IOWA STATE UNIVERSITY
College of Engineering

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Department of Materials Science and Engineering

Karl Gschneidner, Jr., elected to National Academy of Engineering

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INSIDE ISSUE

Greetings from the Chair

Materials science is undergoing a revolution based on our increased ability to examine materials at the atomic scale. New characterization equipment, coupled with new computational capabilities, now enables studies of nanoscale features not dreamt of even a few years ago. With recent acquisitions, the Department of Materials Science and Engineering (MSE) at Iowa State is at the vanguard of these new capabilities.

During the past year MSE, along with partners in the mechanical engineering and chemical and biological engineering departments, purchased a local electrode atom probe. This remarkable device uses a laser to blow atoms off the surface of a nano-sized sample, slowly working its way down through the material. Accurate measurements enable the identification of both the position and chemical identity of each atom in the sample, creating a three-dimensional map of the structure. Having the data is not enough, however. To best use that data requires being able to visualize it. Iowa State is uniquely positioned to do the advanced computation needed to process the data, hosting one of the most powerful computers at a university in the United States, the 1,024-node IBM BlueGene/L. To visualize the data, Iowa State boasts the highest resolution three-dimensional visualization cave in the U.S. at the Virtual Reality Applications Center. Researchers can use these tools to examine atomic-level characteristics of structures, including internal interfaces, subscale particles, etc., being able to “walk through” their three-dimensional representations. Using this type of capability brings the skill to manipulate and create materials from the atomic level up that much closer.

Another major advance in materials research is the greatly increased ability to model and simulate complex materials behavior. From electronic-structure calculations coupled with materials informatics, to atomistic simulations of polymers, to dislocation-based studies of metals, to microstructural models of solidification and growth, researchers in MSE bring to bear advanced algorithms, massively parallel computing, and detailed analysis to shed light on almost all levels of materials behavior.

As you look through the rest of the bulletin, you will see many other examples of how materials science and engineering at Iowa State is strong and poised for the future of materials research. We are excited about that future and hope you join us as we move forward.

Richard LeSar

Richard A. LeSar, MSE Chair

Coating for turbine blades licensed to Rolls-Royce

Brian Gleeson, former Alan and Julie Renken Professor in MSE and scientist with the U.S. Department of Energy’s Ames Laboratory on the Iowa State campus, is the co-inventor of a bond coating that has been licensed to Rolls-Royce.

The coating helps jet engine turbine blades made of nickel-based superalloys stand up to intense heat. Those superalloys are designed for strength, but need help withstanding metal temperatures approaching 2,100 degrees Fahrenheit inside the hot section of a jet engine.

“This coating composition performs well,” Gleeson says. “It offers significant advantages over existing coating technologies.”

Co-inventor **Daniel Sordelet** (PhDMSE’95), senior scientist and group leader in the Ames Laboratory, said the bond coating improves the durability and reliability of a ceramic thermal barrier that’s applied over the bond coat.

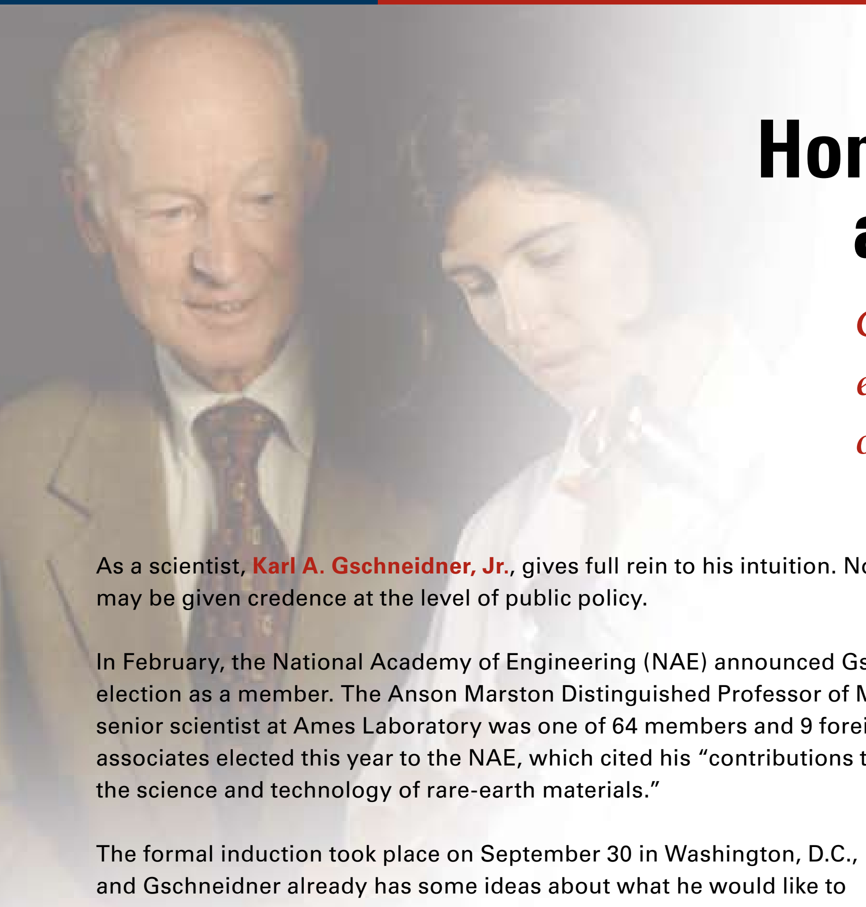
Gleeson says the coating, which won a prestigious R&D 100 Award in 2005, is based on a composition comprising platinum, nickel, aluminum, and hafnium. It was invented by Gleeson, Sordelet, and **Wen Wang**, a former Iowa State postdoctoral associate. Gleeson, Sordelet, **William J. Brindley** (chief technologist for Rolls-Royce), and **Bingtao Li** (PhDMSE’03 and former postdoctoral researcher) also developed a cost-effective method for applying the coating to engine parts.

Gleeson and Sordelet hope to develop a better and cheaper way to produce the coating. They’re also looking for new coating compositions and new ways to deposit them on materials.

“We say that we put science to practice,” Gleeson says, referring to the “Science with Practice” motto on the university seal. “And this is an excellent example of that.”

Brindley says, “This new coating offers excellent oxidation resistance. It’s a new concept in coatings and a real step forward in understanding how and why coatings work. The technology also represents a remarkably quick transition from fundamental science to practical application.”

Standing from left to right: Mark Kushner, Brian Gleeson, Ted Okiishi, Nita Lovejoy (ISURF Associate Director), Daniel M. Barbieri (Legal Counsel for Rolls-Royce Corp.), and William J. Brindley (Rolls-Royce Corp.). Seated from left to right: Kenneth Kirkland (ISURF Executive Director) and Norman F. Egbert (Rolls-Royce Corp.).



Honored and motivated:

Gschneidner looks ahead after election to National Academy of Engineering

As a scientist, **Karl A. Gschneidner, Jr.**, gives full rein to his intuition. Now his hunches may be given credence at the level of public policy.

In February, the National Academy of Engineering (NAE) announced Gschneidner's election as a member. The Anson Marston Distinguished Professor of MSE and senior scientist at Ames Laboratory was one of 64 members and 9 foreign associates elected this year to the NAE, which cited his "contributions to the science and technology of rare-earth materials."

The formal induction took place on September 30 in Washington, D.C., and Gschneidner already has some ideas about what he would like to do for the academy, which often convenes panels to review issues raised by Congress.

"When the new academy president was elected (in April), he sent out a message asking what we should be doing," Gschneidner says. "So I wrote him. I said, 'The two E's: environment and energy.'"

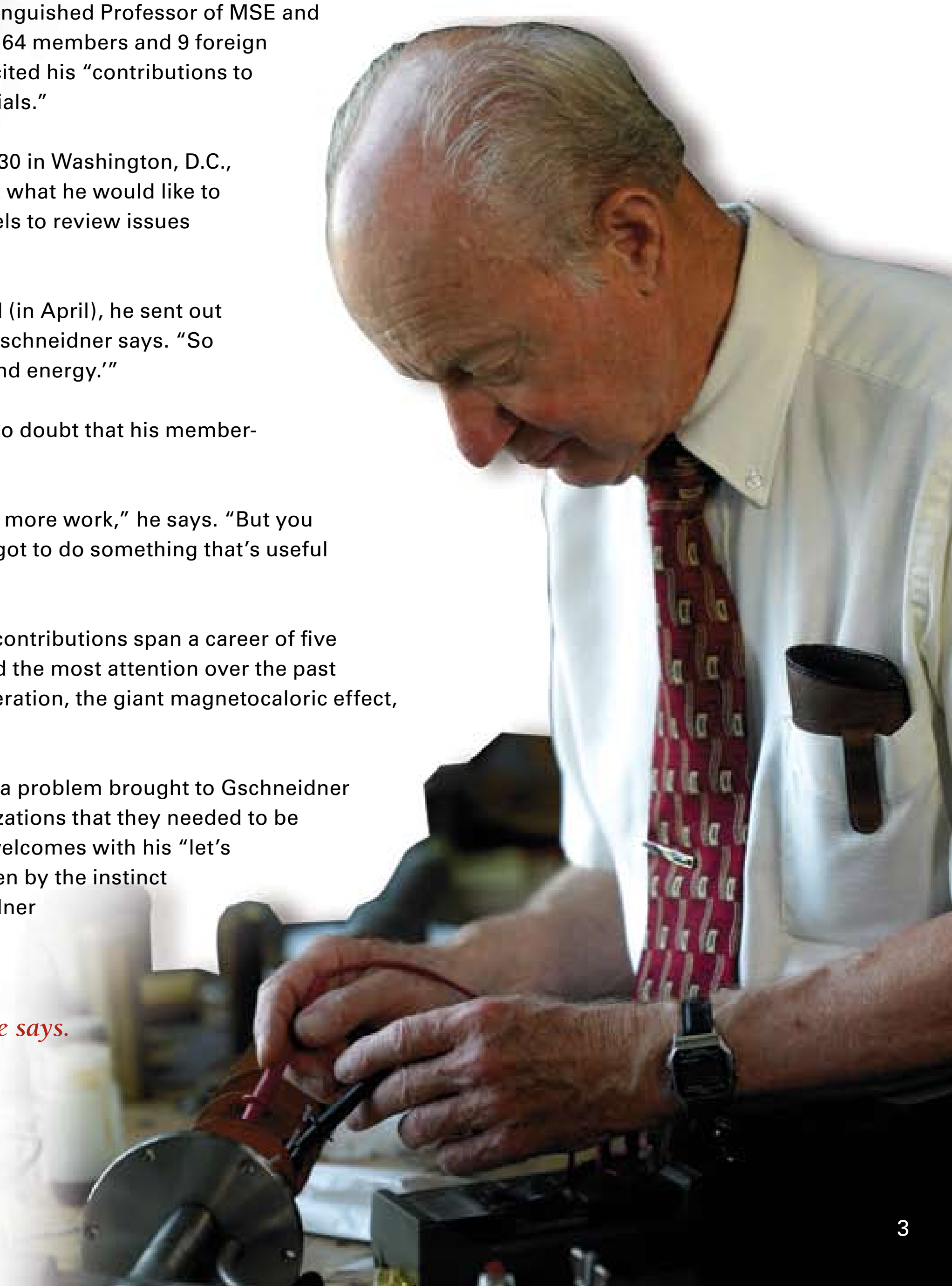
Gschneidner has yet to get a reply, but he has no doubt that his membership will result in some sort of assignment.

"It's nice to get elected, but boy, that generates more work," he says. "But you can't just stop and rest on your laurels. You've got to do something that's useful to society."

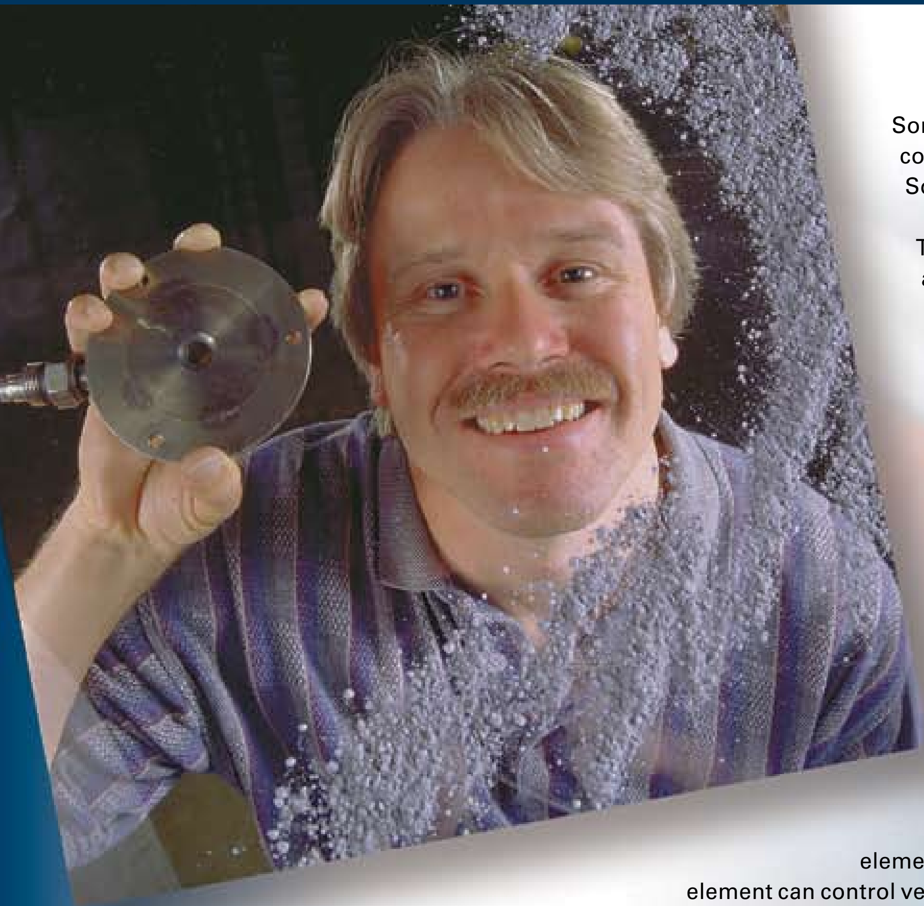
Although Gschneidner's voluminous scientific contributions span a career of five decades, he and his collaborators have received the most attention over the past 10 years for three in particular: magnetic refrigeration, the giant magnetocaloric effect, and ductile intermetallic compounds.

Each of those lines of research originated from a problem brought to Gschneidner by other scientists or engineers at other organizations that they needed to be solved—a challenge that Gschneidner always welcomes with his "let's just take a look at this" intuitive approach. Driven by the instinct to look forward, rather than to reflect, Gschneidner is ready for the next issue to present itself.

"You've just got to keep your eyes open," he says. "I've got lots of other ideas."



Lead-free solder gains status, with more improvements to come



Iver Anderson holding up the nozzle used to make the powdered metal that was critical to developing the lead-free solder formula.

Sometimes the culmination of painstaking research comes into a world that is just waiting for a change. Sometimes the world needs to do a little changing first.

The lead-free solder alloy developed by **Iver Anderson**, an MSE adjunct professor and Ames Laboratory senior metallurgist, is becoming an industry standard in a world that is increasingly more sensitive to technology's environmental impact. Sixty companies have signed licensing agreements for the alloy, which was patented in 1996 and 2001, pushing royalties to $13 million. More of the alloy in electronic components means less lead ending up in electronic waste.

Yet Anderson's work with the alloy is far from complete. Enhancing reliability is one of the next challenges; reaching that goal involves formulating new combinations and peering deeper into material characterization.

"I think we are at the point where we have tweaked the three-component (tin, silver, copper) alloy to a very good formulation that is most useful if you add one additional element into it," Anderson says. "That additional element can control very closely how the solder joint solidifies so that it forms the best possible microstructure at the start of its lifetime."

That fourth element—at least the one that Anderson is willing to disclose—is zinc. (There is another candidate, but he's not talking about it just yet.) Zinc, Anderson explains, controls the original solidification of the joint and also seems to be the most effective at long-time, high-temperature aging conditions by maintaining the strength and ductility of soldered joints.

Anderson was recognized by the Iowa Intellectual Property Law Association as its 2006 inventor of the year, 10 years after the original patent. His research toward that first formulation had evolved from classical metallurgical training and close collaboration within Ames Lab. Today, however, his work benefits from the scrutiny of a wider research community. Published work from other laboratories and thermodynamic modeling at the National Institute of Standards and Technology have contributed to a growing body of knowledge.

"We're taking that information and going further," Anderson says, "so we're a whole lot smarter than we used to be. Plus there is plenty of data that have been accumulated on reliability, and the community has been good about sharing it."

Although reliability is foremost for the military and automotive customers of Anderson's solder technology, he seeks to augment the performance of the solder in other ways. One project involves Nihon Superior, a Japanese solder manufacturer.

"We are looking at how we can design a solder alloy that works well with high-power electronics," Anderson says, "preserving the audio quality of these very high-power devices."

The work presents Anderson with new problems to solve and opens even more potential for the already successful solder. For example, he sees plenty of room for more detail in microstructural analysis, a line of pursuit that is more accessible as techniques and equipment become available. (See "Atom Probe" on back cover.)

"There's alloy design space left that we haven't even touched," he says. "We're surprised every day with new things."

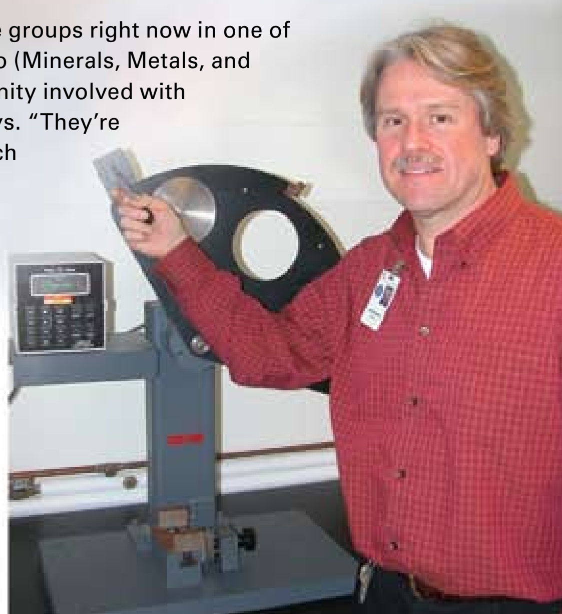
The motivation to improve upon a successful alloy goes beyond just scientific interest. Bringing lead-free solder to more companies and expanding its applications reinforce Anderson's conviction that electronic waste is affecting the environment. He is not alone in holding that view. On July 1, 2006, the European Union began strictly limiting the amount of lead and other hazardous materials used in the circuitry of any electronic appliance sold. A similar approach is being taken in Japan.

"In the last half dozen years, more electronic trash has accumulated," Anderson says. According to a 2005 U.N. report, up to 50 million tons of "e-waste" is generated annually, mostly in the form of computers and cell phones. As much as 70 percent of that ends up in China. Anderson has seen examples on various Web sites of it piled high—and out in the open—in some locations there. The biggest concern for any form of electronic waste is the potential for runoff into groundwater.

"We should not be adding to this," Anderson says. "I think that in some small way here, we can have an impact on reducing the toxicity of that runoff."

Perhaps more than just a small way. Anderson's idea seems to have found its time, and the momentum is building.

"Probably one of the most active groups right now in one of the technical societies I belong to (Minerals, Metals, and Materials Society) is the community involved with lead-free solders," Anderson says. "They're driven. It's a real exciting research environment, and there's a lot of interest in every new development that comes along the way."



Photos courtesy of the U.S. Department of Energy's Ames Laboratory.

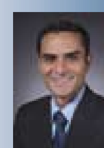
New Names/Faces to MSE (2006–07)

Jerry Amenson
Lab Manager
Coordinated Materials Analysis and Characterization Lab

Krishna Athreya
Adjunct Associate Professor

Ashraf Bastawros
Associate Professor
(Courtesy appointment with Aerospace Engineering)

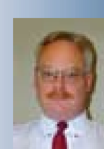
Sumit Chaudhary
Assistant Professor
(Courtesy appointment with Electrical Engineering)



Angela Clarahan
Administrative Specialist
Institute for Combinatorial Discovery (Rajan)

Andrea Klocke
Academic Advisor

Scott Schlorholtz
Scientist
Coordinated Materials Analysis and Characterization Lab



Warren Straszheim
Associate Scientist
Coordinated Materials Analysis and Characterization Lab

The view from up there:

Informatics takes system-level approach to materials development

As measurements in nanometers become mundane and the interest in electrons turns to controlling their spin, this is no time for materials science to be bound by tradition.

Krishna Rajan, MSE professor, Stanley Chair of Interdisciplinary Engineering, director of the international combinatorial sciences and materials informatics collaboratory, and director of Iowa State's Institute for Combinatorial Discovery, does not suggest an abandonment of the past. After all, long-established methods have produced major advances and continue to deliver subtle improvements. Instead, Rajan is looking beyond the limitations of method and material, and what he sees is the promise of materials informatics.

Through informatics, Rajan extracts patterns from vast amounts of data by applying well-established principles of mathematics and physics in novel ways. The methodology is far more than data mining and is not merely some software trick—instead, it is an advanced tool for describing complex systems, and it may well be the future of materials science.

As Rajan explains it, the point is to see all that can be seen about a system, to integrate it mathematically, and then to extract patterns that can be interpreted.

"The ability to survey and comprehend material in an intelligent way, a more rational way," he says, "is the aim of informatics."

The comprehensive approach adapts well to a wide variety of pursuits and complements other techniques and equipment that are becoming available to materials science researchers. For example, the powerful combination of informatics, supercomputing, and atom probe microscopy takes materials characterization to a new level of sophistication. (See "Atom Probe" on back cover.) In the area of life sciences, Rajan is co-principal investigator of a research center funded by the Office of Naval Research (ONR) that links informatics with biology to assist in vaccine development. Three-dimensional imaging is yet another collaborative venture to which Rajan brings his expertise and ONR funding.

Such a flurry of activity illustrates the growing attention being given to informatics, which does have its skeptics. Materials science, Rajan acknowledges, is a field built on empirical observations and painstaking work that often leads to an accidental discovery or unexpected result, both of which must then be explained. Informatics also involves observations, but taken alone, they would be just a collection of data.

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Rajan continued—

Interpretation plays a key role. "It's more than just looking at what is already there," Rajan says. "We make heuristic observations of what the data are and how the data are correlated, and then we try to make some interpretations."

And where is the physics? Everywhere, Rajan says—in every bit of information, and in every equation. "You must be able to understand subtleties," he says. "Informatics in fact requires you to have a rigorous understanding of fundamental principles as it does not allow you the luxury of ignoring anything."

Informatics does, however, provide the luxury of paying attention to just about everything in a system. "We're setting up databases to be a research laboratory where you can see connections that otherwise you would never be able to see," Rajan says. "That makes databases a proactive research tool instead of a handbook approach to materials science."

If informatics employs data at previously unseen scales, then to work efficiently and effectively with that data requires collaboration at new levels. Informatics, Rajan points out, requires distributed collaboration through a cyberinfrastructure that can handle gigabytes and terabytes of information.

"You cannot do this unless you find people who are not just willing to share the data but also who understand what you're doing with the data," he says.

For example, the Combinatorial Sciences and Materials Informatics Collaboratory, based at Iowa State, is an international research and education center sponsored by the National Science Foundation that operates through a cyber-infrastructure composed of an international consortium of universities and laboratories.

In addition, Rajan's group at Iowa State, supported by funding from the Defense Advanced Research Projects Agency, has teamed with Stanford University and the University of California–Berkeley to form the Center on Interfacial Engineering for Microelectromechanical Systems. Through the use of informatics, Iowa State's role is to identify and predict the behavior of new materials that can be used for the next generation of MEMS devices.

Rajan with postdoc Michael Stukowski

More than a face in the crowd:

Approach, technique set Tan apart

When **Xiaoli Tan** was a PhD student, his research interests were whatever his adviser told him they were. Once on his own as an assistant professor, his biggest challenge was finding a research niche.

That's no longer a problem. Buoyed by a National Science Foundation CAREER award and with a unique transmission electron microscopy (TEM) technique in his repertoire, Tan is following three lines of work in piezoelectric and ferroelectric materials. Each ranges from fundamental to applied science, which allows for creativity, productivity, and a singular place in a field crowded with teams and projects.

"What I proposed in my CAREER project was to find the correlation between chemical order and ferroelectric properties, and no one has ever done this before," says Tan. "Everybody else is working on new compounds with no attention to chemical order, so that is my unique contribution."

Piezoelectric and ferroelectric materials are used in sensors, filters, and communication devices to convert electrical signals into mechanical vibrations, or vice versa. For example, one of Tan's funding sources is the U.S. Department of Defense, which uses piezoelectrics to emit and receive ultrasonic waves for underwater communications.

Tan continued on page 9—

“Don’t lecture me”

Constant’s light touch gets the point across

Alan Constant enjoys bringing humor into his classrooms, so he must appreciate the irony of his title as “lecturer.” He is anything but.

Instead, he is a storyteller, a performer, a teacher at heart who infuses materials science classrooms with his energy and personality. He also knows his stuff, and hundreds of engineering students benefit from that knowledge each year.

“I just try to remember they’re a bunch of students like I was as an undergraduate,” Constant says, “and I thought the worst thing that could happen was to walk into a course and be lectured at.”

Most of the 200 or more students who file into *MatE 272: Principles of Materials Science and Engineering* probably expect a lecture. The required two-credit course gives non-MSE engineering students of varying backgrounds a sweeping overview: potentially a formula for instructional nightmare. Not under Constant’s watch.

“I always remind myself to remember my audience,” Constant says. “They’re not majors, and it’s not their first choice to be there.”

Constant remembers his audience by trying to be more like another student—albeit, a much more educated one—than a distant professor. He uses humor as the currency of communication, not by telling jokes, but by finding the lighter side of serious topics, preferring informality to jargon when possible. When he explains how atoms bond, a story unfolds about two people meeting: there is attraction, movement, repellence, then equilibrium, all performed by Constant and the surprised student he has randomly selected from the front row. With a segue into crystal structure, Constant makes his point and the class makes it through another topic.

“The truth is I don’t even know I’m doing it anymore,” Constant says. “I just try to make the stories as interesting as possible, and I try not to talk over their heads.”

But he does strive to stay in touch with what’s in their heads. “I have three kids, so it’s sometimes easy to do that,” he says, which explains how a PowerPoint slide featuring the buckles on a pair of pop-star Beyonce’s shoes has found its way into one of his presentations. The story is a long one, but the point comes back to powder metallurgy, and Constant’s hope is that the cultural reference will result in a scientific one.

“I’m a big-picture type of guy,” he says. “I figure it this way: if they’re having fun and they’re showing up, they’re going to learn more than if I hit them with fact after fact after fact.”

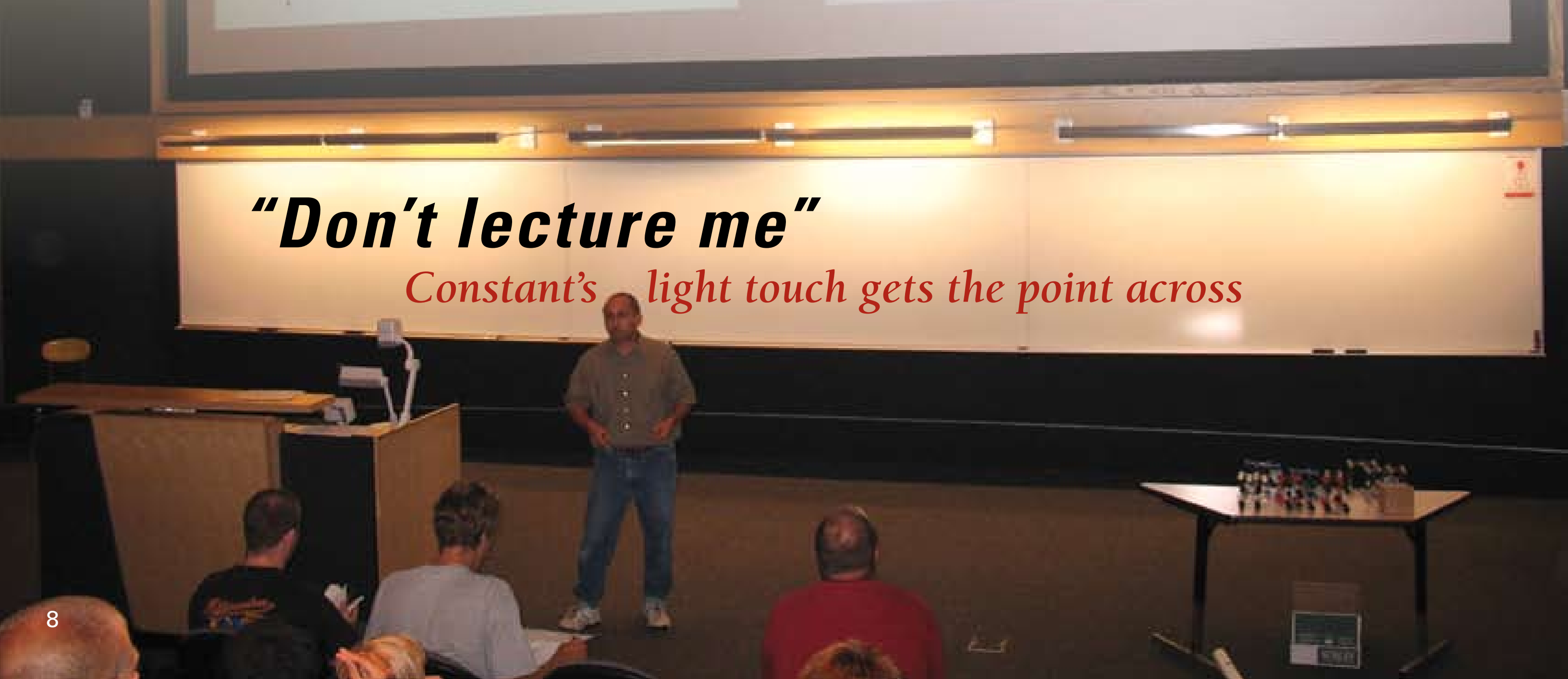
After all, Constant points out, “Nobody is going to build a plane based on what I tell them,” although that doesn’t stop him from extolling aerospace engineering students to pay attention to what he has to say about glass transition temperature.

“I could spend more time teaching them facts about it,” he says, “but I figure if they can remember the fact that there is such a thing as a glass transition temperature, that’s all I have to worry about.”

Of course, Constant does focus on more detail in upper-division courses, such as *Advanced Ceramic Materials*. But even there he makes the course accessible by making his presentations interesting. Students in all of his classes respond by giving him high evaluation scores.

“Alan is always at the top of the list for our instructors, and it doesn’t matter what course he’s teaching,” says Professor and Associate Chair **Larry Genalo**. “He takes the time to be there for students by holding extra help sessions when it’s convenient for them. He seemingly can teach any course in the department and do it well.”

“I love teaching,” Constant says. “Even if I had a bad day for other reasons, if I know I’m going to talk to a class, I know I’m going to have fun.”



ADVANCE
sees the science in diversity

Engineering may be a discipline in which calculus is the primary language and precision is an assumed standard, but in some ways it still defies logic. How is it, after all, that women make up more than half our nation's population but less than 12 percent of tenured or tenure-track engineering faculty at four-year colleges and universities?

"When you're cutting a significant fraction of the available workforce out of the running for reasons that are not relevant to the performance of the job, that just doesn't make sense at all," says Associate Professor **Kristen Constant**.

Addressing the issue is a central goal of Iowa State ADVANCE. The project, funded by a $3.3-million grant from the National Science Foundation, aims to develop and implement programs that enhance the recruitment, retention, and promotion of women scientists and engineers at Iowa State. Faculty members in several departments have been designated ADVANCE professors. Constant is one of them.

"One thing I'm trying to help people understand is that this is about evolving the whole environment to be more friendly to everybody," says Constant, who is quick to point out that this is neither about her nor is it as simple as a male-dominated field deciding "we need to be nice to them."

"A more diverse faculty results in better science," she explains. "There isn't anyone on the faculty who isn't interested in better science and a more prestigious department."

Constant notes that the issue extends far beyond the reaches of an academic department's halls. The nation is already struggling to educate enough engineers for its workforce, she says. And if the environment for women faculty is less than comfortable, the same will be true all the way down to undergraduate students. "It's more pervasive than just making sure that the faculty ranks have some equity," she says.

ADVANCE has initiated a three-step process, the first of which involved focus groups facilitated by social scientists. "The idea is that, in order to see real changes in the work environment, you really need to understand the culture at the department level," Constant says.

The results of those fact-finding sessions are being assessed in preparation for steps two and three: training and collaborative problem solving. Throughout the process, Constant acts as the intermediary between the university-level ADVANCE team and the MSE department.

Tan continued from page 7—

In terms of fundamental research, Tan is working to find correlations between the microstructure, composition, and property of new materials in order to "optimize or tailor the property for some specific applications." For more immediate application, he is working with Iowa State's Center for Nondestructive Evaluation to improve the effectiveness of ultrasonic transducers, which use piezoelectric materials to detect defects in large structures.

Tan is also involved in the search for effective lead-free piezoelectric materials, a pursuit that has taken on more significance because of legislative directives in Europe and Japan. (See "Lead-Free" on page 4.) Bismuth, a safer element, has emerged as a leading lead substitute. "Our idea is that we can use it to replace the lead completely or reduce usage of lead to a very large extent," Tan says. "Hopefully we can generate some new piezoelectric materials with properties comparable to the current lead-containing materials."

The third area of Tan's research focuses on magnetic ferroelectrics, a "very hot topic" that includes one of the latest technology buzzwords: spintronics. "This special material combines magnetic behavior with electrical behavior in the same oxide," Tan says. "If you apply an electrical field to this type of material, you can not only generate an electrical polarization, but you can also control the spin of the electrons."

Tan's methodologies in these areas are as distinct as the topics themselves. Data-rich informatics (see "The View from up There" on page 6) comes into play in the development of lead-free materials. That approach is contrasted with one that is much more instinctive: periodic tables showing ionic size and valence states are scattered around his office. "When I have time, I just stare at them to see what I can put together to form a new compound," he says. And when he has an idea, "it's just like cooking," he says of baking compounds in a high-temperature furnace. Yet his most distinct contribution continues to defy researchers around the world.

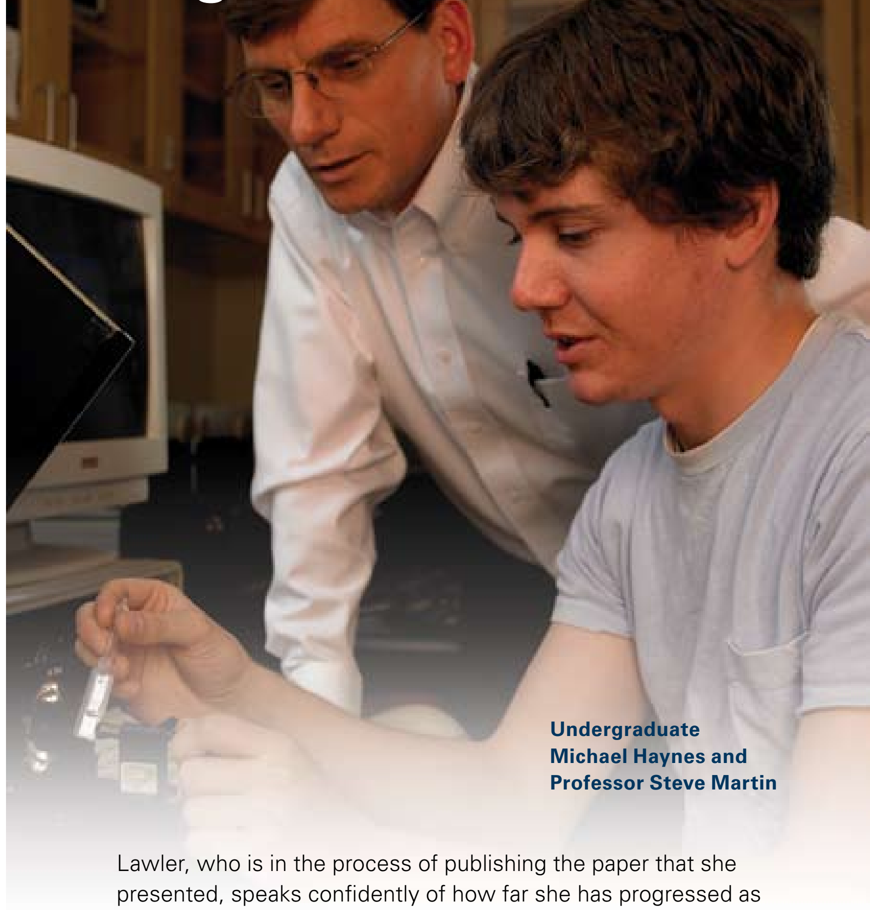
Through an experimental in situ TEM technique, Tan says he can control the electrical field and the temperature of a sample at the same time, allowing him to observe the microstructure of the sample and see down to nanometer scales, or sometimes even atomic scales. "I know of several groups that have been trying to do this, and they have not been successful," he says. "But we have a few tricks."

Research reinforces undergraduate lessons

Undergraduate research is growing in popularity as students show more interest in being mentored and universities emphasize experiential education. For engineering students, co-ops, internships, and international exchanges have traditionally been avenues for gaining first-hand experience.

Today, undergraduate research is becoming a more prevalent part of an integrated curriculum that focuses on creative problem solving and critical thinking under the guidance of a mentor. High-performing MatE students may choose from a wide variety of opportunities to assist professors with research that includes materials development, characterization, analysis, and testing.

The MatE students highlighted here vary greatly in experience and background, but all of them see the benefits of hands-on experience in a laboratory, and they each hope to parlay that experience into successful graduate study and professional careers.



Undergraduate Michael Haynes and Professor Steve Martin

Enriching the academic journey

Katherine Lawler knew that she wanted to be an engineer and that she wanted to attend Iowa State, and after a summer experience in the Women in Science and Engineering program, she knew what she would study.

"I had a really good experience that summer working for Dr. **Steve Martin**, so I declared materials engineering and nothing has turned me away from it," says Lawler, a senior this year who is also in the concurrent BS/MS program. "I've worked for him in his lab throughout my years here."

Lawler has been working on the characterization of a glass system as part of the Glass and Optical Materials group. The work took her to Rochester, New York, to present a paper this summer. She has also traveled to Korea as part of a collaboration with the Korea Institute of Technology regarding lithium battery anode materials.

"It's prepared me for the future," says Lawler, who plans to go on for her PhD. "The research is making me more aware of what goes on in the other side of academia. You could go through all your college years and maybe have some lab assignments, but you would never have a project where the end is not defined."

A summer internship for Momentive Performance Materials in Cleveland, Ohio, resonated well with the lab experience, reinforcing Lawler's appreciation for undergraduate research. "Once you get an engineering job, you don't get out of the lab," she says, "so even if you plan to go into industry straight from school, any research you do in college will help you."

Lawler, who is in the process of publishing the paper that she presented, speaks confidently of how far she has progressed as an undergraduate. "I'm not in high school anymore," she says. "Working in a research position makes you more savvy. I can draw on my experiences from working in different labs, so if in the future I have a problem and I need to run some tests to see what's going on, I'll be in a better position to know what to do."

A matter of practice

Wilber Lio doesn't have a great deal to say about his work in general, but maybe that's because he has such a great deal to do.

In his fifth year at Iowa State, and hoping to enter the concurrent BS/MS program, Lio is a materials engineering and music double major who may just be adding a Spanish minor after studying in Mexico this fall—all in addition to working with Assistant Professor **Michael Kessler** in his Polymer Composites Research Group.

In the spring, Lio worked with Kessler to write a proposal, and he spent the summer evaluating adhesive properties. Although much of the work involves composites for aircraft applications, Lio is interested in eventually pursuing "bio-type fields" such as biomaterials or biomedical engineering. "I'm sure I'll find some connection to use my lab experience in the future," he says.

The lab work, which takes place in Gilman Hall, gives Lio the opportunity to work with specialized equipment. While performing lap shear tests, for example, he uses an Instron machine to determine the maximum loads of various adhesives. “The experience of doing research involves learning how to formulate educated hypotheses and the different means with which to test them,” Lio says. “It’s kind of like practicing for the work I’ll do someday.”

As a violinist for the Iowa State University Symphony Orchestra, Lio knows all about practice, although he hopes that his practice in the lab will one day result in a PhD and a materials science research career.

Anticipating opportunity

For **Elease McLaurin**, an incoming freshman from Clinton, Mississippi, undergraduate research experience is still in the future—her immediate future, that is. After her resume circulated through the department, she learned that she had caught the attention of Professor **Krishna Rajan**, Stanley Chair of Interdisciplinary Engineering, director of the international combinatorial sciences and materials informatics collaboratory, and director of Iowa State’s Institute for Combinatorial Discovery. Now she’s going to be part of his team.

“I was amazed by Dr. Rajan being open to let a freshman into his research group,” McLaurin says. “He told me to be an ‘intellectual tourist’ by continuing to explore my interests.”

Those interests originated in a young girl who liked tearing apart and reassembling her toys and germinated at science camps through the years. But McLaurin’s more grown-up research interests were inspired by a “Bill Nye the Science Guy” episode on prosthetics. “That got me interested in materials as a process,” McLaurin says. And that curiosity led to a more specific interest in polymers, which McLaurin may someday apply to biomedical pursuits.

Whatever path she chooses, McLaurin sees research as a complement to coursework. “I think they will actually support one another,” she says. “The research will provide a concrete application of what I’m learning in the classroom.”

There may be plenty of research and classrooms in her future. McLaurin, a National Merit and Achievement Scholar and a George Washington Carver Scholar, is interested in earning her PhD and becoming a professor.

Material Advantage leads the nation again

With a fourth national title in a row, the Iowa State student chapter of Material Advantage has gone from “three-peat” to dynasty. The chapter can now claim the distinction after having captured the 2007 Most Outstanding Chapter Award. Chapters from throughout the country entered the competition, making Iowa State’s accomplishment even more remarkable. The chapters were scored for programming, career development, service, social activities, and chapter management. Winning the national title yet again underscores Iowa State’s consistent achievements in those categories. The award was presented in September at the 2007 Materials Science and Technology Conference and Exhibition in Detroit, Michigan, to which MSE sent 22 students.

Undergraduate Students
Jobs After Graduation—2006–07

Job Title	Company/Institution/Location
	Rock Island Arsenal
Manufacture Engineer	John Deere—Ankeny, IA • Quad Cities • Waterloo, IA
Teacher	Japan, Teach English
	Etrema Products, Inc., Ames, IA
	U.S. Steel, Gary, IN (3)
	Fisher Controls, Marshalltown, IA
	Rolls-Royce, Indianapolis, IN
Component Engineer	Rockwell Collins, Cedar Rapids, IA
Engineer	Carleton Life Support Systems, Davenport, IA
Grad School	Northwestern University, PhD Program • Iowa State University, Ames, IA (2)
Grad School	Georgia Tech University, Atlanta, GA (PhD Program in Polymer Engr.) • University of Illinois at Urbana–Champaign (PhD) • Goodrich Turbine Fuel Technologies, West Des Moines, IA
	Caterpillar, Peoria, IL (2)
	John Deere, Quad Cities
Medical School	Currently Applying

2007–08 Awards Banquet

MSE Scholarship and Award Recipients

The 2007 MSE Spring Awards Banquet was held April 18 at the Knapp-Storms Center on the Iowa State campus. Guest speaker Iver Anderson, MSE adjunct professor and senior metallurgist at Ames Laboratory, delivered a presentation titled "Lead-Free Solder: Improving our Environment and our Electronic Tools and Toys." Student scholarship recipients were acknowledged at the banquet, and retiring Professor Thomas D. McGee was honored for 50 years of service.

Alcoa Foundation Scholarship
Benjamin Pierce

Arie and Catherine Breed Scholarship
Charles Fisher

Otto and Martha Buck Materials Science and Engineering Scholarship
Kyle Sears

Clayton Family Scholarship for Studies in Powder Metallurgy
Amy Bergerud*

Jack and Dilla Cosgrove Scholarship
Andrea Siefers

Deere Foundation Scholarship
Jace Indrelie
Nicholas Martinez
Kathryn Schlichting *

O. Robert Eddy Scholarship
Jason Britson *

College of Engineering Scholarship
Amy Bergerud *
Jason Britson *
Kara Christensen
Molly Grisham
Trenton Jacobson
Alyson Lieser
Matt Poulter
Daniel Putnam
Benjamin Rattle
Pylin Sarobol *
Kathryn Schlichting *
Alexander Smith
Erin Sunseri
Jarrett Wendt

Engineering Leadership Program Scholarship
Scott King
Leo Salat

Engineers Week Scholarship
Craig Ament
Laura Barker
Travis Brammer
Jennifer Byer
Jeffrey Czerniak
Emily Decker
Rachel Hawkins
Wilber Lio
Katelyn Mathews
Samantha Meyer
Anne Stockdale
Michael Vosatka

Herb Erbe Scholarship
Jarrett Wendt

Fehr-McGee Scholarship
Pylin Sarobol *

Murray Gautsch Scholarship
Greg Vetterick

Frank Kayser Scholarship
Timothy Cleveland

Mary and Donald Martin Memorial Scholarship
Fabian Stolzenburg

Materials Science and Engineering Scholarship
Adam Boesenberg
Travis Brownlee
Dan Cavanaugh
Adam Duzik
Brian Ferguson
Nathaniel Grinvalds
Michael Haynes
Michael Horras
Daniel White

Micron Technology, Inc., Scholarship
Joshua Frederick
Matthew Goodman
Katherine Lawler
Nathaniel Oster •

Ralph S. Millhone Scholarship
Andrew Miller •
Sara Moser •
Cory Sents •
Adam Stone •
Morgan Walter •
Emma White •

David T. Peterson Scholarship
Paul Czyz

Harry Oakley Price Scholarship
James Lauer
Sarah Nevole

Rockwell International Scholarship
Emily Merrick

Claude R. and Christina A. Summers Scholarship
Alexander Smith

Samuel Walker and Jennie Morrison Beyer Scholarship
Brett Krull

Weiss–Hanson Scholarship
David Lantz

David R. Wilder Scholarship in Materials Science and Engineering
Benjamin MacMurray

George Washington Carver Scholars
Joshua Frederick
Wilber Lio
Nicholas Martinez
Emily Merrick
Eric Ostrander

National Merit Scholars
Andrew Miller
Sara Moser
Sarah Nevole
Nathaniel Oster
Cory Sents
Adam Stone
Morgan Walter
Emma White

Chair Richard LeSar, presenter, Nathan Fischer

Krista Briley, staff

Jason Britson

National Hispanic Scholar
Nicholas Martinez

* *received scholarship funding from two sources*
• *scholarship supporting National Merit*

2006–2007 MSE Special Awards

MSE Outstanding Senior Award
Nathan Fischer

MSE Student Leadership and Service Award
Charles Fisher

Rohit Trivedi Best Student Paper Award
Jun Xu

Zaffarano Prize for Graduate Student Research
Sergiy Peleshanko

MSE Graduate Research Excellence Award
Sergiy Peleshanko
Hang Yan Yuen

Mufit Akinc MSE Excellence in Teaching Award
Zhiqun Lin

Mufit Akinc MSE Excellence in Research Award
Xiaoli Tan

Mufit Akinc MSE Excellence in Service Award
Krista Briley

Xiaoli Tan, faculty

Additional Awards for MSE Faculty, Staff, Students, Alums—2006–07

Iver Anderson, Adjunct Professor	2006 Iowa Inventor of the Year awarded by the Iowa Intellectual Property Law Association
Amy Bergerud, MSE Undergraduate	ISU Scholar Award (Top 2%)—Senior Class
Jason Britson, MSE Undergraduate	ISU Scholar Award (Top 2%)—Senior Class
Alan Constant, Lecturer	Superior Engineering Teacher Award
Charles Fisher, MSE Undergraduate	ISU Homecoming Cardinal Court 2006
Joshua Frederick, MSE Undergraduate	ISU Scholar Award (Top 2%)—Senior Class
Karl Gschneidner, Jr., Distinguished Professor	Patent Recognition at Marston Club and Patent Dinner, April 2007
Youngsik Kim, PhDMSE'06	Norbert J. Kreidl Young Scholars Award from the Glass and Optical Materials Division of the American Ceramic Society for his thesis research on the lithium ion conductivity of lithium germanium oxy-sulfide glasses
Katherine Lawler, MSE Undergraduate	2007 Alfred R. Cooper Young Scholars Award in Glass Science and Technology Best Looking Mug Contest Runner-Up at MS&T Conference, October 2006
Benjamin MacMurray, MSE Undergraduate	ISU Scholar Award (Top 2%)—Junior Class
Surya Mallapragada, Professor	"Rising Star" innovator by the Big 12 Conference Patent Recognition at Marston Club and Patent Dinner, April 2007 Fellow, American Institute of Medical and Biological Engineering
Lawrence Margulies, PhDMSE'99	ISU-COE Professional Progress in Engineering Award
Steve Martin, University Professor	Patent Recognition at Marston Club and Patent Dinner, April 2007
Nan Mu, MSE Graduate Student	Gordon Research Conference Best Student Poster Award, August 2007
Andrew Nelson, MSE Undergraduate	ISU Alumni Association Wallace E. Barron All-University Senior Award ISU Homecoming Cardinal Court, 2006
Vitalij Pecharsky, Distinguished Professor	Patent Recognition at Marston Club and Patent Dinner, April 2007
Dan Shechtman, Professor	Honorary Member, Japan Institute of Metals
Xiaoli Tan, Assistant Professor	Young Engineering Faculty Research Award
Bruce Thompson, Distinguished Professor	One of 150 VISIONaries (recognized in the Alumni Association publication *VISIONS*—University 150th Celebration Edition) 2007 Research Award for Sustained Excellence from the American Society for Nondestructive Testing Research Council

Inductees

The Department of Materials Science and Engineering has added two more members to the MSE Hall of Fame. Karl A. Gschneidner, Jr., and R. Bruce Thompson, both members of the National Academy of Engineering, bring decades of professional success and international recognition to the exclusive collection of MSE luminaries.

Hall of Fame inducts new members

Karl A. Gschneidner, Jr.

The sort of awards that imply lifetime achievement are coming Gschneidner's way, which would be expected from a productive 50-year career, but he intends to do plenty more achieving. "It's nice to be recognized and to know that other people support you," he says. "But people ask me if I will retire and I say, 'Why should I?' Think of me as a ballplayer: I can still hit home runs with the best of them, so why should I quit when I can help the team win ball games?"

Gschneidner's major advances in magnetic refrigeration are an oft-referenced career highlight, although the Anson Marston Distinguished Professor in MSE and senior scientist at the U.S. Department of Energy's Ames Laboratory is also recognized internationally for his body of work with rare earth materials, including the Frank H. Spedding Award from the Rare Earth Research Conference. He has been a faculty member at Iowa State since 1963, during which time he has learned to "roll with the punches" in the increasingly competitive arena of research. "If I see something anomalous, I say to myself, 'This looks like an interesting problem.' It's lots of fun and it keeps me young."

R. Bruce Thompson

A career with its beginnings in a "specialized, enabling" field has paralleled the establishment of nondestructive evaluation (NDE) as an important scientific discipline. NDE involves the testing of a material's ability to perform its intended function and prevent failure without destroying the sample. Thompson, who entered the nascent field in the early 1970s, is widely acknowledged for his contributions to NDE, including work to enhance aviation safety. He is the director of Iowa State's Center for Nondestructive Evaluation, director of the Ames Laboratory Applied NDE Program, and Anson Marston Distinguished Professor in MSE and aerospace engineering.

As materials structure and usage changes, thus presenting NDE with new challenges, Thompson continues to be motivated by intellectual curiosity, the interdisciplinary nature of his work, and the opportunity to make a difference in society. "To be part of something that has obvious practical impact and saves lives, that's personally rewarding," Thompson says. "The materials science department is one of the proud traditions of Iowa State, so it's a great honor to be recognized."

Job Title	Company/Institution/Location
Chemist	Hewlett Packard Research Center, San Diego, CA
	Intel, Hillsboro, OR
Grad School (3)	Iowa State University, Ames, IA, *PhD* • University of Minnesota, Minneapolis, MN
	University of Illinois at Urbana–Champaign, Urbana, IL, *MatSE department*
High-Temperature Corrosion Engr.	Haynes International, Inc., Kokomo, Indiana
Materials Engr.	Rolls-Royce, Indianapolis, IN, *Joining and Brazing Group*
Materials Research Engr.	ATK Thiokol, Promontory, UT
Materials Researcher	Whirlpool Research Center, Benton Harbor, MI
Patent Examiner	U.S. Patent and Trademark Office, Alexandria, VA, *metallurgy and materials science-related patents*
Postdoc (6)	Rensselaer Polytechnic Institute, Troy, NY • Clarkson University, Potsdam, NY
	Iowa State University, Ames, IA (3) • Northwestern University
Process Engr.	Micron, Boise, ID
Senior Associate Engr.	Caterpillar Technology Center, Messville, IL

McGee honored for 50 years of service

Thomas D. McGee, alumnus and professor, was honored for 50 years of service to the Department of Materials Science and Engineering at a retirement reception on May 22.

McGee began his career at Iowa State in 1956 as an assistant professor in ceramic engineering. He concluded it while holding full professorships in MSE and in biomedical engineering, and as a collaborator with Veterinary Clinical Services on a courtesy appointment.

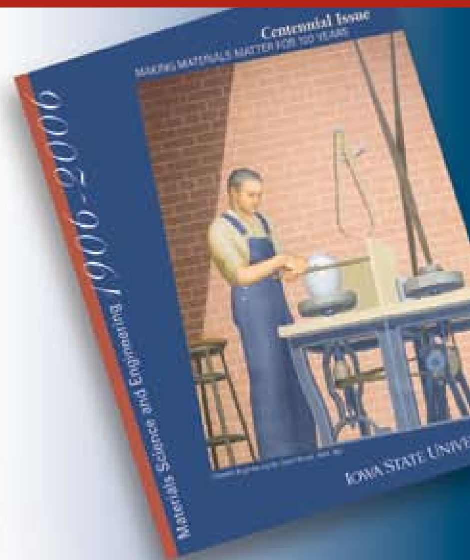
Ten patents resulted from McGee's development of bioceramics for producing reconstructed bone, and he is the owner of Osteoceramics, Inc., a start-up company for biologically active orthopedic implants. Additional highlights of McGee's career include the following:

- *Outstanding Engineering Educator, Engineering Student Council (2001)*
- *Greaves Walker Award, National Institute of Ceramic Engineers (1991)*
- *Faculty Citation, Iowa State Alumni Association (1988)*
- *Outstanding Professor, Ceramic Engineering, Engineering Student Council (1983)*
- *Fellow, American Ceramic Society (1979)*

He also served as the major professor for 30 PhD and 20 MS students, several of whom are currently or have served as Iowa State faculty and/or MSE Industrial Advisory Council members and two who received MSE's Hall of Fame Award.

McGee graduated from Iowa State with BS degrees in ceramic engineering and mechanical engineering in 1948, an MS in industrial engineering in 1958, and a PhD in ceramic engineering and metallurgy in 1961.

President Gregory L. Geoffroy and MSE Chair Richard LeSar presented Professor McGee with a commemorative gift.



Centennial issue wins two design awards

MSE's centennial issue newsletter, *Making Materials Matter for 100 Years*, received two regional awards in January from the Council for Advancement and Support of Education.

The publication was given a silver award for "Excellence in Graphic Design, Series or Multiple-Piece Project—Four or More Colors." A bronze award was given for "Excellence in Graphic Design, Newsletter/Tabloid."

Both awards cited the work of Carol Melvin, a graphic designer for Engineering Communications and Marketing.

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

Symposium unveils atom probe

A full-day symposium, "Atom Probe Tomography: Opportunities and Challenges for New Materials Science," was held on May 30, coinciding with the official opening of the local electrode atom probe at Iowa State's W. M. Keck Laboratory for High Throughput Analysis of Atom Scale Chemistry.

The $1.6-million atom probe, which is one of only four such instruments in American academic institutions, provides scientists with the unprecedented ability to spatially resolve millions of individual atoms and molecules and their chemistry in three dimensions.

Data from the new atom probe are already being integrated with the BlueGene/L supercomputer and the revamped C6 virtual reality room to provide unmatched capabilities for analysis and visualization of atomic structure.

The symposium also featured lectures from groups in Australia and participants from other overseas laboratories being presented via online links.

The researchers leading the lab are **Krishna Rajan**, director of the international combinatorial sciences and materials informatics collaboratory, Stanley Chair in Interdisciplinary Engineering, director of Iowa State's Institute for Combinatorial Discovery, and professor of materials science and engineering; **Balaji Narasimhan**, associate dean for research and economic development, and professor of chemical and biological engineering; **Andrew Hillier**, associate professor of chemical and biological engineering; and **Sriram Sundararajan**, assistant professor of mechanical engineering.

The symposium was sponsored by the National Science Foundation's International Materials Institute for Combinatorial Sciences and Materials Informatics Collaboratory, the W. M. Keck Laboratory, and the Richard H. and Mary Jo Stanley Foundation.