Exploring Materials at Virginia Tech

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News from the Department of Materials Science and Engineering
Virginia Polytechnic Institute and State University

Dwight D. Viehland named Jack E. Cowling Professor of Engineering

Professor Dwight Viehland has been named the Jack E. Cowling Professor of Engineering by the Virginia Tech Board of Visitors. This endowed professorship, given in recognition of faculty excellence, was established as part of the bequest of the late John E. "Jack" Cowling, a 1939 chemical engineering graduate of Virginia Tech.

Since joining the materials science and engineering department at Virginia Tech in 2001, Dr. Viehland has been a pioneer in the discovery and development of magnetoelectric (ME) and multiferroic materials. These materials have multiple order parameters in response to a stimulus. To date, no single-phase magnetoelectric material has been found that has notable ME coefficients. However, Viehland's research programs have focused on two-phase ME thin layers and laminated composites which have both polar and magnetic subsystems that are coupled together through an elastic exchange. Using this approach, he was the first to study laminated layers of magnetostrictive Metglas alloys and piezoelectric fibers.

Dr. Viehland has developed composite materials that have ME coefficients nearly 10^5 times larger than those of single-phase ME materials. The tremendous enhancement in the ME voltage coefficient achieved by the new approach has unleashed a near-ideal magnetoelectricity, representing a magnetic-to-electric energy conversion. His discoveries, both in ME composites and $BiFeO_3$ layers, have received worldwide attention. More recently, his research group has been actively involved with the forward transitioning of these discoveries in ME laminate composites into unique hybrid uncooled magnetic sensors. Dr. Viehland has developed a new generation of magnetic sensors based on these materials that are capable of pico-tesla resolution at low frequencies while operating at room temperature and in a passive mode of operation.

Improving magnetoelectricity has been one of the 'holy grails' of modern solid state science for nearly 50 years. As a result of the five orders of magnitude improvement in ME coefficients, entirely new magnetoelectric/multiferroic materials have been developed, resulting in Dr. Viehland becoming a highly respected materials scientist. He has 449 papers and 16,000 citations with an h-index of 56, twice the average for materials science researchers with the same number of publications. He has developed magnetic sensors that have SQUID-approaching capabilities in battery-operated uncooled devices for long-term deployment. In addition, Dr. Viehland established the protocols for ME sensor manufacturability and reliability. These new technologies have potentially important applications in national defense.

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Virginia Tech Honors Charles "Chip" Blankenship, Jr. for Career Achievements

Blacksburg, Va., April 24, 2014 – Charles "Chip" Blankenship Jr. of Louisville, Ky., who earned his bachelor's in materials science and engineering from Virginia Tech in 1988, is a 2014 inductee into Virginia Tech's College of Engineering Academy of Engineering Excellence, joining an elite group of 126 individuals out of more than 60,000 living engineering alumni.

The Academy of Engineering Excellence was founded in 1999 by F. William Stephenson, past dean of the college of engineering, and the College's Advisory Board. The inductees are engineering graduates of Virginia Tech who have made continuous and admirable engineering or leadership contributions during their careers. This year marked the fifteenth anniversary of the first induction.

From birth, Blankenship seemed destined to be a Hokie. His father, Charles Blankenship, is a 1960 and a 1962 MSE distinguished alumnus, and 2007 Academy inductee. His aunt and uncle earned graduate degrees in Virginia Tech's Chemistry Department. His mother was also a chemist.

His academic proficiency resulted in the Air Force Academy offering him a full scholarship. Virginia Tech, a state school, also wanted Blankenship, but did not offer any financial package.

In the end, Blankenship chose Virginia Tech and MSE as his first choice. Research with Larry Taylor, in the chemistry department, helped him secure a co-operative education experience with Martin Marietta Laboratories after his freshman year. His research was part of the interdisciplinary materials groups that crossed the boundaries of chemistry and engineering.

In 1988 Blankenship received his baccalaureate degree and a marriage license. He and his wife Belinda, a graduate of William and Mary, quickly moved to Pittsburgh, Pa., where he had accepted an offer from Carnegie Mellon to work with its Dean of Engineering on a research project while he pursued his doctorate. Ironically, his adviser left to take a job with GE Aircraft Engines.

A combination of a change of events and conversations his father had with Ed Starke, also a Virginia Tech engineering graduate, who was then the Dean of Engineering at the University of Virginia, convinced Blankenship to transfer from Carnegie Mellon to UVA. There, he worked with Starke on aluminum lithium alloys, an alloy system that became instrumental for the second generation of the space shuttle's external tank.

Pictured from left are: Richard C. Benson, the dean of the college of engineering, Chip Blankenship, and David Clark, department head of materials science and engineering.

Blankenship received his doctorate in 1992 and was a sought after commodity, with offers from such global companies as Boeing, Alcoa, McDonnell Douglas, and GE. "I chose GE because of the variety of technical challenges. I could work on everything from Tungsten filaments for light bulbs to Ni-base Superalloys for gas turbines," Blankenship explained. He began his career as a staff scientist at GE's Corporate Research and Development facility in Schenectady, N.Y.

In 1994, he was promoted to program manager where he led a team of scientists and engineers developing alloys and processes for aircraft engine, land-based gas turbine, lighting systems, medical systems, and diesel engine applications.

Two years later, Blankenship transferred to the Aircraft Engines business in Cincinnati and held a number of technical and product management roles. For three of the years, he split time between Cincinnati and Brazil, in charge of the Embraer CF34 programs, creating a new 70 to 100-passenger jet.

In 2002 Blankenship assumed responsibility for all of GE's regional jet business, and this position represented his first $1 billion fiscal responsibility. In 2006, Blankenship was reassigned to a larger role with GE, serving as the general manager for GE Aero Energy, and then later in 2008, Blankenship landed his first vice-presidency with the company, in charge of GE Aviation's Commercial Engines group, a $5 billion annual revenue business.

In 2013, GE named him President and CEO of Appliances and Lighting, with revenues now coming in at $8 billion a year.

Blankenship continues to be dedicated to his alma mater. He has served on both the MSE and the College Advisory Boards, improving MSE's senior design experience, bringing the VT-FIRE Building to fruition, and creating the Materials Characterization Laboratory with the Institute for Critical Technology and Applied Science. ❖

Lynn Nystrom, College of Engineering

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At present, the U.S. Navy is studying the use of these sensors for integration into several next generation platforms. In addition to magnetic sensors, there are other potential industrial applications of the ME composites and materials developed by Dr. Viehland, including energy harvesting and electric read/write of magnetic spin states.

Dr. Viehland is a recipient of the Office of Naval Research Young Investigator Award, multiple best paper awards, and Virginia Tech's Alumni Award for Excellence in Research.

He has served the American Ceramic Society as head of the Electronics Division, as a trustee, and as an associate editor for the Journal of the American Ceramic Society. He has also served on the Steering Committee of the Institute of Electrical and Electronics Engineers Ferroelectrics Society.

Dr. Viehland received his bachelor's and master's degrees from the University of Missouri at Rolla and a doctoral degree from Pennsylvania State University. ❖

The American Foundry Society Piedmont Chapter held their annual VT-FIRE meeting in Blacksburg on March 26 and 27. Eleven MSE and ME students received $12K in scholarships at the dinner. In addition, Paul Huffman and Greg Southerland presented a check for $16K to Dr. Clark for the Kroehling Foundry. Dr. Alan Druschitz and MSE senior, Myrissa Maxfield, gave a VT-FIRE update, which included showcasing samples of castings completed at the foundry. Of particular interest was a lamp project presented by architecture student Reza Mousavynejad. On Thursday, senior design project presentations were given at the foundry. Scholarships awarded included PCC: Myrissa Maxfield, Allison Popernack, Peter Kim, Corey O'Connell; AFS Piedmont Chapter: Drew Snelling (ME), Cameron Reynolds, Joseph Ogea; AFS-FEF: Dan Diner, Gabriella Mirabelli, Devon Baker, Ethan Edwards. ❖

The Lotus: A Kinetic Luminary Object is a prime example of how VT-FIRE and the Kroehling Advanced Materials Foundry offer research and educational opportunities across the university. Prof. Alan Druschitz assisted architecture student, Reza Mousavynejad, in designing and casting an aluminum base for Reza's lamp, using the lost wax method. This spring, Reza's Lotus was one of two Object Designs to win an Inform Award presented by *Inform: Architecture + Design in the Mid-Atlantic,* which is published by the Virginia Society of the American Institute of Architects. The 23rd annual Inform Awards drew 122 submissions in the areas of interiors, landscape architecture, and object design. "Lotus provides an operable mechanism to control the effect of its illumination. The object includes two parts. A blossoming luminary upper element changes the impact of the light while the lower base defines the relationship between the object and the ground and provides stability." Reza completed the Master of Architecture program in the Virginia Tech School of Architecture in February, and he is now practicing architecture in Cambridge, Mass. ❖

Reza Mousavynejad and Dr. David Clark stand next to Reza's Lotus Luminary Object, exhibited at the AFS Piedmont Chapter dinner in March.

MSE Senior Design Teams win honors at AFS/FEF 2014 Student Technology Contest

Effect of Chemical Composition and Heat Treatment on the Corrosion Resistance of Cast Nickel Alloy C276, Devon Baker, Warren Denning, Gabriella Mirabelli, won second place. The team will receive a $1,200 FEF scholarship. *Casting and Heat Treatment of Thick Advanced High Strength Steel*, Daniel Diner, Bradley Walters, Rafael Gil-Figueroa, received an honorable mention. Prof. Alan Druschitz is the advisor for each of these senior design teams. Several projects were submitted, representing five universities. Each project went through a full technical review by a number of leading metalcasting professionals. Both teams will have papers published in the winter 2015 issue of *International Journal of Metalcasting (IJMC)*. Congratulations to both teams! ❖

Peter Kim, Dan Diner, Myrissa Maxfield, and Drew Snelling won the 2014 FEF Saginaw Valley Casting Competition based on accurate and complete engineering drawings compared to final casting. The students used their CAD expertise, 3-D printed polymer pattern, and investment casting, plus good metallurgy and interdisciplinary team work. ❖

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Fracture surface of a magnesium alloy AM50 tensile bar showing ductile dimple rupture. Photomicrograph taken on a scanning electron microscope using secondary electron imaging at BWXT, Lynchburg, Va. Courtesy of Professor Alan Druschitz.

MSE Student Team Wins International Contest With Probe Experiment

October 1, 2013 - A group of Virginia Tech College of Engineering alumni have won the ASM International Society's 2013 Undergraduate Design Competition, based on a project they completed as seniors in the Department of Materials Science and Engineering.

This entry represented the first time the department participated in the competition held by the society. The poster project, entitled "Controlled Deformation of a Slender Structure," stems from an ongoing senior design class experiment involving the creation of a thin polymer rod that could be used as a probe when inserted into a biological tissue substitute such as gelatin, and then maneuvered and controlled by an outside source such as heat, electric voltage, or light.

Each of the winning students have now graduated from the Virginia Tech College of Engineering with bachelor's degrees in materials science and engineering.

They are **Daniel Flagg of Seaford, Del.**; **Michelle Leslie of Cleveland, Ohio**; and **Brendan Robert Ondra of Sunderland, Mass.** Faculty advisors for the team were Douglas Holmes, an assistant professor in the Department of Engineering Science and Mechanics, and Diane Folz, faculty advisor for the Virginia Tech Material Advantage Student Chapter in the materials science and engineering department, who oversees senior design projects for the ASM International Competition.

The team won $2,000 and received $500 in travel assistance to attend the Materials Science & Technology 2013 conference held in Montreal last October. Additionally, the materials science and engineering department will receive $500 to support future design teams.

Each of the Hokie alumni are now seeking doctoral degrees, with Flagg and Ondra both at University of Massachusetts Amherst, focusing their studies on polymer science and engineering, while Leslie is in the macromolecular science and engineering program at Case Western Reserve University.

"Being a part of this senior design team was an honor," said Leslie. "We were able to make great progress and were prepared for the next journey in our education. With senior design projects, the materials science and engineering department is offering its students an invaluable opportunity to grow as scientists and young professionals, and I am very thankful to have had that opportunity."

Work on the project began as a senior class study spanning two semesters, the first in-classroom proof of concept planning and the second in-lab practice of the written work. The research was dedicated to making the practice versatile, from probing inside a human artery to probing in soil or sand when inserted into the ground, said Holmes. The rod also could one day be used to explore damaged, dangerous areas, including those underground, if attached to the end of an exploratory unmanned robot, Holmes added.

The team's work also won the Department of Materials Science and Engineering Outstanding Senior Design Project for 2013. It was the first time the department held such a poster competition.

Steven Mackay, College of Engineering Communications Manager ❖

Meps 2013-14 Highlights

Anthony Schiavo, MEPS President

The Materials Engineering Professional Society (MEPS) is the student organization that encompasses the Material Advantage chapter as well as the Materials Society, American Institute of Steel Technology, and American Ceramic Society chapters. MEPS promotes student development in materials science and engineering by organizing professional and academic activities, performing outreach to the community, and hosting social events.

The 2013-2014 academic year saw a great expansion of MEPS at Virginia Tech. As enrollment in MSE continues to grow, so do the programs and activities of MEPS. This year, guest speakers from Precision Castparts Corporation, ATI Allvac, the National Transportation Safety Board, Corning, and others spoke to students at chapter meetings and special symposiums. These symposiums introduce students to what the industry does, teach students new skills, and build professional connections. The outreach program continued to grow in 2013-2014, building new partnerships with the campus scouts to teach metallurgy and safety skills in conjunction with VT-FIRE. Students toured facilities at the Corning plant in Blacksburg, the Steel Dynamics foundry in Roanoke and the ATI Allvac plant in North Carolina. MEPS also formed a softball team to compete in intramural sports, in addition to our usual tailgates and gatherings.

VT MEPS made an exceptionally strong showing at the annual Materials Science and Technology conference, sending twelve students to Toronto to attend. Kirby Boone and Myrissa Maxfield represented us at the ACerS and AIST meetings, respectively. Sophomore Joseph Ogea became the first VT student to compete in the MS&T Speaking Competition and was able to place well on the national stage. Six students were sent to the AFS 118th Metalcasting Congress, where they forged strong connections with industry members and attended technical sessions on real world industry challenges.

One of the most exciting accomplishments this year is the formation of a MEPS tutoring program. Given the highly specific nature of MSE classes, help outside the classroom can be difficult to come by for those students who cannot attend office hours. This program brings together undergraduates in MSE with upperclassmen to provide tutoring and support. I'm immensely proud of all the tutors who volunteered their time and efforts to help their fellow MSE students. They embody the school motto of Ut Prosim and the MEPS goal of enriching the student experience here in the MSE Department. In all, MEPS has continued a legacy of professional, academic, and personal development in the 2013-2014 school year. ❖

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MSE Advisory Board Members with several MSE faculty

MSE Advisory Board Meeting Highlights

The MSE Advisory Board held their annual meeting at Virginia Tech on November 6 and 7, 2013. Ten of the active thirteen members were present. They heard a department status report as well as presentations on the department's recent graduate and undergraduate program reviews. Dr. Ed Nelson, Associate Dean of the College of Engineering, presented a detailed discussion on the status of the College, with emphasis on the new Signature Engineering building. He also talked about the planned renovation of Randolph Hall, which will provide added space for MSE and also for mining engineering. Other items on the agenda included a VT-FIRE update, plans to hire a full-time polymers faculty, meetings with students, and discussions about the senior design program.

We are sad to report that Warren Wolf passed away on April 25. Warren was a long time member of the MSE Advisory Board, and he made many contributions. He will be greatly missed. ❖

Dr. Tom Staley joined MSE full time as an associate professor of practice last fall, and he has been appointed as the lab manager for the department. Dr. Staley has served as an instructor for MSE since 1998 in addition to serving as an instructor for the Department of Science and Technology Studies (STS). Dr. Staley holds Ph.D. and M.S. degrees in MSE from the University of Wisconsin - Madison, prior to which he earned a B.S. in chemical engineering from the University of Delaware. He also holds a Ph.D. in science and technology studies from Virginia Tech. He teaches courses in thermodynamics; laboratory techniques (including phase behavior, microscopy, and thermal, rheological, and mechanical analysis); and introductory materials. Beginning in Fall 2014, he will be supervising the senior design projects that are a capstone requirement for all MSE majors. In addition, he teaches a variety of courses for the STS department and coordinates a university-wide Applied Ethics Initiative for the VT Institute for Society, Culture & Environment. His research interests center around the history and philosophy of sensory technologies and the human sciences, as well as ethical issues in science and technology. ❖