sleds, which experienced major engine problems. And it performed up to the expectations of snowmobile riders—quick and powerful.

"We didn't have a single failure," Schroeder said. "It was better than we ever could have hoped for. That was our whole goal—to make a sled that we ourselves would want to ride."

Team proves stretched surfaces make better catalysts

Pictured below: NO molecules adsorbed on an Ru surface dissociate preferentially at edge dislocations. This long-discussed effect was demonstrated with the aid of scanning tunneling microscope images that show a higher concentration of nitrogen molecules near such defects.



Manos Mavrikakis (left) and Jeff Greeley

Chemical & Biological Engineering Assistant Professor Manos Mavrikakis and graduate student Jeff Greeley, in collaboration with colleagues in Germany, have provided the first atomic-scale evidence for enhanced catalytic reactivity at stretched surfaces. The team offers microscopic evidence showing that molecules tend to adsorb and break on metal surfaces in locations where individual metal atoms are further apart than others and they demonstrate that this behavior agrees with other results.

"We also proved with our studies that the reaction rate for this specific bond-breaking event can be several orders of magnitude higher at the defect compared to the equilibrium lattice constant surface," says Mavrikakis. "That is extremely important because even one defect site can accomplish more work than a million nondefective sites in the same amount of time. The turnover rate, or rate at which molecules adsorb and dissociate, at the defect site overwhelms all contributions to reactivity from the large area of the catalyst that does not contain defects. As a result, turnover rates achieved at a few defect sites on catalytic particles can be responsible for the entire reactivity of metallic nanoparticles, such as those typically used in industrially important catalytic processes."

Bi-metallic catalysis is a bread-and-butter technology for many industries including petrochemical, pharmaceutical, polymer and energy industries, as well as for pollution prevention technologies. For years it had been theorized that molecules on the surface preferentially adsorb at the stretched part of the defect and preferentially dissociate in the area of the defect. By comparing lattice constants via atomic-resolution scanning tunneling microscopy in connection with state-of-the-art quantum mechanical analysis, the research team confirmed these theories and put a solid foundation under techniques to generate better catalysts through strain.

"If you can be sure to provide defective areas, you can reduce the amount of catalyst that you need for processes where bond breaking is the rate-limiting step. That is directly related to the particle size in catalysis," says Mavrikakis. "The smaller the particles you have, the more defects you create, the more steps you have compared to terraces on the surface of the catalytic particle. Terraces are the most benign, so you go to smaller and smaller particles to generate more and more steps and therefore increase the reactivity."

The team published in the June 2003 "frontispiece" of *Angewandte Chemie International Edition.* The work holds significance for understanding the growth and electronic structure of layered metal nanostructures, which could play an important role in a number of technological applications beyond catalysis. Similarly, surface strain plays a critical role for the surface chemistry and properties of other solid materials, including semiconductors.

Harmon Ray joins the active emerti

Chemical and Biological Engineering Vilas Research Professor Emeritus **W. Harmon Ray** entered a new phase of his career this past summer with his formal retirement after 27 years on the faculty, and a 37-year career in academia. Ray began his career in 1966 as assistant professor at the University of Waterloo and moved to SUNY Buffalo in 1970. He has held visiting professorships at Cornell University, the University of Minnesota, the Technische Universität Stuttgart in Germany, Rijksuniversiteit Gent in Belgium, and University of Leuven, also in Belgium.

Over the course of his career, Ray achieved a level of research scholarship, as well as industrial and educational impact, that is universally admired. Today, the field of polymerization reaction engineering, his area of expertise, serves a huge industry that demands "close-to-the-edge" operating conditions in order to provide exacting control of product characteristics, to maintain safe operating conditions, to reduce environmental impacts and to control costs. Such operating conditions are not possible without sophisticated process models and control strategies.

The mathematical models and computer simulations that have emerged from over three decades of progress in his research program provide a clear picture of microscale mechanisms for the main classes of polymerization reactions. These models help to elucidate the links between observable variables and control parameters, and can show ways to achieve the industry's goals. The leading companies in the chemical process industry followed his work closely. These same companies joined his consortium, the University of Wisconsin Polymerization Reaction Engineering Laboratory (UWPREL), established in 1983, and a steady stream of visitors insured a high technological impact for his work. As Ray has said, "When you work on problems related to a quarter-trillion-dollar-per-year industry, someone cares about your results!"

Over the years, these contributions have been widely recognized by his peers. Ray received several major awards and fellowships from professional societies including AIChE's Professional Progress Award for Outstanding Progress in Chemical Engineering, and the Richard E. Bellman Control Heritage Award from the American Automatic Control Council. He has given named lectureships at Imperial College, Caltech, University of Illinois, and Purdue, among others, and has received honorary degrees from the University of Waterloo and the University of Minnesota. He has been a member of the National Academy of Engineering since 1991. Within UW-Madison, his achievements were recognized through the Byron Bird Award for an Outstanding Research Publication from the College of Engineering, the Hilldale Award, and both the Steenbock Chair and Vilas Research Professorships.

Ray graduated 53 PhD students and more than 30 MS students, including one PhD student who is now on the CBE faculty, Jim Rawlings. To date, Ray has coauthored or edited 262 papers and six books. His most recent book, *Process Dynamics, Modeling and Control* (with B.A. Ogunnaike, a 1981 Ray PhD) is a seminal treatment of process control and is now widely used as a textbook. Ray's judgment is highly valued and is sought for many of the important positions in national service pertaining to research, including key committees of the National Science Foundation and the National Academy of Engineering.

As an emeritus professor, Ray plans to remain professionally active, focusing on writing, personal research, and work with postdoctoral research associates.

ECE research advances cell phone technology

A new amplifier, developed by electrical and computer engineering researchers, promises to both significantly improve the quality of transmitted signals and use less battery power.

"When you've been talking on a cell phone for a long time, you can feel how hot it gets," says Assistant Professor of Electrical and Computer Engineering Zhenqiang "Jack" Ma. "This kind of overheating has always been a barrier to improving wireless communications."

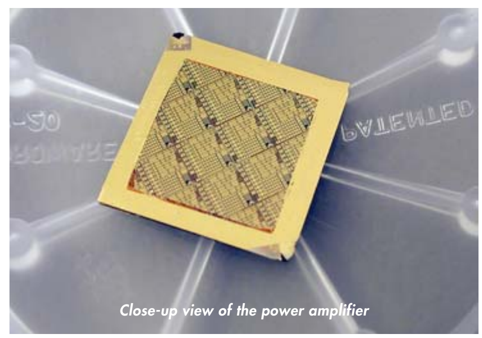
The power amplifier, composed of tiny energy cells, does the heavy lifting when it comes to communicating via a mobile phone and consumes the most battery power as a result.

This power drain, as Ma explains, poses challenges to improving the capabilities of cell phones. Electrical current converges in the center of the power amplifier when the device is overpowered. As a result, it heats up and, in some cases, even burns out.

To prevent this overheating, the makers of power amplifiers add current-controlling devices called ballasting resistors. Ma says that while these resistors stabilize the internal temperature, they also sacrifice power output. Less power, he explains, means weaker cell phone signals and batteries that need to be charged more often.

One of the few ways to improve cell phone technology—including the amount of data that can be transmitted, battery efficiency and hardware cost—is to overcome the overheating within power amplifiers, eliminating the need for the power-limiting resistors, says Ma, noting that the last major advance in this area occurred in 1989.

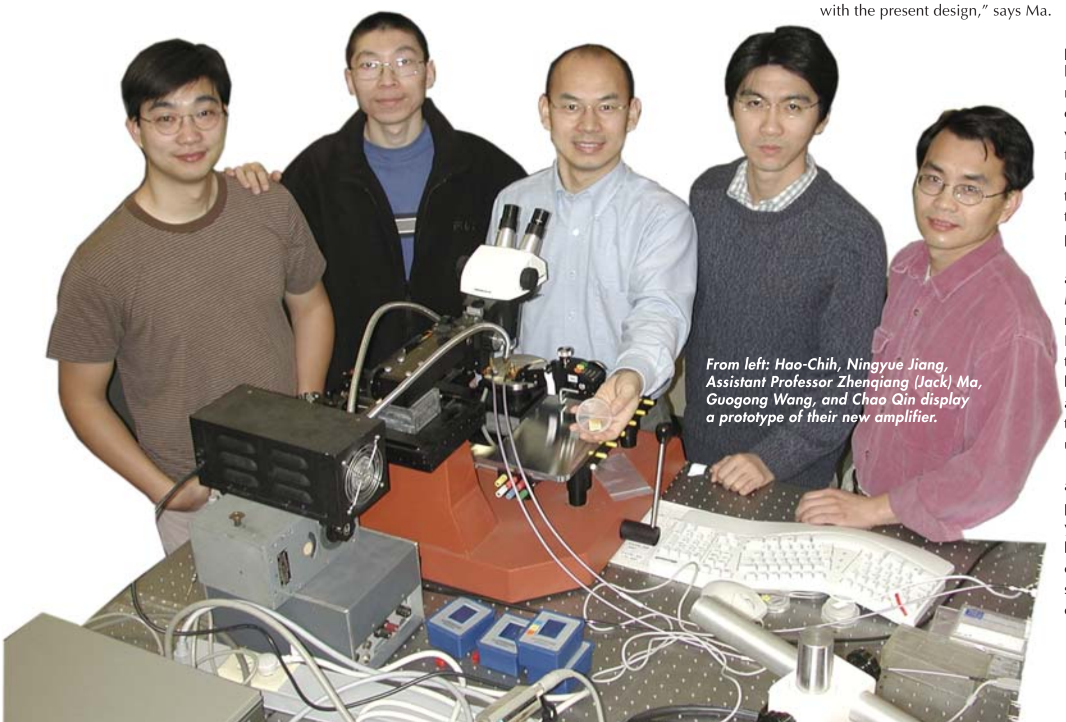
What Ma, along with his graduate students, developed could mark the next step in power amplification technology. After reading through dozens of scientific papers and analyzing heat transfer within power amplifiers housed in wireless communication devices, Ma and his students found a way to significantly reduce the rising temperatures inside amplifiers from the increased electrical current.



Close-up view of the power amplifier

"If the heat transfer mechanism within the devices is fully understood," Ma says, "the solution to overcome the overheating becomes quite obvious." The solution the Wisconsin engineers came up with was to rearrange the energy cells within a power amplifier so that any heat produced dissipates uniformly, rather than moving toward the center. This rearrangement reduces the overall temperature, which enhances overall performance.

"We have found a new power device structure that can counterbalance heat transfer, restoring the degradation in capability associated with the present design," says Ma.



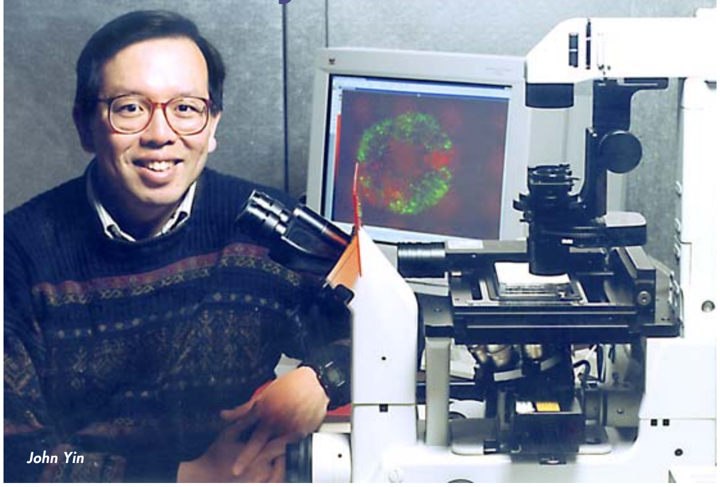
From left: Hao-Chih, Ningyue Jiang, Assistant Professor Zhenqiang (Jack) Ma, Guogong Wang, and Chao Qin display a prototype of their new amplifier.

Both theoretical models and a prototype Ma and his collaborators have created confirm that this new structure can increase the output of the power amplifier while reducing its input—energy from an internal battery. The end result could mean cell phones that receive more data, reach towers farther away and stay powered longer.

With the new design, patented and to be licensed by UW-Madison's intellectual property manager, the Wisconsin Alumni Research Foundation, Ma says that cell phones not only will be better, but also cheaper to make, and will provide a very competitive edge to companies that utilize the new development.

Ma is excited about this advance in power amplifiers and predicts that within the next 10 years the new structure designed by the Wisconsin engineers could become the industry standard for any type of wireless communications device.

Viruses may meet their match—and lose



John Yin

Viruses, often able to outsmart many of the drugs designed to defeat them, may have met their match, according to new research published in the March issue of the journal *Antimicrobial Agents and Chemotherapy*. The findings show that the introduction of a harmless molecule that uses the same machinery a virus needs to grow may be a potent way to shut down the virus before it infects other cells or becomes resistant to drugs. "When a virus encounters a susceptible cell, it enters and says, 'I'm now the boss,'" explains John Yin, an associate professor of chemical & biological engineering and biomedical engineering and senior author of the paper. "It pirates the cell's resources to produce virus progeny that, following release from the host cell, can infect other cells."

The current technique to stop a virus in its tracks is to develop drugs that bind to and block the function of virus proteins—molecules the virus produces, with the aid of host cells that help the virus replicate, or make copies of itself. The drugs, says Yin, are like hammers that knock out key functions that the virus uses for growth and reproduction.

But, he points out, this antiviral approach cannot always outsmart the virus: "When a virus reproduces, it doesn't do so perfectly. Sometimes, it inserts genetic typos, creating variations that may allow some versions of the virus proteins to develop an evolutionary advantage, such as drug resistance."

While improvements in molecular biology and chemistry have led to new drugs that precisely target virus proteins, they have not been able to stop viruses from producing drug-resistant strains.

"Despite advances in the development of antiviral therapies over the last decade, the emergence and outgrowth of drug-resistant virus strains remains problematic," says Hwijin Kim, a graduate student in chemical and biological engineering, and co-author of the March paper. Given that drug-resistant virus mutants can arise, Kim and Yin wondered if there might be some antiviral strategies that are harder for a virus to beat.

Rather than designing a drug molecule that inhibits virus proteins, the researchers created a molecule that acts just like the parasitic virus: It enters the cell and hijacks the very machinery the virus requires for its own growth. But unlike the virus, the diversionary molecules are much smaller, meaning they can grow a lot faster and steal away even more resources from the virus. Plus, they don't encode any virus proteins, which renders them powerless inside a cell, says Yin. Although the diversionary molecules do need resources from the cell to work, Yin clarifies, "they essentially shut down virus growth while expending only a small fraction of the resources that the virus would normally use."

Yin and Kim analyzed the potency of this parasitic antiviral approach in computational models where *E. coli* had been infected with a particular virus. For the diversionary molecule, they introduced a short piece of RNA that competes for the same resources as the infectious virus to replicate. The researchers note that the models are based on experimental data and decades of biophysical and biochemical studies.

The analysis shows that when the parasitic molecule was absent, the virus had produced more than 10,000 copies of itself less than 20 minutes after infection. In the presence of the parasitic molecule, however, no new progeny of the virus existed. The analysis, says Yin, also shows that the diversionary molecules had grown in number by more than 10,000-fold just 10 minutes after infection, further suggesting that the molecule successfully stole away resources from the virus.

"The parasitic strategy outperformed the non-parasitic strategies at all levels," says Kim. "It inhibited viral growth, even at a low dose, placed minimal demands on the intracellular resources of the host cell and was effective when introduced either before or during the infection cycle." One other important finding, he adds, is that the strategy created no obvious way for the virus to develop drug-resistant strains.

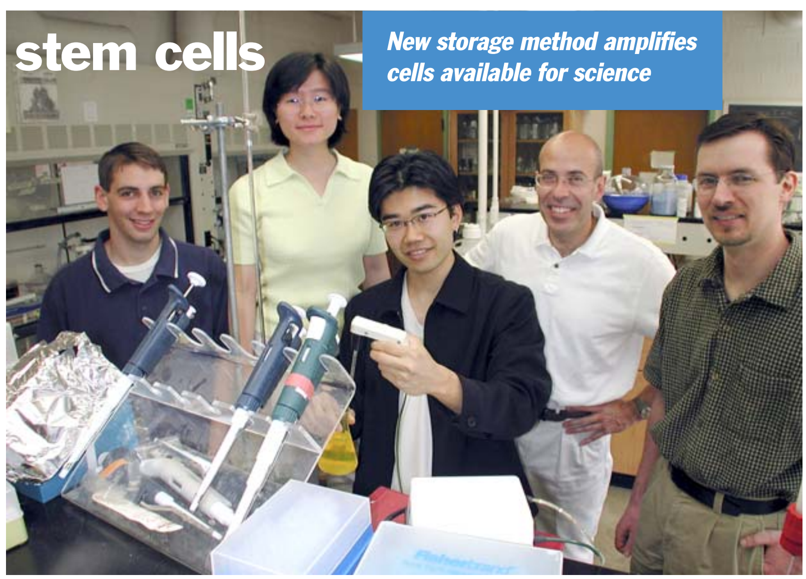
"Our calculations suggest that this antiviral strategy is a very effective approach, one that's very difficult for a virus to overcome," says Yin. "There are technical challenges to implementing this approach, but the findings open the door to a broader way of thinking about antiviral strategies."

Yin says the next step is for researchers to test these ideas inside living cells.

By Emily Carlson

Making the most of stem cells

New storage method amplifies cells available for science



From left: Grad students Jeffrey Mohr, Ying Nie and Satoshi Ohtake, and Chemical and Biological Engineering Professor Juan de Pablo and Assistant Professor Sean Palecek are improving preservation of biological materials.

Like many other kinds of cells used in biomedical research, human embryonic stem cells are stored and transported in a cryopreserved state, frozen to -320 degrees Fahrenheit, the temperature of their liquid nitrogen storage bath.

But when scientists thaw the cells for use in the lab, less than 1 percent awake from their frigid slumber and assume their undifferentiated state. This "blank slate" form is characteristic of stem cells and essential for the basic science required before the promising cells are ready for the clinic. So scientists are required to place the few survivors in culture and painstakingly tend to them for weeks before new colonies are abundant enough to conduct experiments. "Human embryonic stem cells have a very low survival rate following cryopreservation, which causes several problems," says Sean Palecek, an assistant professor of chemical and biological engineering and biomedical engineering.

Not only does that low rate make working with human embryonic stem cells time and labor intensive, but—because so few survive freezing—it may also mean that natural selection is altering the stored cells in unknown and undesired ways, he says.

But now Palecek, along with colleagues Juan de Pablo and Lin Ji, is putting the finishing touches on a new method for preserving and storing the finicky cells. The work, presented March 30 at a meeting of the American Chemical Society, promises to greatly increase the number of cells that survive their enforced hibernation, that remain undifferentiated, and that are more readily available for research. What's more, with more survivors, genetic variability becomes less of an issue.

By freezing the cells attached to a gel matrix instead of suspended in solution, and adding the chemical trehalose—a disaccharide or sugar that some animals and microbes produce to protect cells and survive in dry, low-temperature conditions—the Wisconsin team was able to increase stem cell survival rates by more than an order of magnitude, with as many as 20 percent of a cell culture surviving the freezing-and-thawing process. "By using the gel and adding the disaccharide to cells, you can increase their chances of survival," notes de Pablo, also a professor of chemical and biological engineering. "Twenty-percent survival doesn't sound like much, but that's a huge improvement. Taking the few survivors from current methods and growing them takes weeks. It's a real bottleneck in the field. Also, the amount of uncontrolled differentiation is reduced drastically."

The ideal system for preserving and storing valuable cells and other biological materials, says de Pablo, would be one where the cells are freeze-dried, and that's the ultimate goal of this line of research. The Wisconsin group has already successfully developed methods for freeze-drying bacterial cultures used to make cheese and yogurt. Their method, now in use commercially, reduces storage and transportation costs for food processors. "The idea now," explains de Pablo, "is to extend the technology to mammalian cells." He cites blood products as an example of cells that could potentially be freeze-dried for easy long-term storage, and blood products have become a new focus for his research group.

"If you can freeze-dry these types of cells, you can store them for indefinite amounts of time" and costs would be greatly reduced, he says. Such a technology would also help alleviate the chronic shortages of blood products. Some blood products are perishable and currently must be discarded after a certain amount of time in storage. Freeze-dried blood products would have no such liability. Moreover, it would make blood products more readily available for emergencies and mass casualty events, and in remote and difficult settings such as a battlefield environment.

The work by Palecek, de Pablo and Ji, which was supported by a grant from the Defense Advanced Research Projects Agency, is also scheduled for publication in an upcoming issue of the journal *Biotechnology and Bioengineering*. A patent for the technology has been applied for through the Wisconsin Alumni Research Foundation.

By Terry Devitt

IN THE NEWS

Chemical and Biological Engineering John T. and Magdalen L. Sobota Professor Nick Abbott and his research group have published two articles in *Science*. The first, published in the Aug. 1, 2003 edition and coauthored with postdoctoral research associate Yan-Yeung Luk, demonstrated new ways to couple the orientations of liquid crystals to chemical and electrical stimuli in electro-optical devices and chemical sensors through electrochemical control of the oxidation state of ferrocene-decorated electrodes. The second article, with Jeffrey Brake (PhD '03), now with Atofina Chemicals, and Maren Daschner (MS '03) as coauthors in addition to Abbott and Yan-Yeung, appeared in the Dec. 19, 2003 issue. This paper demonstrated novel principles for label-free monitoring of aqueous streams for molecular and biomolecular species without the need for complex instrumentation.

Biomedical and Industrial Engineering Professor Rob Radwin was quoted in a Jan. 27 *Washington Post* story about ergonomics researchers who boycotted an Occupational Health and Safety Administration symposium on injuries and repetitive motions in the workplace. The group said the conference was unnecessary. "We've had symposia on top of symposia followed by symposia, and all have arrived at the same conclusion ... that there is a clear relationship between musculoskeletal disorders and physical loading in the workplace," said Radwin.

Harrison Schmitt, adjunct professor of engineering physics, wrote a Jan. 14 *Los Angeles Times* commentary about President Bush's plan to explore the moon. Schmitt, an Apollo astronaut, cited the need for further exploration. "As Apollo 17 explored Taurus-Littrow in 1972, we were unaware that the soils beneath our feet contained commercially significant quantities of helium-3, a future fuel for fusion electrical power," wrote Schmitt. "Realization of the importance of the discovery in all of the soils of the moon was left to young engineers at the University of Wisconsin-Madison about 13 years later."

Assistant Professor of Mechanical Engineering Xiaochun Li received extensive national and international coverage of a technique he developed that utilizes cold laser machining to cut cheese into shapes such as Bucky Badger. He received coverage on CNN, National Public Radio, *USA Today*, the *New York Post*, the *Chicago Sun-Times*, *The Washington Times*, *The Baltimore Sun*, *The Minneapolis Star Tribune*, *The St. Paul Pioneer Press*, *The Globe and Mail* in Toronto, Canada, and other newspapers, television stations and websites worldwide. Read more at **www.engr.wisc.edu/news/headlines/2004/Jan19.html**.

Nanotechnology Now, an Internet gateway to nanotechnology news, featured the work of Chemical and Biological Engineering Assistant Professor Manos Mavrikakis, graduate student Jeff Greeley and Professor Joost Wintterlin (University of Munich). The group provided the first atomic-scale evidence for enhanced catalytic reactivity at stretched surfaces. The site linked back to the College of Engineering story at **www.engr.wisc.edu/news/headlines/2003/Dec29.html**.

Chemical and Biological Engineering Steenbock Professor James Dumesic and former UW research scientist Randy Cortright (now with Virent Energy) were featured in the December/January issue of *Technology Review* magazine. The article in the "Materials" section looks at hydrogen production and recent advances that are bringing the hydrogen economy closer to reality. Versions of the article also appeared in *Fuel Cell Today* and *EVWorld.com*.

A February 2004 story in *Materials Performance* magazine highlights COE research that may improve the performance and cost-effectiveness of nuclear reactors. A multidisciplinary group led by Engineering Physics Senior Scientist Kumar Sridharan is exploring the effectiveness of alloying boron or gadolinium onto reactor fuel rods to absorb excessive neutrons released during initial stages of reactor operation. The magazine is a publication of the National Association of Corrosion Engineers.

Nanotechweb.org published a Feb. 3 story about a new method of manipulating nanowires developed by Engineering Physics and Biomedical Engineering Assistant Professor Wendy Crone and her group. The researchers capped copper-tin alloy nanowires with nickel, which enabled them to accurately position the nanowires via magnetic fields. Read the story at **nanotechweb.org/articles/news/3/2/1/1**.

Engineering Physics Professor Fabian Waleffe's research on turbulence was cited in the February issue of *Physics Today*. "New Experiments Set the Scale for the Onset of Turbulence in Pipe Flow" highlighted recent experimental results by other researchers, but mentioned Waleffe's self-sustaining process that leads to nonlinear three-dimensional traveling-wave solutions of the Navier-Stokes equations for plane Coutette and plane Poiseuille flows.

A hardware-in-the-loop transient test system developed in the Powertrain Control Research Laboratory in the Department of Mechanical Engineering was featured on the cover of *Powertrain International*, Vol. 6, No. 3. The authors are Mechanical Engineering Professor John Moskwa, who serves as director of the laboratory, and PhD student John Lahti. The test system for single-cylinder engines has the potential to dramatically reduce engine development time and cost by closely replicating the multi-cylinder engine performance and inter-cylinder dynamic coupling.

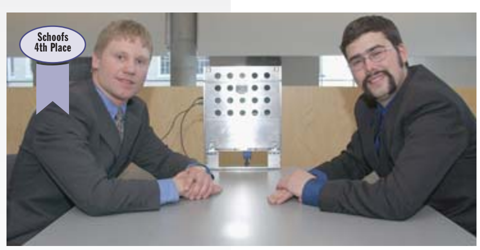
The March 5 edition of *The Chronicle of Higher Education* quoted Biomedical Engineering Professor and Chair Rob Radwin in "How Sound is Bush's 'Sound Science.'" The story covers the assertion of nearly 60 of the nation's top scientists that the Bush administration has misrepresented scientific findings in many fields to support its policies. Shortly before President Bill Clinton left office, he enacted regulations that required employers to act to minimize workplace injuries, particularly musculoskeletal disorders. Regarding President Bush's suspension of those regulations, Radwin said: "Industry is considering the practicality of implementation" and the costs of changes in the workplace. "But to say, 'We don't like the scientific evidence because it implies certain policies are warranted, and we don't like the policies'—you can't do that. Science should be outside the consideration of public policy."

Innovation Days *(Continued from front page)*

Entering a prototype in the competition was optional, but nearly every team built and demonstrated its idea. For some, the experience of constructing what they'd designed played a key role in its final incarnation. "When I did build the desk, things I had over-thought in the design phase were replaced by more obvious solutions," says engineering mechanics student Trenton Kirchdoerfer of his solid-wood portable modular desk, the Flexi-Desk, which earned second place in the Tong competition.

Similarly, mechanical engineering seniors Mike Casper and Anthony Nichol say building their second-place Schoofs design, the Ice Light, ultimately saved them a lot of time. "We originally thought we had to lay tiny fiber-optic strands in a horizontal manner using epoxy and metal for our light-passage medium," says Casper. "When researching materials for our prototype, though, we found a company that makes this part (a linear light) and it saved us tons of time. It also made our idea more viable if it went to a full-scale product."

The competitions are sponsored by the UW Technology Enterprise Cooperative. The Schoofs Prize is funded by Richard J. Schoofs, who received a BS degree in chemical engineering in 1953 from UW-Madison. The Tong Prototype Prizes and grants are sponsored by the Tong Family Foundation, including COE alumnus Peter P. Tong, who received his master of science degree in electrical and computer engineering in 1965.



Other winners include:

SCHOOFS PRIZE FOR CREATIVITY

- Second place and $7,000—"Ice Light," a replaceable edge-lighted film that creates illuminated images such as logos or advertising within ice sheets in ice arenas. The images are easy to turn on and off. Invented by mechanical engineering students Mike Casper and Anthony Nichol.
- Third place and $4,000—"Infinitely Variable Chain-Driven Transmission," a system that uses moveable sprockets, rather than the standard derailleur, to provide an infinite number of drive ratios for bicycle riders, making a more user-friendly, robust shifting system. Invented by mechanical engineering student Jason Zuleger.
- Fourth place and $1,000 (tie)—"Air-Tuner Drum System," a pneumatically driven device for tuning drums quickly and accurately. Invented by mechanical engineering student Joshua Lohr.
- Fourth place and $1,000 (tie)—"Laptop EZ Store," a removable desk-mounted laptop support that doubles as a space-efficient storage device. Invented by business student Peter Norenberg and mechanical engineering student Grant McNeilly.
- Fourth place and $1,000 (tie)—"Barrel Tattoo Machine," an improved, battery-operated tattoo machine that is easier for artists to handle. Invented by mechanical engineering student Andrew Lawson.
- Best presentation and $1,000—"S-BMX Conversion Kit," a system that quickly transforms BMX-style bicycles into downhill skiing machines for the extreme sport ski-biking. Invented by engineering mechanics and astronautics students Eric Schroeder, Mike Guthrie, Aaron "Sonny" Nimityongskul and Luke Henke.

TONG PROTOTYPE PRIZE

- Second place and $1,250—"Flexi-Desk," an adjustable, portable computer desk. Invented by engineering mechanics and astronautics student Trenton Kirchdoerfer.
- Third place and $700—"Ice Net X," a novel tool for landing large fish while ice fishing. Invented by engineering mechanics and astronautics students Nick Passint, Joe Cessna and Bryan Wilson.

CONGRATULATIONS

Recipients of the 2004 Grainger Power Electronics Student Awards

2004 Grainger award recipients

The 2004 winners of the Grainger Power Electronics Student Awards, which recognize promising students with an interest in the field of power electronics, were presented at an April 26 banquet.

BACHELOR'S DEGREE

Nathaniel Brown, Daniel Gutzke, Joshua Kagerbauer, Michael Motkowski, Tyler Perry, Brandon Pierquet, Kevin Resch, Daniel Statz, Chris Streufert, Paul Van Opens, Nathan West, Jonathan Zenker

MASTER'S DEGREE

Jeff Connors, Dave Farnia, Jesse Krase, Mark Spickard, Ray Tang, Rick White, Jared Winters

Polygon Teaching Award winners

The winners of the annual Polygon Teaching Awards were announced at an April banquet. The winners are chosen by engineering students, with both a faculty member and a teaching assistant (TA) chosen for some departments.

The winners for 2004 are—

Biomedical Engineering:
Professor Willis Tompkins, TA Paul Victorey

Chemical and Biological Engineering:
Associate Professor Dan Klingenberg, TAs Jesse Bond and Mariam Debs Gonzalez

Civil and Environmental Engineering:
Assistant Professor Chin-Hsien Wu, TA Rebecca Wuellner

Electrical and Computer Engineering:
Professor Nick Hitchon; TA Aravind Kailas

Engineering Professional Development:
Lecturers Susan Hellstrom and Laura Grossenbacher

Engineering Physics:
Professor Gregory Moses, TA Daniel Niedermaier

Industrial Engineering:
Professor Harry Steudel, TAs Shanmugasundar Ganapathy and Yuri Ramirez

Mechanical Engineering:
Professor Tim Osswald, TA Paul Nelson

Materials Science and Engineering:
Lecturer Jay Samuel, TA Jonathan Puthoff

Steuber Writing Prize winners

The 2004 winners of the Steuber Writing Prize were announced in April. The competition honors the best writing by engineering undergraduate students. The prize is funded by and named for UW-Madison alumnus William Steuber.

The winners are—

First place, $5,000 prize: "The Proscenium: A Cloak of Immunity," by Eli Gratz, sophomore, industrial engineering

Second place, $3,000 prize: "Lower Limb Prostheses: Design Considerations," by Christine Lauren Weisshaar, junior, biomedical engineering

Honorable mention, $500: "Case Studies in Biomimicry," by Robert Slowinski, senior, mechanical engineering

Honorable mention, $500: "Sailing," by Jeff Schneider, junior, geological engineering

BME senior in *USA Today* top-20 students

USA Today has named Jacqueline Gerhart, a biomedical engineering senior, to its College Academic All-Stars first team. The publication's program honors 60 undergraduates representative of outstanding students around the country, and who excel not only in the classroom, but also in leadership both on and off campus. Gerhart maintains a 3.8 GPA and hopes to be a physician. Among her activities, she volunteered with a Salvation Army MEDIC clinic and won a grant to build a database to track patient care, analyze trends and promote preventative care. She currently is working to add MEDIC reading volunteers and transportation programs. In addition, she is Women in Science and Engineering program coordinator, Polygon Engineering Student Council president, a team leader of Engineering Projects in Community Service, triathlon team workout leader, and was 2000 homecoming queen.

Hansen wins campus classified staff award

Nancy Hansen, a program assistant with the Pre-Engineering Office, has won a UW-Madison Classified Employee Recognition Award for 2004. Hansen, a 35-year employee of the university, received a cash award and a paid registration to an employee development program of her choice. Hansen's nomination singled her out for her responsiveness, positive attitude and ability to deal with complex situations with skill and grace. Her supervisor, Assistant Dean for Pre-Engineering Don Woolston, lauded Nancy's major role in making the office run smoothly. "She just wants to be the best office support person she can be, and she excels, in every way, every day: accuracy, timeliness, cheerfulness, productivity and efficiency. She's the one that keeps the rest of us from getting flustered during the busiest times of the year. She spells better than Webster, and writes better than Hemingway."

nPoint, Dumesic honored by MIT club

The MIT Club of Wisconsin has named nPoint, Inc. as small company of year for major contributions to Wisconsin's economy through technological innovation. nPoint was founded by Erwin W. Mueller Professor and Bascom Professor of Surface Science Max Lagally. The company is a Madison-based provider of motion devices and controllers for nanoscale research and manufacturing. The club also honored Steenbock Professor of Chemical and Biological Engineering James Dumesic with an award in the individual scientist category. The MIT Club of Wisconsin consists of alumni of the Massachusetts Institute of Technology who live in the state.

FORE!

CIVIL & ENVIRONMENTAL ENGINEERING FALL GOLF OUTING

The annual Department of Civil and Environmental Engineering golf outing will be held Sept. 13 at Lake Wisconsin Country Club in Prairie du Sac, Wisconsin. The cost of the outing is $75, and participants are also encouraged to consider a sponsorship. The outing helps raise scholarship donations for the department. Full details and an entry form will be available in the spring edition of the Conduit, the department's newsletter. See: www.engr.wisc.edu/cee/newsletter/.

Research/patent newsletter tops 1,000 subscribers

The college's e-newsletter on research and patents has now topped 1,000 subscribers in just its first year of existence. Research Review, delivered quarterly, highlights the latest in research activities in the college's departments and centers. It also includes recent patents applied for and intellectual property available for licensing.

Subscriptions are free, and the mailing list is not sold or used for other purposes. To read the latest edition and subscribe, go to **www.engr.wisc.edu/news/signup4research.html**.

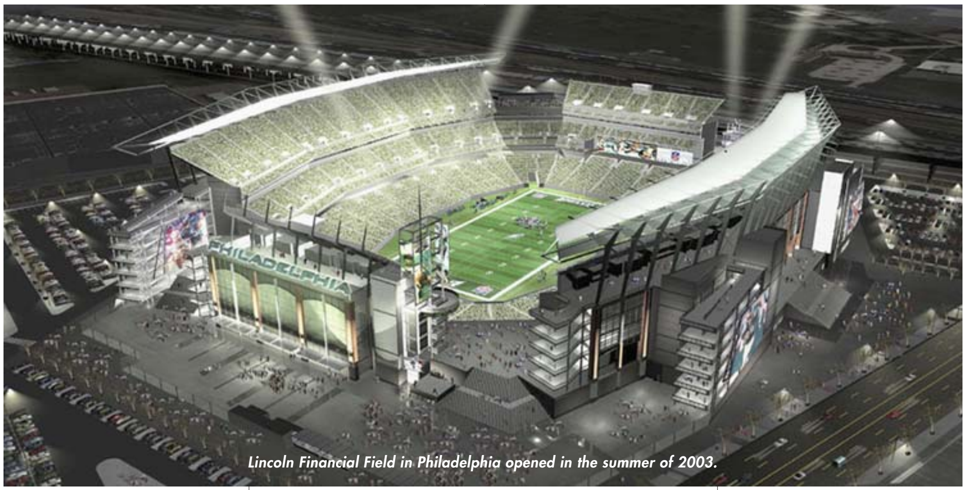
IN MEMORIAM

Frank Katcha (BSME '52), Milwaukee, Wisc., passed away in December 2003.

Robert Ludwig (MSMSE '48), Kingston, Tenn., passed away in December 2003.

William McMahon (MSME '35), Clearwater, Fla., passed away in December 2003.

Scott Jenkins, BS '86 (Civil & Environmental Engineering)
Vice president of stadium operations and facilities, Philadelphia Eagles



Lincoln Financial Field in Philadelphia opened in the summer of 2003.

In the construction business, few projects have as much public visibility as sports arenas and stadiums. Scott Jenkins has had the good fortune in being at the forefront of three major projects in the past decade—a new professional football stadium, the Milwaukee Brewers' Miller Park, and UW-Madison's Kohl Center.

Jenkins, a Kenosha native who received his BS in construction management in 1986, was a well-known UW-Madison distance runner before entering the world of sports stadiums and arenas.

"At the time, I didn't think that was going to be the path I was going to go down," he says. "It's been a lot of fun. I never dreamed I'd be in this business."

After working for the Wisconsin Department of Administration overseeing state office buildings, Jenkins was hired in 1994 by his alma mater's athletic department to be its director of facilities and athletic events. His move coincided with the department's largest project ever—the construction of the Kohl Center.

Jenkins says in many ways, UW-Madison's Kohl Center project was the most successful one he has worked on. The university worked smoothly with state officials, private donors and the city of Madison in completing the project on time and within its budget.

Scott Jenkins

"The Kohl Center just hit on every single cylinder," he says. "It's definitely one of the best facilities for both basketball and hockey."

Shortly after completion of the Kohl Center, Jenkins took up an offer to oversee a similar project—construction of Miller Park. Unlike the Kohl Center, Miller Park was built amid a sea of controversy, ranging from its local tax funding mechanism to construction delays and the unfortunate death of three construction workers during its building. Its state-of-the-art roof has also leaked, and occasionally had trouble opening and closing.

But Jenkins says Miller Park would benefit the Brewers in the long run, by giving them a stadium with amenities that are competitive with other new ballparks in the major leagues. "Miller Park was very challenging," he says. "But it's a big improvement for the Brewers."

Ownership changes at the Brewers, however, forced Jenkins to look elsewhere to continue his career, and in December 2002 he headed east. The Philadelphia Eagles, who played in what was generally recognized as the worst football stadium in the National Football League—Veterans Stadium—were looking for someone to oversee the opening of their new Lincoln Financial Field. Jenkins quickly hopped on board, and helped open the stadium in August of 2003.

Despite one misstep—the stadium was built without water fountains, leading to a few days of ridicule in the local media—the operations of Lincoln Financial Field have gone on without a hitch. The stadium now has water fountains, draws the envy of other teams in the league, and hosts other events such as international soccer games and concerts.

Meanwhile, Scott and his wife, Mary, and their three young children have adapted well to life in the Philadelphia area, even enduring jabs from locals who have yet to forget the Eagles' triumph over the Green Bay Packers in last year's playoffs at—yes—Lincoln Financial Field.

"That one was hard to take," he admits sheepishly.

ALUMNI NEWS

Biomedical Engineering

The Wisconsin Alumni Research Foundation recently hired **Jeanine Burmania** (BS '01, MS '02) as a licensing assistant in the biological sciences. She will manage select technologies within WARF's bio-science portfolio, evaluate licensing opportunities and assist with marketing efforts.

Chemical and Biological Engineering

Bart S. Hersko (BS '78) has joined Taylor & Aust, P.C., Indianapolis, Indiana, as of counsel, concentrating on intellectual property law. Previously a senior counsel intellectual property attorney with Procter & Gamble Co., Cincinnati, Ohio, Hersko received his JD from UW-Madison in 1985.

Civil and Environmental Engineering

Lisa Fleming (BS '81) has joined Ayres Associates as a transportation engineer in the company's Eau Claire, Wisconsin, office. She is responsible for providing transportation design engineering and project management services for the Wisconsin Department of Transportation and county and municipal clients.

TELL US WHAT YOU'RE UP TO!

Please let us know what good things are happening with your lives and careers—and we'll share it with our readers in this column. *(We do not include E-mail addresses unless you specifically request we do so.)*

U.S. MAIL: **PERSPECTIVE Editor**
215 N. Randall Ave.
Madison, WI 53706-1688

FAX: **608/263-9259**

E-MAIL: **perspective@engr.wisc.edu**

Also, visit uwalumni.com or call (888) WIS-ALUM (947-2586) to update your address and more.