DEPARTMENT OF

Materials Science & Engineering

College of Engineering University of Wisconsin-Madison

MS&E NEWS: The Materials Science & Engineering Department Newsletter

HOME BACK ISSUES CONTACT US JOIN OUR MAILING LIST SUPPORT MS&E

Sam Zelinka, scholarship recipient

SPRING/SUMMER 2004

(pdf version)

Featured Articles

Perepezko named to National Academy of Engineering

Voyles' work on metallic glass earns him NSF CAREER Award

Paper explains ferroelectrics memory losses

Babcock takes over as department chair

Kou returns to faculty after department chair duties fulfilled

Student wins prestigious Goldwater scholarship

Hellstrom receives Excellence in Teaching Award

Regular Features

Student news

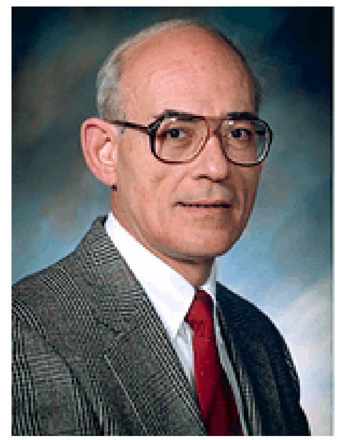
College of Engineering Department of Materials Science & Engineering University of Wisconsin-Madison

For help with this webpage: webmaster@engr.wisc.edu.

Date last modified: 26-July-2004
Date created: 26-July-2004

Perepezko named to National Academy of Engineering

The Department of Materials Science and Engineering keeps adding to its roster of faculty members recognized as among the very best in the nation.



John Perepezko
VIEW LARGER PHOTO (20K JPG)

In February, IBM Professor of Materials Science and Engineering **John Perepezko** was been named to the National Academy of Engineering, one of the highest honors accorded to engineers.

Perepezko becomes the fifth faculty member of the department to be named to the national academy. Department Chairman **Sindo Kou** said only a few similar departments nationwide can boast of such an array of NAE members.

Fellow department members in the national academy 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 College of Engineering Dean **Paul Peercy**, who holds a faculty appointment in the department.

“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,” Peercy said .

Perepezko, a department faculty member for 29 years, was cited by the academy for his innovative work in solidification processing to obtain useful micro-structured, nano-structured, and amorphous materials. His election was announced in February.

On the basis of a series of papers he authored in the 1980s, Perepezko identified a unique perspective on nucleation behavior that has been adopted by the materials processing community as the benchmark for understanding nucleation and solidification in highly under-cooled alloy systems. In addition, his research into hightemperature 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.

“John's election the academy confirms our department's strength in assembly an outstanding team of faculty,” Kou said.

Perepezko is a member of TMS — The Minerals, Metals and Materials Society, the American Institute of Mining, Metallurgical and Petroleum Engineers, ASM — The Materials Information Society, the Electrochemical Society, the Materials Research Society, and the American Society of Engineering Education.

Perepezko joined the College of Engineering in 1975. He has won several teaching awards, and was also awarded the college's 1997 Byron Bird Award for Excellence in a Research Publication.

Membership in the National Academy of Engineering is accorded to those in the field who have made “important contributions to engineering theory and practice,” as well as those who have demonstrated the “pioneering of new fields of engineering, making major advances in traditional fields of engineering, or developing/ implementing innovative approaches to engineering education,” according to a statement released by the academy.

Founded in 1964, the NAE is a branch of the National Academies, which also includes the National Academy of Science, the Institute of Medicine, and the National Research Council. The academy advises the federal government on public policy issues involving technology and engineering, and conducts independent studies on technology and engineering matters.

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

MS&E NEWS: The Materials Science & Engineering Department Newsletter

Voyles' work on metallic glass earns him 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.

Paul Voyles
VIEW LARGER PHOTO (18.5 KB JPG)

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. But 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 education 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.

Paper explains ferroelectrics memory losses

While the memory inside electronic devices may often be more reliable than that of humans, it, too, can worsen over time.

Paul Evans
VIEW LARGER PHOTO (28K JPG)

Now a team of scientists from UW-Madison and Argonne National Laboratory may understand why. The results are published in the online edition of the journal Nature Materials.

Smart cards, buzzers inside watches and even ultrasound machines all take advantage of ferroelectrics, a family of materials that can retain information, as well as transform electrical pulses into auditory or optical signals, or vice versa.

"The neat thing about these materials is that they have built-in electronic memory that doesn't require any power," explains Assistant Professor **Paul Evans** , a co-author of the recent paper.

But there's a problem preventing many of these materials from being used more widely in other technologies, including computers. As Evans says, "Eventually they quit working."

The ability of ferroelectrics to store information resides in their arrangement of atoms, with each structure holding a bit of information. This information changes every time the material receives a pulse of electricity, basically switching the arrangement of atoms.

However, each electric pulse - and corresponding change in structure - gradually diminishes the capability of these materials to store and retrieve information until they either forget the information or quit switching altogether.

"It could switch 10,000 or even millions of times and then stop working," says Evans.

Engineers call this problem fatigue. With little evidence for what happens to the structure of ferroelectrics as the material's memory fatigues, Evans and his colleagues decided to look inside this material as its arrangement of atoms, controlled by electrical pulses, switched inside an operating device.

"We'd like to understand how it switches so we could build something that switches faster and lasts longer before it wears out," says Evans.

To create a detailed picture of how the atoms rearrange themselves inside an operating device during each electrical pulse, the researchers used the Advanced Photon Source — the country's most brilliant source of X-rays for research, located at the Argonne National Laboratory - to measure changes in the location of atoms. By seeing how the atoms changed their positions, the researchers could determine how well the material switched, or remembered information.

"One advantage to working with X-rays is their ability to penetrate deep into materials, which is why they are so extensively used today in medical imaging," says Eric Isaacs, director of Argonne's Center for Nanoscale Materials, and one of the paper's co-authors. "Utilizing this property of X-rays, [we] were able to peer through layers of metal electrodes in order to study ferroelectric fatigue in a realistic operating device."

He adds that the very high brightness of the Advanced Photon Source allowed the researchers to focus X-rays to unprecedented small dimensions.

The X-rays showed that, as the researchers repeatedly pulsed the device, progressively larger areas of the device ceased working, suggesting that the atoms were switching structures less and less.

"After 50,000 switches, the atoms were stuck - they couldn't switch anymore," says Evans, adding that a stronger electrical charge did put the atoms back in motion.

When the researchers used a higher voltage of electricity from the beginning, switching stopped 100 times later, as reported in the paper. And, in this instance, applying an even stronger pulse made no difference.

"With higher voltages, the material can't switch because something has changed about the material itself," says Evans. "When you use bigger voltages, it's not just the switching that stops working, but something even more fundamental."

Because previous researchers have not peeked inside working ferroelectric materials to understand their arrangement of atoms - key to the ability to recall information — the reasons why switching eventually stops had not been clearly identified.

"The electronic memory is stored in the structure of atoms, and that's why it's so important to see what the structure looks like," explains

Evans. By looking inside these devices, he says engineers can begin to understand why the atoms stop switching and then manufacturers can start to design better devices.

With this promise, Evans asks, "Wouldn't it be nice to have a computer that doesn't forget what it's doing when you turn it off?"

Other researchers involved in the work include **Chang Beom Eom**, Dong Min Kim and the paper's first author, Dal-Hyun Do, from UW-Madison; and Eric Dufres, from the University of Michigan.

Date last modified: 26-July-2004
Date created: 26-July-2004

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

MS&E News

MS&E NEWS: The Materials Science & Engineering Department Newsletter

HOME BACK ISSUES CONTACT US JOIN OUR MAILING LIST SUPPORT MS&E

Babcock takes over as department chair

Susan Babcock thinks the time is right to take over as chairwoman of the Department of Materials Science and Engineering.

Susan Babcock
VIEW LARGER PHOTO (34K JPG)

Faculty members in the department conducts groundbreaking research in areas such as superconductivity, quantum computing and nano-spin devices. Babcock, a member of the department since 1990, said the research being conducted in the department attracted her to the chair's post. In addition, the department has hired three new faculty members in recent months — Assistant Professors **Paul Evans**, **Padma Gopalan**, and **Paul Voyles**.

"I think it's an exciting time for our department with three new faculty members," said Babcock, who will assume the chair's post this summer. "It gives the department an opportunity for some growth. It's an exciting field and with new people, it's a time to do exciting things."

Babcock plans to keep her hand in her own research, which focuses on defect structures in materials and electron microscopy. She will continue to advise a small group of graduate students, and maintain her ties to the Materials Research Science and Engineering Center.

Babcock received her BS (1982) and her PhD (1987) from the Massachusetts Institute of Technology, and came to the College of Engineering as a post-doctoral student in the Applied Superconductivity Center. She joined the department's faculty three years later.

Babcock becomes the first woman to chair a department in the college's history. She said that wasn't her motivation for pursuing the post, but notes its importance in a field that has struggled to attract women.

"I think it's important for women in the college to take on leadership roles," she said. "It's important to have women in the profession to get more ideas and more ways of thinking about things."

In her spare time, Babcock spends time with her family – former department faculty member Tom Kelly and their two children – coaches in a youth soccer league, and plays herself in a women's soccer league.

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

MS&E News

MS&E NEWS: The Materials Science & Engineering Department Newsletter

HOME BACK ISSUES CONTACT US JOIN OUR MAILING LIST SUPPORT MS&E

Kou returns to faculty after department chair duties fulfilled

After leading the Department of Materials Science and Engineering for four years, Professor Sindo Kou is looking forward to focusing on his teaching and research efforts.

Sindo Kou
VIEW LARGER PHOTO(17K JPG)

Kou will hand over the reins of the department to Professor Susan Babcock this summer. He said he enjoyed his tenure as department chairman.

“I understand the department much better than before,” he said. “I understand how the department functions.’

During his tenure, the department hired three new faculty members – Assistant Professors Paul Evans, Padma Gopalan, and Paul Voyles. In addition, four members of the department — 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, IBM Professor of Materials Science and Engineering John Perepezko; and College of Engineering Dean Paul Peercy, who holds a faculty appointment in the department -- were named to the National Academy of Engineering during his tenure, raising the national profile of the department.

“I had nothing to do with that,” Kou said with a chuckle about the prestigious NAE memberships. “But it’s a good thing to think about.”

Kou said he was particularly pleased that the department, with a number of senior faculty members, was able to hire three early-career professors during the past 18 months.

“They are the first new hires in a number of years,” he said. “We kept pushing for them. That’s very important for a small department like ours. A lot of people put in a lot of time to make that happen. Our hiring committees put in a lot of effort.”

In addition, Kou said undergraduate enrollment has stabilized, and that the department's graduate program continues to be recognized as one of the best in the country by publications such as *U.S. News & World Report*.

Kou will now have more time to focus on his teaching and research, which centers on welding, metal casting, and crystal growth of semiconductors. He has continued to advise students while serving as department chairman.

"It was enjoyable," he said of his tenure as chairman.

College of Engineering Department of Materials Science & Engineering University of Wisconsin-Madison

For help with this webpage: webmaster@engr.wisc.edu.

Date last modified: Monday, 26-July-2004
Date created: 26-July-2004

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

MS&E News

MS&E NEWS: The Materials Science & Engineering Department Newsletter

Student wins prestigious Goldwater scholarship

During his time in college, Sam Zelinka has taken up grading papers to help pay his way through college.

Sam Zelinka
VIEW LARGER PHOTO (18.5K JPG)

Now, the Materials Science and Engineering student will probably spend more time on his research and less time grading papers as the result of winning a prestigious Barry M. Goldwater Scholarship. Zelinka, who will be a senior this fall, won the $7,500 scholarship this past spring after competing with more than 1,100 undergraduate students nationwide.

Congress established the scholarship in 1986 in honor of the late United States senator from Arizona to foster a continuing pool of highly qualified scientists, engineers and mathematicians.

The scholarship recognized one of the department's outstanding undergraduate students. Zelinka has taken on several research projects at the U.S. Forest Product Laboratory on campus in addition to his regular coursework. He is part of the laboratory's "condition assessment and rehabilitation team," and has focused on wood engineering and mechanical properties. As part of his research, he has evaluated building codes, assessed the strength of nails used in wood manufacturing, and studied fastener corrosion.

Zelinka, who grew up in nearby Waunakee, Wisconsin, figured he go into the sciences when he went off to college. He always enjoyed math and science, and his father works as a chemist for the Madison Metropolitan Sewerage District.

"He would always drag me along to work," he says.

For Zelinka, the $7,500 scholarship eases his worries about how to pay for his last year in college. As for the future, he plans to pursue a PhD in the area of materials science.

"I don't want to close any doors,'' he says. "There are so many interesting things going on."

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

MS&E News

MS&E NEWS: The Materials Science & Engineering Department Newsletter

Hellstrom receives Excellence in Teaching Award

His colleagues describe his teaching as “exceptionally imaginative, inspiring, interactive and inclusive,” and call him a mentor and positive influence both in the classroom and via informal interactions with students.

Eric Hellstrom
VIEW LARGER PHOTO (18.5K JPG)

Materials Science and Engineering Professor Eric E. Hellstrom brings passion and infectious enthusiasm not only to the department, but to the College of Engineering . In his classrooms, engineering truly is hands-on and with his guidance, students develop as thinking engineers. “He is the kind of person that merely by being around you feel as though you can accomplish more than you believed,” says a former student.

For his dedication to teaching, Hellstrom has been named the College of Engineering ’s 2004 recipient of the Benjamin Smith Reynolds Award for Excellence in Teaching.

Shortly after it began, Hellstrom joined UW-Madison’s Creating a Collaborative Learning Environment program, a time-consuming endeavor that helps committed faculty improve their teaching by understanding how students learn. As a result, he made a number of effective changes to all his courses to increase student participation and understanding. “Having had Eric as a teacher has been one of those key transformational experiences that we so much hope all students have at least once in their undergraduate career,” says a colleague. “He is always motivated by what is best for the student.”

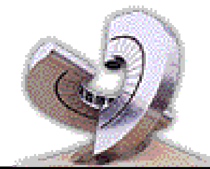
Characteristic of Hellstrom’s approach to teaching is in-depth, hands-on interaction — and never time-minimization. In his introduction to materials course, students learn via “controlled destruction”: They disassemble boom boxes and study each component see how materials science enables modern technology. “He is not only introducing the concepts and skills, he is deeply committed to helping the students formulate their uncertainties and to express their ideas, both orally and in class discussion, but first of all one-on-one as the experiment takes place," says a former student.

Hellstrom redesigned this course nearly a decade ago to become a hook for landing outstanding students to the department. Since then, the number of undergraduate students in the department has increased and their median GPA has risen from 3.0 to 3.3.

As an instructor in the college's introduction to engineering course, and as an advisor for student presenters in the university's ESTEAM and SOAR programs for high school students, Hellstrom opens the doors of materials science and engineering to potential students. As a result, he has drawn more and better students to the department. "He inspires students to think independently, generate useful questions, and solve problems in a team environment," says a former student. "His ability to convey to us the excitement of the materials field was a major factor in my decision to pursue MS&E here."

Hellstrom, who worked five years at Sandia National Laboratories, joined the department in 1985. Since then, he has taught or guest-lectured in 15 different courses and, despite the extra effort, has taught courses for faculty on sabbatical and volunteered to teach courses vacated by retirees—all with high student evaluations. "Professor Hellstrom taught me not with a PowerPoint presentation or with board and chalk," says a former student. "Now, as a professor myself, I can say that I can partially 'blame' him for my decision to join the academia."

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING



MS&E NEWS: The Materials Science & Engineering Department Newsletter

STUDENT NEWS

Degrees granted

BACHELOR OF SCIENCE (Materials Science and Engineering):

May 2004

Calvin Choi
Raymond Eisemann
Taslin Kimball
Jeff Waters

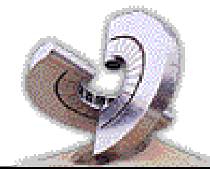
August 2004

Scott Harrington
Thomas Thersleff

For help with this webpage: webmaster@engr.wisc.edu.

Date last modified: 26-July-2004
Date created: 26-July-2004

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING



MS&E NEWS: The Materials Science & Engineering Department Newsletter

HOME BACK ISSUES CONTACT US JOIN OUR MAILING LIST SUPPORT MS&E

You can also send your address changes, alumni news or questions to:

MS&E News
Attention: Lynn Neis
1509 University Ave.
Madison, WI 53706-1595

Tel: 608/262-3732
Fax: 608/262-8353
E-mail: lynn@engr.wisc.edu

We'd like to hear from you!

Do you have a new job, job title or promotion? A new address, spouse or child? Please let us know what good things are happening with your lives and careers--and we'll share it with other alumni here in MS&E News.

Name:

UW degree(s) and year(s):
(e.g. MS in MSE '87)

E-mail:

Address:

☐ Check here if this is a new address

News:

Send your news Start over

College of Engineering Department of Materials Science & Engineering University of Wisconsin-Madison

For help with this webpage: webmaster@engr.wisc.edu.

Date last modified: 26-July-2003
Date created: 26-July-2004

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

MS&E NEWS: **The Materials Science & Engineering Department Newsletter**

HOME BACK ISSUES CONTACT US JOIN OUR MAILING LIST SUPPORT MS&E

You can also join our mailing list by sending your name and address information to:

MS&E News
Attention: Lynn Neis
1509 University Ave.
Madison, WI 53706-1595

Tel: 608/262-3732
Fax: 608/262-8353
E-mail: lynn@engr.wisc.edu

Please join our mailing list

If you would like have a printed version of MS&E News sent to you, please join our mailing list by completing the form below.

Name:

Address:

Send your info   Start over

College of Engineering   Department of Materials Science & Engineering   University of Wisconsin-Madison

For help with this webpage: webmaster@engr.wisc.edu.

Date last modified: 26-July-2004
Date created: 26-July-2004

THE DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

MS&E NEWS: The Materials Science & Engineering Department Newsletter

Back issues

For help with this webpage: webmaster@engr.wisc.edu.

Date last modified: 26-July-2004
Date created: 26-July-2004