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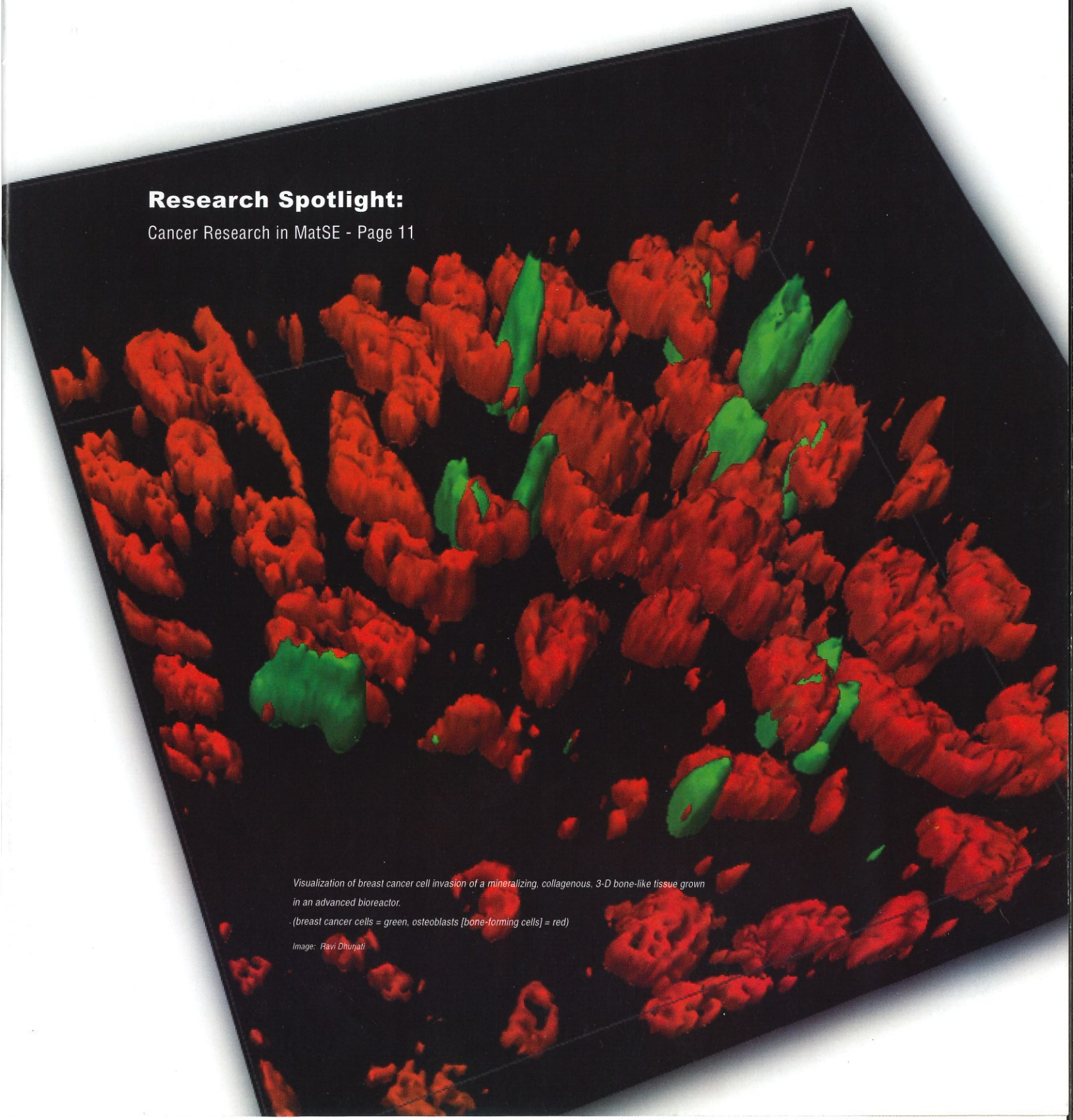
MatSENews

Materials Science and Engineering Fall 2006 www.matse.psu.edu

Research Spotlight:

Cancer Research in MatSE - Page 11



Visualization of breast cancer cell invasion of a mineralizing, collagenous, 3-D bone-like tissue grown in an advanced bioreactor.

(breast cancer cells = green, osteoblasts [bone-forming cells] = red)

Image: Ravi Dhurjati

Dr. Gary L. Messing

Distinguished Professor of Materials Science and Engineering
Head, Department of Materials Science and Engineering

The fall semester is well underway - the air is crisp and cool, and the fall colors are beginning to show. This is a beautiful time of the year in Happy Valley.

As you will see in the newsletter, a lot is happening this year. The Materials program at Penn State continues to be one of the best academic programs in the country thanks to our successful alumni, active faculty and graduate students. As always we are interested to see how we did in the U.S. News and World Report rankings of Materials Science and Engineering departments. Again this year our undergraduate and graduate programs continue to be ranked in the top 10. But these rankings got me thinking about whether there aren't other, or even better, measures of excellence. A recent issue of Science Watch reported that Penn State was tied with Northwestern University for 5th place in the impact of its peer-reviewed publications in materials. It also reported that Penn State faculty published the most peer-reviewed papers in the field of materials amongst U.S. universities and that total was 30% greater than each of the next two schools listed (MIT and Berkeley). A couple of years ago, ISI reported that there were 12 Penn State faculty included in the list of most highly cited materials researchers of which four were MatSE faculty members. As noted in their editorial, "Penn State dominates the (materials) category." As one of the largest MatSE departments in the country, we regularly are one of the top producers of Ph.D. graduates. In research funding, NSF ranks Penn State #1 in funded materials research in the country. The above data clearly demonstrates that materials at Penn State has earned its position in the top ten. As this issue demonstrates, the faculty continue to excel across the full spectrum of materials.

While research excellence is prized, we also strive to provide a first rate education for our undergraduates. Our undergraduate program continues to grow with 27 incoming freshmen. Four of them are members of the Scheyers Honor College, and 56% were ranked in the top 10% of their graduating class. We would like to grow the total number of undergraduates from 150 today to around 200 in a couple of years. A recent article in the Journal of Materials (TMS) reported that many students learn about our discipline through the materials alumni.

Therefore we seek your help in bolstering the number of young people who know about the materials field. We will be sending you information later this year to help recruit young people to our field. To further our educational goals we are designing a new undergraduate processing lab that will house state-of-the-art equipment for the processing of polymers, ceramics, and metals. Semiconductor processing is handled in the EE Microfabrication Lab next to Steidle Bldg. The new lab will replace the old 'mud lab' located in rooms 22-23 Steidle for a targeted opening in fall semester 2007.

Finally, energy is on everyone's mind with sky high gas prices. To enhance the department's contributions to long term solutions in the energy field we have launched a new faculty search committee to identify two new faculty members with an emphasis on materials for energy applications.

We look forward to seeing you in town. Go Lions!

In this Issue:

Editor: Gary L. Messing
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DEPARTMENT OF
MATERIALS SCIENCE AND ENGINEERING
COLLEGE OF EARTH AND MINERAL SCIENCES

Thank you to all who have contributed to MatSE!

The following is a list of donors to the department from June 15, 2005 – July 31, 2006. We have checked our records carefully but if you do not see your name listed, please contact us at (814) 865-0497 so that we can correct our records.

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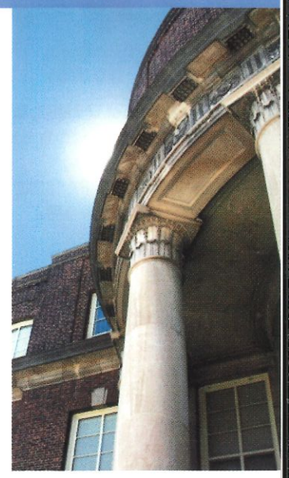


Bayer Gives $300,000 to Materials Science and Engineering

Photo: Mike Fleck, Materials Science and Engineering

Left to right: Gregory S. Babe, Alan Scaroni and Gary L. Messing.

PITTSBURGH, PA, September 15, 2006 – At a gathering of students and faculty, Bayer MaterialScience executives today presented a $300,000 grant from the Bayer Foundation to The Pennsylvania State University and its Department of Materials Science and Engineering to fund the Bayer Graduate Fellowship in Materials Science as well as the Bayer International Internship Scholars.

Gregory S. Babe, President and CEO, Bayer MaterialScience LLC, and board member of the Bayer Foundation, presented the grant to Alan Scaroni, Associate Dean of Graduate Education and Research in the College of Earth and Minerals Sciences, and Professor Gary L. Messing, Head of the Materials Science and Engineering Department in the College of Earth and Mineral Sciences, on a day when he and Robert Kumpf, Vice President, Future Business, Bayer MaterialScience LLC, and Daniel Skrovanek, Vice President and General Manager, Thermoplastic Polyurethanes, Bayer MaterialScience LLC, toured Penn State's new materials science and engineering facilities and met with students who are benefiting from the Bayer Foundation grant, including:

Bayer Graduate Fellows:

- **Christina Lentz** – BS from Cornell in Materials Science and Engineering
- **Nicholas Smith** – BS from PSU in Materials Science and Engineering

Bayer International Internship Scholars fund recipients and the locations where they will spend their internship:

- **Erin Haworth** - National School of Industrial Ceramics, Limoges, France
- **Andrea Fortunato** - University of Padua, Padua, Italy
- **Dennis Shay** - The University of Sheffield, Sheffield, England
- **Garnia Juwondo** - Swiss Federal Institute of Technology, Zurich, Switzerland
- **Alejandro Levander** - University of Leeds, Leeds, England
- **Alexana Cranmer** - Darmstadt University of Technology, Darmstadt, Germany
- **Alexander Adler** - University of Leeds, Leeds, England
- **Christopher Brink** - Swiss Federal Institute of Technology, Zurich, Switzerland
- **Katherine Williams** - University of the Basque Country, San Sebastian, Spain

"At Bayer, we are committed to help strengthen U.S. science education at every educational level, from pre-college to graduate programs," explained Babe. "We view this grant to Penn State as a solid investment in the future – that of the students and also of Bayer MaterialScience – because we understand that our future vitality and viability as a science-based company depends, in part, on the kinds of education investments we make today."

Penn State and Bayer share a long collaborative history, with Bayer's support to the University totaling more than $2.2 million over the past two decades, plus more than $1 million in research grants. Bayer employs more than 185 Penn State alumni.

"The Bayer International Internship Scholars program has helped to eliminate the financial barrier for study abroad for our undergraduate students and helped transform their interest in having an international educational experience," said Gary Messing of Penn State.

"As a result of Bayer's support, seven Bayer International Internship Scholars will participate in a research internship during the coming academic year. Bayer's support demonstrates the importance of an international experience as the professional world becomes more global. Because of this unique program and Bayer's support, we have been able to recruit outstanding freshmen to the materials field and provide an educational experience that is impossible to provide in the classroom."

The Bayer Graduate Fellowships are awarded on a competitive basis to the most outstanding students entering the Materials Science and Engineering graduate degree program. The Bayer International Scholars fund provides travel expenses and a partial stipend for undergraduate students who participate in the Materials Study Abroad program, a one-semester research internship for selected students based on collaborations of Penn State's faculty and faculty at host institutions in England, France, Germany, Italy, Spain and Switzerland.

"As our professional disciplines become increasingly global, this type of educational experience, afforded to more students through the Bayer grant, becomes ever more invaluable, giving them – the next generation of inventors and innovators – a significant competitive edge," said Kumpf.

While the students discussed how the new support from the Bayer Foundation is enhancing their education, both Babe and Kumpf shared with them a real-world industry perspective, including how they, the students, can apply their education in the workplace, what managers are looking for in new hires and why international experience is critical today.

The Bayer Foundation is an endowed 501(c)(3) entity and is the primary source of Bayer Corporation's philanthropy in the United States. With a programmatic focus on civic and social service programs, education and workforce development, arts and culture, and health and human services, the Bayer Foundation creates and supports partnerships that improve communities in which Bayer employees live and work.

Bayer Corporation, headquartered in Pittsburgh, is a subsidiary of Bayer AG, an international health care, nutrition and innovative materials group based in Leverkusen, Germany. In North America, Bayer had 2005 net sales of 7.3 billion euros and employed 16,200 at year end. Bayer's three operating companies -- Bayer HealthCare LLC, Bayer CropScience LP and Bayer MaterialScience LLC -- improve people's lives through a broad range of essential products that help diagnose, prevent and treat diseases, protect crops and advance automobile safety and durability.

Contact: Rebecca L. Lucore, Bayer Foundation

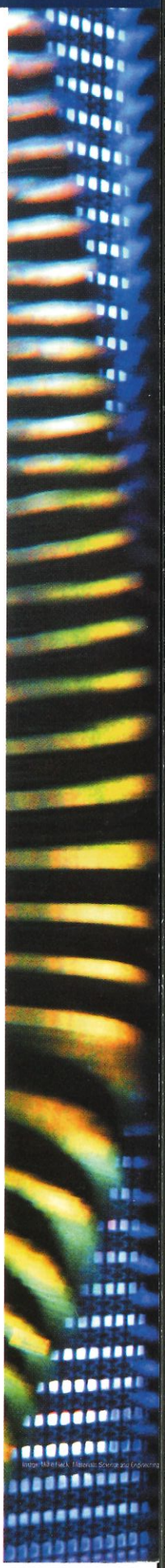


Photo: Mike Fleck, Materials Science and Engineering

2006 Taylor Lecturer Says Solar Energy at Tipping Point

On the 50th anniversary of the development of the first practical solar cell, at Bell Labs in 1956, Lawrence Kazmerski, director of the National Center for Photovoltaics at the National Renewable Energy Laboratory at Golden, Colorado, came to Penn State to deliver the 2006 Taylor Lecture. With humor and a tremendous breadth of knowledge on the past, present, and future of solar cell technology, Dr. Kazmerski enlightened and entertained an enthusiastic audience in the HUB-Robeson Center with a multimedia presentation that included footage of old newsreels, an original solar transistor radio from the 1950s, and a current European television commercial that portrays solar energy raining from the sky in the form of batteries.

Kazmerski expressed the belief that the use of solar energy worldwide is at a "tipping point" for explosive development. In Germany, for instance, solar panels have been installed on 700,000 roofs and a "feed-in" tariff has been established by the German government that guarantees a high rate of return to consumers for generating electricity and returning it to the energy grid. He warned, however, that the U.S. may be losing out as other countries forge ahead with government support. "The United States is losing photovoltaic market share," Kazmerski told the audience. "We need to maintain consistent federal research funding or scientists will leave this field."

He also expressed concern with the slow process of commercializing solar technology in this country. He passed around a 1950s-era solar-powered transistor radio for the audience to inspect. "This solar-powered radio was in production within a year of the development of the first solar cell," Kazmerski said. "We don't do that anymore. We have to cut the time to market, which is currently eight years. We need to get going."

Questioning the lack of urgency Kazmerski joked, "Maybe it's all in the name. Bell called them solar batteries. That sounds better than photovoltaics."

A second generation of solar technology, with either much greater conversion efficiency or lower materials cost, is ready to come to the market, he said. This technology, which includes thin films, organics, concentrators, thin silicon wafers, will have a disruptive effect on the energy field. This is a critical time for research and development in materials science and chemistry. "If we don't invest in 3rd and 4th generation solar cell research, in 25 years we won't own them."

Penn State faculty call for aggressive energy research

In presentations given prior to Kazmerski's talk, Penn State professors Harold Schobert, Thomas Mallouk, and Digby Macdonald presented both overviews of the current energy crisis and details of their energy-related research. Schobert, who recently stepped down as director of the Penn State Energy Institute, offered a history of various energy crises that began with the Hittites 3500-4000 years ago. The Hittites, the first civilization to smelt iron, cut down all of the trees in their region to make charcoal for their iron furnaces. This led to the first energy crisis and the collapse of the Hittite civilization.

Today we are in the midst of an energy crisis of our own, Schobert told the audience. There is good reason to believe that petroleum availability will be a growing problem, as a result of civil unrest, growing demand, and Hubert's peak, which predicts a peak in production followed by a rapid depletion of finite resources. The best way to find "new" energy is to conserve what we've got and use energy more efficiently, according to Schobert. Carnot's equation suggests that the best way to raise efficiency in a closed system such as an engine or furnace is to raise the temperature. This requires new materials, "superalloys for ultrasupercritical systems."

Tom Mallouk, Dupont Professor of Materials Chemistry and Physics, agreed that energy security is a national concern but believes that the environmental problem from the accumulation of greenhouse gases may be more serious. With the growth in energy use, which is expected to double by 2050, we could be facing environmental disaster in 10 to 50 years, he said. "For students thinking about what to do with your life, this is the most important problem," Mallouk asserted.

In his solar cell research, Mallouk is using an approach that involves photonic crystals that can slow light so that it stays in the dielectric material of the solar cell longer and enhances the absorption of the red wavelengths. So far, this method has shown a 25 percent increase in the current 10 percent efficiency of traditional dye-sensitized solar cells. By contrast, silicon solar cells are already 25 percent efficient, he said, but cost too much in materials. With Penn State colleague Joan Redwing, Mallouk is trying to lower the materials cost by using silicon nanowires.

Digby Macdonald, professor of materials science and engineering, directs the Center for Electrochemical Science and Technology at Penn State. MacDonald is interested in the degradation of electrodes in fuel cells. Fuels cells are a promising technology that could produce clean energy by combining hydrogen and oxygen to produce electricity. The oxygen electrode reaction, Macdonald suggested, is one of the Achilles heals of fuel cell technology.

Within the cell, energy is produced by an electrochemical reaction that also produces hydrogen peroxide, which degrades the electrodes and reduces the fuel cell performance. The actual catalysis process is still not well understood, he said. New methods for investigating the effect of the thin oxide films (50 to 10 angstroms) that form on the platinum electrodes need to be developed. "It's hard to measure that thin a film," Macdonald said. His group developed a formula to measure oxide film thickness by the current voltage. "Our conclusion – the thickness of the film is the most important factor in electrode efficiency in a fuel cell. Now we can try to engineer a better electrode."

Written by: Walt Mills

Transition of the Industrial and Professional Advisory Council (IPAC) to the newly formed Materials Science External Advisory Support Board

Since the last newsletter the newly formed board adopted standard operating procedures, grown to 15 members, and voted in our first President, David Greenspan, Vice President and CTO of NovaMin Technology, Inc. In addition to current board members, Craig Berkey '83, David Johnson '64, '68, Theresa Kotanchek '84, '87, '91, Leslie Kramer '68, '71, Robert Kumpf '84, '86, '88, James Loftus '84, '86, '88, Sam Mouck '82, and Robert Statz, we have added four new members. Our newest Board members are Charles Carson, III '66, '70, Sandra Greensburg Kosinski '78, Robert Petcavich '80, and James Uchno '71, '73.

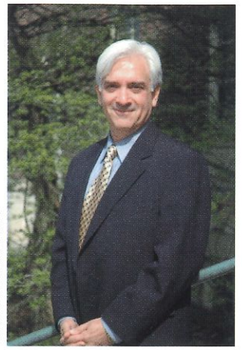
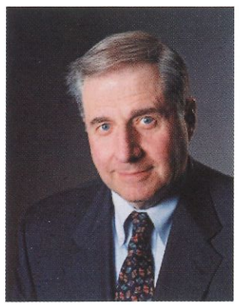


Photo: Mike Fleck, Materials Science and Engineering

Dr. David Greenspan
Vice President, CTO
NovaMin Technology, Inc.
Alachua, Florida

At the upcoming meeting in October, the board will focus on three new areas to assist the department. In addition, this board will continue to play a key role in the ABET accreditation process. The three new areas of focus are to assist with development opportunities to strengthen the financial position of the department, assist with recruitment efforts of both undergraduate and graduate students, and strategize in showcasing the department through marketing and planning activities. In the coming months we will have formalized some of these activities. You can find current information about the board at our website, www.matse.psu.edu. If you would be interested in becoming involved, please email David Greenspan, greenspan@novamin.com, or Kathy Spicer, kkm1@psu.edu. We are excited about the opportunity for our alumni and friends to assist in the advancement of the department.

John Coppola Recipient of the 2006 McFarland Award



The Penn State Chapter of ASM International is pleased to announce that **Dr. John Coppola** received the 2006 David Ford McFarland Award for Achievement in Materials Science at the 58th annual banquet on Saturday, April 22. Dr. Coppola presented the McFarland lecture titled "A Material Scientist's View of Industrial Technology Management: Key Learnings from 35 years of Change."

Dr. Coppola earned his B.S. in Ceramic Engineering at Alfred University and received M.S. and Ph.D. degrees in Ceramic Science at Penn State. Dr. Coppola is senior vice president of science and technology for Johns Manville, headquartered in Denver, Colorado. He is the chief technology officer for JM with oversight responsibility for research and development, new product and process development. Additionally, JM's worldwide information technology organization reports to Coppola. At Johns-Manville he successfully brought back the asbestos-litigation ravaged company to a technology leader in building products. Prior to joining Johns Manville, he worked for The Carborundum Company for 24 years. At Carborundum, Dr. Coppola and coworkers patented silicon carbide ceramics technology that has been commercialized worldwide. This technology is now one of the most important developments in the history of the Carborundum Co. (now part of St. Gobain, the French conglomerate).

The McFarland Award is named in honor of David Ford McFarland, who was head of the Department of Metallurgy at Penn State from 1920 to 1945.

Kotanchek Receives 2006 GEMS Alumni Achievement Award

Dr. Theresa (Guiton) Kotanchek (Ph.D. '91, Materials Science M.S., B.S., Ceramic Science) has been selected to receive the 2006 GEMS Alumni Achievement Award. This is the highest recognition given by GEMS, the Alumni Society of Penn State's College of Earth and Minerals Sciences.

Theresa is currently the Asia Pacific R&D Technology Director for Dow Chemical Company, a >$40 billion multinational company. In this role she is one of the top five technical leaders reporting to the CTO/CEO of Dow Chemical. She has moved to Shanghai, China to provide leadership for the entire Asia Pacific Technology sector. This includes establishing Corporate Centers of Excellence in China and India, where she will set technology strategy and priorities while establishing external alliances and partnerships. Theresa is also a member of the Corporate R&D Leadership Council, Basic & Performance Business Management Teams and the China Country Management Team.

Before this promotion, Theresa was the Global Research and Development Director for Ventures. In this role, she provided global technical leadership for Dowpharma and AEM businesses. In addition, Theresa was accountable for the identification, evaluation and implementation of strategic technologies and capabilities enabling rapid commercialization of new business growth platforms.

Prior to being named Global Research and Development Director for Ventures, Theresa served as Senior Director of Technology for Dow's Growth Center and also held positions at Dow Chemical as Director of INSITE* Technology and Growth for the Polyolefins and Elastomers (PO&E) business group. There she led the global PO&E R&D organization responsible for new technology, including the Chemistry & Advanced Process Research and Materials Science laboratories, and new application development, including Dow Fiber Solutions, Hygiene & Medical and New Business Growth.

Theresa has been actively engaged with the Department of Materials Science and Engineering for many years and is a member of our External Advisory Support Board.

If you are interested in making a gift, please contact:

Kathy Spicer
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Shrout Receives MatSE Alumni Award

Thomas R. Shrout, Senior Scientist and Professor of Materials Science and Engineering at Penn State, is the inaugural recipient of the Distinguished Alumni Award in MatSE.

Tom received his B.S. in Ceramic Science at Penn State in 1976, and his Ph.D. in Ceramic Science under the advisement of Professor L. Eric Cross. Tom has made numerous innovations in the area of processing and material design of piezoelectric materials. He has over 16 patents and over 225 publications and is one of the most highly cited researchers in materials. Tom has interacted on a global scale; traveling and collaborating with researchers and companies all over the world.

One of Tom's first major contributions was the Columbite precursor route that enables PMN and other electrostrictive ceramics to be processed without pyrochlore second phases. His work on single crystal PMN and PZN crystals changed the landscape of ultrasonic transducers. These crystals have been recently introduced by Philips Medical in the new generation ultrasonic imaging system. The new system, which is based on single crystal relaxor ferroelectrics, has revolutionized the imaging field. TRS Technologies is a major supplier of these crystals.

Tom founded TRS Technologies, Inc. (formerly TRS Ceramics, Inc.) in 1991. TRS Technologies is currently scaling-up and commercializing a number of piezoelectric ceramic materials. In 2003, TRS expanded its range of products to include scintillating crystals for medical applications and supplies, piezoelectric powders, crystals, and ceramic components to military, medical, and industrial markets. TRS Technologies has hired many Penn State students and has subcontracted millions for research to Penn State faculty. For his internationally recognized contributions, we honored Dr. Thomas Shrout with the MatSE Distinguished Alumni Award at the department's annual Awards Banquet in April.

The Distinguished Alumni Award recognizes graduates or friends who have most positively represented, influenced or contributed to the Department of Materials Science and Engineering. Please consider nominating a fellow classmate for this award by e-mailing Gary Messing at messing@matse.psu.edu.

Wei Zhang, 2006 Henri Granjon Prize

Dr. Wei Zhang is the recipient of the 2006 Henri Granjon Prize, sponsored by the International Institute of Welding (IIW), Villepinte, France. The Granjon Prize is awarded based on an annual international competition among single authored papers based on recent work carried out in an university for master's or doctor's degree project or part of an industrial project at an equivalent technical level. Wei presented his research findings and accepted the Granjon Prize during the opening ceremonies of the IIW Annual assembly in Québec, Canada on August 27, 2006.

After graduating from Penn State, Wei joined the Edison Welding Institute (EWI) Inc., where he is currently an Applications Engineer. His research interests include the computational modeling of transport phenomena, metallurgy, and stress and distortion. He received a Graduate Fellowship from the American Welding Society (AWS) in support of his doctoral research at Penn State. He was a co-author of papers winning the 2003 Kenneth Easterling Best Paper Award from IIW and the 2005 William Spraragen Memorial Award for best technical paper published in the Welding Journal. Wei's Ph.D. thesis "Probing heat transfer, fluid flow and microstructural evolution during fusion welding of alloys," was supervised by Professor Tarasankar DebRoy.

Palmer Receives 2006 Professor Koichi Masubuchi Award

Todd A. Palmer, Ph.D. '99 Materials Science and Engineering, B.S. and M.S. Metals Science and Engineering. Todd received his Ph.D. under the advisement of Professor Tarasankar DebRoy.

Todd is the recipient of the 2006 Professor Koichi Masubuchi Award. This award is sponsored by the Center for Ocean Engineering at the Department of Mechanical Engineering, Massachusetts Institute of Technology. The award was established to recognize Professor Koichi Masubuchi, who has made significant contributions in advancing the science and technology of welding, especially welding fabrication of marine and space structures. This award is presented to an individual who has made significant contributions to the advancement of science and technology of materials joining through research and development. The candidate must be 40 years old or younger, and may live anywhere in the world. Todd will receive his award at the 2006 FABTECH International & the AWS Welding Show, October 31-November 2, in Atlanta, Georgia.

Todd has been at Lawrence Livermore National Laboratory, Livermore, CA, since 2000, where he started as a post-doctoral technical associate. He is currently a metallurgist with the Materials Science and Technology Division in the Chemistry and Materials Science Directorate.

He is vice-chair of the C7B sub-committee on Electron Beam Welding and Cutting and is also a member of the Peer Review Panel for Welding Journal Research Supplement, the Editorial Board of the journal, Science and Technology of Welding and Joining, and a Key Reader for Metallurgical and Materials Transactions. Todd received the Geoffrey Belton Award of The Iron and Steel Society in 2000 and the ASM International Graduate Student Paper Competition in 1999. From June 1995 to June 1998, he also held an American Welding Society Graduate Research Fellowship. Todd is the author or co-author of over 25 articles and reports. His current research interests involve the characterization of phase transformations in structural materials using synchrotron based in situ x-ray diffraction techniques, high energy density (electron beam and laser) welding and joining processes, and electron beam welding diagnostics.

Photo: Mike Fleck, Materials Science and Engineering

Penn State and ASM Partner to Introduce High School Students to the Amazing World of Nanomaterials

The Department of Materials Science and Engineering, in conjunction with the ASM Foundation and The Penn State Center for Nanoscale Science, hosted a residential summer camp for rising high school juniors and seniors, July 10-14. Twenty-one students from all over the country traveled to Penn State to delve into Nanoscience and Nanotechnology: Studying How the Smallest Building Blocks of Materials Will Have a Large Impact on the Future.

During the week long camp, students explored the use of nanoparticles for drug delivery, the creation of metallic nanometer thin films by Physical Vapor Deposition, synthesis of nanowires for electrical, magnetic and optical devices, and the change in polymer properties with the addition of nanometer sized clay particles. In addition, students toured state of the art facilities on the University Park campus and learned about the multitude of ways materials scientists and engineers impact our daily lives.

New Course in Materials Engineering Methodology and Design Pairs Undergraduates with Industry

Have you ever wondered how your company could involve our talented undergraduates in helping you solve a materials-related problem? Well, we've recently implemented a new course in which your company can engage in such a process.

The course, MatSE 492W: Materials Engineering Methodology and Design, was included in our undergraduate curriculum this past spring semester. Required of all juniors in MatSE, the intent of the course is to develop problem solving skills in a team setting, with guidance from faculty and industrial mentors, on industrially-inspired topics related to the design of, and with, materials.

The topics are solicited annually from our alumni and colleagues in industry. Students, working in teams of four, meet weekly with their faculty mentors to identify the relevant issues, build a plan for addressing the problem, and offering a detailed analysis and recommendations for solving the problem. The students and mentor travel to the industrial site at the start of the spring semester to confer with their industrial mentors on the characteristics of the problem. At mid-semester, the students present their preliminary findings and recommendations to their mentors, and collaboratively refine their approach in the context of those findings. The balance of the semester involves fine-tuning their recommendations, which they formally present in written-, oral-, and poster-form to their industrial mentor the last week of class.

In addition, students receive formal instruction on technical writing and presentation skills, intellectual property considerations in materials development and engineering, interacting in a team environment, and developing a solution to an engineering problem in the context of the economic, environmental, sustainability, manufacturability, ethical, health and safety, social and political forces acting on the design process.

This past year, our students worked with mentors at companies such as PPG, Concurrent Technologies, USX, CED Minerals, Army Research Lab, Electro-Optics Center, Tyco Electronics, among others. A broad array of topics were addressed, such as new materials for coronary stents and hip implants, ceramic joining, CVD processing of thin films, self assembly of monolayers, synthesis of resins from renewable resources, corrosion of metal subassemblies for armored vehicles, and alternative materials for investment casting of precious metals.

This is a great way to engage undergraduates in projects of interest to you and your company, as well as to develop contacts with faculty possessing similar interests and expertise, all while helping Penn State to develop the next cadre of materials engineers. If you're interested in participating, contact either John Hellmann (jrh3@matse.psu.edu) or Earle Ryba (rx7@psu.edu) this fall semester, and we'll include your project for the students to consider this spring semester.

Pennsylvania Ceramics Association Establishes Endowment for MatSE Scholarships

After 61 years, the Pennsylvania Ceramics Association's Board of Directors made the decision to disband the organization. Since 1945, the Pennsylvania Ceramics Association (PCA) provided an avenue for industries within Pennsylvania to interact with the Materials Science and Engineering Department, formerly with the Ceramics Department, at Penn State. Over the last six decades the PCA met and accomplished its objectives; among them, recruiting, educating, and training the next generation of ceramists. The PCA accomplished this in part by donating student scholarships. Since inception, the PCA has donated an annual scholarship to a deserving undergraduate student member of the Ceramics/Materials Science and Engineering Department. The PCA would like to leave the University and the MatSE Department with a lasting memory of the organization by donating their remaining funds to the University and establishing an endowment. This way, the PCA Scholarship will continue to be awarded each year to an undergraduate student enrolled in Materials Science and Engineering Department.

If you are interested in contributing to the scholarship fund please make your check payable to The Pennsylvania Ceramics Association and send to: Dr. David Green, Department of Materials Science and Engineering, 121 Steidle Building, University Park, PA 16802-5005.

www.matse.psu.edu

Annual MatSE Awards Convocation

The MatSE Department celebrated the achievements of its students, staff, faculty and alumni at the annual Awards convocation on April 26, 2006, at the Atherton Hotel.

More than 180 students, staff, faculty and alumni gathered for a reception and dinner followed by an awards program. After a warm welcome and remarks by Gary Messing, department head, the program was then handed over to the student emcees. Undergraduate student, Erica Redline, presented the undergraduate awards, while graduate student Matt Heidecker presented the graduate awards.

Undergraduate awards were presented in the categories of academic excellence, service and leadership, and for the Undergraduate Poster Competition for Excellence in Undergraduate Research. Graduate student awards were presented for outstanding service and leadership to the Department, academic excellence and for the Graduate poster competition. Presentation of the MatSE Staff Excellence Award and MatSE's very first Outstanding Faculty Award and Outstanding Alumni Award concluded the program.

MatSE Academic Excellence Award
Brad Jones

MatSE Service and Leadership Award
Alexana Cranmer

3rd Place: Kevin Masser

"Nanoscale Patterning of Polymer Surface for Next-Generation Nanolithography"

Advised by: Ronald Hedden

Undergraduate Team Winner: Team T.A.R.M.

"Ceramic Tubes for Gun Barrel Applications"

Trevor Buehl, Matthew Fimiano, Alejandro Levander, and Raj Pathak

Intercollege Materials Science and Engineering Graduate Program Service and Leadership Award

Matthew Heidecker (left) and John Creek (right)

Intercollege Materials Science and Engineering Graduate Academic Excellence Award

Qihua Xiong; advisor, Peter Eklund

MatSE Awards for Excellence in Undergraduate Research

1st Place: Erica Redline

"Formation & Crystallization of Polycarbonate/Poly(ethylene terephthalate) Blends and Nanocomposites"

Advised by: Vagelis Manias

2nd Place: Dennis Shay

"Interface Engineering of Ni on Multilayer Ceramic Capacitors"

Advised by: Elizabeth Dickey & Clive Randall

Graduate Research Poster

1st Place Individual: Walter Luscher

"Dopant Enhanced Densification of Aluminosilicate Proppants for Oil and Natural Gas Extraction"

Advised by: John Hellmann

2nd Place Individual: Robert Klein

"Secondary Lithium-ion Batteries: Insights into the Local Ion Conduction Mechanism"

Advised by: James Runt

Cancer Research in MatSE

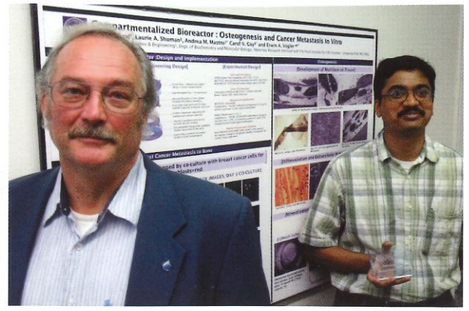


Photo: Mike Fleck, Materials Science and Engineering

Dr. Erwin Vogler (left), and MatSE graduate student, Ravi Dhurjati (right).

Cancer research may seem quite distant from classical materials science to many reading this newsletter, but not to Erwin Vogler, Associate Professor of Materials Science and Engineering (MatSE) and Bioengineering, or Ravi Dhurjati, MatSE graduate student working in Vogler's Biomaterials Surface Science Laboratory. Vogler explains, "Basic biological research is carried out using a dizzying array of biomedical devices. Materials is an enabling technology, without which these devices would be unavailable in the large numbers currently in use. Biomedical research would grind to a slow pace or halt without materials."

Consider as an example the ubiquitous culture flask in which biological cells are grown surrounded by a culture medium. Historically, flasks and bottles were fabricated from soda-lime glass, requiring labor-intensive hand washing, wrapping, and sterilization before use. Glassware has been supplanted by disposable plastic containers that come to the lab pre-packaged and sterile in mass quantity. But just substituting plastic for glass is not all to this story. Before this technology could be enjoyed by biomedical researcher, ways and means to treat the dish surface that stimulated cells to attach and grow had to be invented by biomaterials scientists. Materials science to the rescue.

Biologists, cancer researchers among them, have used plasticware in 'classical tissue culture protocols' for decades with considerable success. However, difficulties in maintaining cell cultures for periods longer than about 1 month has become a serious limitation for many investigations. And lab-grown cells do not generally form a three-dimensional (3D) tissue like that encountered in living organisms. As a consequence, lab-grown cells are really not a satisfactory surrogate for animals. But using animals has its own set of problems: complexity of a whole organism, cost and availability, and ethical issues among these.

Ravi Dhurjati (M.S. Ceramic Science and Engineering, Penn State University) set out to solve some of these problems with classical tissue culture by developing a new way to grow cells in the lab. Capitalizing on a "simultaneous cell-growth-and-dialysis" concept published by Vogler years earlier, Ravi configured a novel "bioreactor" constructed from gas permeable films that eliminated many of the problems of conventional culture. He showed that he could grow bone cells, one of the more difficult types of cells to culture in the lab, for indefinite periods longer than 10 months. The resulting 3D tissue was characteristic of authentic bone, including formation of visually-apparent mineral that proves to be nearly identical to bovine bone.

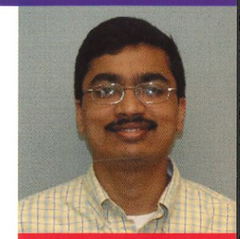
Working with Professors Andrea Mastro and Carol Gay (Dept. of Biochemistry and Molecular Biology), Dhurjati and Laurie Shuman (graduate student in Mastro's lab) found that bioreactor-grown bone tissue could be "challenged" with metastatic breast cancer cells known to invade skeleton. This unique interdisciplinary collaboration (supported by MatSE, Materials Research Institute, and Huck Institutes of Life Sciences), has shown, for the first time, that important hallmarks of cancer-cell metastasis and tumorgenicity can be observed in a lab device rather than a whole animal. Using state-of-the-art confocal microscopy, optical sections clearly show cancer cell (green) penetration of bone tissue (red) [see cover]. Now that important steps of cancer metastasis can be identified and precisely characterized in a lab device, it should be easier to find ways to interrupt the process and, hopefully, find new therapeutics for one of the more pernicious forms of cancer.

"Biomedical research would grind to a slow pace or halt without materials."

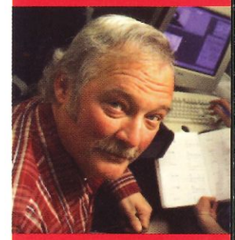
Erwin Vogler, Associate Professor of Materials Science and Engineering and Bioengineering

This work has attracted considerable attention at recent scientific meetings. Laurie Shuman's poster session was overwhelmed at the American Association of Cancer Research held in Washington DC this spring. Ravi was awarded the Outstanding Poster Award at the American Vacuum Society Symposium held in Chicago IL. Better yet, extramural research funding has been obtained from the Department of Defense and the Susan G. Komen Breast Cancer Foundation that supports continued work.

Materials Science and Engineering in cancer research? Of course, and much more of that to come.



Ravi Dhurjati is a MatSE graduate student working in Dr. Erwin Vogler's Biomaterials Surface Science Laboratory



Erwin Vogler, Associate Professor of Materials Science and Engineering and Bioengineering

Cells in conventional culture are grown in sterile disposable plastic flasks and dishes.

Photo: Mike Fleck, Materials Science and Engineering

Samrat Choudhury, graduate student in materials science and engineering

Congratulations Graduates! Spring and Summer 2006

B.S.
Stefanie Anderson
Stephen Benko
William Castle
Kurt Chiang
Michael Creamer
Kaleb Fitch
Brian Gabriel
Brett Goldhammer
Brad Jones
Sandy Larios
Kevin Masser
Gaurav Mehta
Erica Redline
Tuan Tran
Jayson VanShura

M.S.
Andres A. Bujanda
Man Gu
Taehee Jeong
Daniel R. Metrey
Sung Woo Wee
Mei Yang

Ph.D.
Shashnk Agrawal
Steve R. Badger
Michael D. Biegalski
Seokyong Chae
Hongqi Deng
Lisa F. Edge
Elise B. Fox
Xiuli He
Abhishek Jain
Hyeoungwoo Kim
Do-Kyun Kwon
Amit Kumar
Ziqi Liang
Fuqiang Liu
Brian M. Marx
Saurabh Mishra
Adan Sun
Tao Wang
Qihua Xiong

Samrat Choudhury Receives One of the First Acta Student Awards

Samrat Choudhury, a graduate student in materials science and engineering, has been selected to receive an annual Acta Student Award for his primary contribution to the manuscript, "Phase-field Simulation of Polarization Switching and Domain Evolution in Ferroelectric Polycrystals," Acta Materialia 53, 2005; 5313-5321.

The Acta Student Awards is a new annual program that awards five $2,000 prizes, two of each for Acta Materialia and Scripta Materialia and one for Acta Biomaterialia. Samrat, who was among a very impressive field of nominees, was selected to receive his award based upon the exceptional value his paper demonstrates to the materials community and his exemplary personal credentials and recommendations.

Samrat is pursuing his Ph.D. under the advisement Professor Long-Qing Chen. As a part of his dissertation, Samrat has developed a three-dimensional phase-field model to predict the formation of domain structures during polarization switching in ferroelectric bulk and thin films. His results show that using phase-field approach it is now possible to predict quite accurately, the ferroelectric properties like coercive field and remnant polarization, as well as temporal evolution of domain structures during polarization switching in ferroelectric bulk and thin films.

Samrat received his award at the ASM Materials Science and Technology (MS&T) Conference, in Cincinnati, Ohio, October 15-19, 2006. In addition to accepting his award, Samrat gave a presentation titled, "Phase-Field Simulations of Ferroelectric Domain Structures and Domain Switching in Ceramics and Thin Films."

The NCIIA Recognizes Penn State's Biomedical Engineering Innovations Team

The National Collegiate Inventors & Innovators Alliance (NCIIA) presented a 2nd place award to the Penn State UltraMed Ultrasound Breast Cancer Detection team, led by Ioanna Mina, PhD student in the Intercollege Graduate Degree Program in Materials Science and Engineering. The NCIIA presented awards to four collegiate biomedical engineering teams, recognizing their outstanding work in the field. The top winners in the Biomedical Engineering Innovation, Design and Entrepreneurship Award (BMEidea) Competition—a national competition celebrating student biomedical innovation—were announced during the Medical Design Excellence Awards ceremony at the Medical Design & Manufacturing (MD&M) East trade show at the Jacob Javits Center in New York on June 7. Ioanna accepted the honor and cash award of $2,500 on behalf of the team.

Ioanna Mina was an instrumental part of the UltraMed Ultrasound Breast Cancer Detection team's development and submission of their business plan into the competition. The team comprised of Penn State scientists and business scholars merged technology and business to create a business plan to market their innovative ultrasound technology. This team is developing alternatives to available breast cancer detection methods by improving current ultrasound technology. Ultramed's detection system will offer advantages over mammography which may fail to detect cancer in women with high breast density. Team members include: Ioanna Mina; Susan Trolier-McKinstry, Professor of Materials Science and Engineering and the co-inventor of the proposed Ultrasound technology; Dr. Richard L. Tutwiler, Research Associate at the Applied Research Laboratory; Thomas Jackson, Professor of Electrical Engineering; Sungkyu Park and Hyunsoo Kim, Ph.D. students in Electrical Engineering; Kyusun Choi, Assistant Professor of Computer Science and Engineering; Insoo Kim, Ph.D. Student in Computer Science and Engineering; Dr. Anthony C. Warren, Director of the Farrell Center for Corporate Innovation and Entrepreneurial Research at The Smeal College of Business; and Supreet S. Saini, MBA candidate in the Smeal College. Ioanna is pursuing a Ph.D. under the advisement of Dr. Susan Trolier-McKinstry and is conducting this project as her final dissertation. The BMEidea Competition, now in its second year, is open to collegiate teams from NCIIA member institutions across the United States.

MatSE Students Return from Abroad

Senior MatSE undergraduates **Erin Haworth** and **Andrea Fortunato**, were the first students to participate in the International Internship in Materials, a materials study abroad program in the Department of Materials Science and Engineering. Erin recently returned to State College after spending the spring 2006 semester at the National School of Industrial Ceramics (ENSCI) in Limoges, France. Erin is pursuing a double major in Materials Science and Engineering and French, which made Limoges the perfect place to study abroad. Erin says, "Doing a research project for five months in Limoges is one of the hardest things I've ever done, but this was a once in a lifetime experience and I'm glad I went." Erin gained lab experience through her class work and by working in Dr. Adair's lab. Besides working on her research project "Preparation of Hydroxyapatite and Polymer Beads for Use in Heterocoagulation," Erin found time to travel within France and Europe.

Andrea spent the summer 2006 semester at the University of Padova in Italy. Andrea felt the University was a perfect match not only because of her Italian heritage and her interest in the culture, but the academic opportunities which turned out to be invaluable. Andrea became involved in research as a freshman through the Women in Science and Engineering program. She is currently working on making bioceramic foams for applications in bone defects. Andrea sums up her experience by saying, "The IIM was incredibly challenging both personally and academically, but because of this it was certainly the most rewarding experience that I have ever had. In my opinion, one of the most important things about the program is that element of personal growth -- traveling alone and learning to adjust socially and culturally, while still being able to focus on your research. I could not have had the same experience working at any lab in America; there is just nothing like it."

3rd Place Individual: Harshad Patil

"Effect of Chemical Microstructure on Phase Behavior of Main Chain Liquid Crystalline Poly (Carbosiloxanes)"

Advised by: Ronald Hedden

1st Place Group: Dr. Qing Wang's group

"Polymer Electronics"

2nd Place Group: Dr. John Hellman's group

"Thermomechanical Properties and Performance of Materials at the Nano-, Micro-, and Macroscale"

3rd Place Group: Dr. Darrell Schlom's group

"Molecular-Beam Epitaxy of Oxide Thin Films"

Department Awards

Staff Excellence Award: Michael Fleck

"In recognition of enthusiastic and skilled use of creative means to enhance e-learning courseware and the professional presentation of the Department"

Outstanding Faculty Award: Professor Joan Redwing

"For creating a learning environment that demonstrates how to balance extraordinary mentorship, high quality instruction, citizenship and family life"

Outstanding Alumni Award: Professor Thomas Shrout

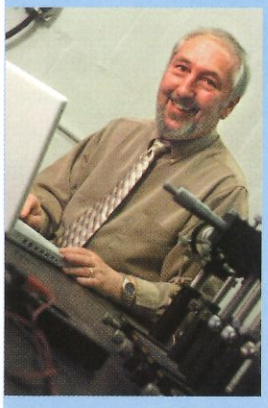
"In recognition of outstanding research and professional contributions in the field of piezoelectric and dielectric materials"

MatSE Faculty and Students Honored at EMS Wilson Awards Banquet

MatSE was well represented at the College of Earth and Mineral Sciences annual Wilson Awards Banquet on Sunday, April 30 2006. MatSE faculty members were honored for excellence, service, and mentoring. MatSE undergraduate students were also honored for their achievements.

Eric Barron (left) and Susan Trolier-McKinstry (right).

Susan Trolier-Mckinstry, Professor of Ceramic Science and Engineering, received the Wilson Award for Excellence in Research, the college's highest honor for sustained research achievement. Trolier-McKinstry is recognized world-wide as one of the foremost leaders in the field of electronic ceramics. She is recognized as a world leader in the field of ferroelectrics and piezoelectric materials through her profound knowledge in piezoelectric characterization and piezoelectric properties of bulk and thin films, and in processing of piezoelectric ceramics. Through her pioneering contributions in piezoelectric and dielectric thin films, Trolier-McKinstry has excelled and brought great prominence to the College of Earth and Mineral Sciences. Her contributions have placed Penn State at the cusp of the next technical shift of materials integration for electronic applications. Her cutting edge development of technical understanding and definitive demonstration of the role that domain mobility, stress effects and dopants have on piezoelectric thin film response has made her one of the top two invited speakers in the world concerning the subject matter of piezoelectric thin films. Despite Troiler-McKinstry's highly impressive published output, indicative of an energy-sapping research workload, she still finds time and energy to give back to the research community through her leadership roles within the Ultrasonics Ferroelectrics and Frequency Control Society of the IEEE. She has been recognized with an NSF Presidential Young Investigator Award, the Coble Award for Young Scholars of ACerS and was named Fellow of the American Ceramic Society in recognition of her scientific contributions to the field of electroceramics. Currently she is president elect of the Ultrasonics, Ferroelectrics and Frequency Control Division of IEEE, the largest transducer society in the world.



David Green, Professor of Materials Science and Engineering, received a Faculty Mentoring Award in Earth and Mineral Sciences. Green was recognized for his mentoring efforts as an advisor to incoming freshman, honors students, and MatSE International Internship students. Green guides these students through their class selections and helps them determine which options fit their interest. He gives freely of his time and spends countless hours ensuring that MatSE students achieve their educational and professional goals.

continued on page 8 >>

MatSE Faculty and Students Honored at EMS Wilson Awards Banquet (continued)

Eric Barron (left) and Richard E. Tressler (right).

Richard E. Tressler, professor emeritus of materials science and engineering, received the Charles L. Hosler Alumni Scholar Medal. Dick is a widely respected emissary for materials science and engineering both nationally and internationally while being at the forefront of high temperature materials behavior research. Throughout his career, his interdisciplinary approach and vision led to the creation of the Materials Research Institute. Thanks to his legacy, Penn State can boast that the Department of Materials Science and Engineering and the Materials Research Institute are the leading materials education and research institutions in the world. As an educator, Tressler has been extremely successful in instilling his passion to nearly three generations of materials scientists. He is widely recognized as an excellent role model for academic excellence, superior work ethic, polished professionalism and integrity and as a life-long contributor and citizen of the materials community. Tressler joined Penn State as an assistant professor in 1972. He served as chairman of the Ceramic Science and Engineering Program from 1980-86. He was founding director of the Center for Advanced Materials from 1986-92 and head of the Materials Science and Engineering Department from 1991-2001.

Eric Barron (left) and Trevor Buehl (right).

Trevor Buehl, an undergraduate in the electronic and photonic materials option, received the George W. Brindley award in Nonmetallic Crystal Chemistry. The award honors the memory of Dr. George Brindley who was head of the Department of Ceramic technology from 1955 to 1962. This award recognizes materials science students who do outstanding work in crystal chemistry.

Eric Barron (left) and Stefan T. Yohe (right).

Stefan T. Yohe, an undergraduate in materials science and engineering, received the Robert W. Lindsay Award in Metallurgy. This award honors the memory of Dr. Lindsay who served 27 years on the faculty and was head of the Department of Metallurgy from 1960 to 1969. The award recognizes students who do outstanding work in physical metallurgy.

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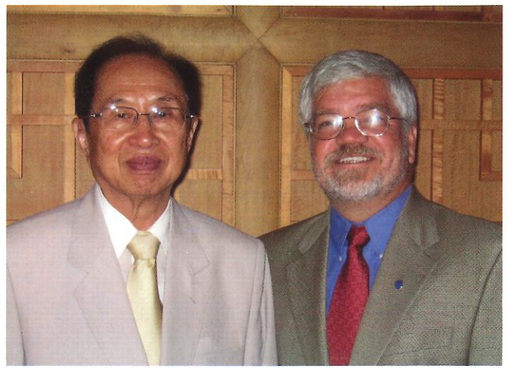
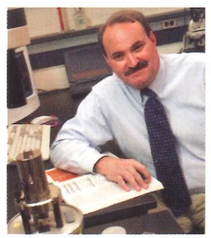
Messing Visits Choe in Korea



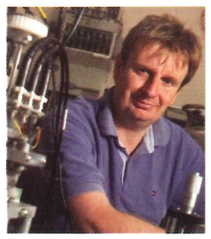
During a recent visit to South Korea, Professor Messing met with Mr. Jyung-Oock Choe of Obong International, Inc. and Professor Doh-Yeon Kim of Seoul National University. Mr. Choe was a graduate student at Penn State working with Professor George Brindley. He received his M.S. in 1960, however, before he was able to finish his Ph.D., he was recalled to Korea. Mr. Choe returned to Penn State in 1992 to accept the Distinguished Alumni Award.

Since 1994, Mr. Choe has supported a unique fellowship for Seoul National University graduates who pursue their graduate studies in the College of Earth and Minerals Sciences at Penn State. With the generous support of the Brindley-Choe Graduate Fellowship in Earth and Mineral Sciences, many students have been able to pursue their graduate studies in MatSE.

Adair and Randall Elected to the World Academy of Ceramics



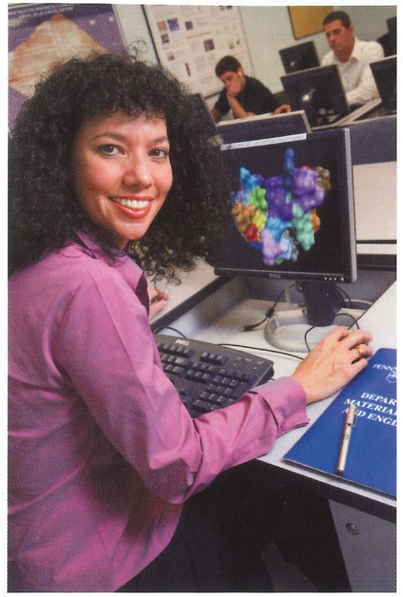
James Adair



Clive Randall

James H. Adair, Professor of Materials Science and Engineering, and **Clive A. Randall**, Professor of Materials Science and Engineering and Director of the Center for Dielectric Studies, were elected to the World Academy of Ceramics. The World Academy of Ceramics is located in Italy, and joins internationally renowned individuals who have made a significant contribution to the advancement of the ceramics field. This brings the number of Penn State faculty to eleven. They join Professors R. E. Newnham, L. E. Cross, R. Roy, D. M. Roy, R. E. Tressler, G. L. Messing, S. Komarneni, D. J. Green, and C. G. Pantano as members of the Academy.

New Faculty Member on Board



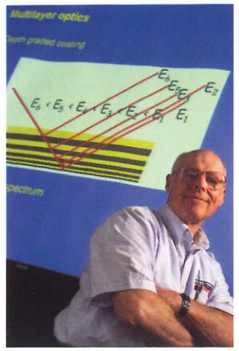
The Department is pleased to announce that **Coray M. Colina**, joined the faculty as an associate professor of Materials Science and Engineering. Coray comes to us from The University of North Carolina at Chapel Hill where she was a Postdoctoral Research Associate. She received her B.S. and M.Sc. from Simón Bolívar University, Venezuela, and her Ph.D. from North Carolina State University, all in chemical engineering.

For Dr. Colina and her research group, the fusion of materials science and computational science gives them the opportunity to engineer materials for applications to separations, sensors, microelectronics, drug delivery, and biomaterials. In the quest towards understanding such phenomena, they use materials theory, modeling and computer simulation, methods ranging from molecular-based equations of state with a rigorous statistical mechanics basis to high-performance computer modeling. Dr. Colina's current research focuses on three major areas: a) understanding the thermodynamics of polymeric materials in order to create new materials with desired properties that meet application requirements; b) developing rational design methods for blocking or altering the growth of macromolecular aggregates when proteins dock in a highly oriented manner; and c) predicting the behavior of materials under conditions of extreme temperature and pressure.

Professor Colina will be teaching polymer and computational courses for undergraduate and graduate students.

Coray resides in State College with her husband, Jhon Castano and their son, Jorge Castano. Coray and her family are apprehensive about winter in Central Pennsylvania. Coray prefers to work in the garden, but who knows; maybe she'll take up skiing!

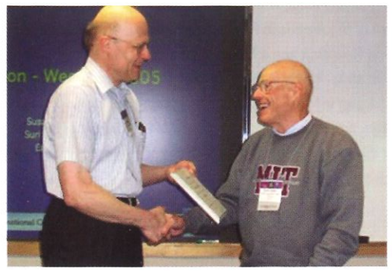
Earle Ryba Named Fellow of the International Centre for Diffraction



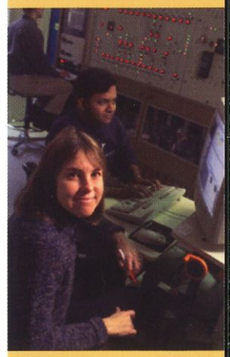
Earle Ryba was recognized and named a Fellow by the Board of Directors of the International Centre for Diffraction Data for his teaching excellence and many contributions to education in the fields of materials and x-ray analysis. Since 1960, Earle has served as a faculty member in the Department of Materials Science and Engineering at Penn State. Earle's teaching responsibilities include instruction in both powder and single crystal x-ray diffraction, crystallography, characterization of materials, microcomputer usage, general aspects of materials, physical metallurgy, electronic and other physical properties of materials, and technical writing. He also teaches courses in geometrical crystallography, advanced x-ray diffraction, the Rietveld method, and small angle scattering.

Earle's dedication to education expands beyond PSU. He was actively involved in teaching at the State University of New York in Albany (SUNYA) X-ray Clinics from 1983 through 1989. Earle then became involved in continuing this tradition of excellence as he was instrumental in bringing the clinics to PSU and ICDD. He participated as an instructor and local coordinator for the ICDD-JCPDS X-ray Clinics in 1990-91, held at PSU. The following year, the clinics moved to ICDD, and were held initially in Swarthmore and then later in Newtown Square. Today, he continues to share his expertise as an instructor at the ICDD X-ray Clinics, and specialized courses. In addition, Earle has represented the ICDD at various short courses around the globe, and also served as an Editor for the Metals and Alloys Subfile of the Powder Diffraction File.

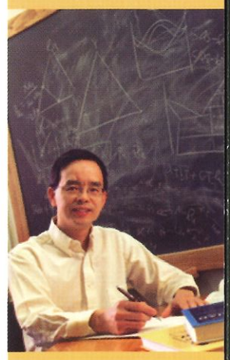
"The designation of Fellow may be given by the ICDD Board of Directors to individuals who have given their time and talents beyond that normally associated with membership." ICDD states that Earle exemplifies the meaning of ICDD Fellow as he has given generously of his time and talents beyond that associated with regular membership.



Jim Kaduk, Chairman, presenting to Earle Ryba

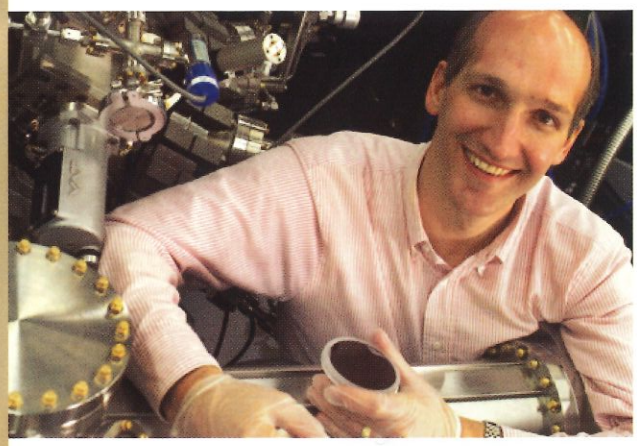


CONGRATULATIONS
to Joan Redwing for her recent award of tenure and promotion to Professor!



CONGRATULATIONS
to Zi-Kui Liu for his recent promotion to Professor!

Darrell Schlom Awarded Faculty Scholar Medal

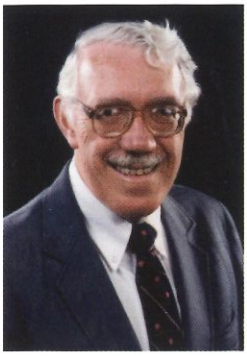


Darrell G. Schlom, professor of materials science and engineering, received the 2006 Faculty Scholar Medal in Engineering. The Faculty Scholar Medal is given in recognition of scholarly excellence demonstrated by a single contribution or series of contributions focusing on a coherent theme. Schlom received his award in recognition of his contributions in the area of strain-engineered thin films. Strain is widely used to improve the properties of semiconductor thin films. Schlom and his collaborators have applied this concept to ferroelectric oxides and have shown tremendous improvements in their properties. His group has used molecular-beam epitaxy to create materials with unprecedented properties and perfection, allowing the structure of a variety of dielectric and ferroelectric oxide thin films to be customized at, literally, the atomic-layer level. The resulting ferroelectric materials, through strain-engineering, can be enhanced to the point that they perform better than conventional lead-containing materials, allowing useful properties to be achieved without the need to use more toxic compositions.

Schlom received his B.S. in engineering and applied science from the California Institute of Technology in 1984 and his M.S. in electrical engineering and Ph.D. in materials science and engineering from Stanford University in 1989 and 1990, respectively. After postdoctoral research at IBM's Zurich Research Laboratory, he joined the faculty at Penn State as assistant professor of materials science and engineering in 1992. He became an associate professor in 1998 and a professor in 2002. In 1999 he was an Alexander von Humboldt Research Fellow at the University of Augsburg, Germany. He is a Fellow of the American Physical Society. He was both an Office of Naval Research and a National Science Foundation Young Investigator in 1993. He received the Penn State Wilson Research Award in 2001 and the Semiconductor Research Corporation Inventor Recognition Award in 2004. Darrell received his award at the Faculty/Staff Awards Recognition luncheon held at the Nittany Lion Inn on March 20, 2006.

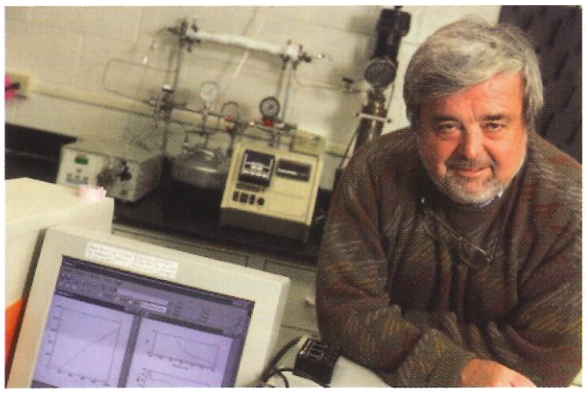
Newnham Receives 2005 UFFC Achievement Award of the IEEE

Professor Robert E. Newnham is the recipient of the 2005 UFFC (Ultrasonics, Ferroelectrics and Frequency Control) Achievement Award of the IEEE. He will receive the award at the 15th International Symposium on The Applications of Ferroelectrics at Sunset Beach, NC on August 1-3, 2006. The Achievement Award is the highest Society-wide award given in recognition of outstanding technical performance and service to the Society.



The citation on Dr. Newnham's award reads: *"For his pioneering work on piezoelectric composite transducers, and for his distinguished service to the teaching of structure-property relations in electroceramics to the national and international engineering communities."*

Macdonald Appointed Fellow of the International Society of Electrochemistry



Distinguished Professor Digby Macdonald has been appointed an ISE Fellow by the Executive Committee of the International Society of Electrochemistry. "ISE Fellow" is a category of membership conferred upon an individual in recognition of their continuing outstanding scientific and/or technical achievement within the field of electrochemistry. This honor is limited to a small fraction of the active membership. Professor Macdonald was inducted at the Edinburgh Annual Meeting.

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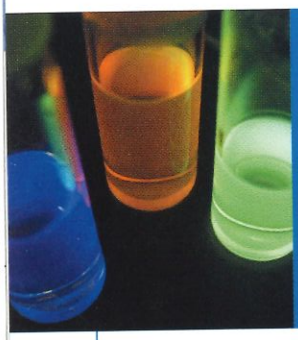

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