VOLUME IV, NO. 1
JULY 2000

# MATSE

PENN STATE

PENNSTATE

1855

## On The Cover

*If everything was bathed in synovial fluid, there would be a lot less friction in life, and the rheometer used for the polymers research of Wendy Krause, described in this issue, might look a little like it does on the cover (instead of its real look, below).*

*Penn State MATSE* is published by the Department of Materials Science and Engineering. For a free subscription, write us at *Penn State MATSE*, 118 Steidle Building, The Pennsylvania State University, University Park PA 16802–5006.

Editorial Director: Richard Tressler
Writer/Editor: Gary W. Cramer
(814) 865-3208
Contributing Writers/Photographers: Michael Bezilla, Kathy Gummo, Barbara Hale, Donna Lucas, Julian Thomas, Karen Trimbath



# An Update on Accreditation from the Department Head...

Dear Alumni and Friends,

In the fall semester of 2002, all Penn State engineering programs will be visited by examiners from the Accreditation Board for Engineering and Technology (ABET) for renewal of our accreditation, which is carried out on a six-year schedule. We have already been preparing for this process for a year now, because the new ABET 2000 criteria for accreditation represent a major departure from the old criteria. No longer based on meeting minimum standards, the new criteria are outcomes based, and permit the individual programs to define their educational objectives and determine how they will achieve the outcomes specified by the criteria. A key part of the process is an ongoing evaluation of the achievement of our educational objectives, the lessons from which will lead to more improvements in the effectiveness of the program. Our corporate colleagues will recognize this process as Continuous Quality Improvement applied to our production of fully capable materials science and engineering B.S. graduates.

How is this new accreditation scheme affecting MatSE at Penn State? We see no reasons to make sweeping changes in our basic curriculum, but since reorganizing the department, we have taken advantage of the outcomes based philosophy to make a variety of coursework and facilities revisions to better meet the needs of our constituencies—our students, employers, alumni, and faculty. We are a large faculty that covers the field with breadth and depth so that we can continue to offer specializations to our students, as well as opportunities to gain some peripheral vision in the field. Thus, we will still offer one degree, the B.S. in Materials Science and Engineering, but with an accredited Metals Science and Engineering option, an accredited Ceramic Science and Engineering option, and an accredited Materials Science and Engineering option with specialties in Polymers and in Electronic and Photonic Materials. For the future, we are considering a specialization in Biomaterials and a general option. This approach seems to best meet the needs of our constituencies.

What are we doing between now and fall 2002? We will write the first draft of an ABET self-study that will help us identify weaknesses in our programs and the assessment of them. We will involve our Industrial and Professional Advisory Committee in our deliberations as a captive group of very interested professionals representing diverse professional activities. We will also put the self-study on the Web, so that all of you can review it and give us comments for use in revising our thinking in later drafts. The final submission of the self-study will come in July 2002. So we look forward to a thorough self analysis, followed by serious input from our constituencies, and, ultimately, a successful program of continuous improvement. We hope to hear from you as we go through the process.

Richard E. Tressler, Professor and Head
Department of Materials Science and Engineering

# Research Roundup

## Polymer Science Seeks Clues to Why HA Becomes No Laughing Matter

Most people who use painkillers for relief from arthritis or other inflammations of joints are like the man who always raps a certain spot on his television set to improve reception: he doesn't know why it works, he just knows that it does. **Wendy Krause,** who recently earned her doctoral degree from Penn State, says the medical community's understanding of the mechanics of joint pain is increasing, and that polymers play a role in the potential for new drugs to remedy the problem with a different kind of rap.

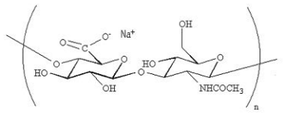
*Wendy Krause at work on a rheology experiment.*

Although she was enrolled in the Department of Chemistry, Krause's interest in helping drugs hit painful joints in better ways led her to take in-depth looks at the synovial fluid that protects freely moving joints, such as the knee and elbow. Thus, she spent the past several years as a team member of **Ralph Colby's** Polymer Dynamics and Complex Fluids Rheology group in the Department of Materials Science and Engineering, especially investigating the polymers hyaluronic acid (HA) and the plasma proteins albumin and gamma-globulins. These polymers play major roles in the healthy functioning of the synovial fluid as it provides essentially frictionless motion between limb segments.

### UNDER PRESSURE

"The very name 'synovial fluid' is descriptive of its rheology, or the way it flows, because synovia means egg-like," Krause says. "Joint swelling is determined in part by the osmotic pressure of the synovial fluid, which is controlled by the polymers present in it. For instance, the concentration of albumin in rheumatoid arthritis patients, compared to healthy controls, is simultaneously larger in the synovial fluid—kept around the joint by a semi-permeable membrane called the synovium—and smaller in the plasma outside the membrane."

Since albumin can cross the synovium, this observation is evidence of albumin binding to something in synovial fluid that cannot cross the synovium, and Krause explains that the likeliest suspect is HA. A high molecular weight, water soluble, charged polymer like HA—referred to as a polyelectrolyte—is large enough that it does not cross the synovium easily. HA is known to form soluble complexes with a variety of proteins under physiological conditions, and soluble complexes formed from polyelectrolytes and proteins are highly viscoelastic compared to the individual polymers. This means that, like the behavior of flour dough, the polyelectrolytes resist deformation and partially return to their original state upon removal of a deforming shear stress (for more about shear, see the sidebar article on page 5). Krause, Colby, and colleagues with Eastman Kodak have published several articles on polyelectrolytes in the *Journal of Polymer Science*.




*Structure of Hyaluronic Acid*

### TOOL TIME

Despite the simple, well defined structure of HA and more than sixty years of research on its properties, the conformation of HA in solution is still controversial. "Rheology is a powerful tool in determining whether HA is a weak reversible gel, as other researchers have suggested," Krause says. "The rheology of weak reversible gels is strongly dependent on prior shear history, but such shear history dependence has not been observed for protein-free HA solutions in our laboratory or discussed in the literature."

When Krause combined an HA solution with the proteins found in synovial fluid in the lab, the rheology of the

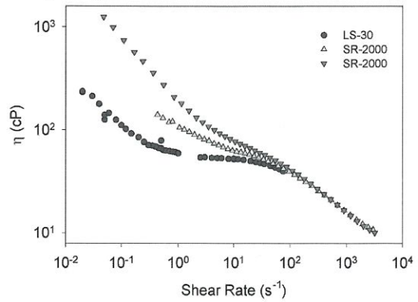
**continued on next page**

Research Roundup continued from previous page

resulting solution became strongly dependent upon shear history (see figure below), indicating that a weak reversible gel had been formed. She explains that, as with any polyelectrolyte, counterion condensation occurs on HA chains as a natural consequence of trying to force the bare charges on the polyion to be too close together. Since the charge density on the albumin and gamma-globulins proteins is too small for them to have any condensed ions, the rheology group members suspect that the HA's condensed counterions, about 20 percent, might be the key to controlling the osmotic pressure of synovial fluid, and therefore to controlling swelling.

"Our initial hypothesis was that if too many of the plasma proteins albumin and gamma-globulins bind to HA, this would raise the osmotic pressure of the fluid," Krause offers. "Binding would raise the pressure in two ways: first, by releasing any condensed counterions; and secondly, by retaining the proteins—which are small enough to cross the synovium—on the joint side of the membrane."

The membrane used in the osmotic pressure experiments investigating this hypothesis had a 30,000 Dalton molecular weight cut off, which is small enough to retain albumin and gamma-globulins, so that only the effects from released counterions could be observed. The group members had speculated that if an additive inhibited the binding between HA and the proteins, then the osmotic pressure of the solution would decrease due to counterions condensing on the chain. Furthermore, they suspected that this decrease would correspond to a decrease in swelling, and offer an alternative mechanism of action for anti-inflammatory drugs.




*An example of the synovial fluid model's dependence upon shear history.*

## THE MAGNIFICENT SEVEN?

The seven additives considered in Krause's studies were adenosine, aspirin, hydroxychloroquine, ibuprofen, methotrexate, (D)-penicillamine, and sulfasalazine. Some of these additives are capable of directly changing the charge on the sodium hyaluronate complex (NaHA), and others indirectly. When added to 3 mg/mL NaHA solution (the relevant concentration for human synovial fluid) at a drug concentration of $7 \times 10^{-4} M$ (the equivalent of one dose of "Genuine Bayer Aspirin™," or 650 mg of aspirin, uniformly distributed in the bloodstream of a 175-pound person) only (D)-penicillamine had a significant effect on the viscosity of the solution. It reduced the viscosity by a factor of three, possibly by disrupting intramolecular hydrogen bonding within the HA chain, which would decrease the stiffness of the NaHA chains, and hence decrease the viscosity. When the same anti-inflammatory agents were considered in relation to a simple model of synovial fluid consisting of a solution of 3 mg/mL NaHA, 11 mg/mL albumin and 7 mg/mL gamma-globulins in phosphate buffered saline, the hydroxychloroquine and (D)-penicillamine strongly affected the rheology of the model. However, none of the additives significantly affected the osmotic pressure of the synovial fluid model.

*Wendy Krause considers some rheometer readings.*

## THE TRUTH IS (STILL) OUT THERE

"So, contrary to our hypothesis, the osmotic pressure results on these solutions do not clearly indicate that any condensed counterions are released, and the addition of drugs to the synovial fluid model has no significant effect on its osmotic pressure," Krause notes. "An interesting future study would be to repeat the measurements using a membrane with a molecular weight cut off that allows the proteins to pass but retains the HA. This system would more closely mimic the synovium, and perhaps the osmotic pressure of the synovial fluid model would be dependent on the additives if they change the binding of the proteins to HA."

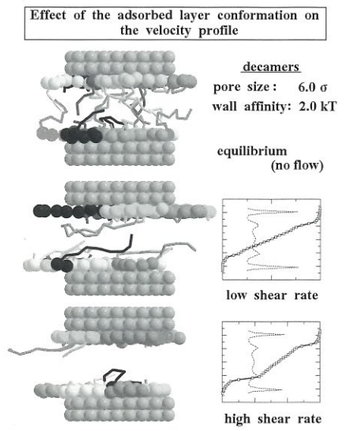
Originally from Wilton, Maine, Krause did her undergraduate work in chemistry at MIT. She began her graduate work at Penn State in 1993 with an International Paper Fellowship, and joined Colby's research group in 1996. In 1999, she was a finalist for the American Physical Society's Padden Award. She received her Ph.D. last May, and has accepted a job at Lynntech, Inc., a technology development company in College Station, Texas.

▲▼▲



# High-Tech Advances Put the Pressure on Shear Research

Shear affects polymers when they are caught between two surfaces, one or both of which can move independently of the other. A good mechanical example is what a lubricating polymer film on a computer's hard disk experiences when the disk moves rapidly under the magnetic head element. In the human body, the polymers in the synovial fluid (see main research feature starting on page 3) that keeps joints from grinding together experience shear from the force of the joints' movement. Inspired by these real-life situations, when a polymer scientist studies shear, he or she is usually concerned with the deformation that occurs in polymers from the forces of two confining surfaces in parallel sliding motion (shown below is a computer simulation of shear effects on an adsorbed polymer lubricant).




**Evangelos Manias,** assistant professor of materials science and engineering, had already investigated various aspects of tribology—the science of the mechanisms of friction, lubrication, and wear of interacting surfaces that are in relative motion—at Cornell University before joining the faculty at Penn State in 1998.

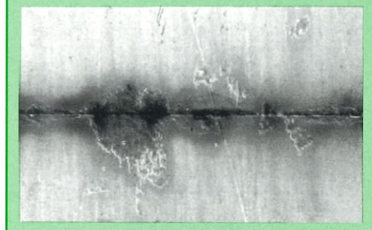
Manias notes that while rheometers can be used to measure the flow of polymer-based liquids at relatively low shear rates (typically: rheometer $< 10^5$ sec$^{-1}$, Surface Forces Apparatus $< 10^8$ sec$^{-1}$, etc.), sometimes it is desirable to probe materials at higher shear rates that are relevant to high-tech mechanical applications, and which cannot be reproduced inside rheometers. For example, a hard disk lubricant may experience shear at a rate of ~$10^{10}$ sec$^{-1}$ and the lubricant used for a spacecraft's high rpm bearing at ~$10^{12}$ sec$^{-1}$.

Moreover, as miniaturization and acceleration of devices requires faster motions over thinner films—thus introducing even higher shear rates—insight on the response of polymers under extreme shear/flow conditions has become crucial to industry. Manias is gaining such insight through Non-Equilibrium Molecular Dy-

continued on page 7

# Faculty Share the Research Wealth Through Their Websites

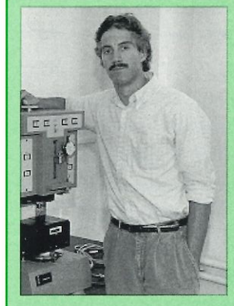
When examining the intricacies, successes, and limitations of various materials, MatSE faculty members often seek input from other researchers to broaden their understanding of the matter at hand. In turn, to share the knowledge they have gained with colleagues around the world, as well as with students interested in the state of the art in materials science, some of these faculty members have created websites loaded with information freely accessible to all visitors.



The picture at left reveals that submicron-grained zirconia blocks are not suitable candidates for joining by diffusion bonding. The joint line is visible, and the joined pieces fall apart on machining. This view comes from **Merrilea Mayo's** website on "Applications of Nanocrystalline (and Near-Nanocrystalline) Ceramics at Penn State" at http://www.ems.psu.edu/MATSE/nanocrystalline.html.

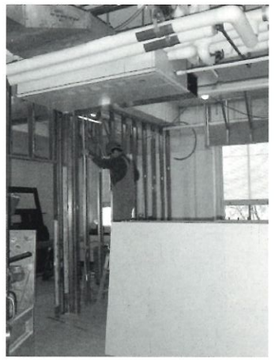
**Zi-Kui Liu's** Phases Research Lab, the spring 2000 lineup of which is seen here with Liu at the far right, concentrates on phase equilibria, phase diagrams, and phase transformations, and has a website at http://phases.metsce.psu.edu/. Student members in the past semester were, from left, **Chao Jiang, Haibo Li, Koray Ozturk, Melissa Marshall,** and **Ricki Stevenson.**

The work of **Ralph Colby's** Polymer Dynamics and Complex Fluids Rheology Group, including the recent investigations of polyelectrolytes described in this issue, can be delved into at http://felix.metsce.psu.edu/Rheology/index.html. At left, Colby shows off a rheometrics stress rheometer that is used by the group. ▲▼▲



# Department Details

### Department Relearns the Three "R"s



Lately, the three "R"s have meant Reorganization, Renovation, and Relocation for many faculty, staff, and students of the department, especially in Steidle Building. The pictures at right show (clockwise from upper left) **Carey Stover** ready for action in the newly organized Graduate Program office in Room 101, **Cindy Lake** and **Tina Shawley** sifting through the never-ending files of the newly organized Undergraduate Program office in Room 124, **Deb Brown** helping polymers faculty member **James Runt** in the Financial Office in Room 116, and the early stages of now-completed work on the Department Head's new office in Room 121.

Other changes in Steidle include Room 120's conversion from lab space into a greatly improved Student Lounge, and the forthcoming arrival of a new Student Computer Lab in Room 119. The Computer Lab will feature about a dozen MacIntoshes and more than twenty PCs, and an advanced projector system for the display of information from individual computer monitors to the rest of the room.

Other recent shufflings of space in Steidle have led to faculty members **David Green** and **John Hellmann** moving portions of their operations to the Materials Research Laboratory Building; and **Darrell Schlom** to the Materials Research Institute Building.

Also, as the summer progresses, some of the polymers science facilities are getting a facelift on the third floor of Steidle.

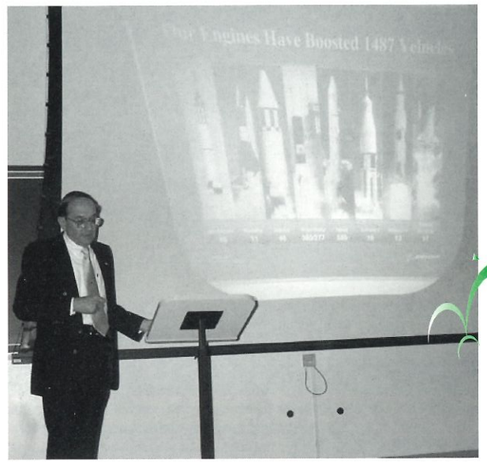
### Hellos, Goodbyes

The department staff recently bid farewell to **Gloria Henry,** a stalwart of the Financial Office for nearly two and-a-half years, when she took a new position in the Department of Food Science. Her old duties now belong to **Melanie Hall,** who has been with the College of Earth and Mineral Sciences in such offices as Petroleum and Natural Gas Engineering, Coal and Organic Petrology, and the Energy Institute since 1988.

Another new face is that of **Trisha Koch,** who came to Penn State from Mertztown, Pennsylvania, and recently landed her bachelor's degree in psychology. Trisha has taken on a variety of receptionist, mailroom, seminar scheduling, and purchasing duties, and is based in the department's main office.



## McFarland Lecturer Halchak Blasts Off on Blue-White Weekend




A look at the past, present, and future of the use of titanium alloys in the U.S. space program was the featured topic of the 52nd Annual David Ford McFarland Award Lecture and Banquet, held on the Blue-White Game weekend in April. Shown here are some of the weekend events honoring the 2000 McFarland Lecturer, **John A. Halchak** ('62 Metals), director of material applications for Rocketdyne Propulsion and Power, a part of the Boeing Company, in Canoga Park, California. Left: during the award lecture to a crowd of University and general public listeners (lower right), Halchak describes how Boeing engines have boosted nearly 1,500 launch vehicles into orbit. Top right: seated with Halchak during the award banquet are, from left, **W. Murray Small,** former MatSE faculty member and chair of the 2000 award committee; **Yurie Halchak,** the awardee's wife; and **Kwadwo Osseo-Asare,** chair of Metals Science and Engineering.

*For more pictures of this year's event and background on the McFarland Award, visit the web at http://www.ems.psu.edu/MATSE/mcfarland2000.html and http://www.ems.psu.edu/MATSE/metals-news.html.*

**Shear Research cont. from page 5**

namics (NEMD) computer simulations that investigate polymer lubricants that experience ultra-high shear flows under severe confinements and pressures.

"Conceptual—computer designed and executed—experiments offer the possibility to view directly the molecular mechanisms underlying the macroscopic material behavior," says the native of Greece. "At the same time, they offer information that cannot be obtained through laboratory experiments—such as slippage location, energy dissipation mechanisms, velocity profiles, and so on."

His studies of viscosity in films in nanometer confinement under shear have found strong inhomogeneities in the dynamics of the system. For instance, nearly all of the shear thinning takes place inside the solid-oligomer interface, and the adsorbed layers are more viscous than the middle part of the films (see figure on page 5). Moreover, the shear thinning inside the interfacial area is determined by the wall affinity and is largely insensitive to changes of the film thickness and the molecular architecture. Some of Manias's papers on the topic with colleagues at the University of Florida and the University of Groningen, The Netherlands, were published in *Europhysics Letters* and *Langmuir* in 1996, and more recently in *Physical Review Letters* in 2000. ▲▼▲

# Alumni Annals

## Howard Bomberger, 1974 McFarland Award Winner, Passes Away

**Howard B. Bomberger** ('42 Metals) of Canfield, Ohio, died of a heart attack in February at the age of 77. A native of Lebanon, Pennsylvania, he went on from Penn State to earn a doctorate in metallurgy from The Ohio State University in 1952. His career included work in research and development for REM-CRU Titanium, Crucible Steel, and RMI, from which he retired as director of metallurgy and research in 1982.

In 1974, he received the David Ford McFarland Award for distinguished accomplishments in the field of metallurgy from the Penn State Chapter of ASM International. In addition to his corporate work, he was an instructor of metallurgy in the graduate school at Youngstown State University, and for sixteen years was an honorary faculty member of the Metals Engineering Institute. He also served on the National Materials Advisory Board Subcommittee on Titanium, and was a visiting scientist with the Air Force Materials Laboratory. Following his retirement, he was active as a consultant. He served in the Army and was a member of the Zion Hill Church of the Brethren in Columbiana, Ohio, to which memorial contributions may be made.

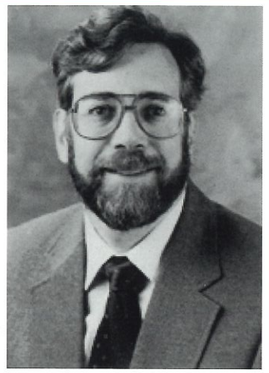
His wife, Emma, died in 1994. He is survived by a son, two daughters, five grandchildren, a brother, and two sisters.

**Ritwik Biswas** ('99g Metals) and his wife, Atreyee, are now living in Orlando, Florida. Their phone number is (407) 681-0882.

**Andrew J. Bonser** ('86 Ceramics) reports that he has left Premier Refractories International and obtained a new position as sales and market development engineer with the Drever Company, coordinating customer contacts and expanding markets for the steel equipment and general furnace divisions. He and his wife, Donna Marie, had their second child, Andrew James, Jr. in November 1999. He can be reached at work at 380 Red Lion Road, Huntingdon Valley PA 19006; (215) 947-3400.

**John P. Butchko** ('96 Ceramics) is now living at 438 Orchard Street, Larksville PA 18704; (570) 288-2217. He is working for Intersil Corporation, 125 Crestwood Road, Mountaintop PA 18707; (570) 474-3701.

**Harvey P. Hack** ('87g Metals), a fellow engineer at the Northrop Grumman Corporation in Annapolis, Maryland, was elected to a one-year term as chairman of the 2000 American Society for Testing and Materials Board of Directors in February. A resident of Arnold, Maryland, his career concentration has been in marine corrosion, cathodic protection, crevice corrosion, and electrochemical testing. In his current position, he performs corrosion and materials engineering for marine vehicles and systems being built for the Department of Defense.



*Harvey P. Hack*

**Bing Lu** ('99g Polymers) is living at 600 Village Road, Apartment 201F, Port Lavaca TX 77979; (361) 552-6335. He is working for Formosa Plastics Corporation, 201 Formosa Drive, Point Comfort TX 77978; (361) 987-7676.

**Sriram Madhavan** ('96g Ceramics) is living at 1244 Henderson Avenue, Apartment 1, Sunnyvale CA 94086; (408) 615-1138. He works for Cypress Semi in San Jose.

**John P. Manko** ('95 Ceramics) is a product development engineer on Tran-Cor H, a high permeability/low core loss silicon steel for stacked core power transformers, at AK Steel's Butler Works. He is living at 624 North McKean Street, Butler PA 16001-4430; (724) 284-1178. He can be reached at work at Armco Drive, Butler PA 16003; (724) 284-2294.

Our thanks to **William E. Royer** ('47 Metals) of LaFayette, New York, for the interesting brochure that he sent us about some of his Blair County, Pennsylvania, ironmaster ancestors from the 1800s. Metallurgy has certainly played a big role in the Royer family geneaology.

**continued on next page**



## Alumni Donors Vault to Top Again

For the third consecutive year, Penn State leads the nation in the number of alumni making gifts annually to their universities, according to figures recently made available by the Council for Aid to Education (CAE).

For the fiscal year ending June 30, 1999, 72,208 Penn State alumni made gifts to their university. The University of Michigan ranked second, receiving gifts from 68,602 of its alumni. Harvard University ranked third with gifts from 65,496 alumni. Among Big Ten public universities, Penn State also ranked first in the percentage of alumni who made gifts in fiscal 1999.

For more information on this story, visit http://www.psu.edu/ur/2000/alumgiv00.html. For a more complete list of rankings in the categories that measure how Penn State compares with other universities philanthropically, go to http://www.psu.edu/ur/about/bigten/rankings.html.

**continued from previous page**

**Walter L. Saccani** ('48 Metals) of Upland, California, died in February at the age of 75. A native of Donora, Pennsylvania, he worked as assistant to the vice president of operations at Kaiser Steel Corporation in Fontana, California, for thirty years before his retirement. He is survived by his wife, Mary Kathryn, two daughters, three grandchildren, a sister, and five nephews.

**Matthew E. Stahley** ('00g Ceramics) and his wife, Kara, are living at 316 Brookfield Circle, Macungie PA 18062. Matthew is working for Lucent Technologies at 9999 Hamilton Boulevard, Room 3I-125, Breinigsville PA 18031-9359; (610) 391-2813.

**Craig P. Waverka** ('90 Metals) and his wife, Ellen, are living at 191 Aspen Lane, Gilbertsville PA 19525; (610) 608-8218. Craig is working for CoreTech Consulting Group at 1040 First Avenue, 4th Floor, King of Prussia PA 19406; (610) 265-8222, ext. 3614.

**Beth M. Wichterman** ('94g Ceramics) and her husband, Bill Simpson, are living at 7105 S. Green Hills Drive, Saline MI 48176. She works for Visteon Automotive Systems in Dearborn, where she can be reached at the Visteon Product Assurance Center—A103Q, 401 Southfield Road, Dearborn MI 48121; (313) 621-7626.

## Upcoming Events

**August 4, 2000**
Second 6-week summer session classes end

**August 5, 2000**
Summer commencement
University Park campus

**August 22, 2000**
Fall classes begin

**September 8–9, 2000**
**Obelisk Society Weekend/E&MS Tailgate**
University Park campus
For more information: (814) 863-4667 or jxh33@psu.edu

**September 28–30, 2000**
**55th Annual Forum of the Pennsylvania Ceramics Association: Meeting Technological Needs Through Industry-University Partnerships**
Keynote Lectures—**Gary W. Weber,** Assistant Vice President for Research and Director of Technology Transfer at Penn State on "Technology Transfer Issues Between University and Industry"; **Randall M. German,** Brush Chair Professor in Materials at Penn State on "Center for Innovative Sintered Products: An Industry Directed Academic Program"
Penn Stater Conference Center Hotel at University Park
For more information: call (814) 865-4992, e-mail jrh3@ems.psu.edu, or check the web at http://www.ems.psu.edu/MATSE/ceramics-news.html

If you have an event for the Upcoming Events Column, please contact the *Penn State MATSE* editor for consideration.

Penn State's graduate programs in materials have been ranked 7th best in the nation in the *U.S. News & World Report* guide to "Best Graduate Schools 2001." Check out the complete rankings on the web at http://www.usnews.com/usnews/edu/beyond/gradrank/gbengsp9.htm.

# Faculty Facts

Congratulations on the achievment of promotion and tenure in the department to **Clive Randall** and **Ralph Colby,** who are both now full professors of materials science and engineering; and to **Suzanne Mohney,** now an associate professor of materials science and engineering.

**Tarasankar DebRoy,** professor of materials science and engineering, presented the 57th Comfort A. Adams Lecture on "Computer Modeling—A Path to Understanding the Science of Welding" to the American Welding Society (AWS) during its April conference in Chicago. Each lecturer in the Adams series appears only once, making it one of the most prestigious recognitions that can be bestowed within the $40 billion welding industry. Adams was the AWS's founding father and first president.

**Venkatraman Gopalan,** assistant professor of materials science and engineering with the Materials Research Laboratory, has earned a National Science Foundation Faculty Career Development Award. He will use the award funding to perform real-time studies of domain dynamics in ferroelectrics for photonic applications. His group will investigate the structure and dynamics of individual domain walls in ferroelectrics using a range of probing techniques such as real-time electro-optic imaging microscopy, second harmonic generation microscopy, near-field scanning optical microscopy, and scanning probe microscopy. These fundamental studies aim to break new ground in understanding the nucleation, growth, and merger dynamics of domains on nanometer length scales and during microsecond time scales, and to suggest effective ways to create diverse shapes in domains for integrated optical applications.

**Ian R. Harrison,** professor of polymer science, was a co-recipient of a 2000 Outstanding Achievement Award from the Society of Plastics Engineers (SPE) at the ANTEC 2000 conference in Orlando, Florida, last spring. The award came from SPE's Thermoplastics Materials and Foam Division for Harrison's pioneering work on polymer characterization with Temperature Rising Elution Fractionation (TREF) technology. His earliest work on TREF was done in cooperation with **Les Wild,** formerly of Quantum Chemical Corporation, who was also a co-recipient of the SPE award. The understanding of polymer structure produced from their efforts led to the industrial synthesis of Linear Low Density Polyolefins using single-site, or constrained geometry, catalysts.

**John R. Hellmann,** associate professor of ceramic science and engineering, was elevated to Fellow in the American Ceramic Society (ACS). He serves the society as president of the Ceramic Education Council, chairman of the Phase Equilibrium Committee, member of the Nominating Committee, and as an associate editor of the ACS's *Journal.*

**Gary Messing,** professor of ceramic science and engineering, recently gave invited lectures on "Co-Sintered Multi-Layer Ceramics" at the Fourth Symposium on Synergy Ceramics in Nagoya, Japan, and on "Fabrication of Textured Ceramics and Single Crystals by Templated Grain Growth" at Toyota Central R&D Labs, Inc., in Nagakute, Japan.

**Suzanne Mohney,** associate professor of materials science and engineering, is principal investigator on a National Science Foundation-supported project to develop multimedia courseware for upper level undergraduate students in materials science and engineering and related disciplines. She is working with **Gary Gray,** of the Department of Engineering Science and Mechanics, and MatSE's **Ian Harrison, Paul Painter, Susan Trolier-McKinstry,** and **Michael Coleman,** as well as with student assistants. The courseware will undergo initial tests at Penn State, then be refined at other institutions and eventually made commercially available. It will cut across the boundaries of the sub-disciplines of materials science and engineering and will include simulations,

**continued on next page**



**continued from previous page**

animations, and virtual instruments. The majority of the courseware projects will require students to interact with the software and each other to complete diverse assignments.

**Kwadwo Osseo-Asare,** professor of metallurgy and geo-environmental engineering, will use a leave of absence during the 2000–2001 academic year to conduct collaborative studies leading toward a unified approach to aqueous processing education and research.

**Carlo G. Pantano,** professor of materials science and engineering, was one of three faculty members of the College of Earth and Mineral Sciences, and one of seventeen faculty from across the University, named Distinguished Professors this year in recognition of their outstanding contributions to Penn State. Candidates are nominated by their peers, departments, or programs, and must be active members of the faculty who are not presently holding an endowed chair, professorship, or faculty fellowship.

**Karl E. Spear,** professor of materials science and engineering, will be on sabbatical during the spring of 2001 to advance both teaching and materials research in applied thermodynamics and thermochemical modeling by discussions with colleagues in Canada, Europe, and the United States.

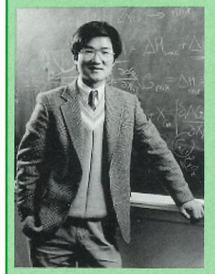
**Vladimir S. Stubican,** professor emeritus of materials science and engineering, was recently named by Cambridge University, England, as one of the 2,000 outstanding scientists and educators of the 20th century. Stubican was cited for his work on the structure of silicates, on the nature of atomic defects in ionic solids, and on solidification and diffusion studies in oxides. He will also be listed by the American Biographical Institute in a forthcoming reference book on "1,000 World Leaders of Influence."

**Susan Trolier-McKinstry,** associate professor of ceramic science and engineering and associate director of the Materials Research Laboratory, and **Della M. Roy,** professor emerita of materials science, were among ten women from across the University who were recently honored with Achieving Women Awards by Penn State's Commission for Women.

## Words of Praise for Our 2000 Wilson Awards Winners

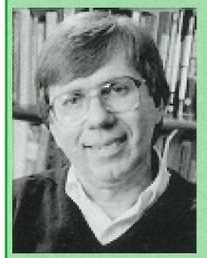
When the College of Earth and Mineral Sciences held its 2000 Wilson Awards Banquet in April, three well known faculty members from Materials Science and Engineering were among the total of seven faculty honored for their dedication to Penn State. Here are the MatSE winners and some anonymous excerpted comments from persons who nominated them.

**Long-Qing Chen,** associate professor of materials science and engineering, was one of three faculty members in the college to receive the Excellence in Research Award.



*"The pervasive character of (Dr. Chen's) research is its elegance. He has created a highly influential body of work, which illustrates (his) versatility and scientific imagination ... (and brings) startlingly refreshing scientific insight into classes of problems that permeate essentially all sub-fields of our community."*

**Donald A. Koss,** professor of materials science and engineering, received an Outstanding Teaching Award.



*"Dr. Koss has been my instructor for three courses ... (each) a rewarding and enriching experience ... (combining concepts) with real world examples to facilitate students' understanding. ...(He) is an outstanding instructor and a valuable resource of knowledge for students."*

**Susan Trolier-McKinstry,** associate professor of ceramic science, also received an Outstanding Teaching Award.

*"I have never enjoyed a class in college as much as I have (Dr. Trolier-McKinstry's). ...We definitely worked in her class for our grades, but the ability to do this effectively was a result of her excellent teaching skills. ...Her professionalism commands respect and I hope to emulate this skill...."*

# Neighborhood Notes

## University Fires Up Center for Innovative Sintered Products

With the aid of a $1 million grant from the Pennsylvania Technology Investment Authority, Penn State engineers have established a Center for Innovative Sintered Products (CISP) to serve the powder metal and particulate materials industry—forty percent of which is concentrated in Pennsylvania's northcentral region. The center includes the College of Engineering's previously existing P/M Lab, the largest of its kind in the world, and a partnership with the Penn State DuBois campus.

**Randall German,** who holds the Brush Chair in Materials at Penn State, heads the new center. He says the CISP team, which includes thirty-five Penn State faculty members, is targeting activities in three thrust areas: functionally designed structures, time compression technologies, and complex precision structures. More than thirty Pennsylvania companies and fifty outside the Commonwealth have already become members of the center. It is supported by cash and in-kind contributions, plus industry and federal government research grants and contracts currently totaling $ 2.5 million. CISP has a website at http://www.pmlab.psu.edu/CISP. ▲▼▲

*Advanced engineering aide Tracy Potter, left, and visiting scholar George Li at work in the pressing area of the CISP. Photo courtesy the center.*

## Fundamental Knowledge About Glass Surfaces to be New Center's Focus

The National Science Foundation's Industry-University Center for Glass Research (CGR) has formally established the Center for Glass Surfaces and Interfaces at Penn State. **Carlo Pantano,** professor of materials science and engineering and director of the Materials Research Institute, will direct the new research site. The center aims to improve the science, technology, and manufacture of glass in ways leading to the development of products with greater strength, corrosion tolerance, optical reflectivity, and resistance to weathering and scratches.

*Glass research facilities in Steidle Building were shown off to the public during the 2000 Earth and Mineral Sciences Exposition (EMEX) in March.*

"Although many applications of glass require that the surface form an interface with other materials—such as semiconducting thin films, polymer coatings, diffusion barriers, and metal coatings—fundamental knowledge about the surface of glass has been limited," Pantano says. "This is especially true regarding multicomponent, commercial glass compositions. For instance, the use of glass as a substrate for flat-panel displays in electronic devices exerts considerable demands on the glass surface, and this is just one performance facet that could be enhanced by the research being conducted with CGR support."

The CGR is a multi-university center based in the NYS College of Ceramics at Alfred University in Alfred, New York. Five recent additions to the list of corporate partners that support the CGR are dedicated to the Penn State center: Alcatel, Cerdec Corporation, Sierracin/Sylmar Corporation, Schott Glas (Mainz, Germany), and St. Gobain.

Penn State experts conducting CGR research include Pantano; **David Allara,** professor of polymer science and engineering; **John Badding,** associate professor of chemistry; **Victor A. Bakaev,** research associate; **David Green,** professor of ceramic science and engineering; **John Hellmann,** associate professor of ceramic science and engineering; **Sanat T. Kumar,** professor of materials science and engineering; **Karl Todd Mueller,** associate professor of chemistry; **Timothy Ovaert,** associate professor of mechanical engineering; and **Nicholas Winograd,** professor of chemistry. ▲▼▲



# Student Scoops

## Reorganization Garners New Graduate Students

The reorganization of Materials Science and Engineering, described in the January 2000 *Penn State MATSE,* is having a notable impact on graduate student recruitment, says Graduate Program Coordinator **Long-Qing Chen.** Chen notes that this year, twenty-eight new grads will join the department as a result of a spring recruiting event and other efforts of faculty and staff members. "A record ten of the new students will hold awards or fellowships, up from just one or two in most years," he adds (see page 14). "I think we are seeing such high-quality recruits because our academic reorganization makes us very attractive to some of the brightest young scholars out there right now."

*Although it brought a "snow day" for the rest of University Park campus, the weather didn't stop a group of nearly thirty prospective graduate students from learning more about the opportunities for research in materials science at Penn State during a departmental recruiting event in February.*

## New NSF-backed Curriculum Begins in Fall

This fall, a National Science Foundation-supported integrated education program that is first of its kind in the United States will be launched as the new graduate curriculum in Materials Science and Engineering at Penn State. The program creates pilot computational courses on thermodynamics, kinetics, and materials design. It represents a revolutionary modernization of previous courses dealing with the fundamental principles needed to quantitatively solve practical materials research and engineering problems. The courses initially will be taught by the curriculum designers—**Zi-Kui Liu,** assistant professor of materials science and engineering, Graduate Program Coordinator **Long-Qing Chen,** and **Karl Spear,** professor of materials science and engineering—and later integrated into the core components of the upper-level undergraduate MatSE curriculum, as well. NSF funding of nearly $370,000 is enabling the purchase of new computer hardware and software for the courses, and the development of new instructional materials. "Our goal is to erase the stereotypical view among students that thermodynamics and kinetics are problematical to learn and difficult, if not impossible, to apply in the real world," Spear notes.

## Summertime is Research Time

*Materials Science and Engineering is a National Science Foundation-supported site for the Research Experiences for Undergraduates program, which offers free housing during a summer of paid research in University labs. This summer, twelve students are tackling MatSE projects. Junior* ***Stephanie Schaum*** *(Electrical Engineering), of Pittsburgh, right, is working on the corrosion behavior of electroplated Sn-Zn alloy for* ***Howard Pickering,*** *Distinguished Professor of Metallurgy, and graduate student* ***Kai Wang*** *(Metals). Visit http://www.ems.psu.edu/MATSE/REU/ for more program details.*

## Outstanding Research Earns Five Students Xerox Awards

On May 9, 2000, the 24th Annual Xerox Awards Day was held at the Materials Research Laboratory. The awards, given for research accomplishments, are open to any Penn State student who is completing work in materials research. The 2000 winners were Ph.D. students **Ender Suvaci** (Materials Science and Engineering) and **Vijayakumar C. Venugopal** (Engineering Science and Mechanics); M.S. students **Faisal M. Al-Faqeer** (Metals Science and Engineering) and **Kenneth E. Strawhecker** (Materials Science and Engineering); and B.S. student **Elif Ertekin** (Materials Science and Engineering).

**Mark B. Myers,** senior vice president for research and technology at the Xerox Corporation in Stamford, Connecticut, gave the first E. F. Osborn Memorial Lecture in Materials during the program. His talk on "Materials in the New Economy" dwelt on the internet's impact on society and materials processing. The Osborn Lecture honors an individual for his or her long-term contributions to interdisciplinary research in materials.

*Gathered at the Xerox Awards Day are (in the front row, from left to right):* ***Gary L. Messing,*** *director of the Materials Research Laboratory, Mark B. Myers, Vijayakumar C. Venugopal, and Elif Ertekin. In the back row: Materials Science and Engineering faculty members* ***Sanat Kumar*** *and* ***Howard Pickering,*** *Kenneth Strawhecker, Engineering Science and Mechanics faculty member* ***Akhlesh Lakhtakia,*** *and Faisal M. Al-Faqeer.*

## Other Recent Awards

**1999 ASM International Graduate Research Paper Award (a national competition):**
**Todd Palmer**
*For "A Study of Nitrogen Dissolution Into the Weld Metal During Arc Welding"*

**George W. Brindley Award in Nonmetallic Crystal Chemistry:**
**Nicholas J. Smith, Kyle R. Zarambo**
*Honors the memory of the head of Penn State's Department of Ceramic Technology from 1955 to 1962. Undergraduate recipients are chosen based on their research.*

**The Harman Award in Metallurgy:**
**Amy Stauffer**
*Named for the family of Christian Harman, Jr. and Eleanor Hoy Harman and presented annually to an outstanding junior in the Metals Science and Engineering program.*

**The Robert W. Lindsay Award in Metallurgy:**
**Peter A. Kirkham, Melissa Lee Marshall**
*Honors the memory of the head of the former Department of Metallurgy from 1960 to 1969. The award recognizes students who do outstanding work in physical metallurgy.*

**Materials Research Laboratory Undergraduate Research Fellowships:**
**Obiefune Ezekoye, Melvin Gottschalk**

**Materials Research Society Undergraduate Materials Research Initiative Grants:**
**Obiefune Ezekoye, Lisa Friedman**

**Ellen Steidle Achievement Award:**
**Ryan D. Williams**
*Established in 1953 by former College of Earth and Mineral Sciences Dean Edward Steidle to honor the memory of his wife. Made to juniors and seniors who have been particularly active in advancing the welfare of the college and its student body.*

### 2000–2001 Awards/Fellowships Held by Graduate Students

**Applied Research Laboratory Fellowship Awards**—William Golumbfski, Tara Plew, Joseph Ryan
**Graduate Minority Scholars Award**—Larry Hurtt
**Materials Research Institute Awards**—Kevin Fox, William Golumbfski, Joseph Ryan
**Muan Award**—Matthew Krohn
**University Graduate Fellowships**—Carl Brubaker, Elam Leed, Aravind Mohanram, Katherine Oates
**Wilson Fellowship**—Katherine Oates
**Xerox Awards**—Faisal M. Al-Faqeer, Kenneth Strawhecker, Ender Suvaci (see story above)



### Three Show Posters at Graduate Exhibition

Materials Science and Engineering was represented by three students at Penn State's Fifteenth Annual Graduate Exhibition Poster Session last March: **Liang Guo** (Polymers), **Nopparat Plucktaveesak** (Polymers), and **Bernd Wittek** (Metals).

Guo's work dealt with "Rheology and Structures in Aqueous Mixtures of Nonionic Surfactants" and Plucktaveesak's with "Surfactant Effects on the Gelation Temperature of a Hydrophobically Modified Polyelectrolyte." Both are members of **Ralph Colby's** Polymer Dynamics and Complex Fluids Rheology group.

Wittek's poster was on his research stream of "Surface Alloying and Dealloying in the System Cu-Au." His advisors are **Howard Pickering** and **Konrad Weil.**

The number of students participating in the Graduate Exhibition grew to a record 223 this year.

### Barnes a Winner at Chemistry Symposium

Graduate student **Amy S. Barnes** (Ceramics), a National Science Foundation Fellow, was honored for giving the Best Overall Poster Presentation during the Third Environmental Chemistry Symposium at Penn State last spring.

Barnes's research on "Geomicrobial Surface Interactions Between Hornblende or a Hornblende Glass Analog and *Arthrobacter sp.* and *Streptomyces sp.*" was featured among fourteen posters and seventeen oral presentations at the symposium. Her co-authors on the project from the Department of Geosciences are **S. L. Brantley** and **L. J. Liermann,** and her advisor is **Carlo Pantano.**

At the same event, **Bernd Wittek** received an honorable mention for a poster that he also showed at the Graduate Exhibition (see previous item).

The symposium is coordinated by the Center for Environmental Chemistry and Geochemistry, and sponsored by the Eberly College of Science and the Colleges of Agricultural Sciences, Engineering, and Earth and Mineral Sciences, along with the Environmental Resources Research Institute.

### Friedman's Research a Runner-up at ACS

Being named first runner-up in a national student research competition at the American Ceramic Society's annual meeting in St. Louis, Missouri, in May is just one of **Lisa Friedman's** (Ceramics) academic successes so far this year. She spoke on her ongoing, Office of Naval Research-funded project with advisors **John Hellmann** and **Rustum Roy** on fiber reinforced composites fabricated via a rapid matrix infiltration process. The contest is sponsored by the Ceramic Educational Council.

Friedman also presented her work before the recent Materials Research Society meeting in San Francisco, California, and she has an MRS grant to continue the project. Furthermore, she is holding down a summer internship at the Bettis Nuclear Power Lab in Pittsburgh and pursuing the Integrated Undergraduate/Graduate (IUG) Program in Materials Science.

"I feel that the IUG program is a great opportunity to get your Master's degree in an efficient manner," she says. "It also allows you to work on more challenging research as an undergrad."

## High-tech Interactive Learning Center Built for a CAUSE

A new high-tech classroom in Deike Building has become home base for the collaborative learning CAUSE seminars, which address issues of broad appeal to students throughout the College of Earth and Mineral Sciences. CAUSE (Center of Advanced Undergraduate Studies and Experiences) classroom instruction is held in the recently dedicated Myrna Hill and Fred Samuel Harris Interactive Learning Center—named after the parents of **Donald Hill** ('75g Geophysics), who created an endowment to benefit CAUSE. A different six-credit, year-long CAUSE seminar is offered each year, and the 2000 program focuses on the costs and consequences of energy choices for the new millennium. Department of Energy and Geo-environmental Engineering faculty members and this year's seminar students have already conducted field research on renewable energy resources in Colorado, Nevada, and California. They also visited the U.S. Department of Energy's National Renewable Energy Laboratory in Colorado.


▲▼▲

# In This Issue...




PENNSTATE

*Penn State MATSE*
Department of Materials Science and Engineering
118 Steidle Building
University Park PA 16802-5006




Kathy Gummo
Department of Materials Science and Engineering
101 Steidle
The Pennsylvania State University
University Park PA 16802