Exploring Materials

at Virginia Tech

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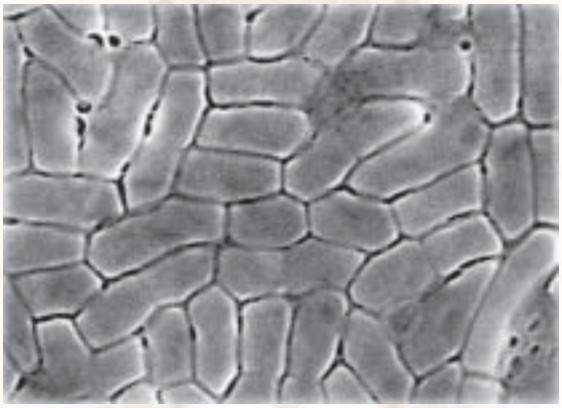
News from the Department of Materials Science and Engineering
Virginia Polytechnic Institute and State University

Research Spotlight

E. coli and materials science?
Meet Professor Guo-Quan Lu and read about his nanotechnology research on page 2.



People in Materials

Discover the Skipper-MSE connection on page 6.

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Virginia Tech

Discover what we're made of...
www.mse.vt.edu

Research Corner

Meet Professor Guo-Quan Lu

LeeAnn Ellis

Guo-Quan Lu was just 16 when he left his family and all that was familiar in Mainland China to come to the United States. GQ and a fellow student had received full scholarships from ALCOA to attend Carnegie Mellon and study materials science and engineering.

GQ remembers the culture shock and loneliness he experienced during those early months. Relief came by way of a kind older student named Bill Reynolds, now on the MSE faculty at Virginia Tech, who invited two homesick boys to his dorm room to watch the World Series. The year was 1979, "a great year for Pittsburgh!" GQ points out.

So he learned all about American baseball, and he persevered at Carnegie Mellon, completing B.S. degrees in MSE and in physics in 1984. By 1990, he had earned graduate degrees in applied physics from Harvard, and he had married Shufang Luo, who also attended Harvard.

After completing his Ph.D., GQ went to work at the ALCOA Technical Center in Pittsburgh as a senior scientist, where he got involved with the development of electronic materials and packaging. "I had a special connection with ALCOA," he explained. "They supported me so I could come to this country. They treated me very well."

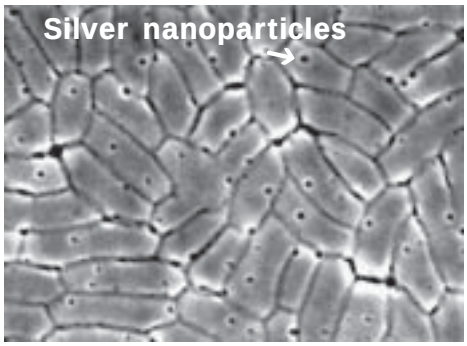
When ALCOA began reorganizing, GQ decided it was time to move back into a college environment. "I was always interested in academics, but I thought I'd get some industrial research experience first." He joined the MSE faculty at Virginia Tech in 1992, and ALCOA donated the optical system GQ had built for the study of sintering processes in ceramics and metals.

For his first teaching experience, GQ volunteered to teach solid state physics to electrical engineering students. "It was an infamous course!" he discovered, a service course demonized by EE students. He was nervous on the first day, his very first time teaching, and he walked into a packed classroom. His thinking back then was that he should give his students the highest expectations and the hardest problems, and this would help them learn. To his surprise, the students were angry and argued with him over the usefulness of solid state physics.

"I tried to reason with them," GQ said. "I was willing to go the extra mile to help them." He offered extra office hours and help sessions. After a dismal midterm exam, the class size dropped from over 100 students to 89. Those who stayed "appreciated the fact that I tried very hard and I was genuinely sincere in wanting them to learn." GQ's hard work paid off. At the end of that first semester he received an astounding 3.47 out of 4 on his teaching evaluations. "Incredible," he said, "for such an unpopular class!" In 1995, GQ received the prestigious Sporn Award for excellence in teaching engineering subjects.

Since that first difficult semester, he has changed his approach to teaching. He has improved his delivery, and he tries to use concrete analogies to explain tough concepts. "My job is to make sure the students learn the subject. The purpose is not to fail them." There are only a few concepts they need to know; "the rest of the course is how to apply these concepts to real problems."

In research, GQ is currently pursuing nanotechnology. He is quick to point out that when nanotechnology came to the forefront a few years ago, he did not jump on the bandwagon. "I'm becoming more practical when I do research," GQ explained. "I want to do research that has a clear purpose." So he took some time to learn about practical applications for nanotechnology. For example, one of his projects involves the development of silver nanoparticles that can kill *E. coli* bacteria. "If you break up a gram of silver into nanoparticles, you increase the surface area," GQ said. "Therefore, it can be more effective in attacking bacteria." The micrograph on the front page shows active *E. coli* cells. The micrograph on this page shows dead *E. coli* cells in the presence of silver nanoparticles.



E. coli bacteria killed by silver nanoparticles

In other research, GQ's group is studying nano applications for electronic packaging (see related article, this page). He is also collaborating with Lou Guido in the area of solid state lighting.

Away from the office, GQ can sometimes be found on the golf course with Lou Guido, who has fostered an interest in the sport. "It really tests your composure," GQ said. "I thought it was easy before," and even boring. Now he finds the game fascinating. He's interested in the science of the game and how body position affects his swing. His goal is to one day be skilled enough to beat Lou Guido. ❖

Nanoscale Silver as an Interconnecting Material for Semiconductor Devices

J.G. Bai, Z.Z. Zhang, J.N. Calata, and G.Q. Lu

An important aspect of device packaging involves the interconnection of a semiconductor device to a package substrate. The substrate must provide electrical conduction or isolation, a robust structure, and efficient heat removal.

Wide-band gap semiconductor devices, such as SiC, GaN, GaAs, and InP, are widely studied for emerging applications in high-power electronic circuits and solid-state lighting systems. As these devices are operable at temperatures over 200°C, which lowers the requirement for cooling, the development of new materials for their interconnection is critical.

The existing interconnection technology using solder alloys presents a host of difficulties that limit its use with the wide-band gap semiconductor devices. These difficulties include low thermal and electrical conductivities, ease of fatigue failure, and low-melting temperatures.

Silver continued page 7

The Materials Science and Engineering Department Welcomes Five New Faculty

Kathryn V. Logan
NASA Langley Professor

Specialization
Advanced synthesis, processing, and dynamic behavior of high performance ceramic materials

Kathryn Logan has been named the NASA Langley Professor at Virginia Tech. This professorship is one of six established by the National Institute of Aerospace (NIA), a consortium of universities working with NASA to develop new technologies and perform advanced aerospace and atmospheric research. Dr. Logan holds emerita status from Georgia Tech, where she has conducted research since 1969 in advanced synthesis, processing, and dynamic behavior of high performance ceramic materials. She earned three degrees from Georgia Tech in ceramic and civil engineering, and she is a licensed professional engineer. She is the president of Powder Technologies, Inc., which she founded in 1989. As the NASA Langley Professor, Dr. Logan will coordinate research and educational activities between Virginia Tech and NIA, which is headquartered in Hampton, Virginia.

Levon V. Asryan
Associate Professor

Specialization
Computational materials science, nanophotonics

Levon Asryan earned both his Ph.D. and Doctor of Sciences degrees in physics and mathematics from the Ioffe Institute of Physics and Technology in St. Petersburg, Russia, and a master's in radiophysics from Yerevan State University, Armenia. Among his many achievements is the development of a pioneering theory of threshold characteristics of quantum dot lasers, a concept of a temperature-insensitive semiconductor laser, and the development of a general theory of internal efficiency of heterostructure lasers with quantum-confined active regions. In 2001, he received the Highest Award (State Prize) in Science and Technology in Russia for his contributions to the development of quantum dot lasers – an honor he jointly shared with Nobel Prize laureate Zhores Alferov and others. Prior to the present appointment, Dr. Asryan held positions of research associate professor at the State University of New York in Stony Brook and senior research scientist at the Ioffe Institute.

Gary R. Pickrell
Assistant Professor

Specialization
Photonic sensors, novel optical fibers, nanomaterials, glass processing, and business improvement methodologies

Gary Pickrell joins MSE after serving as a research assistant professor in the ECE Department at Virginia Tech with a joint appointment as an affiliated research assistant professor in MSE. He is currently the associate director of the Center for Photonics Technology. He has held various industrial positions at Owens Illinois (development engineer), Corning (glass technology manager), and Porvair Advanced Materials (technical director). Dr. Pickrell received bachelor's and master's degrees in ceramic engineering from Ohio State University and a doctorate in MSE from Virginia Tech. His research focuses on random hole optical fibers (of which he is an inventor), optical fiber sensors, porous materials fabrication, sol-gel processing, nanomaterials, luminescent materials, high temperature corrosion, glass and ceramic processing, and business improvement methodologies.

Yu Wang
Assistant Professor

Specialization
Computational materials science

Yu Wang comes to MSE from the Department of Ceramic and Materials Science and Engineering at Rutgers, The State University of New Jersey, where he was a research associate. He completed his doctorate in mechanical engineering at Rutgers in 2001 and earned a mechanical engineering degree from the University of Science and Technology of China. Dr. Wang's expertise is materials modeling and computer simulations, in particular the novel mesoscale phase field microelasticity theories that incorporate atomistic calculation results and predict continuum constitutive relations to bridge materials modeling over multiple time and length scales. Dr. Wang has a wide range of research interests with a unifying goal of computer modeling that enables the computer-aided design of advanced materials and microdevices at nanometer and micron scales.

Peizhen Kathy Lu
Assistant Professor

Specialization
Nanomaterials and graded materials

Kathy Lu joins MSE after serving as a staff technology engineer at Energizer Holdings Inc. in Westlake, Ohio. Prior to that, she was director of materials processing at the Center for Innovative Sintered Products at Pennsylvania State University. She has held research associate positions at Ohio State University and at Tianjin University in China. She also worked as an assistant professor of MSE at Beijing University of Aeronautics and Astronautics. Dr. Lu earned her bachelor's and master's degrees in ceramics from Tianjin University. She received a master's and a doctorate in MSE from Ohio State University. She plans to focus her research on nanomaterials and functionally/structurally graded materials.

Department News

MSE Advisory Board Fall Meeting

Warren White

The advisory board to the MSE department conducted its fall meeting on campus on September 9 and 10. Once again we experienced excellent response from the board members with 8 of the 11 current members in attendance. All of our members are busy individuals in their professional and personal lives. Dr. Clark and I wish to thank all of our members for their active and enthusiastic participation in the growth and development of the department.

This session began on Thursday evening with a celebration. Dr. Clark hosted a reception at the Donaldson Brown Center for the board and the entire MSE department. This provided the opportunity to renew acquaintances with the faculty and staff (and with each other) as well as meeting some of the students. The highlight of the event was the chance to meet the five new members of the MSE faculty. Since our first meeting with Dr. Clark, the board has encouraged and supported his plan to grow the department into one that is recognized as a peer with those at other top engineering colleges. Accomplishments have been made in many areas, but growth in faculty was deemed as essential to achieving the goal. The addition of five new faculty to the department is evidence that a major milestone has been reached. After meeting these individuals and discussing their goals and objectives, the board is convinced that the respective search committees performed their tasks well. The prime benefactors to this effort will be the graduate and undergraduate students, and we believe that more top quality students and faculty will be drawn to the program.

Advisory Board reception held at the Donaldson Brown Center

On Friday we held our business meeting. During this time Dr. Clark and the faculty presented the current status of the department. What we witnessed was an in-depth review and analysis of the undergraduate and graduate programs, the layout and infrastructure of the proposed materials characterization facility and of VT Fire (Foundry Institute of Research and Education), MSE's participation in the National Institute of Aerospace, and student activities in the combined professional and technical societies. As is our tradition, the board concluded with a question-and-answer session with MSE students to discuss department progress from their perspective.

After these presentations, the board met separately to determine what we can do to support the department during the next six months. We concluded that it is necessary to move the materials characterization facility and the VT Fire projects forward. The members committed to actively promote these two projects through their business and personal contacts and to work with University Development to secure additional sources of support for them.

As always, it has been a pleasure to chair this organization and to experience the satisfaction of participating in such a successful endeavor.

Viehland Named NIA Fellow

Dwight Viehland has been named to the newly formed NIA Committee of Fellows. This committee has been established by the National Institute of Aerospace (NIA) and NASA Langley Research Center. Faculty are chosen from member universities. The NIA Committee of Fellows Charter states that the 15 to 25 faculty chosen to serve "will be nationally and internationally known for their expertise, and also will be selected to achieve balanced coverage of key research areas important to the future of NIA."

The committee will meet three times per year with senior research scholars at NASA Langley who will form the Committee of NASA Langley Counterparts. An important objective of NIA is to "work closely with NASA personnel to help shape the future direction of research programs to be accomplished at Langley."

CASE Honors Amy Hill

Amy Hill was honored this summer with one of two Employee Recognition Awards. This award is presented by the Virginia Tech College Association for Staff in Engineering (CASE) to recognize outstanding service and contributions to the college. As the business manager for MSE for the last 12 years, Amy has overseen most of the department's budgeting and has worked with faculty to prepare research budgets. In nominating Amy for the award, MSE Department Head, David Clark, said, "The faculty, staff and students rely heavily on her for problem solving, not just financial but with other issues related to getting the job done." Adam Maisano, MSE alum and now graduate student, said, "In my four years in MSE, I have yet to encounter a problem that Amy cannot find an answer to, and it is always delivered with a smile."

Hasselman Named WIF Consulting Fellow

D.P.H. Hasselman was recently named consulting fellow of the World Innovation Foundation (WIF). The WIF has a worldwide membership of about 2000, which includes about 60 Nobel Prize winners. It provides independent consulting services to governments around the world on issues relating to science and technology development. Hasselman, Whittemore professor of engineering emeritus, is the second Virginia Tech faculty member to receive this honor.

Hasselman has received numerous awards during his career, including the John Jeppson Award with Gold Medal (ACerS), the Humboldt Prize (Senior Scientist Award, German Government), and the International Thermal Conductivity Award (ITC Conferences).

Human-Powered Submarine Team Continues to Set Records

This summer the Virginia Tech HPS team set two world records at the international Human-Powered Submarine Contest, held in Escondido, California.

HPS team members with Specter

Adam Maisano, a graduate student in MSE, set a men's world speed record in the one-pilot, non-propeller-driven submarine category with a speed of 3.574 knots. Amy Linklater, a graduate student in aerospace engineering, set the women's world speed record in the same category with a speed of 3.427 knots. Both records were set piloting "Specter," a two-part submarine design that features a composite nosecone fitted with SCUBA gear. The pilot propels the craft by butterfly kicking with the help of a fish-style fin.

Other members of the team include Elizabeth Jeffers (MSE), John Hennage (ME), Andrew Hopkins (AOE), Daniel Schaefer-Friedman (AOE), and John Wilde (AOE).

The team also won top prizes for most innovative submarine and best operating team, and they won second place awards for best submarine design and most safety-conscious team. Learn more at *www.hps.vt.edu*. ❖

Penny Wars

Diane Folz

The MSE department is in high gear, preparing for the 2005 Penny Wars, held during National Engineers' Week in February. Despite its small size, MSE is the defending champion for two years running.

Penny Wars is a competition among the 13 engineering departments to accumulate the most "points" during Engineers' Week. Pennies count as positive points, while silver change and paper bills detract from the point total. Proceeds, plus a $500 gift from the Student Engineers' Council, go toward a charitable function selected by the winning department. MEPS has contributed their winnings to help reinvigorate a scholarship fund originally created by students of the Metallurgical Engineering department back in 1965 (see *Michael A. Stubach Scholarship* below).

Since last February, MSE students, faculty, and staff have been collecting pennies and small change for this year's event, but we also need you, our alumni and colleagues, to help. Our goal is to donate one hundred thousand pennies, $1000 in pennies! The College of Engineering has authorized us to collect individual donations up to $50 each that can be converted to pennies. If you would like to help our small department repeat its big showing at the 2005 Engineers' Week (February 2005) by way of a donation, please write a check to: "Treasurer, Virginia Tech," and be sure to mark the memo line "MEPS." Send it to Amy Hill, Materials Science and Engineering, 213 Holden Hall (0237), Blacksburg, VA 24061. ❖

MEPS Update

Daniel Durrbeck

The Materials Engineering Professional Societies (MEPS) at Virginia Tech is a blanket organization comprised of student chapters of The American Ceramic Society (ACerS); ASM International; The Minerals, Metals, and Materials Society (TMS); the American Foundry Society (AFS); and The Materials Research Society (MRS). We do not require members of MEPS to join a national society to participate in events, but it is strongly encouraged.

This year, three of the national societies (ACerS, TMS, and ASM) merged the administration of their student chapters into a single, unified program known as Materials Advantage. This has simplified the interface between the student chapters and the national organizations and has also resulted in many new benefits for the student members.

Throughout the year MEPS participates in many different activities, such as hosting the "Engineering is a Contact Sport" tailgate parties for the College of Engineering before each of the Virginia Tech home football games. We also take many plant visits every year to expose our members to industrial settings to prepare for life after college. Tours taken last year included the Westinghouse Savannah River Site in Aiken, South Carolina; Roanoke Electric Steel in Roanoke, Virginia; and the NASA Langley Research Center in Hampton, Virginia. MEPS is competitively involved in Engineering Olympics held every year by the Student Engineer's Council. We currently hold the title as Penny Wars Champion (see previous article). MEPS also participates in intramural sports. In the fall we have a soccer and volleyball team, and in the spring we field a softball team.

We invite anyone interested in MEPS to attend one of our meetings held the second Wednesday of every month at 5:00 PM in 212 Holden. For more information please visit the MEPS website at *www.meps.org.vt.edu*. ❖

Westinghouse Savannah River, Aiken, SC, a 2003 MEPS-sponsored field trip.

*The **Michael A. Stubach Memorial Scholarship** was created in 1965 by classmates in the Metallurgical Engineering department to honor Michael's memory following his untimely death during his senior year at Virginia Tech. Scholarships were sporadically awarded from the fund over the years. When Dr. Steve Kampe became coordinator for MSE scholarship efforts in 1999, he set out to increase the principal of the account to a level that would enable a yearly award for a worthy MSE student. With two years of "Penny Wars booty" contributed towards the goal, the account will soon reach the balance required for regular disbursement from earnings. "Michael Stubach was obviously highly regarded and admired by his classmates," says Dr. Kampe. "It is terrific that his legacy will continue in MSE. I am grateful for the efforts and generosity of the MSE students towards making this project successful."*

People in Materials

The Skipper: How the Huffmans Helped Forge a Virginia Tech Tradition

LeeAnn Ellis

If you've ever been to a Virginia Tech football game in Lane Stadium, you've heard the resounding boom of the cannon each time the Hokies score. It might surprise you to discover that there is a connection between that cannon and the Materials Science and Engineering department. But let's start at the beginning.

In the fall of 1963, Paul Huffman Sr., proprietor of the Virginia Foundry in Roanoke, received an unusual phone call from a young VPI cadet named Ben "Butch" Harper. The VPI Corps of Cadets, he was told, wanted to build a cannon. (Virginia Tech was known as VPI back then.)

Mr. Huffman was familiar with the rivalry between VPI and VMI. Every Thanksgiving Day since at least 1918, these two football teams met on the field at Roanoke's Victory Stadium in a game known as the "Military Classic of the South." Mr. Huffman, like many of his neighbors, looked forward to this annual event.

On game day, the VPI and VMI Corps of Cadets would march through the streets of Roanoke from the train station to the stadium, often trading friendly barbs. Then, at the start of the game, VMI would fire their cannon, nicknamed "Little John," and the VMI Corps would chant, "Where's your cannon?" Three VPI cadets, Butch Harper, Homer "Sonny" Hickam, and George Fox, decided it was time for the VPI Corps of Cadets to have their own cannon.

Ben "Butch" Harper (BUS '64)

Homer "Sonny" Hickam (IE '64)

George Fox (ME '64)

1964 Bugle

Back in Blacksburg, Sonny convinced his industrial engineering class to take on the project of building a wooden model of a cannon using blueprints he had found. The boys enlisted the help of the entire Corps, who gladly donated money and old brass to help build the cannon. And Butch located a foundry.

When Mr. Huffman received the call from Butch Harper, asking for a cost estimate for casting a cannon, he told the cadet there would be no charge. He was a big Hokie fan and a former cadet from Greenbrier. He'd be happy to offer his services to VPI. So, the cannon was cast, using Corps donated brass. This included bullet casings from the school's rifle range, which, to everyone's surprise, were not all empty. After the fireworks died down, Huffman discarded the rest of those bullet casings and added brass from the foundry's stock. Stamped around the rim of the barrel are the years 1964-65-66-67, representing those classes of the Corps who contributed to the effort.

1964-65-66-67 stamped into cannon rim

On Thanksgiving Day, 1963, VMI was speechless when VPI rolled out their cannon and fired the first round. Mr. Huffman was given a seat of honor with the Corps. He remembers the tremendous boom of the cannon that shook the glass in the sportscasters' booth and blew the hats up on many a head in the stands. The cannon was a huge hit, and a tradition was born. Huffman received a call from VMI soon after the game. "They asked if I would cast a cannon for them. A larger one!" He told the caller that he "wasn't in the cannon business."

Sadly, the excitement over the cannon was overshadowed by the assassination of President John F. Kennedy. Like all Americans, the cadets were deeply affected by the President's death. In honor of Kennedy's naval career, they christened the cannon "Skipper."

At the age of eight, Paul Huffman Jr. was well on his way to becoming not only a huge Hokie fan, but also a metallurgist like his father. "My earliest recollection of Skipper," says Paul Jr., "was the annual VPI/VMI football game. I can remember telling all my buddies that Dad had cast the Skipper. The most exciting part for me was watching and hearing the Skipper roar! At such an early age football was the sideline. The cannon was the real show!"

Paul Huffman Sr. & Paul Huffman Jr. shown with one-half of each Skipper pattern. Paul Jr. says the second half resides at his dad's house. "I think he was afraid we would make another one for home use!"

The Skipper proudly served Virginia Tech for the next 19 years, until an overcharge of gunpowder caused a blowout in 1982. Skipper now resides in the Virginia Tech Corps of Cadets museum. Before every home game, freshman cadets polish the cannon to a mirror shine.

By 1984, Paul Jr. was in the process of moving home to Roanoke. He had graduated from Virginia Tech with a degree in metallurgical engineering (MSE) in 1978, and he had been working in Maryland since then. While he was scanning the *Roanoke Times* for real estate, he read that the Virginia Tech Corps was hoping to raise funds to replace the Skipper. Paul called the Corps and said, "This is your lucky day!" He explained that his father had cast the first Skipper and he would be honored to create the next generation Skipper, and at no charge.

He first went to his new boss at Graham-White and presented the idea. He was hired to make money, he was told, not give it away. Paul was persistent, and his boss finally said go ahead. So Paul took on the project on his own.

He traveled to Gettysburg to research Civil War cannon, and he selected a three-inch Confederate iron rifle to replicate. He took careful measurements and returned to Roanoke, where a pattern was created by a local company. In designing this replica, Paul used updated techniques and a better understanding of metallurgy than would have been available back in 1862. "We calculated the metallurgy down to the element," Paul said.

He contacted area businesses to solicit materials. "I called several suppliers and told them about this great story," Paul recalls. Not only did the companies donate materials, they came over to help.

Skipper II debuted October 1984 at the Homecoming game in Lane Stadium. October 2004 marks 20 years of service for this second generation Skipper. And thanks to careful research and design by Paul Huffman Jr., this one should be around for a long time. "There are several safety precautions," Paul explained. "It's made of high-tensile strength gray iron, with a reinforced stainless steel pipe in the center." He also noted that the Corps' Skipper Crew holds to a high standard of discipline in maintaining and firing the cannon.

It turns out that foundry work, and even cannon making, are Huffman family traditions dating back to the Civil War. Father and son are metallurgists with years of foundry experience. Paul Sr.'s father was also a foundryman. And the Huffmans discovered some years after creating Skipper II that there is a family connection to the three-inch field rifle that Paul replicated for the Corps. Back in 1862, "the main confederate foundry, Tredagar Iron Works, was located in Richmond, Virginia," Paul Jr. explained. "The general manager of the foundry was General Joseph Anderson, who was my triple-great uncle."

In recent years, the three former cadets have reunited on several occasions, and they have also met up with the two men who helped bring their dreams to life. Pictured from left to right, holding the original Skipper pattern are Butch Harper, George Fox, Homer Hickam, and Paul Huffman Jr.

Today, Paul Jr. is the president and Paul Sr. is the chairman of Dominion Metallurgical (Domet) in Roanoke. Established in 1992 by Paul Jr., Domet acts as a general contractor to supply cast metal components to industrial clients. "This allows us to not only assist our customers in their casting design and procurement processes, but also assist the manufacturers in their manufacturing techniques."

Paul Jr. is on the Board of Directors for the American Foundry Society and Foundry Education Foundation. As a member of the MSE Advisory Board, he is overseeing an effort to build a foundry teaching lab at Virginia Tech, named VT FIRE (Foundry Institute of Research and Education). Contact Paul to find out how you can play a part in this endeavor: phuffman@dommet.com.

Silver continued from page 2

New interconnection materials must have better electrical, thermal, and thermomechanical properties. In addition, a low processing temperature is necessary for low-cost and low-entry barrier into the existing manufacturing processes.

Research has shown that nanoscale materials can be sintered at lower temperatures because of large surface energy. Nanoscale silver made into a paste can be processed at low temperatures, so it shows promise as a lead-free, high performance interconnection material.

Professor Guo-Quan Lu's research team has fabricated a nanoscale silver paste for use as a novel interconnecting material. This silver paste can be sintered at a temperature as low as 280°C. It offers better thermal removal capability than material currently used for interconnection, as well as lower electrical resistivity than solder alloys. It also exhibits a much lower apparent elastic modulus than bulk silver. As a softer interconnecting material, it can serve as a better mechanical buffer layer with superior thermomechanical properties compared to bulk silver. ❖

Casting Skipper

Skipper I Green Sand Casting

Green sand is a traditional casting method, in use during the Civil War and today, although by 1963, the method had evolved into using natural sand with additives like bentonite, a synthetic clay, used to increase the strength of the sand mold so it will hold together better.

Courtesy Paul Huffman Sr., 1963

Green sand molding involves mixing sand, clay, and water with other additives and ramming it around the two halves of the pattern to form a hard mold. The pattern halves are removed, the mold is put together, and molten metal is poured into the mold through a gating system. Green sand molding is still the most widely used method today. Skipper I is composed of red brass.

Skipper II Nobake Molding

Nobake molding is a method of making a sand mold using a chemical compound that allows the sand mixture to cure in air so that it hardens similar to concrete.

Courtesy Paul Huffman Jr., 1984

Skipper II is composed of high tensile strength gray iron. Paul calculated the exact chemistry and solidification rate to provide an ultimate tensile strength of 40,000 psi. He also calculated and constructed the gating system for feeding the molten iron into the casting cavity.

For more stories and photos, visit www.mse.vt.edu/Skipper.html

Head's Up!

David Clark

This has been another exciting and productive period for the department. In August, we hired five faculty members with a range of expertise including ceramics, photonics, and nanomaterials. Our existing faculty and staff worked hard to prepare space and provide resources for the new faculty. Two new members, Levon Asryan and Yu Wang, are heavily involved in computational materials science and will take advantage of Virginia Tech's System X supercomputer (3rd fastest in the world). They will also work closely with senior-level MSE faculty, Diana Farkas, a world renowned expert in the computer simulation of crack growth. In addition to adding new research directions to the department, we expect this "computational cluster" to broaden and strengthen the computational components of the undergraduate and graduate curricula. Gary Pickrell and Kathy Lu are experimentalists and will apply their expertise in ceramics and nanomaterials to the development of sensors, fuel cells and photonic devices, to name a few. Kathryn Logan, hired as the NASA Langley Professor, will coordinate research and education activities between Virginia Tech and the National Institute of Aerospace (NIA). Professor Logan is past president of the American Ceramic Society and the National Institute of Ceramic Engineers, and she is a Fellow in both of these professional organizations. It is a rare opportunity for an MSE department to be able to hire five new tenure-track faculty in one season, and we are grateful for the confidence and support provided by the College of Engineering. These new hires move us a large step forward in our goal of 19 FTEs.

MSE is playing a major role in the new Institute for Critical Technology and Applied Science (ICTAS). The Institute will provide infrastructure and space to further synergistic research between engineering and the sciences. When fully operational, ICTAS will occupy several buildings, one of which will be located behind Holden Hall, the present home of MSE. Nanotechnology and advanced materials are among the focus areas for the Institute. Under the leadership of Carlos Suchicital, MSE has designed an advanced materials characterization facility (MCF) that will occupy about 12,000 ft^2 in the first building. The university has already provided $3.2M to purchase a state-of-the-art TEM and an ion microprobe. Within five years, we expect the MCF to house approximately $12M in research equipment. In addition to pulling together the diverse materials community across the university, ICTAS will attract top-notch faculty and graduate students to Tech.

Each fall, MSE hosts an open house for freshmen looking for a home department. This year, over 400 students attended a well-organized program of demonstrations, information sessions and refreshments. Through recruiting events such as this, we expect to reach our goal of about 100 undergraduate students. The department is grateful to Alex Aning, chair of the recruiting committee, Jan Doran, undergraduate program services coordinator, and MEPS for organizing and running this event.

At its September meeting, the MSE Advisory Board made recommendations for new initiatives, quality improvement and growth, especially with respect to the graduate program. Our goal is 95 graduate students, producing about 15-20 PhD degrees per year. A major challenge in achieving this goal is shrinking federal and state government support of basic research. In the future, we will have to rely more on industrial support, fellowships, endowments, fund-raising activities and other resources.

The College of Engineering tailgate parties were a huge success this year. In addition to the fine food prepared by Chef Daniel Durrbeck and the MEPS students, the departments in the College provided tours, displayed student projects and discussed research. This is an excellent opportunity to meet old friends, make new ones and find out what's really happening at Tech. Check the MSE website for details. You do not need to wait until football season to visit us. You are always welcome! Contact Tracey Keister (*tkeister@vt.edu*) or (540) 231-9469 to arrange a visit.

Exploring Materials at Virginia Tech

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On the Cover:
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We always enjoy hearing from alumni and friends. Send us a note at the address above or send an e-mail: mse@vt.edu

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