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MatSE

Department of Materials Science and Engineering **News**

College of Engineering | University of Illinois at Urbana-Champaign | Winter 2013

Self-Organization at the Nanoscale

Self-organized nanostructures possess properties that improve material's performance such as wear resistance

In this issue:

Welcome new faculty members

Scholarship pays tribute to MatSE alumna

Celebrating alumni and student achievement

Greetings from Urbana

MatSE Alumni News

Department of Materials Science and Engineering

David Cahill
Department Head

Cindy Brya
MatSE Alumni News Editor

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Cover Figure:
Spontaneous nanolayering in Cu90Ag10 alloy subjected to dry sliding wear. The layering is revealed by Z-contrast scanning transmission electron microscopy. Ag precipitates, originally equiaxed, evolved into nanolayers, which improve wear resistance (Courtesy of Dr. Fuzeng Ren).

One of the perks of being the department head is that I get to meet dozens of highly-accomplished and supportive alumni. We inevitably get to talking about the goals of the department and how the alumni can help us achieve those goals.

Simply put, our goals are to educate the world's best materials scientists and engineers, to produce the world's best scholarship in the field of materials science and engineering, and to translate our accomplishments in education and research into societal impact. I think that, by any measure, we are doing well in all three areas. Financial support from the campus and College of Engineering is currently strong, but within the next several years, private giving by individuals, foundations, and corporations will become ever more critical for further improving the high quality of our education and research programs.

Private giving helps us in three main ways: accessibility, student engagement, and excellence of faculty scholarship. We feel strongly that all students of talent and commitment should be able to afford a MatSE education. The department currently grants $130k per year in scholarships and awards. Many students, however, have extensive unmet financial need. Growth of the endowed scholarship funds will allow us to meet a larger fraction of financial need in combination with College of Engineering and campus grants.

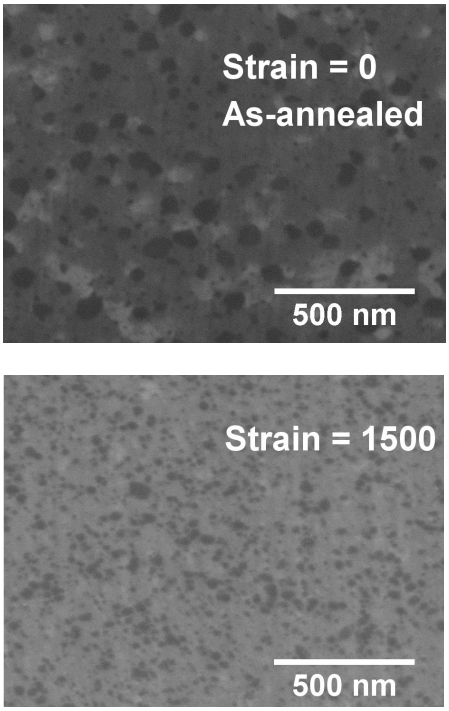
Donations to the department support many of the out-of-the-classroom experiences that are so important in creating the hands-on education for which Engineering at Illinois is known. The department operates 7 instructional laboratories that serve more than 200 students each year. Endowments for the labs will allow us to improve instruction by hiring additional staff and expand course offerings. Major gifts for purchase of equipment will enable us to make available tools, e.g., 3D printing, that can be used for instruction and design. Donations to the annual fund support student-led project teams and the professional development activities of our student societies.

The excellence of faculty scholarship is tightly coupled to the excellence of the Ph.D. candidates enrolled in the department. A major gift from Don Hamer helps us recruit top students by providing supplemental fellowships to incoming Ph.D. students. Building on this foundation of endowment for fellowships will enable us to provide continuing support and to impact a larger number of students. We have made tremendous progress in updating the venerable Materials Science and Engineering Building but much remains to be done. Major gifts for lab renovations will allow us to create world-class research space for faculty and students.

I would like to extend a special thank you to the alumni whose names are listed in the donor recognition section of this newsletter. Your gifts help us remain one of the top materials programs in the nation. To all our alumni, we ask that you remember MatSE in your year-end giving plans.

Sincerely,

David Cahill
Willett Professor and Head



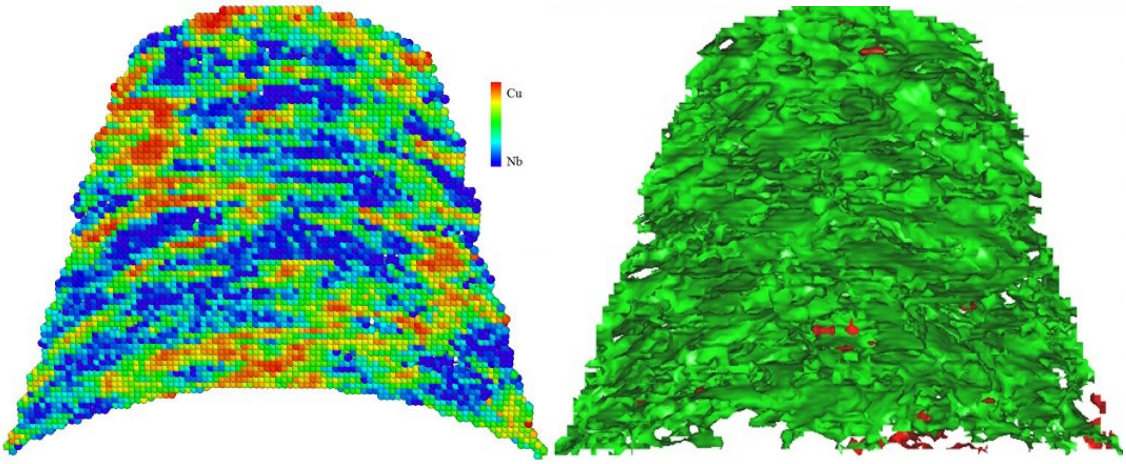


Figure 2 (left): Cu80Nb10Ag10 alloy imaged by scanning electron microscopy after (top, a) fabrication by ball milling and annealing at 600˚C for 1 hour to induce the precipitation of Nb (appearing darker than matrix) and Ag (appearing brighter than the matrix); (bottom, b) and after deformation by high pressure torsion to a shear strain of 1,500 (Courtesy of Miao Wang).

Figure 3 (top): Cu50Nb50 nanocomposite stabilized by high pressure torsion strains of ≈ 2,000, imaged by atom probe tomography: (left,a) atomic composition map; (right,b) high density of interfaces delineating the biconnected Cu-rich and Nb-rich phases (Courtesy of Tim Lach).

Nanoscale self-organization in metallic alloys subjected to severe plastic deformation

Metallic alloys are often subjected to plastic deformation, for instance during fabrication by powder metallurgy routes, during shaping by rolling, forging, or extrusion, and in service, in particular when subjected to sliding contact. Severe plastic deformation imposed by sliding contact can lead to wear and early failure, in systems such as bearing materials. In collaboration with Profs. Averback and Dillon, we have been investigating the evolution of model metallic alloys in response to severe plastic deformation at low processing temperatures. We have identified a new general phenomenon, which is the tendency of these materials to self-organize at the nanoscale. Remarkably, these self-organized nanostructures possess properties that may improve the performance of these materials. For instance the nanolayering illustrated in the Cover Figure leads to an improvement of the resistance to sliding wear. The formation of fine scale nanocomposites, see Figure 2, translates into an increase of interface area per unit volume, which increases hardness and the capacity for trapping point defects for nuclear applications.

Our previous research for the past two decades has established that materials subjected to severe plastic deformation at elevated temperature can self-organize. This self-organization results from a competition between the refinement of the alloy microstructure imposed by plastic deformation and the coarsening of the microstructure promoted by thermally activated diffusion. Our recent work has however shown that self-organization can even take place at temperatures where thermally activate diffusion is limited or negligible. This is a surprising result from a fundamental perspective. It also indicates that self-organization is a more general phenomenon than previously thought and that it can be used to design materials with improved properties. As illustrated, in cases where severe plastic deformation results from service conditions, self-organization provides in fact a pathway for materials to spontaneously improve their performance while in service.

One such example was found in our study of the wear resistance of model Cu-Ag alloys, where Ag precipitates are distributed in a Cu matrix. Our research has shown that, if the initial Ag precipitate size is within a suitable range, shear deformation imposed by sliding at room temperature leads to the spontaneous formation of very thin Ag layers, which persist up to the sliding surface, see the Cover Figure. In this case, the wear resistance is measured to be significantly increased, by a factor 2 to 20 for the conditions we have explored so far. This work has been supported by research grants from the National Science Foundation, and has provided the basis for a new project supported by the BP-ICAM. One possible area of application is the

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Schleife and Shoemaker join MatSE

Andre Schleife

Daniel Shoemaker

The MatSE Department welcomes two new faculty members in the 2013-14 academic year: Daniel Shoemaker and Andre Schleife.

Andre Schleife received his Ph.D. from Friedrich-Schiller University in Jena, Germany, in 2010. Schleife's research is focused on computational materials science. His group will study excited electronic states and their dynamics in various materials using computational methods. "My research will make use of modern super computers in order to understand, for instance, how light is absorbed in photovoltaic materials," Schleife said. "Ultimately, I would like to build the knowledge necessary to design new and better materials for various applications entirely based on simulations. Admittedly, this is still a great challenge that requires experimental and theoretical scientists working hand in hand."

The advantages of computational materials science, according to Schleife, are that researchers can rely more on simulations in situations where experiments are very expensive, or as in the case of radiation-matter interaction, dangerous. He chose the University of Illinois because of the excellent people and excellent resources. "Illinois is in the unique position of having the National Center for Supercomputing Applications with the Blue Waters Super Computer in-house," Schleife said. "In other words, this is the ideal place for my type of research."

Schleife comes to Illinois from Lawrence Livermore National Laboratory. His honors include the Heptagon "Sven-Buehling" Prize for outstanding graduate student research from Friedrich-Schiller University and the Physical and Life Sciences Directorate Outstanding Postdoc Award from Lawrence Livermore National Laboratory.

In the spring 2014 semester, he will teach Atomic Scale Simulations (MSE 485). He is looking forward to training the next generation of scientists and getting them excited about computational materials science and its many applications.

Daniel Shoemaker (BS MatSE '06) received his PhD from the University of California, Santa Barbara, in 2010. His research group is focused on materials chemistry, looking to synthesize new inorganic materials and uncover routes to engineer their response to stimuli. "By making new crystal structures with functional properties, we expand the library of available materials to drive innovation, make devices, and alter the landscape of sustainability and energy security," Shoemaker said. "We are building a synthesis laboratory where we use real-time x-ray and optical techniques to probe how new electronic, magnetic, and optical materials can be grown at low temperatures from liquids."

Half of his group's work is application-driven and the other half concerns the mechanisms. "We love to test theoretical predictions by hunting down computationally proposed compounds, making them, and explaining their properties," he said. Shoemaker joined the MatSE faculty in August, following a postdoctoral appointment in the Materials Science Division of Argonne National Laboratory. His honors include the Graduate Student Gold Award from the Materials Research Society and the 23rd Louis Rosen Thesis Prize from the Los Alamos Neutron Scattering Center.

He is teaching Synthesis of Materials (MSE 403) in the fall semester and Microstructure Characterization (MSE 405) in the spring. Shoemaker is excited to return to the University of Illinois as a member of the MatSE faculty. "As professors we provide instruction and guidance, but real learning and achievement happens in the minds and hands of the students. That's where the exciting progress is found," he said.

New imaging system could lead to breakthroughs in nanomedicine

A $300,000 grant from the Roy J. Carver Charitable Trust has made possible the purchase of a live animal imaging system on the UIUC campus. The new system will primarily be used by campus researchers in the area of nanomedicine.

"The live animal imaging system provides the ultimate combination of sensitivity, speed and flexibility to meet the most demanding challenges for molecular and nanomedicinal in vivo imaging," said Jianjun Cheng, the principal investigator for the grant-funded project.

According to Cheng, the in vivo quantitative assessment of molecular or nanoparticular signals in live animal in real time is extremely challenging but absolutely necessary. "The imaging system is designed for demanding requirements for high sensitivity luminescence, fluorescence, radiographic and X-ray imaging, and will enable the precise and quantitative assessment of targeting efficiency" he said.

In addition to the proposed work to develop orthogonal chemistry mediated cancer targeting, the new imaging system will be used in many other projects by Cheng and his co-PIs. These include aptamer-nanomedicine targeting, in vivo siRNA and gene delivery, dual functional theranostic nanomedicine, and more. The new imaging system will also be available to the many research groups on the UIUC campus that have active research projects involving live animal imaging.

Co-PI's on the project include Yi Lu, Department of Chemistry; Timothy Fan, College of Veterinary Medicine; William Helferich, Department of Food Science and Human Nutrition; and Wawrzyniec Laurence Dobrucki, Department of Bioengineering.

Dillon receives CAREER Award to study light-absorbing photocatalysts

Engineering Communications Office

Shen Dillon

Efficiently converting sunlight and water into hydrogen—through a process called "photolysis"—is an attractive approach to producing "green" fuels that could support the future U.S. economy. Shen Dillon has recently received a National Science Foundation CAREER Award to provide an improved scientific basis for designing efficient and inexpensive nanostructured visible light absorbing photocatalysts.

"A variety of catalysts have been known to perform photolysis for several decades, but many remain too inefficient or expensive for commercial application," explained Dillon, whose long-term research vision includes developing fundamental science underpinning ceramic-based energy storage and conversion systems.

Photocatalysts may be improved most effectively by controlling their electronic structure, which depends on variables such as particle size, shape, chemistry, defect structure, or their interactions with adjoining materials.

"Our approach seeks to characterize structure-properties-performance relationships for individual photocatalytic oxide heterojunction nanostructures as a function of scale," Dillon added. The study is enabled by the development of macroscopically supported geometrically defined single heterojunction nanowires and quantitative in-situ photocatalysis in the transmission electron microscope (TEM).

According to Dillon, the project also incorporates a significant educational component.

"The activity integrates research and education through a research experience for science education majors (RESEM) program that will impact K-12 students through improved teacher experience and education. Two teachers will participate each year throughout the five-year project. Special emphasis will be placed on research experience for undergraduates (REU) during the academic semesters and developing research-based teaching methods for undergraduates.

The National Science Foundation's Faculty Early Career Development (CAREER) Award Program provides five years of financial support for "junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations."

Dillon received his Ph.D. in Materials Science and Engineering from Lehigh University in 2007. Following graduation, he went to work as a Research Associate at Carnegie Mellon University and Visiting Professor at Lehigh University. Dillon spent the 2008 academic year as a Visiting Research Scientist at the Massachusetts Institute of Technology working on materials for energy storage. He joined the University of Illinois faculty in 2009 and received a Department of Energy Early Career Award in 2011.

Nanoscale self-organization, continued

development of high performance bearing materials.

Another case of self-organization has been identified in Cu-Nb alloys subjected to high-energy ball milling and to high pressure torsion at room temperature or below. The former technique is a common powder processing technique for fabricating alloys with extended solubilities. The second technique is of fundamental interest as it makes it possible to subject samples to extremely large and quantifiable strains, up to several thousands. In the case of alloys with rather low Nb content, e.g., 10 at. %, it was found that at large strains all Nb precipitates converge toward an average diameter of ≈ 20 nm, as illustrated in Figure 2b. This length scale selection is remarkable since the initial microstructure contains precipitates that are initially much larger, see Figure 2a. At the same time, the number density of precipitates increases significantly, and this despite the fact that the temperature is too low for thermally activated diffusion to contribute to this phenomenon.

At higher Nb concentration, for instance for equiatomic composition, deformation of Cu-Nb nanolaminates by high pressure torsion leads to the spontaneous formation of three-dimensional nanocomposites, with a characteristic length scale ≈ 5 to 10 nm, as illustrated in Figure 3. The resulting high interfacial area makes this type of nanostructures attractive for trapping point defects in materials that could be used in advanced nuclear reactors.

Contributors to this work include Profs. Robert Averback, Shen Dillon, and Pascal Bellon; post-doc Dr. Fuzeng Ren; graduate students Miao Wang, Elvan Ekiz, Tim Lach, Salman Arshad; visiting scholar Prof. Hongyun Luo (Beihang University, PRC); and external collaborators Prof. Horst Hahn and graduate student Mohsen Pouryazdan (Karlsruhe Institute of Technology, Germany) and Dr. Nate Mara (Los Alamos National Laboratories). The work was funded by NSF-DMR and DOE-BES via the CMIME EFRC at LANL.

Department Notes

John Rogers has been named a permanent member of the Center for Advanced Study at University of Illinois, the highest form of academic recognition that can be bestowed on a member of the faculty. The Center for Advanced Study brings together scholars from diverse disciplines and backgrounds and encourages and rewards excellence in all areas of academic inquiry. These distinguished academics include among others: a Nobel Laureate; a National Book Award winner; a MacArthur Fellow; and a Pulitzer Prize winner, along with many members of the National Academies of Sciences and Engineering.

The following MatSE instructors made the List of Teachers Ranked as Excellent by Their Students for the spring 2013 semester: **Mohamed Aboukhatwa, Les Allen, Andy Ferguson, Nate Gabrielson, Ken Schweizer,** and **Dallas Trinkle**. Nate Gabrielson achieved the rank of outstanding (top 10% for both overall teaching effectiveness and overall quality of course).

Yuyan Hua and **Sam Rappeport** were recognized as outstanding interns by the Research Park at the University of Illinois. Hua was recognized for Best Entrepreneurial Leadership in a Startup, and Rappeport was a finalist for Most Valuable Undergraduate Student in the Research Park.

Ke Yang, Ph.D. student in the Moore group, attended the 15th National School on Neutron and X-Ray Scattering, hosted by Argonne National Lab and Oak Ridge National Lab, and led the group that won the first presentation award.

Mansi Agarwal, Christian Espinoza Santos, Yu-Hao (Howard) Liu, Sujin Seo, and **Zichao Ye** were named Racheff Teaching Fellows for the 2013-2014 academic year.

Qian Yi, Brett Krull, and **Chunjie Zhang** have received 3M Fellowships.

Aaron Brown

Aaron Brown is a new Account Technician in the MatSE business office. He has a B.S. in Industrial Technology from Eastern Illinois University. Brown started his career as a Quality Engineer at an aerospace manufacturer in Danville, IL, with responsibilities for Pratt Whitney and Pratt Whitney Canada. After 2 years, he accepted a position as an Industrial Engineer with FedEX Ground in Champaign, where his responsibilities included process/productivity improvement, building layout, and sort planning. After 5 years with FedEX, he accepted a position with a large forging operation as a Steel Buyer/Inventory Specialist. There he worked with companies such as Timken, Steel Dynamics, and Latrobe Specialty Steel to improve pricing and lead time on purchased product.

Welcome Back Students!

MatSE welcomed new and returning students by holding departmental picnics for graduate students (August 21) and undergraduates (September 5). The weather cooperated for both picnics this year, and everyone had a great time.

On the MatSE Facebook page, alumni responded to the question,

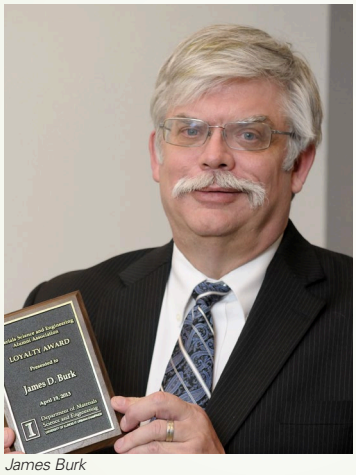
"What advice would you give to new MatSE students?"

- ☐ When the professor says to read something before class, read it! (Aaron Bentz, BS MatSE '13)
- ☐ Learn how to describe Materials Science because 99% of people (even professionals in industry) don't seem to know what the degree is or what it's good for. (Andrew Kieffer, BS MatSE '12)
- ☐ If you are planning to get into aerospace, learn composites as well as metal. And corrosion. (Gerald 'Jerry' Johnson, BS Met '62)
- ☐ Ask as many questions as you can, go to office hours, and network with your classmates! (Arielle Gross, BS MatSE '11)
- ☐ Learn to work effectively in teams, not only for projects but for homework, studying for tests, etc. Your classmates are a fantastic resource. (Eddie Edens, BS MatSE '12)

2013 Alumni Awards

Loyalty Award

James Burk (BS Met '73, MS Met '74, PhD Met '77)

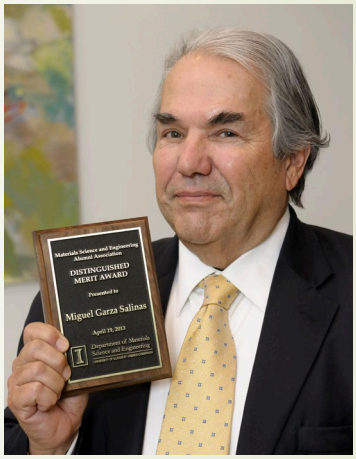


James Burk

James Burk has a long record of service to the MatSE Department. For over 10 years, he served on the MatSE Alumni Board, including a term as President of the Board. He is now an Ex-Officio member of the Board and an active member of the MatSE Department's Senior Advisory Committee. He is a member of the President's Council of the University of Illinois, past member of the College of Engineering Dean's Club, and an active member of Illinois Connection with his wife, Barbara, both being lifetime members of the University of Illinois Alumni Association. He is a member of Alpha Sigma Mu Society-Illinois Chapter, a group recognizing outstanding undergraduate academic achievement. He and Barbara have contributed to the undergraduate scholarships named for Professors Bob Bohl and Ian Roberson and to the lecture fund in memory of Howard Birnbaum. Burk has worked for McDonnell-Douglas (now Boeing), Shell, Brown and Root Marine, as well as Amoco (now BP) for the last 23 years. Currently, he is leading the materials and welding organization, with global responsibility, in the upstream exploration and production division of BP. Throughout his 40+ year career, he has served the petroleum industry and other university organizations by being an active participant on committees and advisory board positions, holding chairs, vice-chairs or memberships on over 25 Materials, Welding, and Corrosion committees, boards, educational and conference organizing groups. He is a member of the API Materials Advisory Board, providing materials advice on API Standards to the Executive Committee on Standards-Materials and Equipment for the Production Department. He has authored or co-authored twelve papers, presented at various technical conferences, including several keynote addresses, and received awards for technical achievement in the materials and welding area.

Distinguished Merit Award

Miguel Garza Salinas (BS Met '61)



Miguel Garza Salinas

Miguel Garza Salinas began his professional career at The Grupo Industrial Alfa, one of Mexico's largest multi-industry conglomerates. He had received his MSc in Industrial Engineering from Monterrey Tech in 1963 and his MBA from the University of Pennsylvania in 1966. Thanks to his metallurgy and management degrees, he led divisions producing oil field forgings, wear-resistant castings, and stainless steel heat-resistant castings, and the construction and operation of a new ductile iron foundry. In 1972, Garza Salinas was appointed internal consultant for Alfa. He worked as the Director of Operations and News Casting for Alfa's national TV network in Mexico City and as consultant for several corrugated board plants. He also directed the construction of corporate offices and headed a joint venture with International Nickel Co. of Canada for exploring precious metals all over Mexico. From 1979 to 1991, he was appointed General Director of Nemak to negotiate a joint venture with Ford Motor Company and a technical agreement with Fiat to construct and operate a $200M aluminum foundry. Nemak is now the world's largest aluminum foundry in the world with plants in 17 countries. After 30 years with Alfa, Garza Salinas formed his own housewares ceramic company. He did consulting work in the fields of extending shelf-life of vegetables and flowers in South America, advised a fresh cut salad plant and water treatment plants, and bought and imported used equipment for upgrading chlorine plants. Four years ago, he joined forces with Basic Resources Inc. of Knoxville, TN, and incorporated a Mexican joint venture, BRI Mexico Foundry Solutions to produce and market aluminum foundry fluxes and consumables for the fast-growing secondary smelters, aluminum extruders and die casters. The company has developed a customer base of about 45 auto parts customers supplying aluminum components to the major automakers for local and exports markets. The company and blending facilities are based in Monterrey, Mexico, and have a sales and distribution office in Central Mexico.

Distinguished Merit Award

Dawn White

Dawn White is the Founder, President, and Chief Technology Officer of Accio Energy, an early stage company engaged in development of Electrohydrodynamic wind energy technology. EHD wind is non-turbine based wind power with potential to be as modular as solar panels, very low in cost, and without the moving blades that create noise, flicker and environmental concerns. At Accio she leads a small team of scientists and engineers working to understand the complex fluid mechanics and electrostatics of producing wind energy using charged droplets instead of turbine blades. Prior to starting Accio Energy, in January 2000, White founded the VC-backed, Ann Arbor-based Solidica, Inc. based on the Ultrasonic Consolidation rapid prototyping process, which she invented and commercialized as the Form-ation rapid prototyping machine. Before starting Solidica, she worked in developing and deploying advanced manufacturing technology at Ford Motor Company where she won Ford Technical Achievement Awards in 1994, 1995, and 1996. She was also involved in materials and manufacturing related research at MTS Systems and the US Army Construction Engineering Research Laboratory. She is currently a member of the Board of Directors of the National Center for Manufacturing Sciences. White's continuous record of commercial innovation in a range of materials processing and manufacturing fields, including welding and joining science, metal spray forming, and rapid prototyping and tooling has resulted in 20 US Patents with nine additional patents pending. She received her Ph.D. in Mechanical Engineering from the University of Illinois in 1986.

Young Alumnus Award

Matthew Meitl

In graduate school, Matthew Meitl worked in John Rogers' group on a set of new technologies called transfer printing that use the properties of soft materials to assemble micro-scale devices onto non-native substrates. Those technologies formed the basis of a start-up company, Semprius, Inc., which was spun-out of the University of Illinois in 2005. Upon his graduation in 2007, Meitl joined Semprius as a scientist to apply transfer printing technologies in the field of Concentrator Photovoltaics. There he developed highly efficient, cost-effective solar cells that integrate advanced semiconductor materials with transfer printing methodologies. He also contributed a method to fabricate concentrating lens arrays and served as a core member of the world-class engineering team that produced the Semprius CPV module, the first commercial module to demonstrate an independently-verified conversion efficiency greater than one-third. MIT Technology review recognized the Semprius CPV module as one of the 10 most important emerging technologies of 2012 and Semprius, Inc., as one of the 50 most innovative companies in 2013. Meitl currently works at Semprius as the technical manager of solar cell development, interfacing with industry-leading providers of PV cell materials and helping to drive the Semprius efficiency roadmap forward. Meitl has coauthored 35 peer reviewed publications and co-invented more than 20 technologies with patents pending or issued. He was selected for the NSF and NDSEG Graduate Fellowships and accepted a Fellowship from the Fannie and John Hertz Foundation in 2002. He was a recipient of the Racheff-Intel Award and was selected as a finalist for the Lemelson Illinois Student Inventor Award (2007).

Ferguson recognized for his pioneering work in vaccine development


Chevron Oronite president and IChemE past president, Des King, presents Andrew Ferguson with the Young Chemical Engineer of the Year Award.

Andrew Ferguson has received the Young Chemical Engineer of the Year Award-North America from the Institution of Chemical Engineers (IChemE). The award is in recognition of his impressive work on thermodynamic modeling for the development of HIV vaccines.

HIV/AIDS is responsible for the death of nearly 30 million individuals, with another 34 million infected. In the developed world, HIV can be managed by expensive antiretroviral drugs, but a vaccine represents perhaps the only hope for the impoverished sub-Saharan nations most severely afflicted. Despite three decades of effort, an effective vaccine is unavailable.

"An impediment to the development of effective vaccines is the absence of 'fitness landscapes' describing the ability of the virus to replicate and damage a host as a function of its DNA sequence," Ferguson explained. "Such landscapes could be used to rationally design vaccines to induce potent immune responses against vulnerable regions of the virus, and possibly abort infection altogether."

Together with his co-workers, Ferguson confronted this challenge by pioneering a novel method to translate clinical databases of HIV sequences into viral fitness landscapes based on statistical mechanical models typically used to describe the physics of magnets and fluids.

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MatSE Scholarships and Awards 2013-2014

Paul A. Beck Scholarship
Timothy Chiu

Harry J. Beckemeyer Jr. Scholarship
Jason Fleischman

Clifton G. Bergeron Scholarships
Sankalp Kota
Taylor Perez
Kristina Stranski

Louis R. Berner Scholarships
Michael Katz
Samuel Mo
Sean Murray

Gerson B. Bilow Scholarship
Michael Szymanski

Robert Bohl Scholarships
Andrew Bettin
Meng Huang
Alex Katsulis
Nipat Liampisan
Vijay Rajendran
Steven Shewchuk
Xizhu Wang
Renhan Wang
Ashton Wasserman
You Wu

Otto Sr. and Mildred Capek Scholarship
Ryan Their

Caterpillar Scholarships
Dominic Bonucci
Seth Cazzell
Jonathan Streufert

Earl J. Eckel Scholarships
Chun-Wei Chang
Yong Bing Chong
Seokhwan Chung
Michael Di Mare
Jonathan Hestroffer
Shuo Li
Yanfu Lu
Anna Mast
Tan Nilgianskul
Eric Przybylski
Liwei Song
Hongyi Wu

M. Laird and Charisann Froberg Scholarships
Daniel Roper
Ryan Smith
Tan Shi

Phillip H. Geil Scholarship
Daniel Li

Henry E. Grein Jr. Scholarship
Luke Shi

Donald W. Hamer Scholarship
Olivia Rogers

Joseph and Wyvona Lane Scholarship
Michael Collins

Robert E. and Karen Martin Luetje Scholarship
Martin Kim

Kevin Moore Memorial Scholarship
Emrys Tennessen

G. Ronald and Margaret H. Morris Scholarship
Janna Eaves

G. Ronald and Margaret H. Morris Opportunity Scholarship
Daisy Fong

James A. Nelson Scholarship
Steven Simpkins

Cullen W. Parmelee Scholarships
Andrew Curtis
Derek Kwok
David Limberg
Katharine Mehan
Akshay Murthy
John Smith
Hannah Taylor
Alexander Trick

Cullen W. Parmelee International Research Scholarships
William Andrews III
Keiko Kato
Janice Yoshimura
Andrew Zhao

Frederick A. Petersen Scholarship
Dennis Jones

Norman L. Peterson Scholarships
Joshua Ayers
Mitchell Bigelow
Carrington Watkins

Larry D. and Carol Rakers Scholarships
Ryan Haney
Douglas Hansel
Shao Mei
Charles Stovall

Ian and Victoria Robertson Scholarship
Timothy Ouradnik

C. M. Wayman Scholarship
Alex Wendt

Wert Scholarships
Lei Che
Nicole Crosby
Tara Cullerton
Yichuan Ding
Nicole Ernat
Andrew Erwin
Samuel Jesse
Euiyeon Jung
Pengyang Li
Timothy Lichtenstein
Enjiong Lu
Ching-Jui Lu
Brian McDonald
Stephanie Nemec
Aibar Nurmukhanov
Adriana Schoenfeldt
Zixing Wang
Rui Wang
Jon Wilson
Jun Kit Wong
Yingjie Xiang
Ruoyan Zhang
Aaron Zhao
Yuecheng Zhou

Alfred W. Allen Awards
Pritam Bhattarai
Fang Jiunn Ewe
Zi Yang Kan
Derek Kwok
Akshay Murthy
Olivia Rogers
Ryan Their
Alexander Trick

Arthur L. Friedberg Awards
Aaron Bentz
Kyle Lamson
Miheer Munjal

Laird Froberg Award
Spencer Wells

Materials Science and Engineering Alumni Board Award
Jordan Turner

Sheryl Blair Tipton Award
Parul Koul

Scholarship pays tribute to Doris Maroney Krumwiede

Doris Maroney Krumwiede (Photo from the 1959 Illini Ceramist)

Jack Krumwiede (Photo from the 1959 Illini Ceramist)

It wasn't until his daughter and granddaughter put together a memory board to put on display at his wife Doris' funeral that Jack Krumwiede realized how Doris had sacrificed her career for her family. One photo on the memory board was a group photo from the 1959-1960 Illini Ceramist, with Doris, Vic Tennery, Art Friedberg, and Clif Bergeron.

Ceramics was not Doris' first choice of college major. She was very athletic and wanted to go into physical education, but scholarships were limited. Recognizing her parents' financial situation, she enrolled in the State University of New York College of Ceramics at Alfred University. In college, she remained active in sports, along with social and honor societies. Jobs were scarce in 1958 when she graduated cum laude. She had enjoyed a summer spent at IBM's Poughkeepsie research lab and decided she would go to graduate school.

Jack and Doris met in the Ceramics Department at the University of Illinois and completed their master's degrees the same year. They were married on June 11, 1960. Jack entered the MBA program, and Doris continued working in the Ceramics Department. Over the course of two years, she advanced to the rank of Research Associate while putting her husband through graduate school. "The Ceramics Department was very kind to Doris," Jack said. "They knew she was not a doctoral candidate, yet they treated her like one."

By the time Jack finished his MBA, Doris was 8 months pregnant. "When the time came, because of our generation, my career became primary and Doris became a mother and a housewife," Jack said. "It was taken for granted at that time. She never brought it up." They left Illinois for Clarksburg, West Virginia, where Jack took a job with PPG.

He remained with the company for 36 years, working in manufacturing for about 16 years and in research for 20 years. He worked in the glass division, primarily in automotive and construction. "When I was in manufacturing, Doris and I moved 14 times," Jack said. "It was like the Army, every two years we got transferred." The family grew during these years. They had three daughters: Linda, Lisa, and Laura.

Jack retired from PPG in 1998. He and Doris lived in Pittsburgh until 2010, when they moved to South Carolina to be closer to Linda. On April 25, 2013, Doris passed away at the age of 76.

Longtime supporters of the University of Illinois, Jack and Doris understood the value of a college education and the difficult choices parents and students have to make. "When I went to college," Jack said, "my tuition was $100 a semester." The cost of tuition at the University of Illinois has risen considerably since the late '50s and early '60s. Tuition and fees are now $20,178 per year for Illinois residents and $34,560 for non-residents (2013-2014 figures).

Thanks to the Doris Maroney Krumwiede Scholarship which Jack has established, a female student in Materials Science and Engineering will get a financial boost. "I hope that it will be a benefit to those who couldn't have afforded it otherwise," Jack said. The first scholarship will be awarded at the MatSE Awards Banquet in April 2014.

Clif Bergeron, Doris Krumwiede, Vic Tennery, and Art Friedberg

Jack Krumwiede at his home in Fort Mill, SC. On the table beside him are the ceramic pigs he and Doris made when they were students in the Ceramics Department.

First C. M. Wayman Scholarship awarded to metals undergraduate

Professor C. M. Wayman

Alex Wendt

The first C. M. Wayman Scholarship was awarded in the 2013-14 academic year to Alex Wendt, a senior from Champaign. A graduate of Centennial High School, Wendt chose MatSE for his major because materials are integral to all other forms of engineering. His favorite class, so far, has been Metals Processing (MSE 441). "It gave us the opportunity to learn about practical processing techniques, and then we got to visit a steel mill at the end of the semester which made what we learned real to us," Wendt said.

In his free time, Wendt plays the violin, banjo, and mandolin and produces music. He enjoys traveling around the country attending various racing events and helps out in the community by doing volunteer work every month with a Christian ministry.

Wendt is very appreciative of the scholarship he has received, calling it "a huge privilege." "It not only makes me realize that my academic efforts have not gone unnoticed," he explained, "but it has also been a great help to me financially. My family doesn't have a lot of money, and with my brother and myself both attending the U of I, every little bit helps!" Following graduation, he hopes to get a job with a steel mill or manufacturing company.

The C. M. Wayman Scholarship is in memory of Clarence Marvin Wayman, a metallurgy professor who taught at the University of Illinois for 39 years. Professor Wayman passed away in 2007.

Wayman was a leading researcher in the crystallography of martensitic transformations. He documented a wealth of transmission electron microscopic detail for a broad range of alloys. He published over 400 papers, more than 100 of which dealt with shape memory materials. His honors included the AIME Mathewson Gold Medal, Eminent Faculty Award of the College of Engineering at the University of Illinois, and honorary professorships at two Chinese universities. He was a Fellow of ASM International, the Metallurgical Society of AIME, the Institution of Metallurgists, the Japan Society for Promotion of Science, and the Guggenheim Foundation.

On a personal note, Wayman was a decorated grill-chef and held summer backyard barbecues at his home for members of his research group and their families. Professor Carl Altstetter recalled that Wayman won a prize at the Champaign County Fair in a cook-off. A donor to the scholarship fund, who had Professor Wayman for his thesis advisor, said his contributions are "to, in a small way, honor his memory and acknowledge the courtesies and kindness he extended to me during my stay at Illinois."

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This list of donors includes alumni and friends who have helped maintain MatSE's outstanding reputation. Included are individuals who have directed their gifts to MatSE between July 1, 20012, and June 30, 2013. We check the list carefully, but if we have overlooked you, please contact us so that we can correct our records. Individuals listed in **boldface** are first-time donors to MatSE.

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For further information about making a gift to the Department of Materials Science and Engineering, contact Allison Winter, awinter@illinois.edu, (217) 244-8307. Thank you for your support!

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Olivia Rogers, Hamer Scholar
Sophomore from Centerville, OH

"I'd like to thank the alumni for their donations. Without the scholarship that they made possible, the cost of out-of-state tuition would have made it difficult for me to come to the U of I. After graduation, I hope to go on to grad school in materials science."

Jay Fleischman, Beckemeyer Scholar
Sophomore from Lincolnshire, IL

"Every student comes from a different background and has a unique financial situation while in school. I know that, personally, the Harry J. Beckemeyer Scholarship has helped me not only to pay for college, but has improved my college experience. Especially for Engineering majors at UIUC, having to spend less time worrying about how to pay for college means more time available for learning and taking advantages of all the fantastic resources at the University."

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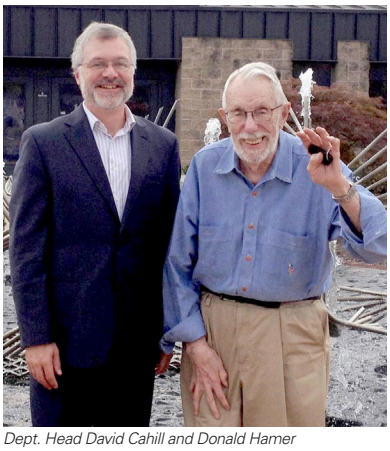
Donald Hamer inducted into Engineering at Illinois Hall of Fame



Dept. Head David Cahill and Donald Hamer

The Engineering at Illinois Hall of Fame recognizes Illinois engineering alumni and affiliates who have significant achievements in leadership, entrepreneurship, and innovation of great impact to society. This year's Hall of Fame inductees included MatSE alumnus and benefactor Donald Hamer (BS Cer '45). Hamer is the Chairman and Chief Executive Officer of State of the Art, the leading American supplier of high reliability thick- and thin-film resistive components for biomedical, communications, aerospace, and defense industries.

"My 70-year journey from going to high school to receiving the University of Illinois Hall of Fame Award was partly (mostly?) the result of a long series of good luck happenings," Hamer said. He was the first person in his family to graduate from high school and had no plans for college. "Almost no one in our town went to college. I had no thoughts about college, just assuming that I would work for my father in his gasoline station/garage business."

In his senior year, the principal of his tiny rural high school told his parents that they should send him to college because he was very bright. The principal suggested going to the University of Illinois as an engineering student, "specifically to enroll in Ceramic Engineering because of its bright future in plastic materials (plastics?)"

Hamer, continued

Hamer enrolled in Ceramic Engineering and discovered ceramics were not about plastics, but loved every bit—the math, physics, labs, everything.

After graduation from the University of Illinois, Donald Hamer served in the Navy and then had a series of ceramic engineering jobs for a decade or so. "I took a job in Chicago with a small electronic component company to put them into the ceramic capacitor business, because they thought (correctly) that ceramic capacitors had a great future," Hamer said.

He earned his MBA at the University of Chicago and relocated to Pennsylvania, where he was chief engineer at the Erie Technological Products Plant. During this time, he earned a second B.S. degree in electrical engineering from Penn State University.

In 1969, he founded State of the Art, Inc., which soon evolved into a leading manufacturer of high-reliability resistors in the microelectronics market. In 1980, the company developed nickel barriers that virtually eliminated solder leaching problems, an improvement which became the industry standard. In 1987, State of the Art became the first manufacturer of quality military-grade chip resistors to "S-level" reliability standards (fewer than one failure per 100 million hours of operation).

A noted philanthropist, Hamer funded the establishment of the Hamer Small Business Initiative at the University of Chicago in 2004. He has strongly supported initiatives at both Illinois (including a professorship, fellowship, scholarship, and renovation of the undergraduate materials laboratories) and Penn State (including the Donald W. Hamer Maps Library and a professorship). He has served on the boards of Clear Water Conservancy, the Centre County Historical Society, and the Palmer Art Museum.

He is a dedicated supporter of conservation, helping to establish a 640-acre prairie restoration project near his hometown of Byron, Illinois, and with his wife, Marisa Bednar, donating $2.5 million to protect the West Branch Wilderness Area in Clinton County, Pennsylvania. In 1992, he was awarded the Teddy Roosevelt Conservation Award in a White House ceremony.

"So what a piece of good luck to have a high school principal who would push me into Ceramic Engineering at the University of Illinois," Hamer said, "which made me a grateful and enthusiastic engineer equipped to be successful—and what a series of other good luck happenings has blessed my career ever since."

Making lab instruction user-friendly

Thanks to the addition of instructional videos and an etextbook, the core undergraduate instructional laboratories in MatSE are becoming more user-friendly. MSE 307, MSE 308, and MSE 405 are required of all students majoring in Materials Science and Engineering, and the labs generally have an enrollment of approximately 90 students each semester. For years, the lab courses have been taught in the traditional format, with a professor lecturing on the material and students performing the lab days later. In MSE 307 and MSE 308, three labs run simultaneously, while in MSE 405, six labs run at the same time. Unfortunately, that means many students will go through the experiments without having heard the lecture first.

With the introduction of videos and etextbook, students can develop an understanding of the background material for each lab independent of the professor. "Along with traditional course material, we will be offering the students the chance to use and view experiment procedure videos, video lectures from the faculty, and even links to outside references and safety information," explained Nicole Robards, Instructional Lab Coordinator.

Funding for video production was secured through a proposal submitted by Matt Sherburne and Nicole Robards. Videos are an integral part of the etextbook. Having 24-hour online access to the course videos allows students who may be unclear on a concept the opportunity to return to that specific concept and review the videos of interest.

The etextbook benefits the professor as well as the student. It can free up time the professor spends on coursework preparation, since the lectures are online. Students who have watched the video and read the material online prior to the lab will be in a better position to ask the professor more informed questions about material they don't understand. The professor can also make notes in the margin of the etextbook to give students extra feedback.

Each lab section is led by a graduate student who often does not have experience with the experiments he or she will be teaching. Viewing the videos and material prior to the lab helps prepare the graduate TAs. It allows the graduate students to have a better understanding of what to expect the undergraduate students to know when starting a lab.

Videos and audio used in the etextbook can be closed-captioned for hearing-impaired students, and the content is designed to work in a web browser making it is available to visually impaired students using screen reading software and devices.

"Students are finding the video lectures and the fact that all of the material is in one place to be the most beneficial part of eText," Sherburne said. "I think just putting everything in one location has made it easier for the students to focus on the material instead of searching for the needed material."

Class Notes


Woodrow Carpenter and Gay Caldwell

Woodrow Carpenter (BS Cer '39) and his daughter, Gay Caldwell, gave MatSE advancement staff member Allison Winter a tour of the W.W. Carpenter Enamel Foundation Museum on her recent visit to Kentucky. The museum is a privately owned collection dedicated to works of enamel art and craft, from historical antique Limoges paintings to a large collection of contemporary works by some of the finest artists in the field. The museum, located in Cold Spring, KY, houses over 600 pieces of enamel art.


Ron Morris and Lynn Chaney, UI Alumni Association

Ron Morris (BS Met '59) has received a Loyalty Award from the University of Illinois Alumni Association. He was honored for his dedicated service and contributions to the University of Illinois. From 2003 to 2008, Morris served on the University of Illinois Alumni Association Board of Directors. Prior to that appointment, he served on the College of Engineering Advisory Board (CEAB). He is a member and current chairman of the MatSE Department's Senior Advisory Committee (SAC). During his service on the SAC, he has advised the department on curriculum, fundraising, and student recruitment. He has also given seminars to MatSE students about his experience in industry and management.


Jim Polak, Tim Steltzer, and Lowell Hoffman

Lowell Hoffman (BS Met '63) hosted a University of Illinois Foundation event at the Governors Club in Chapel Hill, NC, in April. The guest speaker was Tim Steltzer, a professor of Physics.


Barrett Schuckle

Ava Schuckle (maiden name Hoa Trinh) (BS Met '96) runs a consulting business in San Diego, CA. Ava Trinh Consulting, Inc., is a technical sales and business development company with primary experience in the engineering and technology arena, retail and consumer markets, property management, event management and non-profit organizations. Her son, Barrett Brian Schuckle, was born March 14, 2013, and is already an Illini fan.

Cory Padfield (BS Met '96) was recently promoted to Lead Materials Engineer-R&D for AAM North America in Detroit. He works on light-weight materials, new joining technologies, heat treatment processes and coatings.

Jeff Finch (BS MatSE '00) is on active duty in the Air Force. He and his wife, Jackie, are preparing their children (Sebastien, 7; Hadassah, 5; Quinn, almost 2) for another move next year.

Steve Frisbie (BS MatSE '00) is a Process Engineer at GE in Mattoon, IL. He was previously employed with Motorola in Arizona.


Jason Nicholas

Jason Nicholas (MS MatSE '03) has received a National Science Foundation CAREER award. The funds will support his research to reduce operating temperatures, improve performance, lower costs and extend the operational lifetime of Solid Oxide Fuel Cells. Nicholas received his Ph.D. from the University of California, Berkeley, in 2007. Following post-doctorate work at Northwestern University, he joined the Michigan State University Department of Chemical Engineering and Materials Science in 2010.

Jonathan Hollander (BS MatSE '05) is Business Development Manager for Applied Biorefinery Sciences in upstate New York. ABS produces liquid fuels and paper products from woody biomass. The company spun off from SUNY College of Environmental Sciences and Forestry, where Hollander is an adjunct professor.

Lindsay Schubel (BS MatSE '05) is at Rubicon Technology in Batavia, IL, making synthetic sapphire.


Sandie and Jeff Hallman

Sandie Cheung (BS MatSE '06) married Jeff Hallman on May 21, 2013, in Seattle, WA. She is employed with Boeing.

Michael Odlyzko (BS MatSE '09) dropped by the U of I campus after attending a microscopy conference in Indianapolis. He is finishing up his Ph.D. at the University of Minnesota and is recently married.

Lisa Mazzocco (BS MatSE '10) is the Strategy and Execution Manager at Blue River Technology, a robotics start-up in San Francisco, CA.

Meghan McKelvey (BS MatSE '10) is Sr. Design Engineer at EN Engineering in their metallurgy group.


David Cahill with Bob and Ann Hallse

Bob Hallse (BS, Cer '56, MS Cer '57, PhD Cer '59) and his wife, Ann, had lunch with Department Head David Cahill in Palm Springs, CA.

Calling all MatSE couples

Are you and your spouse both alumni of the MatSE Department? As you can tell from the donor honor roll in this issue and the article on Jack and Doris Krumwiede, we have several alumni who met when they were students in our department and got married. We would like to feature stories of MatSE alumni couples in our summer issue. Please send your story to the Editor, Cindy Brya, at brya@illinois.edu, or mail it to 1304 W. Green St., Urbana, IL 61801.

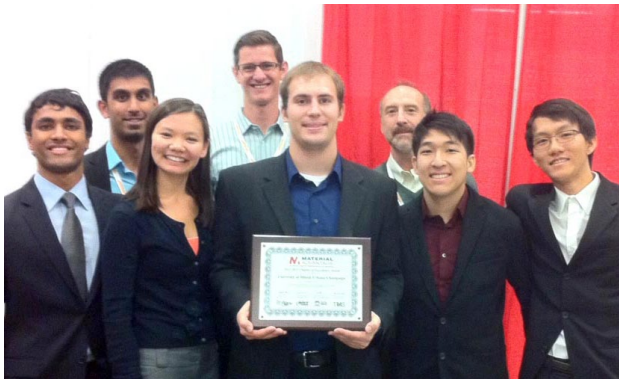
Julie Vroman (BS MatSE '10) and Matt Menke (BS MatSE '10) *were married on May 18, 2013, in Wheaton, IL. Julie is employed at General Mills, and Matt is a Ph.D. student at the University of Minnesota. They live in Minneapolis, MN.*

Alissa Cote (BS MatSE '10) and Ben Pierce (BS MatSE '10) *were married on June 29, 2013, in Palatine, IL. They live in South Burlington, VT, and are both employed at IBM.*

MatSE Student-Alumni Dinner

MatSE students networked with alumni visitors at a progressive dinner on October 18 at Escobar's in downtown Champaign. Alumni participants included Jim Burk (BS 1973, MS 1974, PhD 1978), Angela Gonzales (BS MatSE '07), Eric Hammill (BS MatSE '00), Kate Jakubas (BS MatSE '06), David Moore (BS Met '89), Howard Savage (BS Met '84, MS Met '88, PhD Met '91), Kyle Wilcoxen (BS 2006), and Joyce Yamamoto (BS Cer '84). Students rotated from table to table between courses, meeting alumni from a variety of industries. The progressive networking dinner was such a success that the MatSE Department plans to hold another dinner in 2014.

Undergraduates filled the lecture hall at Material Advantage's first meeting of the 2013-2014 academic year. The guest speaker for the meeting was Prof. John Rogers.



The University of Illinois chapter of Material Advantage received the Chapter of Excellence Award at MS&T'13

MATERIAL™ ADVANTAGE
The Student Program for Materials Science and Engineering

Material Advantage student chapter seeks alumni support

Illinois MatSE Alumni:

Do you wish you had the opportunity to check out the real world while you were a student? Would you like to share your insight and experience with current students to give them a boost in their future careers? I encourage you to connect with Material Advantage (MA, formerly known as Undergraduate Materials Organization).

This semester MA sent seven students to the Materials Science & Technology (MS&T) 2013 conference. We drove 15 hours to Montreal at a cost of around $6,000. Most of this cost came directly out of the pockets of the attendees, with some funding from the MatSE Department, MA auction funds, and the registered student organization office. This semester we also had a very successful site visit to Boeing in St. Louis, and we hosted a Young Alumni Tech Talk for all MatSE undergraduates.

We hope to offer more opportunities for students to see thermodynamic and kinetics of materials in practice. In order to do so, we would love your support! How can you help? Your financial support will help MA afford to send more students to attend conferences such as MS&T. To donate, specify "student conference travel support" on your gift to the MatSE Fund. We are constantly brainstorming about new ways to raise funds, and donations from alumni would be very much appreciated. If you are not able to give financially at this time, we encourage you to return to campus to share your job experiences or help MA arrange a visit to your workplace so students can see how alumni are using their Materials Science and Engineering degree. Please reach out to our current MA Executive Board if you would like to help (contact information below).

Thank you so much, and we look forward to hearing from you!

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Ferguson recognized, continued

"In an application to the structural HIV polyprotein Gag, the model predictions are in remarkable agreement with *in vitro* fitness measurements and clinical data tracking viral evolution in human hosts," Ferguson said.

Heartened by these validations, the researchers have used their models to computationally design a candidate HIV vaccine formulation predicted to have high efficacy that is currently being tested in mice. A research article describing the work was published in the highly regarded journal *Immunity* (Immunity 38 606-617 (2013)) and highlighted in two commentary articles.

The Ferguson Lab continues to refine and apply this methodology to Hepatitis C, another devastating virus for which no vaccine exists.

"It is our hope that the innovative application of thermodynamic models to computational immunology will enable a powerful *in silico* approach to accelerate trial and error experimental vaccine design, and ultimately help alleviate the global suffering caused by infectious disease," said Ferguson.

Ferguson joined the faculty of the University of Illinois at Urbana-Champaign in 2012. He received his Ph.D. in chemical and biological engineering from Princeton University in 2010 and worked as a postdoctoral fellow at MIT before coming to Illinois.

The awards ceremony in San Francisco was one of a series of events organized by IChemE to celebrate excellence, innovation and achievement in the chemical and process industries across the world.

"The IChemE awards program has been running for 20 years, and this year attracted a record number of entries from all over the world," said Andy Furlong, IChemE director of policy and communication. "North America is responsible for producing some of the world's best chemical engineers and all of this year's winners fully deserve their accolades."

IChemE awards were also presented to a team from the Fraser Stoddart lab at Northwestern University and to Quentin Baker from BakerRisk.

In Memoriam

Roderick "Rod" Schutt (BS Cer '70) passed away June 12, 2013. He retired from General Shale in March 2012, after 42 years of service in the clay pipe and brick industry. He was an avid sportsman, an active volunteer at his church, in local prison ministry and with the Cherokee Rod and Gun Club. He is survived by his wife of 39 years, Donna Tyalor Schutt.

Flashback photo identified

Several alumni and friends contacted the MatSE Alumni News Editor to correctly identify Carl Altstter in the flashback photo that was printed in the summer 2013 issue. Gerald Johnson (BS Met '62) was able to identify 5 of the professors pictured in this photo from 1964. Here is the photo again, with names supplied by Carl Altstetter.

1 – Tom Read
2 – Marvin Wayman(?)
3 – Barney Ricketts
4 – Bob Bohl
5 – Carl Altstetter
6 – Earl Eckel
7 – Walter Bruckner
8 – Ted Rowland

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Join us on Facebook (www.facebook.com/matse.illinois) and LinkedIn (www.linkedin.com). The MatSE at Illinois LinkedIn group is a networking group for alumni and students of the Department of Materials Science and Engineering at the University of Illinois. Stay in touch with your classmates and find out the latest department happenings.

MatSE-Intel Dinner

In October, **Britt Turkot (BS Met '90, MS Met '92, PhD MatSE '96)** hosted a dinner party for MatSE alumni employed at Intel. The event was held at her home in Hillsboro, OR. MatSE Department Head David Cahill was present and gave alumni an update on the department.