IOWA STATE UNIVERSITY
College of Engineering

Elements

FALL 2009 — Volume 18, Number 1

Department of Materials Science and Engineering

MSE Distinguished Professor using low-gravity space station lab to study crystal growth

Real-time space experiments controlled by Earth-bound researcher

Photo courtesy of Engineering Communications

AMES, Iowa—A research project 10 years in the making is now orbiting the Earth, much to the delight of its creator **Rohit Trivedi**, a senior metallurgist at the U.S. Department of Energy's Ames Laboratory and Anson Marston Distinguished Professor of Materials Science and Engineering. Equipment recently delivered to the International Space Station by the Space Shuttle Discovery will allow the Earth-bound Trivedi to conduct crystal growth experiments he first conceived more than a decade ago.

The equipment is actually a mini laboratory, known as DECLIC–DEvice for the study of Critical LIquids and Crystallization—will allow Trivedi to study and even control crystal growth pattern experiments, in real time, from his laboratory in Wilhelm Hall on the Iowa State University campus in Ames. The goal is to use the microgravity environment on board the Space Station to determine how materials form crystals as they move from liquid to solid and what effect variations in growth conditions have on crystallization patterns.

"When materials 'freeze' there are specific crystalline growth patterns that appear," Trivedi said, "and there are fundamental physics that govern these patterns. However, small effects can have significant influence on the patterns that form. Snow flakes, for example, form the same basic six-sided pattern, but because of minute variations, no two are exactly alike. These crystallization patterns play a critical role in governing the properties of a solidified material."

Trivedi hopes the experiments will help explain how certain materials, under certain conditions produce particular crystal growth patterns, such as these nickel-based superconductors.

While Trivedi studies primarily metals, the material to be used in the DECLIC experiments is a transparent, wax-like substance called succinonitrile. With a relatively low melting point, 57 degrees Celsius, the material lends itself to study in the controlled confines of the Space

Trivedi continued on page 2—

Trivedi hopes the experiments will help explain how certain materials, under certain conditions produce particular crystal growth patterns, such as these nickel-based superconductors.

INSIDE ISSUE

Two million dollar research award _____ **page 3**

Energy- and cost-saving research _____ **page 4**

Mentoring and learning _____ **page 5**

MSE research briefs _____ **page 6**

MSE student highlights _____ **page 8**

Awards banquet _____ **page 9**

Hall of Fame/Alumni feature _____ **page 10**

Faculty honors and awards _____ **page 11**

From the Chair

As we approach the end of 2009, we have much to be happy about. The undergraduate program continues to grow (we will be close to or over 200 students this year) and our students continue to be best in class, with our chapter of the Material Advantage student program being named the Most Outstanding Chapter for the sixth year in a row. What a remarkable achievement! Our graduate program is doing well, with good rankings and excellent students. We added a great new person, **Melissa Skinner,** to our staff. Our facilities continue to improve, with new equipment on the way. Our faculty continues to be recognized for its excellence, with new fellowships of societies and awards. All-in-all, an excellent year.

Unfortunately, we, like the rest of the country, are in the midst of trying times. The economic turndown has hit Iowa finances hard, with decreased state revenues and a concomitant decrease in state allocations to the University. What level the final cuts to the department will be is not yet known, but we likely will be in for a few years of very tight times.

In light of the budget reductions, our main focus must be to protect the quality of the education we provide our undergraduate and graduate students. Some changes are inevitable, but we will work diligently to keep the high quality of the program and to minimize reductions in the broad curriculum and educational experiences we now offer.

The downturn in the economy affects students' pocketbooks as well. We may, for example, see increases in tuition, adding to the burden for their families. We have to hope that scholarship donations do not also take a hit. We do not know yet how the economic conditions will affect our students' job prospects.

I am often asked by our alumni and friends how they can help. The simple answer is, of course, to donate money. We can always use extra funds to help the educational programs or to fund scholarships. One important way could be to help our students network to find potential new employers, either for internships/co-ops or a job. If you have ideas of how you could help, please contact me.

Despite the current troubles, there is much to be positive about when considering the future of the department. We have a highly-accomplished faculty, a dedicated staff, and wonderful students. The economic turndown is just a temporary blip in the road.

Richard LeSar

Richard LeSar, Department Chair
lesar@iastate.edu

Trivedi continued from page 1—

Station, and its transparency will make it possible for researchers to view the crystal growth process as the material solidifies. However, the basic principles governing crystal growth will be the same.

So why conduct the experiment in low gravity? Trivedi hopes that the low gravity will "erase" the effects of convection, the natural circulation of fluid.

"On Earth, the small effects are masked by convection," he said. "We hope that in a low-gravity environment, convection will be minimized so that we can more clearly see the importance of the small effects and see how the experimental data match our theoretical modeling."

Much of that modeling has been done by collaboration with Trivedi's colleague, Alain Karma, a theoretical physicist at Northeastern University in Boston. The pair has also collaborated closely with the Centre National d'Etudes Spatiales (CNES), the French government space agency that along with NASA, helped fund the work.

After preliminary testing in September, DECLIC went online in October and the first set of experiments will run through February 2010 according to Trivedi. Through a connection with the computation center in Toulouse, France, Trivedi's research group will be able to view video of the material as it solidifies. To pick up the necessary detail, Trivedi's lab is outfitted with a big-screen, high definition monitor. But they won't be just passive spectators.

"If we see something unusual, we can repeat the experiment, all in real time," Trivedi said. "Likewise, if we don't see much happening, we can alter the conditions and move on."

All the video from the DECLIC experiments will be captured and stored for future reference by CNES in Toulouse, France. Trivedi's research proposal was originally selected by NASA for funding back in 1998, receiving approximately $2 million in total through ISU's Institute for Physical Research and Technology, and was later selected as one of only six projects in materials science selected for actual flight. Seeing the project in operation is exciting for Trivedi.

"It's been a long time since we started," Trivedi said, "but it's also given us time to finalize the experiments and work on the theoretical side. Now we're just anxious to get experimental results to see if things behave as we expect."

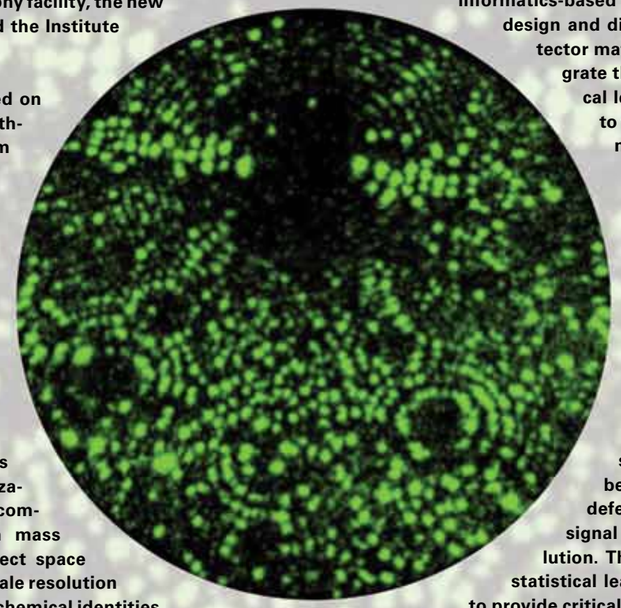
Trivedi's research isn't the only Ames Laboratory science in outer space. Materials developed at Ames Laboratory's Materials Preparation Center are on board the Planck satellite as part of the instrument cooling system.

By Kerry Gibson,
U.S. Dept. of Energy's Ames Laboratory

Combining small scale studies with large scale computing capabilities

Atom probes, super computers, and materials informatics analyze materials atom by atom

Professor Krishna Rajan has recently received three major grants totaling over $3.5 million from the National Science Foundation (NSF) to advance atom probe tomography, combinatorial materials science, and materials informatics. All these projects were enabled by leveraging major infrastructure investments made at Iowa State University including the Atom Probe Tomography facility, the new CyStorm supercomputer, and the Institute for Combinatorial Discovery.

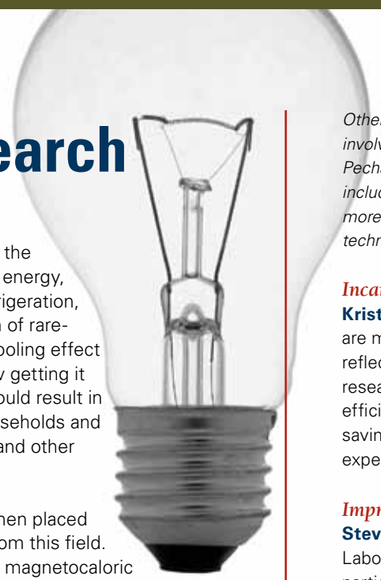


Two of the grants are focused on developing quantitative methods for the analysis of atom probe tomography data and involve collaborations with Prof. Srinivas Aluru of the ECpE department and Prof. Baskar Ganapathysubramanian of the ME department. This includes the first award at Iowa State University from the highly competitive Cyber-Discovery Innovation (CDI) program of NSF. Atom Probe Tomography (APT) represents a revolutionary characterization tool for materials that combines atomic imaging with mass spectrometry to provide direct space three-dimensional, atomic-scale resolution images of materials with the chemical identities of all the detected atoms. APT's depth resolution of one inter-planar atomic layer provides the highest spatial resolution of any microanalysis technique. This capability provides a unique opportunity to study chemical clustering and 3-D distributions of atoms with atomic resolution, providing direct empirical testing and refining of atomic- and molecular-based modeling predictions. APT's capacity to locate and identify hundreds of millions of atoms from a single specimen poses significant data-handling challenges. Rapidly handling the extraordinarily large amounts of data acquired (e.g. giga- and tera-bytes) is essential to use this technology effectively. Informatics techniques will be an integral part of the equipment and sample preparation aspects of APT to facilitate handling, processing, and interpreting such data. By integrating data mining and materials theory, Rajan and colleagues aim to directly link atomic-scale structure and chemical data with materials properties and behavior. This has the potential to revolutionize the study of materials at the atomic scale and to link that information directly to chemistry and properties.

The third grant is a $2M five-year program directed by Professor Rajan for the application of informatics, computational modeling, and combinatorial experimentation to discover a new generation of high-efficiency, radiation detector materials. This grant is jointly funded by NSF and the Department of Homeland Security. This project will develop an informatics-based approach to the accelerated design and discovery of new radiation detector materials. The research will integrate the formal methods of statistical learning in information theory to first-principles and mesoscale modeling, measurements of radiation detection characteristics, and novel high throughput screening and modeling studies of defects in inorganic scintillator materials. The experimental component of the program will introduce a novel atomic scale combinatorial screening technique for dopant diffusion and charge transport analysis to identify the interaction between crystal chemistry and defects, and their role in affecting signal efficiency and energy resolution. The data will be used to refine statistical learning predictions, as well as to provide critical insight into mechanisms that will guide interpretation of the statistical learning analysis. It is expected that this project will lead to new materials with optimized properties that can significantly improve radiation detector performance. This research will also contribute to a better understanding of the relationship between materials chemistry, crystallography, defects and diffusion, and radiation detection characteristics. The research team also includes scientists from Los Alamos National Laboratory and Case Western Reserve University who will develop isotope diffusion and radiation detection experiments.

These awards help to confirm Iowa State University's leadership in the fields of materials informatics and atom probe imaging. Using these methods to advance materials discovery and design underpins the research programs brought to Iowa State University by Professor Rajan four years ago, further enhancing ISU's reputation in interdisciplinary research.

Energy— and cost–saving research



Karl Gschneidner, Jr. and **Vitalij Pecharsky** are on the way to save households (and businesses) not only energy, but money. Their research related to magnetic refrigeration, which is a cooling process that uses a combination of rare-earth materials and magnetic fields to produce a cooling effect that uses less energy, is making great strides. Now getting it commercialized is the next big leap and one that could result in cost-saving and energy conservation for those households and businesses that use refrigerators, air conditioners and other cooling devices.

This process uses rare earth materials that heat when placed in a magnetic field and cool after being removed from this field. The reversible heating and cooling is known as the magnetocaloric effect. Materials discovered by Gschneidner and Pecharsky exhibit a stronger magnetocaloric effect than in compounds available before their discovery. The use of a motor versus a compressor and materials with a potent magnetocaloric effect are the main reasons for energy-savings, and the use of solid, environmentally safe coolants is an added bonus for potential consumers. Gschneidner's and Pecharsky's latest effort, along with engineers at Astronautics Corporation of America, is the viability of room temperature magnetic refrigeration technology that could result in cost-savings up to 30 percent. A more consistent temperature control will also make magnetic refrigerators more efficient.

Working out some issues such as the brittleness of the materials, friability from change in volume during the application and removal of the magnetic field, and large scale manufacturabiity are also being evaluated to allow the magnetic cooling process to perform at its best. These issues as well as others were brought to the table in May, where both researchers co-chaired an international conference in Des Moines, Thermag III –Conference of IIR on Magnetic Refrigeration at Room Temperature – in its third year. This conference allowed researchers from around the world to focus, discuss, and present the latest trends and new research on magnetic refrigeration. The conference was hosted by ISU and Ames Laboratory.

Photos courtesy of U.S. Dept. of Energy's Ames Laboratory

Other researchers within the MSE family are involved in energy-cost saving ventures like Pecharsky and Gschneidner. These ventures include the improvement of battery technology, more efficient light bulbs, energy-efficient vehicle technologies, and low cost gas atomization.

Incandescent bulb reflects heat

Kristen Constant and fellow colleagues are modeling an incandescent bulb that reflects energy back to the filament. These researchers are predicting this bulb to be more efficient than that of the current energy-saving fluorescent and LED lights. Plus, it is expected to hold its luminosity.

Improving Lithium Battery Technology

Steve Martin and fellow researchers at Ames Laboratory are preparing and characterizing particulate anode alloys for lithium batteries. These experts are researching the metal alloy processing, materials characterization, and electrochemistry of lithium batteries. They have been working together to create nanosized "core-shell" particles of metal alloys and carbon. This new material will help to increase the lifespan as well as to boost the capacity of the lithium batteries.

Permanent Magnet Development for Automotive Traction Motors

(DOE-Energy Efficiency, Vehicle Technologies)
Profs. Iver Anderson, **R. William McCallum**, and **Matthew Kramer** are developing materials and processes for strong permanent magnets (PM) that can be used for vehicle traction motors. While PM materials that meet the requirements are most readily achieved using rare earth based alloys, various factors of cost and rare earth metal supply motivated starting a greatly augmented effort on non-rare earth permanent magnets.

Development of Low Cost Gas Atomization of Precursor Powders for Simplified Oxide Dispersion Strengthened (ODS) Alloy Production

(Carpenter Technologies, Inc., Ames Lab WFO)
Prof. Iver Anderson is designing a method for gas atomization reaction synthesis of precursor powders for simplified production of oxide dispersion strengthened (ODS) alloys based on Fe and/or Ni. The atomization approach will generate fine powder with controlled surface films, but will emphasize selection of a system and parameters that result in reduced operating cost on an industrial scale.

Mentoring and learning—

Working together to make new Mat E program a success

When the MSE department gained academic advisor **Andrea Klocke** in the Fall of 2007 – it was a beneficial addition to the MSE team. Her knowledge and mentoring have greatly assisted the students in the Materials Engineering curriculum.

One of the goals of an academic advisor and an academic department is retention of its students – how does MSE hold on to these students and see them through to their academic degree in preparation for the "materials" world? One way to do this is through Learning Communities.

Learning communities are small groups of first-year students (directly from high school or transferring from another institution) who are generally focused on a specific major, take courses together, and may live in the same residence hall. They form academic and social relationships, and it helps to bring what can be a large overwhelming atmosphere at ISU down to a manageable more friendly size.

The MSE department established its learning community through the efforts of Klocke and the support of MSE administration when it began in the 2008-09 academic year. There were two key components to make this program successful – peer mentors and interested first-year students.

While Klocke serves as the administrator for the Mat E learning community, she coordinates a student group of Peer Mentors to help her oversee this program. Peer mentors serve as role models and student leaders to those undergraduates in the Mat E learning community. Peer mentors are selected from Mat E students at the sophomore through the senior level who are academically strong and already active within the department. All Mat E learning community students are assigned a peer mentor—there are usually five to eight students for every peer mentor group.

Thus, the learning community is beneficial in two ways—it allows the new incoming Mat E students a chance to become involved with their academic peers, and it also provides a leadership opportunity for those upper classmen who assist with the learning community. It gives the first-year students a feeling that they are part of the department from the beginning of their academic career.

"Students come to ISU with varying levels of confidence in themselves and feelings, and their choice of major," says Klocke. "The first year is critical for engaging students to become involved with each other and the department."

This program is also an opportunity for Klocke, as well as the MSE faculty who participate in learning community events to interact with and get to know these students earlier than perhaps they normally would.

Inaugural Peer Mentors:
Adam Boesenberg
Travis Brammer
Emily Decker
Ben Rattle
Emma White

Current Peer Mentors:
Christine Gunzel
Emily Kuster
Kate Lindley
Tim Pearson
Brad Williams

Learning Community pumpkin carving under the Marston Water Tower

Mat E Peer Mentors organize many of the activities for the Mat E learning community. Examples of academically-related activities include weekly study nights, faculty-student lunches, and mock interviews. Social networking activities include such events as movie nights, sporting activities, and pumpkin carving at Halloween.

Other opportunities for the future may include incorporating service learning opportunities, field trips, and attending seminars.

The Learning Community and the Peer Mentors had a successful inaugural year. This was acknowledged when Klocke was recognized in April 2009 with an Exemplary Peer Mentor Supervisor award by ISU's Learning Communities Administration which she received for her outstanding efforts in working with the peer mentors in the Mat E learning community.

MSE research briefs:

Rheology of Nanopowder Suspensions (NSF)
Prof. Mufit Akinc is investigating the mechanism of viscosity reduction in concentrated oxide nanopowders afforded by the addition of saccharides and other related compounds. He investigates the rheological behavior of alumina, zirconia, and titania nanopowder aqueous suspensions in the presence of fructose, corn syrup, and other sugar molecules as additives.

Novel Infrared Window Materials with Near Zero Thermal Expansion (ONR)
The objective of the work is to design near zero thermal expansion IR transmitting ceramic nanocomposite by combining positive (Y_2O_3) and negative (ZrW_2O_8) expansion materials. Impregnation of nanoscale yttria compact with a liquid zirconium tungstate at elevated temperature is being explored. The nanocomposite will be characterized for its microstructure, optical, thermal and mechanical properties. **Mufit Akinc** along with **Tom Lograsso** and **Matt Kramer** are leading the effort.

Design of Ultra High Temperature Structural Intermetallic Materials (DOE-NETL)
Matt Kramer and Co-PI **Mufit Akinc** are exploring new inter-metallics for ultra high temperature applications. The approach involves iterative screening of candidates by computationaland experimental techniques. The effort involves extended Miedema model, First Principles calculations, and experimental work. Silicides and aluminides with additives are being investigated.

Development of multiscale self-assembling bioinspired hybrid materials using bottom-up approaches (DOE–BES)
Drs. S. Mallapragada (PI), **M. Akinc**, **K. Schmidt-Rohr**, and **A. Travesset** are designing hierarchically self-assembling templates (synthetic polymers as well as protein and peptide based templates), and use bioinspired methods to synthesize several energy-relevant polymer-inorganic hybrid materials with hierarchical order that are difficult to synthesize otherwise.

Structure-property relationship in ferroelectrics (NSF)
Prof. Xiaoli Tan has been studying the interactions between cation ordered domains and polar nanodomains in $Pb(Mg_{1/3}Nb_{2/3})O_3$-based ferroelectric perovskite oxides. In these compounds, both types of domains are at the nanometer scale and their interactions dictate the dielectric properties. The research is expected to lead to the development of new materials with improved electrical properties.

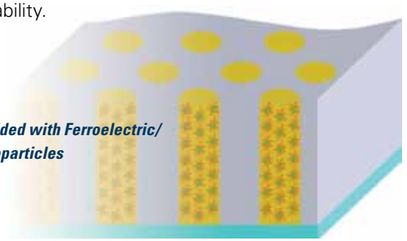
High temperature piezoelectric composites for NDE applications (AFOSR)
Profs. Xiaoli Tan, Mike Kessler and **Zhiqun Lin** are working together to develop PZT fiber/polymer matrix composites for ultrasonic transducers for aircraft engine health monitoring. In these applications, there is a need to push the service temperatures up to 150°C. Such temperatures pose a significant challenge to the polymer matrix that is currently used. Therefore, polymers that are chemically and structurally stable at up to 150°C are being sought to replace those which are currently used in ultrasonic transducers.

Hierarchically Ordered Structures Enabled by Controlled Evaporative Self-assembly of Confined Microfluids (NSF-CAREER)
Prof. Zhiqun Lin is producing hierarchically ordered structures by combining dynamic self-assembly via irreversible solvent evaporation in curve-on-flat geometries at the microscopic scale and spontaneous self-assembly of diblock copolymers or nanocrystals at the nanoscale. These spatially ordered structures can serve as multifunctional materials for potential applications in optical, electronic, optoelectronic, and sensing materials and devices.

Semiconducting Organic–Inorganic Nanocomposites in Well-defined Nanoscopic Geometries for Photovoltaic Application (NSF)
Prof. Zhiqun Lin is rationally designing semiconducting organic–inorganic nanocomposites by grafting long conductive polymer chains on the quantum rod surface (i.e., forming CP–QR nanocomposites), revealing the confinement effects on the photophysical properties of nanocomposites by immobilizing them in cylindrical nanopores and by confining and shearing them between two parallel plates, and exploring their use in organic–inorganic nanohybrid solar cells.

Nanocrystal Sensitized TiO_2 Nanotube Solar Cells
Prof. Zhiqun Lin is developing novel nanostructured solar cells based on TiO_2 nanotubes impregnated with nanocrystals. Recently, a solar cell produced in his research group using 14 μm thick TiO_2 nanotube arrays after rational surface treatments yielded a power conversion efficiency of 7.37%, which is the highest reported efficiency for dye sensitized TiO_2 nanotube solar cells.

Nanocomposites with Long-range Hierarchical Order Based on Block Copolymers Embedded with Ferroelectric/Superparamagnetic Nanoparticles (AFOSR)
Profs. Zhiqun Lin, Muift Akinc, Xiaoli Tan, and **Nicola Bowler** are creating novel nanocomposites with long-range hierarchical order based on block copolymers with nanoscopic ferroelectric particles and superparamagnetic iron oxide nanoparticles selectively incorporated into the target BCP domains. These nanocomposites may promise new opportunities for developing miniaturized multifunctional electromagnetic materials and devices with controlled dielectric permittivity and magnetic permeability.



Block Copolymers Embedded with Ferroelectric/ Superparamagnetic Nanoparticles

Phase Behavior and Phase Separation Kinetics of Polymer Dispersed Liquid Crystal (3M)
Prof. Zhiqun Lin is studying the surface and finite size effects on the phase behavior and phase separation kinetics in liquid crystal/polymer mixtures, both experimentally and theoretically. His research group is planning to synthesize liquid crystal-based block copolymers and explore the confinement effect, both between parallel plates and on a chemically heterogeneous surface, on their microphase separation and long range order (both vertical and lateral orientations).

Generation IV Nuclear Reactor Materials (DOE)
Michigan State **Prof. Robert Buxbaum** and **Prof. Alan Russell** are evaluating plasma coating of Ti_2AlNb onto Nb-1%Zr alloys to study the hot strength, oxidation resistance, and effects of hydrogen on the coated alloy. This combination of materials is thought to be a potential structural material for next-generation nuclear reactors that may operate at 900˚ to 1000˚C.

Plasma coating at Ames Laboratory Plasma Spray Facility

Ammonia Nurse Tank Safety (FMCSA)
Profs. Alan Russell and **Scott Chumbley** are studying stress corrosion cracking in the nurse tanks used to transport ammonia fertilizer to farm fields. They are purchasing used nurse tanks of various ages, searching for cracks with ultrasound equipment, measuring residual stresses around welds using neutron diffraction, and formulating recommendations for future tank inspection standards.

Anhydrous ammonia nurse tank stress corrosion cracking failure

Ultra-hard Boride Coatings (DOE)
Ames Lab scientist **Bruce Cook** and **Alan Russell** have teamed with engineers from Eaton Corp. and Greenleaf Corp. to assess the performance of $AlMgB_{14}$ + TiB_2 thin-film coatings to reduce wear and improve efficiency in cutting tools and hydraulic pump components. The project is performing final development work leading to commercial use of the coating materials.

Improved Atomization Processing for Fossil Energy Applications (DOE-Fossil Energy)
Prof. Iver Anderson is investigating control of metal powder production by gas atomization methods to benefit several emerging Fossil Energy technologies that utilize metal powders of specific size ranges and types. Experiments involve design and analysis of innovative atomization processes and the work utilizes pure metals and simple model alloys for each target area of process or alloy development.

Iowa Powder Atomization Technologies (IPAT): Titanium Atomizer Prototype Design (Grow Iowa Values Fund, Iowa State University)
Prof. Iver Anderson with Iowa Powder Atomization Technologies (IPAT) is pursuing design and fabrication of a novel prototype atomizer for making fine spherical titanium metal powder. Upon completion, this prototype will be used to demonstrate the feasibility of an innovative titanium melt pouring concept that can be coupled to a high pressure gas atomization nozzle to produce Ti powder.

Development of Atomized Magnesium Powder Production Process (ARDEC, Ames Lab WFO)
Prof. Iver Anderson is designing gas atomization nozzles and melting/pouring parameters to produce high yields (>30%) of both 50μm and 500μm spherical Mg powders, working with a system engineering firm. Pure Al will be the surrogate metal for this work, but a passivation treatment for Mg powder also will be investigated to enable verification of the process parameters for Mg.

Development of Pb-Free Solder Systems for a Wide Range of Assembly Parameters (Nihon Superior, Inc., Ames Lab WFO)
Prof. Iver Anderson is performing this study to verify the alloy design parameters and heterogeneous nucleation mechanisms for Sn-Ag-Cu-X solder joint solidification control and to use the findings for analysis of Sn-Cu-X solder joint solidification. He also will develop and demonstrate a Pb-free replacement for Pb-5Sn and Pb-10Sn, current high temperature solders for multi-chip module assembly.

Generation of Nano-Scale Reactive Alloys and Intermetallic Compounds (DOE-Basic Energy Sciences)
Prof. Iver Anderson is pursuing ultra-rapid solidification of special alloys and intermetallic compounds in a nano-particulate form. This research involves ultra-fast (10^9K/s) dielectric liquid quenching of mixed atomic vapor or superheated liquid that is derived from the pulsed plasma heating of consumable electrodes in a spark erosion (SE) process, generating particles (from nanometers to microns) of conducting materials.

Paulson—
MSE student athlete—
Successful on and off the course

Mat E sophomore and ISU golfer **Kristin Paulson** performs at a level that takes great focus for a student-athlete in engineering. While her rookie season on the golf course was quite successful, she also met those accomplishments in the classroom as well.

Paulson's desire to seek an engineering degree came from her golf interests and experience. "I went into materials because I want to design golf clubs," she said. While her aspirations after college are to continue on the golf circuit, her degree will allow her to remain around golf whether it is at the professional level on the course or at the corporate level applying her materials skills.

As a freshman, Paulson's rookie season was one of great pride. She met a record-setting goal of shooting a round of golf in the 60s in an ISU collegiate event. Her 69 at the Mountain View Collegiate in Tucson, AZ put her in the record books for low 18-hole score. There are only a select few who have performed this feat. She also competed in every tournament and was fourth in stroke average for the team in her first season as a Cyclone golfer.

Her academic side holds true as well – she was named an Academic All-American – one of three ISU women golfers to hold a spot on the Division I team for 2008-09. Members of the All-American Scholar team must have a minimum of a 3.50 cumulative GPA and have competed in at least 50 percent of the college's regularly scheduled competitive rounds.

While in high school, Paulson was a state individual champion her senior season and the state's Class 4A Girls Player of the year. She led her Ottumwa teammates to state three years in a row and finished among the top three individuals each year.

Berbano—Research in Japan—Osaka Prefecture University

Seth Berbano, a Materials Engineering senior at Iowa State University was busy in the labs of Osaka Prefecture University (OPU) in Sakai City, Japan this summer on a 10-week research experience (REU program) sponsored by the International Materials Institute (IMI) for New Functionality in Glass. The purpose of the REU in Glass summer program is to introduce US undergraduate students, like Seth, to the opportunities in glass research through active involvement in research at a world class glass technical facility both domestic and abroad. Under the expert guidance of head Professors **Tatsumisago**, **Tadanaga** and **Hayashi** in the Inorganic Chemistry Division of Osaka Prefecture University, Seth investigated the effects of substituting different sulfide compounds in glass and ceramic systems.

Collaboration between the OPU and Iowa State University (ISU) did not end after Berbano's 10 week International REU program, however. His primary graduate student mentor, **Minami**, traveled back to Iowa State University with him to spend two months in **Dr. Steve Martin's** laboratory, where Berbano holds an undergraduate research position. Minami collaborated on researching different glass systems prepared by both melt-quenching and mechanical milling while at ISU in MSE. You can read more about Berbano's experience on the IMI website http://www.lehigh.edu/imi/

Seth holding a conductivity cell

Like Seth, many Mat E undergraduates participate in research opportunities and/or internships in industry to gain valuable hands-on experience and to better prepare themselves for future employment opportunities after graduation.

Awards banquet—2009
MSE scholarship and award recipients

The 2009 MSE Awards Banquet had yet another successful year for awarding scholarships. The department presented scholarships to nearly 70 students. Professor and Chair, Richard LeSar spoke to the crowd of almost 200—including parents and family members — about the ever-popular class that many engineering students take in Mali, a country in western sub-Saharan Africa. His presentation "Preparing Students for 21st Century Challenges: Teaching Appropriate Technology in Africa" gave the audience just a taste of what opportunities (and challenges) these students faced while there.

Beem Patent Law Firm Scholarship
Kathlene Lindley

Clarence H. Ford Scholarship
Kevin Severs*

Clayton Family Scholarship for Studies in Powder Metallurgy
Amy Bergerud
Gregory Vetterick

David R. Wilder Scholarship in Materials Science and Engineering
Kathryn Schlichting*

David T. Peterson Scholarship
Daniel Vennerberg

Deere & Company Scholarship
Jordan Trachtenberg•

Deere Foundation Scholarship
Laura Barker
Nicolas Martinez
Kyle Debelak

Engineering Student Leadership Development Scholarship
Seth Berbano

Engineering Undergraduate Merit Scholarship
Amy Bauer
Malinda Caudle*
Austin Cudworth
Trevor Dobbs
Ryan Gebhardt
Christine Gunzel
Eric Harms*
Matt Heinemann
Jamelia Hershiser
Robert Holec
Trenton Jacobson
Briana Kelly
Olivia Kilgore
Barry King
Jennifer Klavon
Alyson Lieser
Vincent Lilienthal
Kristen Lipschultz
Chad Macziewski
Anthony Marton
Samantha Meyer
Matthew Poulter
Daniel Putnam
David Riegner
Mark Rogalski
Kathryn Schlichting*
Kevin Severs*
Alexander Smith
John Solomon*
Laura Van Steenhuyse
Bradley Williams

Fehr-McGee Scholarship
Lisa Nielsen

Frank Kayser Scholarship
Samuel Young

Herbert C. James Scholarship
Darman "Mitchell" Rock

John D. Verhoeven Scholarship
Rachel Hawkins

Lyle J. & Marcia L. Higgins Scholarship
Mary Burroughs
Karen Derocher
Michael Horras
Jace Indrelie
Kelsey Larson
Scott Long
Benjamin Macmurray

Materials Science & Engineering Scholarship
Andrew Adams
Travis Brammer
Steve Dietz
Haley Dillon
Peter Huffman
Nathan Kleppe
Erik Manatt
Timothy Pearson
Lindsey Servin
Alexander Spicher
Carl Tackes

Mary & Donald Martin Memorial Scholarship
Taylor Grieve

Murray Gautsch Scholarship
Longfei "Joe" Li

Otto & Martha Buck Materials Science & Engineering Scholarship
Tim Cullinan

Paul Emerson Morgan Scholarship
Kristin Paulson
James Acton

P. Fred Petersen Scholarship
James Acton
Cory Sents•

Ralph S. Millhone Scholarship
Alexandra Bruce•
Teresa Goeddel•
Luke Klosterman•
Sara Moser•
Sarah Timmons•

Robert Fields Scholarship
Eric Harms*

Samuel Walker & Jennie Morrison Beyer Scholarship
Kara Christensen

Tau Beta Pi Scholars Program Scholarship
Malinda Caudle*
Alexandra Skora
John Solomon*

2009–2010 MSE National Merit Scholars
Alexandra Bruce
Teresa Goeddel
Luke Klosterman
Sara Moser
Cory Sents
Sarah Timmons
Jordan Trachtenberg

2009–2010 MSE GWC and MVP Scholars
Seth Berbano
Leo Salat
Alexandra Skora
Jordan Trachtenberg
Meredith Young

2008-2009 MSE Special Awards—
MSE Outstanding Senior Award
Matthew Goodman

MSE Student Leadership & Service Award
Anne Stockdale

Rohit Trivedi Best Student Paper Award
Min Zou

ISU Graduate Research Excellence Award
Xia Sheng
Yunus Eren Kalay

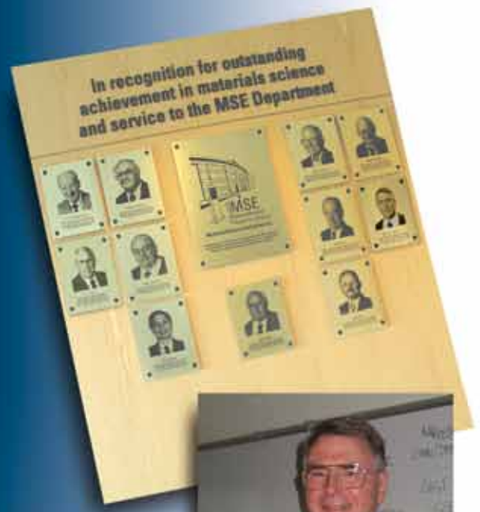
* *Scholarship funding from two or more sources or multiple scholarships received*
• *Scholarship supporting National Merit*

2008-2009 MSE Special Awards

Akinc Excellence in Teaching Award
Ralph Napolitano

Akinc Excellence in Service Award
Larry Genalo

Akinc Excellence in Research Award
Krishna Rajan



Tucker—*2009 MSE Hall of Fame*

MSE's most recent Hall of Fame recipient and MSE Alum, **Dr. Robert C. Tucker, Jr.** has a lifetime of experience and numerous award recognitions for his dedication and expertise in the materials field.

Most of Tucker's career was with Praxair Surface Technologies where he served as Corporate Fellow and Director of Business Development and Strategic R&D. He also oversaw management of materials R&D which included programs to develop materials resistant to high- and low-temperature wear, corrosion, high-temperature oxidation and sulfidation, thermal barriers, and composite materials.

He is retired from that position, but remains active in the field of surface science and engineering. He is currently a consultant for The Tucker Group, LLC in West Chapel, FL and Brownsburg, IN. His consulting also involves new technology assessment including acquisition and licensing, business development, strategic planning, and R&D management.

Tucker received his BS degree in chemistry and mathematics from North Dakota State University and his MS and PhD degrees in Metallurgy with minors in ceramics and nuclear science from Iowa State University.

To highlight a few of Tucker's many recognitions and professional activities—

- Fellow of ASM International
- Inducted into the ASM Thermal Spray Hall of Fame
- Professional membership of ASM International and ASM Thermal Spray Society
- Former president of both organizations
- Former Board of Trustee for ASM International
- Current Board of Trustee for ASM Materials Education Foundation
- Current Board of Trustee for ASM Thermal Spray Society

Where are they now—

Alumni feature: Emily Kinser at IBM

MSE Alum, **Emily Kinser** (BSMatE'04/MSMSE'05) started her materials career with IBM directly after receiving her master's. She worked in the Microelectronics Division at the 300mm wafer fab in Fishkill, NY where she was a manufacturing process engineer who was responsible for dielectric thin film materials deposited using plasma-enhanced chemical vapor deposition (PE_CVD) processes. Then in 2007 she transferred to development to work as part of the Semiconductor Research & Development Center, working as an integration engineer on the process module for the 45nm technology node. She is currently in the 3D Integration department which is an emerging area of microelectronics technology involving the stacking of chips and/or wafers.

Kinser's hard work has lead to her recent selection for the IBM Corporate Services Corps (CSC) program in 2009, where she will work on a project in Egypt from February through March 2010. More than 10,000 IBMers from around the world applied for the CSC program, and only 400 were selected.

She has eight patent applications filed to date. In 2007, she won the IBM Women Inventors Patent Challenge grand prize for a patent application that improves semiconductor manufacturing to enable lead-free packaging of chips.

Her professional activities include being a member of the inaugural class of the ASM Emerging Professional Committee (2006-09) where she was the Vice Chair in 2007-08 and the first committee chair in 2008-09. She has been an active member on various committees for ASM, but currently is on the Metro NY/NJ ASM Chapter Board of Directors. She also serves as a mentor with the Rutgers Material Advantage Chapter and for the local Rhinebeck Science Foundation.


Emily Kinser

2008–2009 MSE honors and awards

Faculty

- **Mufit Akinc**—Fulbright Scholar, Koc University, Istanbul, Turkey; Fellow, ASM International; International Service Award
- **L. Scott Chumbley**—COE Superior Engineering Teacher Award
- **Kristen Constant**—"Women Impacting ISU" Honor
- **Larry Genalo**—University Professor, MSE
- **Karl Gschneidner, Jr.**—45-Year Club, ISU
- **Michael Kessler**—Elsevier Young Composites Researcher Award
- **Alex King**—Fellow, Materials Research Society
- **Valery Levitas**—Einstein Award for Scientific Achievement, International Biographical Centre, Cambridge, UK
- **Zhiqin Lin**—NSF CAREER Award, NSF ; Young Engineering Faculty Research Award, COE – ISU
- **Surya Mallapragada**—Richard Stanley Chair in Interdisciplinary Engineering, ISU; Fellow, American Association for the Advancement of Sciences; also named CBE chair
- **Steve W. Martin**—Anson Marston Distinguished Professor in Engineering, ISU
- **Ralph Napolitano**—Alan and Julie Renken Professorship
- **Vitalij Pecharsky**—David R. Boylan Eminent Faculty Research Award; ISU
- **Scott Schlorholtz**—25-Year Club, ISU
- **Martha Selby**—Superior Engineering Advisor Award, College of Engineering, ISU; 25-Year Club, ISU
- **R. Bruce Thompson**—NDE Lifetime Achievement Award from SPIE Smart Structures/NDE

Staff

- **Andrea Klocke**—Peer Mentor Supervisor Award, ISU, Learning Communities
- **Susan Elsner**—ISU Cytation Award

Students

- **Material Advantage—Most Outstanding Student Chapter** (*sixth time in a row)*
- **Michael Haynes**—2009 Alfred R. Cooper Young Scholars Award, for his research project and work on the preparation and characterization of sodium thioboro-phosphate glasses, presented by the American Ceramic Society

Patents

- **Iver Anderson,** 7,611,565, "Device for hydrogen separation and method" November 3, 2009
- **Nicola Bowler,** 7,443,177, "Characterization of conductor by alternating current potential-drop method with a four-point probe" October 28, 2008
- **Bruce Cook, Joel Harringa, Alan Russell, Justin Peters,** 7517375, "Wear-Resistant Boride Composites with High Percentage of Reinforcement Phase, April 14, 2009" *(Note—Cook, Harringa, and Peters, all alums and currently scientists in AL)*
- **Brian Gleeson,** 7,531,217, "Methods for Making High-Temperature Coatings Having Pt metal Modified Gamma-Ni + Gamma'-Ni_3Al Alloy Compositions and a Reactive Element," May 12, 2009
- **Karl A.Gschneidner, Jr., Vitalij K. Pecharsky,** 7,549,296, "Low temperature cryocooler regenerator of ductile intermetallic compounds" June 23, 2009
- **Michael Kessler,** 7,601,426, "Intumescent substrate coating" October 13, 2009

Meet MSE's new faces

Wei Hong
Assistant Professor (Courtesy appointment) Aerospace Engineering

Mechanics of soft active materials

Modeling and simulation

Valery Levitas
Professor (Courtesy appointment) Mechanical Engineering Aerospace Engineering

Mechanical properties of materials

Stress- and strain-induced phase transformations

Melissa Skinner
Program Assistant

MSE administration

Undergraduate support

IOWA STATE UNIVERSITY
Materials Science and Engineering
Iowa State University
2220 Hoover Hall
Ames, Iowa 50011-2300

Materials Matter

Watch MSE Professor Larry Genalo's materials demonstrations

MSE active recruiters

Much of MSE's success at Iowa State University has been due to the department's on-going recruitment activities the department takes on. MSE Professor & Associate Chair, **Larry Genalo**, leads these efforts and this fall, his recruitment feats reached the national level.

Dr. Genalo worked with a production team from ASM International's Education Committee to put together a video series of demonstrations "Materials Matter" that can be used in the classroom or for other educational and instructional purposes. That video is now available on the ASM TV site and also on MSE's homepage at the following links:

http://asminternational.tv/mvIowaStateVideos.htm
http://www.mse.iastate.edu/

Genalo has also formed an interest group of students in MSE who assist in these recruitment endeavors who reach out to various schools and organizations to perform these demonstrations in an effort to create awareness of the "materials world" of engineering and science.

One group of students here is performing these demonstrations at ISU's annual VEISHEA celebration.