Exploring Materials
at Virginia Tech

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

Norman Dowling
Highlights from a Distinguished Career

LeeAnn Ellis

The title of Professor Emeritus of Materials Science and Engineering has been conferred upon Professor Norman Dowling by the Virginia Tech Board of Visitors, effective January 1, 2015. This title is reserved for retired professors, associate professors, and administrative officers who are specially recommended to the board by Virginia Tech's President Timothy Sands.

A member of the Virginia Tech faculty for 32 years, Professor Dowling has served the university well. He has made significant contributions to understanding the mechanics of materials, especially with respect to fatigue, fracture, and deformation of engineering materials and components. Dr. Dowling points out that about 4% of the GDP of industrial nations goes toward the cost of design, materials, research, and litigation when failures occur. "The overall societal goal of my work is to reduce such failures, and so enhance the public safety and economic efficiency, by disseminating knowledge on how to avoid mechanical failures in machines, vehicles, and structures." He has published more than 40 peer-reviewed papers on materials fatigue, and his first paper, published in 1972, became one of the most cited in the field. His book, *Mechanical Behavior of Materials*, has been widely adopted as an engineering textbook, with over 40,000 copies sold worldwide.

Beginnings

"I had the engineering genes," Dr. Dowling says. "I come from a family that has been running sawmills, cotton gins, and machinery for two hundred years." Despite this heritage, he was initially torn between biology and engineering when he entered Clemson University as an undergraduate. A nature enthusiast, he once owned a massive insect collection. In fact, he annoyed his dormitory neighbor, an entomology major, with his ability to identify some of the lesser known insects lying in a pile on that neighbor's desk.

He ultimately chose civil engineering, which involved structures and seemed to offer a broad range of possibilities, and engineering mechanics soon sparked his interest. He applied to and was accepted into an impressive list of graduate schools: Stanford, Northwestern, Illinois, Purdue. A phone call from the Theoretical and Applied Mechanics department head at the University of Illinois, Urbana, offering a NASA traineeship sealed his decision for Illinois.

"At that time, the government had a lot of merit-based graduate student support." The traineeship provided him with three years of support, which meant that he could approach the professor whose research was of particular interest, rather than searching for funding. Following completion of his M.S. degree in Theoretical and Applied Mechanics, he continued in that field, completing his Ph.D. degree at Illinois under the direction of Professor JoDean Morrow with a focus on fatigue and fracture.

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Dowling continued

In 1972, he accepted a position at the Westinghouse Research and Development Center in Pittsburgh. "I had done a lot of work on fatigue and cyclic loading failures as a graduate student, and Westinghouse had a very good activity in fracture mechanics." The company had, at that time, one of the premier corporate research laboratories in the U.S. "I could bring some expertise there, and I could learn some new things and combine two sub-areas of technology." He engaged in basic and applied research as well as internal consulting and troubleshooting in fatigue, fracture, and life prediction for metal alloy materials and components. He developed laboratory capabilities in the areas of low cycle fatigue testing, analog computation and control, monitoring of small cracks, and combined axial-torsion testing and strain measurement in thin-walled tubes. He was also the principal investigator for the research portion of a large project on Torsional Fatigue Life of Power Plant Rotating Shafts, funded by the U.S. Department of Energy from 1980 to 1982.

From Industry to Academia

By 1981, the age of the large corporate research laboratory was diminishing. More and more Dowling was engaged in troubleshooting internal technical problems rather than research. From the beginning, his plan had been to spend about five years in industry and then move into a university setting. The five years stretched out to eleven years. Dr. Dowling joined Virginia Tech in 1983 as an associate professor in engineering science and mechanics (ESM) and was promoted to full professor in 1987.

Research

He received a nice research grant very early from NASA, thanks to professional contacts that knew his work and were eager to offer research support. "If you wanted research money and you were doing good work, it was fairly straightforward to get it." Out of eleven proposals he submitted, ten were funded. It wasn't necessary to devote large amounts of time to writing proposals, as is the case now. He was able to spend most of his time performing research rather than competing for funding.

As noted above, Dowling's research program started up promptly, with a $250K grant from NASA Lewis Research Center to investigate "Fatigue Growth of Small Cracks." This project was funded from 1983 to 1987. During that same timeframe, he also had projects with NASA Langley, Wright Patterson Air Force Base, the U.S. Army Applied Technology Lab, and the U.S. Army Armament R&D Center, all dealing with some aspect of fatigue, fracture, and crack growth. In addition to military contracts, he has been a principal or co-principal investigator on projects for Norfolk Southern, STI Technologies, Wolverine Tube, Ford Motor, to name just a few. He has also done a great deal of consulting work with industry and government agencies over the years.

Among 40 ESM faculty members in the 1980's, Dowling was engaged in 10% of the research, or four times the average. He had several graduate students, a secretary, and an assistant professor helping him with his research. He maintained a considerable research program for a number of years until federal support began to drop off.

Teaching

Dr. Dowling's career as a teacher began back in his graduate student days when he served as a teaching assistant and also as an instructor while completing his doctorate at Illinois. At Westinghouse, he lectured on fatigue and fracture for various company short courses. He also organized and served as the principal instructor for a three-day course on "Fatigue at Notches," which he presented each year from 1977 to 1982. Joining Virginia Tech was a continuation of a teaching career already well underway.

In 1992, during Dr. Ron Gordon's tenure as department head, Dr. Dowling became a joint faculty member of the MSE department. MSE was mainly scientific and theoretical, and Dr. Gordon was interested in improving the MSE service courses. He also sought to broaden the department towards the practical side of materials. Dowling taught Materials Science and Engineering, a required course for many mechanical engineering (ME) students. Recognizing that a service course geared toward students outside of MSE should meet the needs of those students, he consulted with the ME department to find out what they hoped their students would learn in the course. "I was the faculty member in charge of what is now MSE 2034 for several years. I tailored the curriculum to what was agreed upon with the departments it served, the biggest customer being ME."

Other teaching highlights include continuing education courses for Volvo Trucks taught in Dublin, Virginia, and in Greensboro, North Carolina.

Part of Dowling's teaching philosophy touches on the idea that time spent in industry is extremely beneficial when heading into the classroom. He also emphasizes the importance of professional engineering certification and regrets that more young engineers are not pursuing this. He obtained his PE certificate in 1980 in Pennsylvania in structural engineering and has maintained it through the years, registering in Virginia in 1986.

Service

While teaching Mechanical Behavior of Materials, currently ESM-MSE 3054, Dr. Dowling and many colleagues around the country concurred that there were no books available with a practical orientation that worked well for service courses. One day after class, having reached his limit of frustration, he marched back to his office and wrote out a book outline and began writing a book. Since he had a fair amount of research underway, there were times when the book had to be set aside. "I think it took fully five years from the time I wrote that outline to when the final book appeared in print [in 1993]." He produced a *handwritten* manuscript that stood two and a half feet high. Word processing at the time was new and very specialized. He was fortunate to receive a good deal of clerical support to transform his handwritten pages into a typed manuscript. *Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue* is now in its 4th edition. It has filled the gap that Dr. Dowling and his colleagues perceived and is used all over the world.

When Dr. Gordon left the department in 1999 to pursue an opportunity at Alfred University, there was a need for an interim department head in MSE. With his organizational skills and flair for diplomacy, Dr. Dowling was well qualified to keep the department running, but he admits that he had to be persuaded to step in as head of MSE until a new department head was appointed.

During his year and a half as interim head, the department was in the midst of revising its curriculum and creating new courses in microelectronics. This turned into quite a debacle when it was discovered that seniors were taking courses that had not yet been officially approved. Dr. Dowling got to work on fixing the situation, with help from Dr. Ron Kander. When Dr. David Clark was appointed as the department head in 2001, Dowling became the curriculum chair and continued the complicated business of submitting numerous course proposals that complied with the university's ever changing guidelines. "Thanks to Norm's leadership, the department was in

great shape when I arrived as the new head in January 2001," Dr. Clark said. "Norm's patience and guidance during my first few years made for a smooth transition. He has continued to serve the department selflessly over the years, and I am confident that he will continue to do so in the future."

Two years later, ESM was in need of an interim head. Once again, Dowling had to be persuaded to take the position, and his diplomacy and organizational skills were at the forefront of why he was needed in the position. Between the two departments he spent about four and a half years as interim head.

Kayaking in New Zealand

International Work

Dowling has had many opportunities to collaborate with colleagues around the world. "Japan goes back to my graduate days." While his advisor, Dr. JoDean Morrow, was on sabbatical in Japan, he sent Dowling a master's thesis to study. Dowling recognized there were some important ideas, some that he was already working on. He performed experiments that verified these ideas, giving full credit to his new Japanese colleagues. This lead, years later, to an invitation to visit the mechanical engineering department at Fukuoka University in 2006, courtesy of the Japan Ministry of Education. He gave lectures and discussed common research interests with colleagues, as well as doing some sightseeing.

He made connections in Italy through former ESM department head and associate dean of engineering Ed Henneke, who had a graduate exchange program with the Università di Roma and faculty member Francesco dell'Isola. Dowling advised one of the students, Angela Madeo, who is now on the faculty at Université de Lyon INSA in France. "So my French activity grew out of the Italian activity." Madeo did research on increasing the energy absorption of concrete to damp out vibrations caused by earthquakes, and she traveled to Virginia Tech to do some testing. Dowling's work with Francesco is ongoing.

One great memory he shared concerns his initial efforts to plan an itinerary for the first trip to Italy that would allow time for him to see various parts of Italy with his wife, Nancy, as well as spend two weeks working with Francesco in Rome. Francesco's response was, "It's foolish to leave Roma, there's too much to do here," and he invited the Dowlings to stay in his apartment near the Coliseum. So they stayed in Rome while still managing to visit Naples and Pompeii.

In 2011, the Dowlings traveled to New Zealand on sabbatical, where Dr. Dowling was awarded a prestigious Visiting Erskine Fellowship at the University of Canterbury in Christchurch. His host was mechanical engineering department head, Dr. Milo Kral, who had attempted to visit Dr. Dowling in the U.S. in 2001. The tragic events of September 11 prevented that visit. But Dr. Kral reached out to Dr. Dowling later on with an invitation to spend a semester in Christchurch. Dr. Kral teaches a fracture mechanics and failure analysis course using Dowling's textbook, and he invited Dr. Dowling to teach the lecture portion of the course to a class of about 42 students. "We worked together on that course, which had a very nice lab component involving each student having a failure analysis project." He also worked on setting up fracture toughness and fatigue crack growth tests, something they had not done in the past.

Of special note were the teaching evaluations for the course. One entire class period is set aside and one or two faculty members meet with the class to discuss how the semester went. Then the students complete a form and provide a lot of comments. Dowling received a very high rating compared to what is normally seen. "They were very pleased, and I was pleased it went that well." He returned for a half semester in 2013 and currently has an open invitation. "Professor Dowling is a classic gentleman and a scholar," wrote Dr. Kral in a recent e-mail. "I have had the privilege of working with him to develop my course here at the University of Canterbury, where we have used his textbook for more than 7 years. He is excellent with the students and a perfectionist in regards to his book, which has resulted in a text that we will use for years to come."

Besides teaching, Dr. Dowling was able to help out in the effort to repair the MTS machine, which had not worked properly since the third of three significant earthquakes hit New Zealand that year. The third one struck just two months before the Dowlings arrived, causing considerable damage to Christchurch.

Honors

In March 2009, Dowling was awarded the endowed position of Frank Maher Professor of Engineering by Virginia Tech's Board of Visitors. This endowment was created by ESM alumnus Bruce Vorhauer (1964) in honor of Frank Maher, who was a professor in ESM, and who received a master's degree in civil engineering in 1937.

In November 2004, Dr. Dowling received a Fatigue Achievement Award from ASTM International. And in 1990, he received an ASTM Award of Merit and honorary title of Fellow in ASTM. Further back, in 1972, he was named Outstanding Young Teacher in Engineering Mechanics at the University of Illinois.

The Future

Dr. Dowling plans to continue his involvement with MSE and ESM (now part of the BEAM Department). His MSE committee work is continuing. He is frequently sought out for advice on labs, and he will probably do some part-time teaching. "I hope to be a presence in both departments and help out in constructive ways."

There will be lots of traveling as well, including family visits, fishing in Florida, even a Scotland to Denmark cruise is in the works.

Summing up a fantastic career

Out of his very successful career spanning over 40 years, Dr. Dowling says, "The book is probably my main professional accomplishment." He has performed considerable research and written numerous well-cited papers that have significantly influenced the practice of engineering. A lot of his research went into the book with the goal of introducing students and bachelor's level engineers to the important areas of materials deformation, fracture, and fatigue. The book is used in about 50 schools in the United States and others all around the world. "I get comments all the time about how helpful it is and that's the best thing I've done." ❖

Norman and Nancy Dowling in New Zealand

Céline Hin - Research Overview

LeeAnn Ellis

Since joining the Virginia Tech faculty in August 2011, Assistant Professor Céline Hin has stayed busy building her research program. Jointly appointed in the Departments of Materials Science and Engineering (MSE) and Mechanical Engineering (ME), she was hired as part of the nuclear engineering program (housed in ME). Prior to coming to Virginia Tech, Dr. Hin spent four years as a post-doctoral associate at MIT, first working with Professor W. Craig Carter in MSE. Her research on Li-ion batteries focused on developing a grand Canonical Kinetic Monte Carlo algorithm to study the influence of particle orientations in the electrolyte on the ell voltage at atomic scale. She then joined the ME department where she worked on thermoelectric materials with Professor Mildred Dresselhaus and Professor Gang Chen. She also spent a year in the nuclear engineering department at UC Berkeley.

Currently she is engaged in research sponsored by AFOSR, ORNL, and NEUP (Nuclear Energy University Programs). A couple of projects involve the study of dielectric breakdowns and working to understand leakage of current in particular materials. She is also involved with the development of the nuclear engineering program and the radiation facility at Virginia Tech, as well as teaching ME and MSE nuclear materials courses.

"Structural and electronic effects of helium interstitials in $Y_2Ti_2O_7$: A first-principles study" was published in the *Journal of Nuclear Materials* in 2014. In this project, Dr. Hin and graduate student, Tom Danielson, used density functional theory (DFT) to study helium interstitials in yttrium titanate, $Y_2Ti_2O_7$. DFT is a computational quantum mechanical modeling method used to investigate the electronic structure in atoms and molecules. A summary of this study follows.

Based on previous published studies, "Nanostructured ferritic alloys (NFAs) have shown great promise as first wall and structural components for advanced fission and fusion reactor systems due to their capability of withstanding high neutron fluence, high temperatures and pressures, and high concentrations of transmutation product helium due to (n, α) reactions." A serious challenge in selecting materials for harsh reactor environments is helium accumulation, "due to its negligible solubility in metals." Understanding the theory and characteristics of helium in metals has been the focus of numerous studies.

Helium production during irradiation is accompanied by displacement damage that results in a vacancy concentration. Clusters of helium form in these vacancies and eventually lead to the growth of large helium bubbles. Preventing these bubbles from forming along grain boundaries, dislocations, and voids is crucial since the bubbles cause intergranular fractures and at high temperatures, helium bubbles become pressurized, leading to compromised mechanical properties of the materials (iron). This is of particular concern in a high-pressure reactor environment.

NFAs are promising as a solution for moderating large helium bubble formation because of the presence of complex oxide nanofeatures (NFs) such as yttrium titanate. These NFs slow helium diffusion and trap helium bubbles, preventing delivery to grain boundaries. While experimental evidence has shown that NFs act as trapping sites for these bubbles, there is a need for a theoretical understanding of the energetic mechanism that governs nucleation, growth, and trapping of bubbles at the NF surface. Ultimately, developing more accurate models of helium in reactor environments will improve the ability to prevent helium embrittlement in future nuclear reactors.

The focus of this study was on the behavior of helium in $Y_2Ti_2O_7$. DFT was used to determine "interstitial positions available for helium in the oxide, relative stability of each interstitial position, as well as the structural and electronic interactions of helium in $Y_2Ti_2O_7$." These results produced data that could be used to set parameters for kinetic Monte Carlo simulations for studying the "trapping effect of helium at the interface between the oxides and the ferritic matrix."

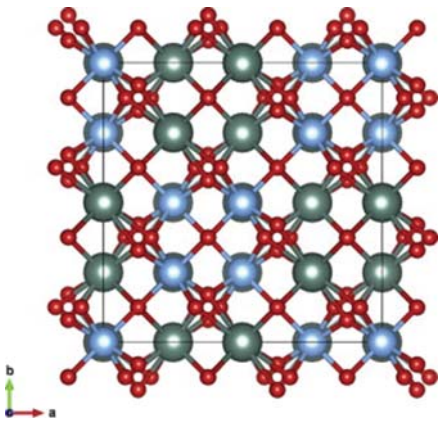
Using an array of calculations and simulations, the authors were able to observe several characteristics in a fully relaxed $Y_2Ti_2O_7$ system. Two pertinent observations are listed here.

- The helium interstitial at the midpoint of two yttrium atoms causes significant distortion to the lattice. The yttrium atoms displace in the direction opposite the helium atom.
- The helium atom at the midpoint of two oxygen atoms also causes considerable distortion to the lattice. The interstitial displaces in the direction opposite the oxygen atoms (towards a Y atom), which also have a significant displacement. The yttrium atom is displaced away from the helium atom. This position creates the largest distortion of the surrounding lattice sites.

Helium interaction with the oxide was investigated using electronic structure calculations from VASP (modeling program). Bader analysis, the change in partial density of states, and the charge density and electron localization function (ELF) provided good insight. "The distortion of oxygen atoms in the ELF indicates that there is a direct interaction between helium and the neighboring oxygen atoms resembling electron-electron repulsion. The balance of the electron-electron repulsion between helium and surrounding oxygen atoms is responsible for the deformation of the unit cell as the helium atom reaches its lowest energy position."

Further analyses yielded the following observations.

- The large volume of free space coupled with a resulting minimized interaction between the helium interstitial and neighboring helium atoms indicates the octahedral and tetrahedral locations cause the least deformation in the cell. Thus, the structural stability of the unit cell is not compromised by the helium interstitial in these locations.
- The bonds most affected by the helium interstitial are Ti-O.



$Y_2Ti_2O_7$ crystal structure. Red, green, and blue atoms are O, Y, and Ti, respectively.

- The helium atom is able to remain centered among neighboring oxygen atoms, "finding an equilibrium position based on the equivalent repulsions coming from each oxygen atom.

Thus, this study found "the helium has a significant interaction with the neighboring oxygen atoms," and "the tetrahedral helium interstitial displaces very little from the vacant O 8a site upon full relaxation."

A brief overview has been presented, summarizing a few of the major points from Hin and Danielson's research. Their conclusions and full citation follow.

The stability of five distinct helium interstitial positions has been evaluated using density functional theory. Of the five positions tested, only four are distinct; the octahedral, tetrahedral, Y–Y and O–O. The electron localization functions, charge densities, change in partial density of states and Bader analysis have given insight to the interaction of the helium atom with the neighboring atoms in the lattice, as well as the effects of the helium interstitial on the bonding of the constituent atoms. The titanium s- and d-states and O p-states were found to be the most significantly affected by the presence of interstitial helium. This consequence arises from two apparent causes; the distortion of the oxygen orbitals resulting in changes to the Ti–O bonding characteristics, and the resulting deformation of the crystal lattice. The octahedral interstitial location has the lowest solution energy and is the most stable and the Y–Y interstitial site is the least stable. The energetic results of this study will further the development of multi-scale models for the management of helium in nanostructured ferritic alloys.

"Structural and electronic effects of helium interstitials in $Y_2Ti_2O_7$: A first-principles study," Thomas Danielson, Céline Hin, *Journal of Nuclear Materials*, 452 (2014) 189-196. http://dx.doi.org/10.1016/j.jnucmat.2014.05.016 ❖

Department News

Annual MSE Advisory Board Meeting

The MSE Advisory Board held its annual meeting November 13 and 14, 2014. Agenda items included updates on the undergraduate and graduate programs, and a presentation by Tom Staley on planned renovations to a section of Randolph Hall, which will house undergraduate laboratories and offices. Alan Druschitz gave an update on VT-FIRE activities, and MSE's newest faculty member, Johan Foster, offered an introduction to his research in the field of smart materials. Cameron Reynolds, the president of the student organization MEPS, gave an overview of MEPS activities. Board members also met with students to get their feedback and suggestions. Break-out sessions with faculty were conducted to propose long-term goals for the department, with a focus on expected growth.

The board received two special guests during their meetings. On Thursday, Associate Dean Ed Nelson joined the group for a lunchtime discussion on the university's plans for reconfiguring Holden Hall in the next few years.

On Friday, the board was pleased to welcome Virginia Tech's new president, Timothy Sands. Dr. Sands joined Virginia Tech as its 16th president on June 1, 2014. He was officially installed at a ceremony held in October. He holds joint faculty appointments in the MSE and ECE departments. President Sands joined the MSE advisory board for lunch to share his vision for the university and to receive input from the board.

Dean Nelson and President Sands were each presented with HokieBirds cast at the Kroehling foundry along with certificates detailing their composition. The presentations were made by Alan Druschitz and Cameron Reynolds. ❖

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MSE Department Head David Clark and Virginia Tech President Timothy Sands

MSE Advisory Board Chair, Warren White, Associate Dean Ed Nelson, VT-FIRE Director, Alan Druschitz, MEPS President, Cameron Reynolds

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Magnetite crystals growing on a steel substrate
Courtesy of Professor Alan Druschitz

Green Engineering Education in MSE

Sean McGinnis

Green Engineering students tour GE Wind Turbines at Beech Ridge, WV.

The VT Green Engineering Program (*www.eng.vt.edu/green*), directed by Associate Research Professor Sean McGinnis, continues to grow and provide students in MSE and the College of Engineering with concepts and skills to make the world more sustainable. Initiated over a decade ago, well before sustainability was a common term on campuses, this program strives to raise students' awareness regarding the environmental impacts of engineering practice. The program also teaches tangible skills that students can take to academic, corporate, or governmental careers for designing products, processes, and systems in ways that minimize environmental impacts. While sustainability courses and programs are growing more common in US universities, this program is still unique in its interdisciplinary reach across the entire College of Engineering instead of being embedded in a specific department or discipline.

Green Engineering focuses on the design of products, processes, and systems with the goal of minimizing environmental impact while still meeting other critical design criteria (cost, schedule, safety, performance, etc.). This design approach requires that environmental constraints be defined and considered from the start and is important since environmental impacts occur through all phases of a product's life cycle: extraction of raw materials from the environment, inputs of energy and materials for manufacturing processes, consumption of energy and materials for product use, disposal of the product at the end of its life, and transportation of materials throughout these phases. This systems-thinking perspective is critical since benefits in one phase of the life cycle may lead to significant environmental impacts in other phases.

The Green Engineering Program is a mixture of education, research, and outreach. Education is the core and strength of this program. A minor in Green Engineering has been available since the 2008-09 academic year. The minor requires 2 core courses (*Introduction to Green Engineering* and *Environmental Life Cycle Assessment*), 2 engineering courses with disciplinary environmental content, and 2 interdisciplinary courses which broaden the students' understanding of environmental issues outside engineering.

The program is in high demand among students and has been growing rapidly. From 23 green engineering minors in 2008-09, the program graduated 168 students with the green engineering minor in 2013-14. Among MSE students, 40% of the 2013-14 graduates obtained the minor. More than 575 students are currently pursuing the minor.

While this program serves all departments in the College of Engineering, as a materials scientist by education and industrial experience, Dr. McGinnis has a particular interest in transforming MSE education and training to embed green engineering and sustainability concepts. Currently, three courses in MSE have integrated environmental concepts to the degree that they count as engineering electives for the green engineering minor.

In MSE 2044, *Fundamentals of Materials Engineering*, environmental issues such as raw material abundance, embodied energy, recyclability, and toxicity are considered for all materials classes. Students also consider the basic concepts of green engineering, life cycle assessment, and sustainability in the context of a research paper on a specific material and application.

In MSE 4055, *Materials Selection and Design*, the basic green engineering concepts are revisited as senior-level students focus in more detail on materials design considerations. A powerful materials design software package, CES Selector (Granta Design Limited), is used to show students examples and case-studies of how specific environmental constraints can be considered explicitly in materials selection. For example, students can consider the ***production energy*** of a material, that is, the amount of energy required to take raw materials and transform them into an engineering material like steel. This constraint can be balanced along with other traditional design constraints such as strength, modulus, fracture toughness, cost, or others as the specific case requires.

In MSE 3344, *Governmental Regulation of the Metal Casting Industry*, the environmental issues associated with the metal casting process and industry are studied along with the science and engineering of casting processes. Students look at state and federal regulations and consider how these impact specific metal casting processes and the industry in general.

These courses represent the start of what Dr. McGinnis hopes is the full integration of green engineering concepts into the education of materials scientists and engineers at Virginia Tech. While these efforts are needed in all fields to address issues of sustainability, the selection, design, and processing of materials represents a significant opportunity to make more sustainable choices for the future. Despite the direct connection between materials and environmental impacts, it is still uncommon for materials science courses or curricula to address environmental issues in a formal way, even though such content is now required in the ABET accreditation for engineering programs.

Dr. McGinnis also advises MSE senior design teams on projects that are relevant to green engineering. In recent years, these projects have included dye-sensitized solar cells, geopolymers based on alumina refining waste products, low cost ceramic water filters for the developing world, and the sorting of plastics for efficient plastic recycling processes.

From a research perspective, the green engineering program often works closely with other faculty from VT on a variety of projects. Life Cycle Assessment (LCA) projects have been done for nanocellulose and nanogold processing in collaboration with faculty in the Institute for Critical Technology and Applied Science (ICTAS).

The green engineering program also does outreach education to discuss the relationship between engineering and sustainability. Presentations have been done for grade schools, high schools, local environmental and civic organizations, and local governments. Green Engineering has also partnered with local governments and businesses on projects related to energy, the environment, and sustainability. Finally, the Dr. McGinnis developed and regularly teaches a Green Engineering Short Course for the National Aeronautics and Space Administration (NASA). ❖

Foundry M&T Hall of Honor Recognizes Dr. Alan Druschitz

Dr. Alan Druschitz is the latest metalcaster enrolled in the Foundry Management and Technology Hall of Honor. His career in research, manufacturing, design, and education has been guided by practicality and inspired by insights and discoveries, and in that way his experience parallels the progress and transformation in the metalcasting industry over the past four decades. The full FOUNDRY M&T article can be accessed in PDF format at *http://www.mse.vt.edu/vtfire*. Click on the News tab. ❖

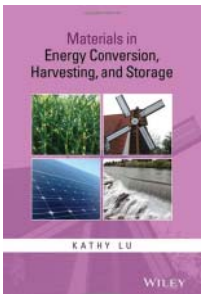
Diane Folz to be Honored

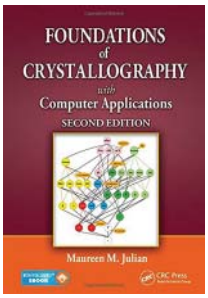
Diane Folz, former senior research associate, has been selected to receive an ACerS/NICE Greaves-Walker Lifetime Service Award. This award is presented to an individual who has rendered outstanding service to the ceramic engineering profession and has exemplified the aims, ideas, and purpose of The National Institute of Ceramic Engineers (NICE). Presentation of this award will take place at the fall 2015 MS&T/ACerS annual meeting in Columbus, Ohio. Congratulations, Diane! ❖

MSE Faculty Publish New Books

September 2014 - Professor **Kathy Lu's** new book, *Energy Conversion, Harvesting, and Storage*, was published on September 22, 2014, by Wiley.

October 2014 - The second edition of Professor **Maureen Julian's** book, *Foundations of Crystallography with Computer Applications*, was published by CRC Press on October 3, 2014. ❖





MSE Welcomes New Arrivals

E. Johan Foster joined Materials Science and Engineering at Virginia Tech in August of 2014 as an Associate Professor. Previously, he was a Maître Assistant (akin to an assistant professor) in Polymer Chemistry and Materials at the Adolphe Merkle Institute at the University of Fribourg (Switzerland). Johan was educated at Simon Fraser University in Vancouver, Canada, where he received his B.Sc. and Ph.D. in chemistry, studying structure-property relationships in disc shaped liquid crystals. Johan was a Post Doctoral Fellow with Prof. E.W. (Bert) Meijer at Technical University Eindhoven in the Netherlands. Johan's main interests focus on design, synthesis, processing, and investigation of functional nanocomposites, biomaterials, supramolecular materials and polymers: materials which exploit both covalent and non-covalent interactions. Johan has ongoing projects utilizing cellulose nanocrystals (CNCs) which are high-aspect ratio, mechanically stiff fibers which can serve as both a bio-renewable reinforcing agent in nanocomposites, as well as a handle for adding stimuli responsiveness. ❖

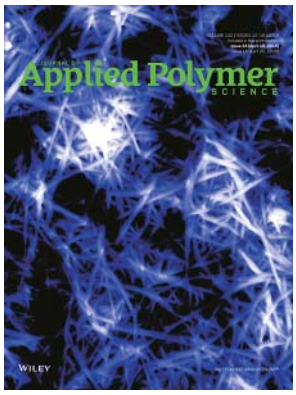
The MSE department is pleased to announce the arrival of our newest member. **Ainsley Harper Lovell** was born January 10, 2015 at 6:25 a.m. Her proud parents are Abby Whittington (MSE) and Brett Lovell (OSP).❖

Patent Issued: *Holey Optical Fiber with Random Pattern of Holes and Method for Making Same*. U.S. Patent No.: 8,861,912. Issued October 14, 2014. Inventors: Gary Pickrell (MSE), Rogers Stolen, Anbo Wang (ECE), Daniel Kominsky, Jeong Kim, Ahmad Safaai-Jazi (ECE). ❖

Noteworthy

VT-FIRE and the MSE metal casting program were featured in the December 2014 edition of INCAST, published by the Investment Casting Institute. Virginia Tech was one of six schools featured. To read the 2-page article, visit *www.mse.vt.edu/vtfire* and click on the News tab.

Materials Views recognized work by **Dr. Johan Foster** and co-author Dr. Mehdi Jorfi published in the *Journal of Applied Polymer Science*. The article notes that reports on biomedical materials based on nanocellulose are growing in prominence. "In light of this progress, two up and coming young researchers present a new review of nanocellulose's biomedical applications." Visit *www.mse.vt.edu* to read more.



MSE Ph.D. student, **Rachel Umbel**, was profiled in VT's College of Engineering 2014 annual report, *Engineering Now*. Visit *www.mse.vt.edu* to read a PDF of her article. You can all visit *www.eng.vt.edu/news/engineeringnow* to read the full report.

MEPS 2014-15 Highlights

Cameron Reynolds, MEPS President

The Materials Engineering Professional Societies (MEPS) is the student organization that encompasses the Material Advantage chapter of Virginia Tech as well as the Association of Iron and Steel Technology; American Foundry Society; The Minerals, Metals, and Materials Society; Materials Research Society; 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 last few years have seen an increase in enrollment in MSE at Virginia Tech and this has also led to a continued increase in participation in our student organization. This year's sophomore class is about twice the size of the current senior class. As these students become more involved in MSE it is expected that MEPS will continue to grow. In an effort to make MEPS more effective and accessible, new officer positions have been created in addition to the existing ones. New to MEPS this year are the positions of Professional Coordinator, Junior Liaison, and Sophomore Liaison. The role of the Professional Coordinator is to help engage students professionally by contacting companies to come and present outside of the regular monthly MEPS meetings, as well as coordinate the trip to the TMS conference in March. The job of the Junior and Sophomore Liaisons is to actively inform their respective classes of MEPS announcements and get feedback by word of mouth.

This year, guest speakers from the AIST Foundation, Virginia Tech Career Services, Graham White Manufacturing Co., Polymer Solutions, and Precision Castparts Corporation visited during dedicated presentation meetings. MEPS students met with the MSE advisory board during the latter part of the fall semester to share ideas and thoughts used to help the department. MEPS Advisor and VT-Fire Director, Dr. Alan Druschitz, along with MEPS President Cameron Reynolds, met with the advisory board and new Virginia Tech President, Timothy Sands, to offer an update on the MSE department.

MEPS also sent 17 students to the Materials Science and Technology conference in Pittsburgh. Of these students there were six design teams who competed in three competitions including the first annual Domes Day competition, where students were tasked with designing a geodesic dome that was judged on its compressive strength to weight ratio and cost to weight ratio. Virginia Tech had two teams compete and won first place in the event. Additionally MEPS competed in the ceramic mug and disc golf competitions. Josh Marett won MEPS' second 1st place in the mug drop competition while Sam Swayne took home MEPS' first 1st place in the aesthetic mug competition. MEPS seniors David Lichtman and Joe Rittenhouse participated in the Undergraduate Speaking Contest and Student Poster Contests, respectively. Myrissa Maxfield represented MEPS as one of only three ASM Student Board Members, as well as representing MEPS at the ASM Leadership Workshop along with fellow officers Cameron Reynolds and Sarah DeSilva.

Mug Drop winners Sarah DeSilva and Josh Marett, with Sam Swayne, winner of the mug aesthetics competition.

First Place Domes Day winners: Joe Ogea, Peter Kim, and Sulman Khan.

In March MEPS will send three teams to Orlando to compete in the TMS Bladesmithing competition as well as in the Materials Bowl, a materials science themed trivia competition.

After last year's work, new t-shirts and a new MEPS brand have been established and met with much enthusiasm. Also new this year was the professor auction hosted by MEPS at the MSE Christmas Party. Activities with MSE professors and staff were auctioned off to help raise money for MEPS.

So far MEPS outreach has worked closely with Michelle Czamanske and the MSE ambassador program to increase enrollment in MSE and participation in MEPS. To begin the year MEPS has participated in the Engineering Showcase for Freshmen, MSE Department Information Nights, two foundry open houses with VT-Fire, two Admissions open houses, tours for the Roanoke Valley Governor's School, and visits from Christiansburg and Eastern Montgomery High Schools. MEPS continues to plan outreach events as the semester progresses.

To foster some team building at the beginning of the year as well as to give back to Virginia Tech, MEPS members helped freshman students move into the dorms through Hokie

Tianjin University students at Dragon's Tooth.

Helpers. MEPS also hosted two football tailgates and attempted a friendly flag football game with our friends in mining engineering with whom we share Holden Hall. In January Tianjin University students visited the MSE department. MEPS members went to dinner with the visitors and also hiked to Dragon's Tooth with them. This hike sparked some interest within MEPS for MEPS hiking trips and has garnered considerable support.

The MEPS tutoring program started last year is also still going strong, offering Virginia Tech students help in MSE related classes. This program was started due to the highly specific nature of MSE classes, and because help outside the classroom can be difficult to come by for those students who cannot attend office hours. This program and the students who volunteer their time embody the school motto of Ut Prosim and the MEPS goal of enriching the student experience here in the MSE Department. ❖

Myrissa Maxfield performs a pouring demo for students from Christiansburg High School and Eastern Montgomery High School

MEPS 2014-15 Officers
President - Cameron Reynolds
Vice President - Myrissa Maxfield
Treasurer - Evan Luthringer
Secretary (Historian/Advertising) - Sarah DeSilva
Secretary (Webmaster) - Sean Cowden
Social Chair - Matt Crowley
Outreach Coordinator - David Lichtman
SEC Chair - Joe Ogea
Sophomore Liaison - Jack Cooper
Senior Liaison - David Lichtman

Scholarship Highlights

FEF SCHOLARSHIPS
The 2014 FEF College Industry Conference was held in November at the Westin Michigan Avenue in Chicago. The conference brings together professors, industry executives, university administrators, and student delegates and provides opportunities for students to interact with metal casting industry representatives. Several scholarships were awarded during the conference, and two MSE students were among the recipients.

Myrissa Maxfield received the Dr. Katherine E. Mortimer Scholarship for Women in Metal Casting. This new scholarship was set up by Dr. Mortimer, an educator with industry experience who seeks to "enable women to advance in the metalcasting industry."

Ethan Edwards received a Keith D. Millis Scholarship. Millis, a 1938 graduate of Rensselaer, was a metallurgical engineer who invented ductile iron. The scholarship was created by the Ductile Iron Society in 1991.

Myrissa Maxfield receiving Mortimer Scholarship at FEF CIC in Chicago.

AIST SCHOLARSHIPS
Joseph Ogea and **Andrew Weir** have been awarded AIST scholarships for 2015. The Ferrous Metallurgy Education Today (FeMET) Initiative was established in 2005 to increase the number of students studying metallurgy and materials science in North America. Up to 10 one-year scholarships of $5,000 each are awarded to metallurgy and materials science students. Each scholarship includes a paid internship with a North American steel company.

HH HARRIS SCHOLARSHIPS
Three MSE students received HH Harris scholarships for 2014/15: Seniors M**yrissa Maxfield** and **Allison Popernack**, and graduate student **Peter Kim**.

GEORGE BARKER FOUNDATION
For the second year in a row, graduate student **Peter Kim** has recieved this scholarship from the AFS Wisconsin Chapter.

For more scholarships, see page 14. ❖

Summer 2014 Internships

Jacob Monzel - Kirtland Air Force Research Laboratory

Jacob Monzel spent last summer in Albuquerque, New Mexico, at the Kirtland Air Force Research Laboratory. He worked under Dr. Brad Hoff in the high-powered microwave group within the Directed Energy Directorate. They were evaluating additive printed materials for high-powered microwave applications, specifically looking at surface roughness and dielectric properties. At the conclusion of his internship in August, Jacob was one of 8 scholars out of 130 who received an Outstanding Scholar Award.

When he wasn't working, Jacob went hiking in the Sandia Mountains. He also visited White Sands and Carlsbad Caverns and did some white water rafting.

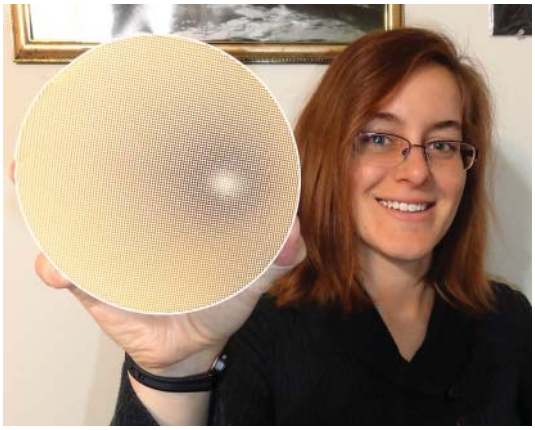
Jacob completed his MSE master's degree under Dr. Alan Druschitz last spring and began his doctoral research in the fall of 2014. Dr. G.Q. Lu is his advisor. He has been awarded an ASEE SMART Scholarship for the next three years. This Science, Mathematics, and Research for Transformation Scholarship for Service Program was established by the Department of Defense (DoD) to support undergraduate and graduate students pursuing degrees in science, technology, engineering, and mathematics (STEM) disciplines. The goal is to increase the number of civilian scientists and engineers working at DoD laboratories. Recipients receive full tuition, a stipend, and paid summer internships, as well as employment placement following graduation. Wright Patterson Air Force Base is funding Jacob's research, and he will spend the summer of 2015 working in their research lab in Ohio. ❖

Corning, Inc.

Rose Roberts

My second internship with Corning, Inc. this past summer was different than my experience with the company in 2012. As a graduate student, I was expected to produce better quality and greater quantity of work compared to my experience as an undergraduate student, and my project focus changed. The work was challenging but not overwhelming. My supervisor, Susan Holt, who received her master's and bachelor's degrees in materials science and engineering at Virginia Tech, set up the project to help me grow as a person and a professional while giving me tasks that would have a positive impact on the plant. Her approach as a mentor reflected how Corning keeps to its values, including The Individual, where there is a focus on helping employees follow a career path they will enjoy and where they will improve their skills.

My project was focused on the raw materials side of catalytic converter substrate production rather than quality control of the final product, which was the focus from my previous internship with the company. I was involved in improving the testing process for raw materials. This process validates that



incoming raw materials will produce a batch of final product with the same properties as what is currently being used on the production line. Validation steps included not only testing the materials themselves but also how they form together in a small batch. The project included a great deal of statistical analysis and background knowledge of rheology, extrusion, analytical chemistry techniques, and ceramics. ❖

Rose is the recipient of a 2014/15 Adhesive Manufacturers Association (AMA) Adhesive and Sealant tuition scholarship. The award is based on her research on "Facile Approach PVAc Based Reversible Adhesives" and a nomination from her advisor, Professor Johan Foster.

Other Summer Internships

Myrissa Maxfield at SSAB

Myrissa Maxfield was at SSAB in Montpelier, Iowa, last summer. SSAB is a Nordic and US-based steel company and a leading producer for advanced high strength steels and quenched and tempered steels for the global market. They also produce standard strip, plate and tubular products, and construction solutions.

Allison Popernack did a second internship with NASA, and **Peter Kim** spent his summer with PCC learning about ProCast. ❖

VT-FIRE and the Kroehling Advanced Materials Foundry Host Summer Programs and Fall Open Houses

VT-FIRE participated in the summer 2014 C-Tech^2 program, one of several programs offered through the Center for the Enhancement of Engineering Diversity (CEED). It stands for Computers and Technology at Virginia Tech. A primary focus of the program is to help develop and sustain the interests of women in engineering. This two-week residential camp encourages rising junior and senior high school girls to explore science and engineering with hands-on experiments and applications. Participants spend the majority of their time involved in activities designed to increase interest in and knowledge of applications of engineering to real world situations. A visit to the Kroehling foundry was one of the hands-on activities offered and students were introduced to the workings of the foundry. They also had an opportunity to design their own sand molds and observe steel pouring.

C-Tech^2 participants prepare sand molds

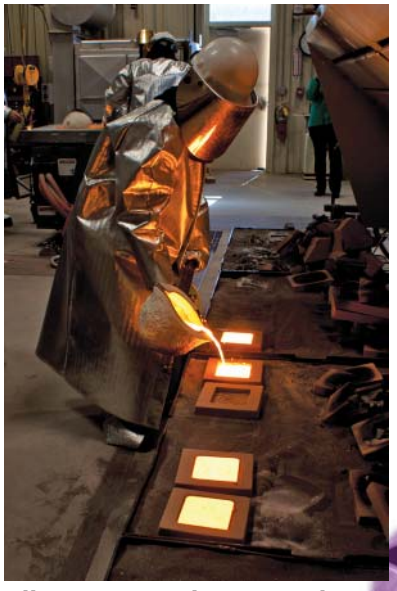
C-Tech^2 students display their completed castings

The foundry also hosted an AFS two-day laboratory course entitled "Nobake Molding & Coremaking," held June 11 and 12, 2014.

This was the second course in the nobake series, providing participants with the next level of knowledge related to the nobake molding and coremaking processes used within a foundry through discussion and laboratory activities. Some of the topics taught included specialty sands; sand variables and sand additives; the types of chemical binders used to make nobake molds and cores; how to determine the correct sand and binder for the application; the use of refractory coatings, adhesives, and release agents; how to evaluate problem areas with raw materials, binders and equipment; and how to make adjustments to ensure a quality mold.

AFS CMI course

Fall open houses at the foundry were well attended. MEPS student ambassadors helped field questions and supervise activities. Among the volunteers was MSE senior, Allison Popernack, whose parents were among the visitors. They were able to get a firsthand look at Allison's skills in pouring molten steel. ❖



Allison Popernack pours steel during foundry open house

Foundry open house visitor works on sand mold design

MSE senior, Allison Popernack with her parents at a foundry open house

MSE Students Participate in International Programs

Sam Swayne & Drew Stutts
Germany May 19 to August 22, 2014

Samantha Swayne (Sam) and Drew Stutts spent the summer at Technische Universität Darmstadt in Germany. They participated in a 12-week International Research Experience program (IREP) designed to give students experience conducting research, as well as living and working in an international academic environment. Following an orientation designed to help the students adjust to new surroundings and gain an understanding of Germany, they began their various research projects.

Samantha Swayne with Herbert, a family friend, at a beer festival in Obertshausen, Germany.

Sam worked in the functional materials group under Professor Oliver Gutfleisch. Her project focused on magneto caloric materials, which heat up or cool down in a magnetic field, depending on the type. These materials are very energy efficient and could revolutionize modern gas-compression refrigerators. However, the current one in use, gadolinium, is a rare earth metal that poses environmental concerns in the mining process. It's also very expensive and difficult to machine. Thus, a replacement material that offers similar qualities without the negatives is needed. Sam's assignment was to make Fe_2Ti (Iron 2 Titanium) and test it for magneto electric properties. She determined that Fe_2Ti had a minute magneto caloric effect, and so it is not a good choice to replace gadolinium.

Sam learned a lot about conducting research, and was particularly impressed by the innovation of her group. If they needed a machine to perform a particular test and no such machine could be found, they created one.

Drew Stutts at train station in Brugge, Belgium

Drew worked in materials science under Professor Alff. His group was using pulsed laser deposition (PLD) to synthesize oxide thin films. Drew performed electrical measurements to determine the resistivity of gadolinium scandium oxide ($GdScO_3$) on a strontium molybdenum oxide ($SrMoO_3$) substrate.

Both Sam and Drew commented on the diversity of their research groups. They met people from Russia, Ghana, Bosnia, Iran, and India, to name a few. All work was conducted in English, so students were not required to learn German, but Drew took a semester of German prior to the trip.

Sam's mother is German and still has family living in Frankfurt. She was able to help them find an apartment in Eberstadt, which was only a 15-minute train ride from Darmstadt.

Aside from their research, Sam and Drew joined other IREP students for after-work activities. They often met for dinner at a beer garden located in the center of the city. Most weekends the group traveled to the Netherlands, Belgium, and Switzerland. Sam especially enjoyed Brugge, Belgium, which she described as a "fairy tale" place. She was also able to spend time visiting her German relatives.

They both found the entire experience to be very positive. "I learned not just the science but how things are done," Sam said. She enjoyed observing the education system in Germany, noting the benefits of doing things differently, as well as the possible hindrances. There are no grades, just a final exam. Students attend classes for three months, and then their finals occur sometime during a three-month break. She also noted that her Virginia Tech professors are much more approachable than professors in Germany. "I definitely recommend it," Drew said. "It was a great summer, just getting exposed to different cultures, working with different people," and being able to see different European cities. ❖

Adwoa Baah-Dwomoh
China July 5 to July 28 2014
by Adwoa

Adwoa with fellow Hokies at the top of the Great Wall of China

The Boeing Student Leadership conference gave me the opportunity to visit China, one of the most historical and culturally diverse nations in the world. Hosted in Beijing by Tsinghua University, this conference brought together Boeing China executives and students from both the United States and China. Participating universities included Virginia Tech, University of California-Irvine, Tsinghua University, Peking University, Civil Aviation University of China, Civil Aviation Flight University of China, Sun Yat-sen University, and South China University of Technology. During this two-day conference, we heard presentations on becoming global leaders and creating our global footprint as well as panel discussions on career and leadership development in a global company. However, the most unique experience in my opinion was hearing the student run presentations. These presentations helped us to understand their design process as well as challenges these students face while creating projects at their Chinese universities. It was fascinating to be able to interact with the students and compare our daily educational lives as American students to theirs as Chinese students.

After the conference we were able to travel and experience China, a beautiful country with a very rich history. We were able to see such landmarks as Tiananmen Square, the Forbidden City, and the Great Wall of China. Some of my favorite experiences in Beijing were taking a photo with my fellow Hokies and the Virginia Tech flag at the top of the Great Wall and eating and experiencing authentic Peking duck. We left Beijing and traveled to Tianjin, where representatives from Tianjin University greeted us. The students and faculty were very warm and receptive, making our Tianjin visit most enjoyable. We also were able to tour their facilities and ask questions about the research being conducted at the university. It was interesting to see the capabilities they have and work with and compare it to our own at Virginia Tech. It gave us a unique perspective on how to tackle our own engineering problems. ❖

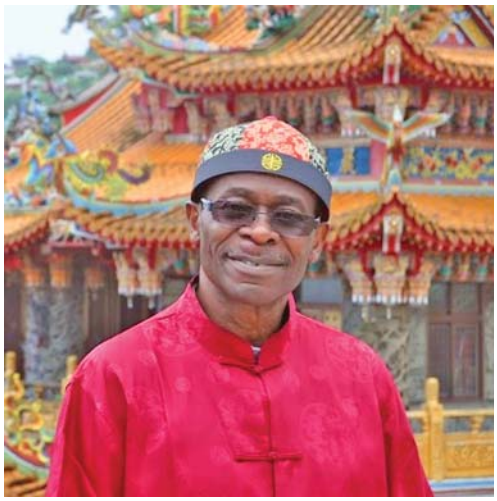
MSE Faculty Visit to China

Alex Aning
China June 2014

Professor Alex Aning traveled to Tianjin University in June to teach a three-week course on composite materials for about 35 seniors and graduate students. This was his second visit to Tianjin to teach. The main purpose is so that Chinese students can adapt to hearing lectures in English. In 2012 he taught physical metallurgy. Professor Abby Whittington also taught a course that year on biomaterials. This summer Dr. Aning will teach an introduction to materials science course. He noted that most of his students are women, and he was told that the women generally are better at understanding other languages.

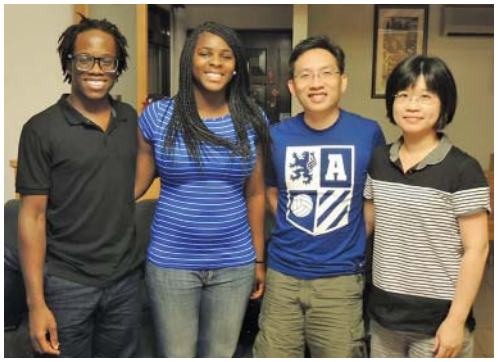
After completing his course at Tianjin, he took time to visit some of the tourist sights. He also traveled to Taiwan, where he met with a former MSE graduate student, J.K. Chen, who is now a professor at a university in Taipei. Finally, he was also able to spend time with his son, Agya, another VT graduate (psychology), who lives in Taichung. ❖

J.K. Chen, former MSE graduate student



Alex Aning in Jiufen, Taiwan

Dr. Aning visited the historic copper and gold mining town of Jiufen near Taipei.



Agya Aning, Adwoa Baah-Dwomoh in Taipei with J.K. Chen and his wife, Hui-Lun (Helen) Cheng.

Alan Druschitz
China July 2014

Professor Alan Druschitz spent two weeks at Tianjin University in July with the purpose of furthering the growing relationship between MSE-VT and MSE-Tianjin. He met with professors in the materials science and engineering department to discuss their different programs and also toured the laboratories. He noted that they have similar equipment to our labs with the exception of the foundry, which consists of a small green sand foundry on the second floor of the mechanical engineering building.

Very few people in the city speak English, so he was appreciative of his excellent tour guides, all Tianjin MSE students. They arranged tours of various sections of the city, including art and natural history museums, the Tianjin River (by boat tour), and a local manufacturing plant that produces laser-welded steel tubing. There was also a tour of the Tianjin University history museum, where he learned that the school was founded in 1895 by Sheng Xuanhuai and an American, Charles Daniel Tenney.

The students he met were all very serious about academics. Advanced degrees are essential to finding a good job, as competition is growing tremendously. The MSE department at Tianjin has an enrollment of 1000 students.

During his visit, a group of students from Virginia Tech's aerospace and ocean engineering department stopped in for a few days. MSE graduate student Adwoa Baah-Dwomoh was among this group (see her story on the opposite page).

Example of some of the modern architecture Dr. Druschitz observed in the city of Tianjin

Dr. Druschitz, Adwoa, & 2 Tianjin students toured the Tianjin TPCO & TISCO Welding Pipe Company.

Dr. Druschitz will be back in China this summer for four and a half weeks. He will travel with a Georgia Tech group as part of their international program to introduce American students to Chinese culture. They will spend nine weeks in three cities, taking classes four days a week and touring three. Dr. Druschitz will teach an introductory materials course during his time with them. The group will divide their time between Shanghai, Tianjin, and Shezhen.

Spring/Fall 2014 Materials Science and Engineering Bachelor of Science Degrees

Patrick John Ahearn
Devon Scott Baker
Sarah Cutler Bennett
Kirby Joseph Boone
Shawn Robert Bottoms
Tyler Anton Campos
Warren Denning
Daniel Paul Diner
Christopher Jacob Dolan
Grayson Stuart Doucette
Joshua Satoru Enokida
Brendan Michael Fajotina
Rafael Eduardo Gil-Figueroa
Farhan Muhammad Hasan
Jordan Matthew Holmes
Kathryn Mae Hoyme
Evan Michael Huffman
Samir Parviz Javid
Megan Ann Kimicata
Carli Madison Kitto
Zachary Gray Lawson
Meaghan Ann Merrill
Gabriella Tull Mirabelli
Nicole Adeline Mottes
Kevin Thomas Mulder
Christopher B. Reynolds
Anthony John Schiavo
Andrew Michael Schultz
Whui Su Shim
Joshua Andrew Stuckner
Katie Michelle Tontodonato
Bradley Eugene Walters

2014 Undergraduate Awards and Scholarships

Charles P. Blankenship
Feiyu Lu
Joseph L. Ogea
Dylan A. Platt
Allison S. Popernack
Andrew J. Stutts

Ronald S. Gordon
Sarah S. DeSilva
David E. Lichtman

Alfred E. Knobler
Anna L. Kofer
Mattie M. LaPrade
Stephanie A. Wiltman

John H. Kroehling
Matthew T. McGuire
Kyle R. Miller
Sarah C. Whipkey
Stephanie A. Wiltman
Nizar B. Zahed

Thomas G. Stroyan Memorial
Joseph L. Ogea
Sarah C. Whipkey

Michael Stuback Memorial
David E. Lichtman
Feiyu Lu

AIST
Joseph L. Ogea
Aaron Weir

Foundry Educaton Foundation
Myrissa Maxfield
(Dr. Katherine E. Mortimer Scholarship)
Ethan Edwards
(Keith D. Millis Scholarship)

HH Harris
Myrissa Maxfield
Allison S. Popernack

Spring 2014 Materials Science and Engineering Graduate Degrees

Doctor of Philosophy

Name	Dissertation	Advisor
David Berry	Design, Analysis and Experimental Verification of a Mechanically Compliant Interface for Fabricating Reliable, Double-Side Cooled, High Temperature, Sintered Silver Interconnected Power Modules	G.Q. Lu/K. Ngo
Menghui Li	Fabrication of Reliable, Self-Biased and Nonlinear Magnetoelectric Composites and Their Applications	D. Viehland
Corey O'Connell	An Integrated Time-Temperature Approach for Predicting Mechanical Properties of Quenched and Tempered Steels	A. Druschitz
Ying Shen	Applications of Magnetoelectric Sensors	D. Viehland
Laura Smith	Atomistic Molecular Dynamics Studies of Grain Boundary Structure and Deformation Response in Metallic Nanostructures	D. Farkas
Ronnie Varghese	3-D MEMS for Energy Harvesting and Sensing	S. Priya
Zhiguang Wang	Magnetoelectric Effect in Ferroelectric-Ferromagnetic Heterostructures	D. Viehland
Kewei Xiao	A Diffusion-Viscoelastic Analysis and Experimental Verification of Defect Formation in Sintered Silver Bond-Line	G.Q. Lu
Yiying Yao	Thermal Stability of Al_2O_3/Silicone Composites as High-Temperature Encapsulants	G.Q. Lu
Chenlin Zhao	Investigation of the Magnetic Properties of Non-Thiolated Au Nanostructures Grown by Laser Ablation	J. Abiade
Yu Zhao	Correlation Between Structure, Doping and Performance of Thermoelectric Materials	S. Priya
Yuan Zhou	Magnetoelectric Composites for On-Chip Near-Resonance Applications	S. Priya

Master of Science/Master of Engineering

Name	Thesis	Advisor
Shelley Cooke	Effects of Therapeutic Radiation on Polymeric Scaffolds	A. Whittington
John Echols	Investigation of Tungsten Surface Effects Under High Heat Flux Conditions	L. Winfrey
Yongxuan Liang	Fabrication and Characterization of Superconducting Core Fibers with Fused Silica Cladding	G. Pickrell
W. Elliot McAllister	A Critical Review of Multi Phase Materials and Optimization Strategies for Additive Printing Technologies	S. Priya
Robert Mills	Abrasive Blasting with Post-Process and In-Situ Characterization	G. Pickrell
Joshua Anderson	M.Eng.	A. Aning
James Stratton	M.Eng.	B. Reynolds
Rachel Umbel	M.Eng.	B. Reynolds

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Heads Up!

David Clark
MSE Department Head

I remember my first day on the job as the new head of MSE in January 2001. Just a few days earlier I had left the University of Florida in Gainesville where it was about 70°F. On this particular day it was in the teens and snowing in Blacksburg. All sorts of thoughts were going through my mind as I walked (and sometimes skidded) from the Donaldson Brown Hotel to Holden Hall. One of those thoughts had to do with whether or not I had made a serious mistake leaving a wonderful university and job in the flatlands of sunny Florida to become an administrator at another wonderful university in the not-so-flat terrain of southwest Virginia. In addition to knowing next to nothing about snow and mountains I knew even less about what it took to run a department. As I entered what would later become the main office for MSE I was greeted by several people with warm and smiling faces. Among them were Norm Dowling (Interim Department Head), Amy Hill (Department Financial Manager), and Tracey Keister (Department Office Manager, now retired). My doubts quickly faded as the day wore on and members of the faculty stopped by to welcome me. Even Dean Stephenson walked over in the snow and welcomed me aboard! By the end of the day I was pretty sure that I had made a good decision to come to VT.

Now, nearly 15 years later, I can say with certainty that it was the right decision. VT is indeed a very special place because of the people who live and work and go to school here. I have had the privilege of serving five deans, two provosts, and two presidents at VT. By the way, our new president, Dr. Timothy Sands, has a Ph.D. in materials science and engineering from the University of California-Berkeley and is jointly appointed in MSE and ECE.

Equally important, I have been blessed with a 'user friendly' department filled with exceptionally bright faculty, loyal staff, and creative students. As you can see from the contents of this issue of *Exploring Materials*, the department is flourishing and our faculty, staff, and students continue to excel. We now have over 220 undergraduates and are still growing. Our challenge here will be to ensure that we continue to deliver the quality education that we are known for. Our graduate program, now with 58 students, was just ranked 21st by *U.S. News and World Report*. We expect to grow this program by about 10-15% per year over the next several years.

On a final note, I would like to add a special thanks to Professor Norm Dowling, now Emeritus Professor, for the numerous contributions that he has made and continues to make to our university, college, and department. As I mentioned earlier, Norm was Interim Head when I arrived in 2001. In addition to being a well-respected colleague, he has been an advisor and mentor to all of us. Norm, we wish you and Nancy the best in retirement! ❖