

# The World of Materials

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

Spring 1999, Vol. 4, No. 1

University Honors Program  
Meet Professor Norm Dowling

Billy Abernathy, MSE Honors Graduate  
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## Greetings from the Department Head Ronald S. Gordon

As we near the end of the 1998/1999 academic year, I am pleased to report that the MSE Department continues to make good progress during a time of significant change. Perhaps the two most important events this year were the Exemplary Department Award presented by the Provost last fall and the re-establishment of the Ph.D. degree in MSE, effective August 15, 1999.

The department expects to graduate 23 B.S., 12 M.S./M.E., and 4 Ph.D. students this academic year. Currently 81 undergraduate and 36 graduate students are enrolled in MSE degree programs. Graduate enrollments are down due primarily to faculty turnover. Recruitment prospects for undergraduate and graduate students are promising, and as faculty vacancies are filled, the graduate enrollments should increase to previous levels.

Under the leadership of Professors Rick Claus and Robert Hendricks, MSE is making significant contributions to the expanding efforts in microelectronics education, research and outreach at Virginia Tech. These programs are being developed in partnership with the Electrical and Computer Engineering Department and others in the university. To date, nearly \$1.5 million in funding has been secured, and Motorola has donated approximately \$1.4 million in equipment. Additional donations of equipment are anticipated. A more detailed report on these activities appears under "Department News" on page 9.

I am pleased to announce the appointment of several new faculty members in affiliated and adjunct appointments in the MSE Department who will participate in the new Ph.D. degree program. New appointments include Dr.

R.H. Yoon, a professor in the Mining and Minerals Engineering Department, Dr. J. Randy Heflin, an associate professor in the Physics Department, and Dr. Willi Graupner, an assistant professor also in the Physics Department. Finally, Dr. Alex Aning, an associate professor in Engineering Fundamentals will also hold a similar faculty rank in the MSE Department. It is anticipated that Professors Yoon, Heflin, Graupner and Aning will be active participants in the graduate degree and research programs of the MSE Department.

To build strong ties with the faculty in Norfolk State University's (NSU) Materials Science Center, we have established adjunct faculty appointments in the MSE Department for the following NSU faculty members in the materials program: Professors Heidi Ries, Larry Mattix, Mikhail Noginov, Edward Gilman, Rakhim Rakhimov, Sam-Shajing Sun, and George Loutts. NSU recently signed an articulation agreement with Virginia Tech permitting students from NSU's Master's programs to matriculate to the MSE Ph.D. program. This is a wonderful recruiting opportunity for our new Ph.D. effort with the potential of recruiting several highly qualified students into our doctoral program every year.

### Faculty Changes

This has been a year of significant transition in the ranks of the faculty. Dr. William Curtin has relocated to Brown University, his alma mater, and Dr. Seshu Desu is now the Electrical and Computer Engineering Department Head at the University of Massachusetts. Professor Dick Hasselman will be retiring at the end of the current academic year. Dr. Sean Corcoran joined the faculty last August as an assistant professor.

## The University Honors Program at Virginia Tech

For gifted students with the drive to reach their full potential, the University Honors Program staff is committed to helping these students make choices that will enhance their education. Jack Dudley, Director of the Honors Program at Virginia Tech, believes that bright students have a

responsibility to develop their talents as much as possible. "We do not give privilege to students in the Honors

***"The Honors Program is about taking a talented faculty and bringing in talented students and mixing them together to see what happens."***

**Jack Dudley**

Program," Dr. Dudley explains, "We give them the opportunity to work much harder." According to Barbara Cowles, Associate Director, an honors education at Virginia Tech has been compared to an Ivy League education. The truly motivated student can accomplish a great deal, she says, by taking advantage of a wide range of opportunities available through research, study abroad, honors colloquia, getting to know the faculty, and through internships and scholarships. In fact, the process of applying for scholarships has proven to be an educational and rewarding experience for many honors students. "Whether you obtain the scholarship or not," said Dr. Cowles, the application process "forces you to ask 'where do I want to go? how am I going to get there? what have I done, and what do I need to do that is going to help me get there?'"

### Who is Eligible?

Participation in the University Honors Program requires meeting high academic standards. Entering freshmen who graduated in the top 10% of their high school class are invited to join the program. SAT I scores must total at least 1300 with a minimum verbal score of 620 and math score of 600. Students already enrolled at Tech are invited to join the program after achieving a cumulative GPA of 3.5 or higher. Once students are accepted into the program, they must maintain a 3.5 GPA and meet certain requirements in addition to their departmental requirements.

### Options and Requirements

Several honors options are available. First, the *Commonwealth Scholar* diploma requires completion of 9 hours of honors courses, colloquia, or graduate level courses. For an *in Honors* diploma, students must meet the above requirements, complete 6-9 hours of undergraduate research, and complete a thesis and/or senior project. The *Honors Baccalaureate* offers the highest honors achievement for Tech students. Requirements for this degree include forming a committee of advisors, completing two majors or one major and two

minors, meeting the *in Honors* requirements in one major, completing at least 9 hours in a tutorial faculty relationship, and additional requirements as outlined by the student's created advisory committee. A final option available to students who have completed 75 hours with a

3.5 or higher GPA is the five-year Bachelor's/Master's program, which provides a head start for students planning to pursue graduate studies.

### Who Keeps the Program in Working Order?

#### Oversight

The University Honors Program is overseen by the Academy of Teaching Excellence. This organization is comprised of faculty recognized for their teaching endeavors through receipt of the W.E. Wine Award, the Sporn Award, or the Alumni Award for Teaching Excellence. The Academy assumed oversight responsibility for the Honors Program in 1990 and appointed Dr. Charles (Jack) Dudley to direct the program. Dr. Dudley is especially pleased with the Academy's participation in the program because "it's the one faculty organization that's truly university wide." The current 70 members represent every college on campus, and they are dedicated to enhancing undergraduate education. Academy members teach colloquia, participate in oversight committees, and offer support for all Honors Program activities.

#### Faculty Interaction

The heart of the university," says Dr. Dudley, "is faculty, faculty, faculty. If you have that, you have everything." What makes the Honors Program work, according to Dudley, is faculty members throughout the university like some he has met in the MSE Department, such as Bob Hendricks, Ron Kander, and Ron Gordon. "They care a great deal, not only about the quantity of education but quality." Over 400 Virginia Tech faculty participate in the

***"One of the great changes in the last eight years is that engineering has become one of the strongest proponents in the Honors Program."***

**Jack Dudley**

University Honors Program by writing recommendation letters for scholarships or fellowships, teaching honors courses and colloquia, or overseeing undergraduate research. Most honors students are involved in research, which requires dedicated faculty members willing to oversee that research.

Staff

At the center of the program is a dedicated staff located in Hillcrest Hall. Jack Dudley handles the Bachelor's/Master's five-year degree, oversees tutorials and research possibilities, and handles general student counseling. Barbara Cowles, Associate Director, assists upper-class students with undergraduate research questions, future plans, and counseling. She also oversees the honors diplomas, honors societies, and scholarships. Katrin Baker, Assistant Director, offers assistance to freshman honors students, and she advises students who are applying to graduate or professional schools. Ed Bunce is the pre-med/dental school advisor for the program. Patty Irwin manages the program office in Hillcrest.

### What Does Participation in the Honors Program Mean for Students?

Primary Benefits...

At the most basic level, being involved in the Honors Program means priority registration, access to honors courses and colloquia, and the distinction of an honors diploma. Colloquia offer a unique learning opportunity, covering a variety of subjects not found in the regular college curriculum, such as "Controversial Issues in Science and Society," or "Biomedical Ethics," or a detailed study of opera. Dr. Cowles explains that colloquia courses meet once a week for two hours. "The emphasis is on thinking, reading, conversation, and writing." Class size is noticeably smaller, averaging about 15 students per class.

...and Beyond

Some students choose to access only the primary benefits. The program is geared toward helping students at various levels, from meeting the basic requirements to juggling class schedules and research to achieve phenomenal things. For example, one honors graduate, Mark Embree,

pursued bachelor's degrees in computer science and mathematics, and minors in history and English during his four years at Tech, and in 1996 he became Virginia Tech's second Rhodes Scholar.

This year, biology/Spanish major, Stacy Smith, received a Marshall Scholarship, considered by many to be equivalent to the Rhodes Scholarship. Stacy pursued several avenues of research and learning, including summers spent in Costa Rica interviewing local farmers to learn about their way of life and its effect on the land.

***"The major goal of the honors program is to help very bright students obtain a superior education."***

***Barbara Cowles***

"Every student has to figure out where they want to go and what they need to do to get there," explains Dr. Cowles. To that end, she emphasizes the importance of getting to know the faculty. Careful course selection will introduce students to faculty who can offer information and insights that will help students to plan for the future. Of equal importance is helping students recognize the value in tutorials, independent studies, research experiences, and internships. "The best students at Virginia Tech are as good as anybody at Harvard, Yale, MIT," Dr. Cowles said. "All they need to do is understand how remarkable they are and decide that they want to do amazing things. Everything is here for them to do it; they just have to make that decision."

Ut Prosim

An important goal of the Honors Program is to create an awareness among honors students of community responsibility. The university motto, Ut Prosim, "that I may serve," is especially applicable to honors students, who may devote considerable time and talent to various service projects. The University Honors Associates is an organization devoted to undertaking service projects within the university and the community such as tutoring, garden maintenance, after school programs, and other public service projects.

### Recent MSE in Honors Graduates

1998

*Billy Abernathy  
Michael Craven  
Justin Gravatt  
Brett Hull  
Elizabeth Oborn*

1997

*Rob Becker*

1996

*Jeff Glenning*

1995

*Bryan Dickerson*

1994

*Michael Bremser  
Jennifer Brooks*

Current

*Kevin Cherry  
Jeffrey Schultz  
Jireh Yue*

### How Do Students Become Involved?

Students who are eligible for the Honors Program receive invitational letters. They are invited to attend information sessions or to set up appointments with the program staff to discuss options and opportunities. Quite often, students will find their way over to Hillcrest after friends have encouraged them to do so or professors have urged them to check out the program. "There are a lot of students who have an amazing amount of potential," says Dr. Cowles, "who are encouraged by other students, who are encouraged by faculty, who are encouraged by us, and they make their own choices. We don't make anybody do anything. We're encouragers and facilitators." Many times students will wait until their senior year to start asking questions about the Honors Program, and by then, it is too late to derive much real benefit. MSE's Dr. Bob Hendricks is a great proponent of the Honors Program, and he encourages qualified students to get involved as early as possible.

### MSE Participation

Most MSE students involved in the Honors Program participate at the *in Honors* level. Dr. Hendricks, the honors advisor for the department, explains that MSE honors seniors must go a step further with the honors thesis requirement. They must complete a senior design project and present the results to the faculty as an official department seminar. Expectations are considerably higher, says Dr. Hendricks, for honors senior design students in terms of the quality and quantity of research work involved. Dr. Dudley describes this as an ideal situation. "These people are treated as colleagues" when they present their research results. "They're individuals, they're held up, they stand out." Dr. Dudley finds great satisfaction in seeing a department showcase its students in this way.

For **Brett Hull** (MSE '98), honors participation represented something extra to set him apart from the average graduating senior. With plans to attend graduate school, Brett saw the Honors Program as a step towards better preparation through more involved research, writing, and presentation experience. Through his work on an honors senior design project in MSE, he learned the importance of setting concrete goals from the beginning for research, and he believes this will help his graduate work run more smoothly. Although



*"The Honors Program definitely helped me to prepare for graduate school."*

he joined the program fairly late, he did not experience any hardships in meeting the requirements. He says the MSE faculty and staff worked to make his transition into the program a smooth one, though he did miss out on opportunities to take honors colloquia because of his late decision to participate. He managed to fit in one course taught by a Tech alumnus which focused on leadership and entrepreneurial principles. The main lesson Brett learned from this course was that an undergraduate degree is really a steppingstone to whatever path you choose to pursue. He is currently a graduate student at Pennsylvania State University with plans to study solid state materials.

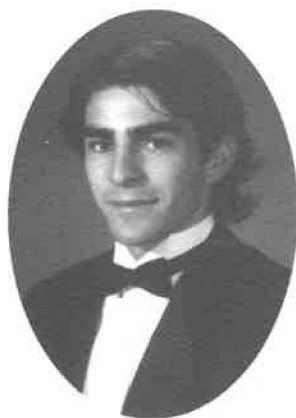
**Mike Craven** (MSE '98) chose to pursue an honors degree to enhance his future plans. He also joined the program late. However, since he had already done some undergraduate research for Dr. Kander, he was well on his way to completing the requirements. Through his honors senior design project, Mike gained a wealth of experience in a variety of areas from materials processing to device characterization and electrical properties. He even tried his hand at some electrical engineering work. "It was a lot of hard work and it was a very unique project." Mike praised the Honors Program staff, who



*"The honors degree is a nice thing to have...Start early!"*

helped him make sure he met all the requirements and still graduated on time. He does, however, recommend getting an early start in the program. There are more choices and more directions to take in meeting the requirements. Mike found the honors colloquia to be beneficial and interesting, especially "Creative Process, Creative Writing and Engineering Design," taught by Dr. Eric Pappas (MSE) and Dr. Ron Landgraf (ESM). "You think of engineering by the book, following process," Mike said. "Engineers are very organized; they are very process oriented." He found this course helpful in learning to view engineering from a more creative perspective. "It puts a whole new twist on the work of engineers" and the potential for daily creativity. Mike is a graduate student at the University of California, Santa Barbara, with plans to study optoelectronic materials.





*The colloquia "were a terrific change from the engineering curriculum."*

colloquia, Rob says that while he found them somewhat lacking, they did provide a nice change of pace from regular classes. Rob is currently a doctoral student at Stanford University with an interest in thin film stresses.

**Justin Gravatt** (MSE '98) did not become involved in the program until his junior year. "I wouldn't recommend waiting until junior year to get serious," he says, "because I was barely able to make my schedule work." Justin found the colloquia valuable. "They allowed me to explore other areas of interest outside of engineering. The courses vary between semesters and many of the courses



*"The 'honors' tag carries status. The program gives you more exposure to professors and professionals."*

cover unique and interesting topics." He also found the honors senior design project to be beneficial. The project "was structured more like a graduate/work research group. [It] requires a greater time and energy commitment, but I think it provided a more professional working environment." Justin echoes the advice of other honors students: "Time is the critical issue; there is never enough. Plan early so you can leave your senior year with large blocks of open time (full days). Get your electives done early." Justin is a process engineer at Motorola in Phoenix, Arizona. He works in the semiconductor manufacturing facility and says his responsibilities vary daily.

**Rob Becker** (MSE '97) joined the program at the end of his sophomore year. He used the fact that his honors thesis was worth six credits to spur him on to finding a challenging senior design project. He designed and built a vibrating reed magnetometer to measure the magnetic characteristics of materials. "I enjoyed the work and it was a good introduction to what may await in graduate school." Of the

colloquia, Rob says that while he found them somewhat lacking, they did provide a nice change of pace from regular classes. Rob is currently a doctoral student at Stanford University with an interest in thin film stresses.

The primary motivation for **Billy Abernathy** (MSE '98) to get into the Honors Program was the opportunity to participate in the University Honors Associates. Community service is important to Billy, so he felt honored to be invited to join this service and leadership organization. He joined the program during his second semester at Tech, spurred on, he says, by a desire to get the most out of his education. For Billy, the program meant pushing himself harder and working to improve weak areas. It meant learning to take a leadership role when he did not believe he was leader material. Jack Dudley and Barbara Cowles helped him see that his ability to move in and get a job done is a form of leadership. Their continued support and encouragement helped Billy fine tune skills he was not totally comfortable with exercising. Through the Honors Program, he says he learned to focus motivation and to put his abilities to better use, as well as how to approach people with new ideas.

Honors, Billy says, "is about expanding yourself." The program encourages students to see the world from a different perspective, which Billy feels is essential for handling real world situations. "With the Honors Program, I've done infinitely more than I would have expected. I'm really happy about it."



*"The Honors Program encourages you to take another viewpoint."*

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## Meet Professor Norm Dowling of ESM and MSE

Norm Dowling comes from a long line of engineers. An eighth generation South Carolinian from Orangeburg, he notes that his family has been involved with engineering-type activities since shortly after the American Revolution. The Dowlings harnessed water power, built an early sawmill, and later added a grain mill and a cotton gin. His grandfather received an engineering education. Norm remembers his father trying to teach him trigonometry when he was ten years old. However, engineering was not necessarily his first love.

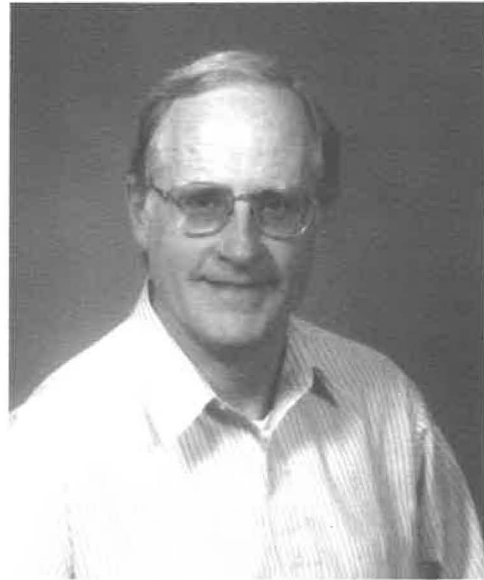
"I also had a passion for collecting insects and for biology in general." He won prizes for his insect collections in school science fairs. When faced with choosing a college major, he had trouble deciding between engineering or something entomological. Engineering won out as the more practical choice.

Dr. Dowling received his bachelor's degree in civil engineering from Clemson University in 1967, with a concentration in structural engineering. During the course of a summer job, he began to realize that life as a civil engineer could mean a lot of time on the road. So, based on this, he migrated to the University of Illinois, Urbana, to study theoretical and applied mechanics, earning an M.S. in 1968, and a Ph.D. in 1972, with a materials engineering minor.

His first job was with the Westinghouse Research and Development Center in Pittsburgh, where he did basic and applied research as well as internal consulting work on fatigue, fracture, and life prediction for metal components. When companies began reducing internal research groups, he turned to academia. Having some ties to Virginia, a grandmother from Orange County and a grandfather who attended Virginia Tech, the natural choice seemed to be Tech, and in 1983 he joined the Engineering Science and Mechanics Department.

For the last sixteen years, Dr. Dowling has been active in teaching, research, and consulting. His wide range of research interests revolve around fatigue, fracture, and deformation of structural components and materials, including the effect of notches, cracks, and plasticity. He is also interested in combined statistical and deterministic characterization of mechanical loading, life prediction for complex loading histories, and finally, biomechanics and biomaterials.

Not long after arriving at Tech, Dowling began to feel that he could be contributing in some areas that weren't encompassed in the ESM Department, and since his area of expertise overlapped with both ESM and MSE, he



requested a joint faculty appointment with the MSE Department. At the time, such appointments were rare and controversial, and his request was turned down. Later on, when the college began seeing joint appointments in a more favorable light, he put in another request and became the second joint appointment in the MSE Department in 1992. "It has worked out well," he says. "It's been very rewarding and stimulating to be exposed to the faculty in two departments."

In the fall of 1998 Dr. Dowling completed the second edition of a textbook that has been adopted at fifty schools in the U.S. and at others in Taiwan, Mexico, Singapore, Australia, and Korea. The idea for the book, entitled *Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue*, came from Dowling's teaching efforts in a junior level ESM course. There was only one book for the course, filled with conceptual errors and poor problems. So, over the course of five years, with numerous interruptions and word processing changes, he managed to put the book together, and it was first published in 1993. The second edition came out last November.

During the last two years, he has been involved in teaching short courses for industry. The goal has been to design courses focusing on materials testing and failure analysis that are tailored to meet the needs of a particular industry. In 1996, he organized a short course for Volvo Truck entitled "Failure Analysis of Components." Dowling and several professors from MSE and ESM traveled to Dublin to teach the 36-hour course, which included two lab visits to Tech. This winter, Steve

Kampe, who also helped with the first course, worked with Dowling to develop and teach a second course at Volvo entitled "Fatigue Life Analysis."

As a teacher, Dr. Dowling has a definite philosophy for working with students. "I think it's important to challenge students but it's also important not to overwhelm them." His goal as a professor is to provide perspective and guidance. He tries to cover each topic thoroughly enough so that students can feel they've accomplished something without finishing the course on information overload. There should be a balance, Dowling explains, between covering substantial material, yet not trying to cover so much and move so fast that everything is a blur. Finally,

being available to spend time with students is a priority, and he usually schedules at least eight hours per week for this purpose.

Aside from his academic endeavors, Dr. Dowling enjoys spending time with his family. His wife, Nancy, is a social worker, and he has a daughter at UVA studying biology, and a son who is a sophomore at Blacksburg High School. He often bicycles to work, a seven-mile round trip, and he enjoys fishing, something he hopes to do more of now that his book is finished. He used to have a good vegetable garden, he said, "before I moved to an area with very little topsoil and a lot of deer." He hopes to overcome these obstacles in the near future.



### Greetings continued

A search is currently underway for a joint faculty appointment with the ECpE Department in the area of microelectronics to fill the vacancy created by Dr. Desu's resignation. Professor Rick Claus is chairing the faculty search committee. Dean Stephenson has approved a senior faculty search, to begin this fall, to replace the two half-faculty vacancies created by the resignation of Dr. Curtin and the retirement of Dr. Hasselman.

Professor Gerald Gibbs will retire at the end of the current academic year after serving on the Virginia Tech faculty for approximately 35 years. He has been affiliated with the MSE Department the past six years as a jointly appointed University Distinguished Professor with the Geological Sciences and Mathematics Departments. Dr. Gibbs (profiled in the last issue) is a truly remarkable educator and scientist. He has set the standard high for a university distinguished professor with excellent teaching, outstanding research contributions recognized throughout the world, and dedicated service to his students, faculty colleagues, and the university. Dr. Gibbs has successfully taught our sophomore students perhaps the most advanced crystallography and x-ray diffraction course that can be found in any MSE curriculum in the nation. Not only did he maintain high standards and expectations for student performance but he has also managed to consistently receive the highest praise and commendation from his students. What is remarkable is that the subject matter covered in this sophomore class would be a significant challenge for many graduate students. Finally, Dr. Gibbs has been an exemplary leader and mentor for MSE's junior faculty. He has served as the chairperson of the Promotion and Tenure Committee since becoming affiliated with the department. We all wish Professor

Gibbs a prosperous and long-lasting retirement. He has worked long and hard these many years for his students and colleagues; he has accomplished many great deeds and has brought significant recognition, not only to himself, but also to his academic departments and to Virginia Tech. We will miss him. The good news is that he will continue his active research program without having to meet daily schedules or serve on numerous committees.

The MSE Department also recognizes the long (22 years) and faithful service of Professor Dick Hasselman to the MSE and ESM Departments and to Virginia Tech. Dr. Hasselman, a fellow of the American Ceramic Society, has achieved international prominence and recognition for his expertise and research on the mechanical, thermo-mechanical, and thermophysical properties of brittle materials. He has been presented the Jeppson Award and Gold Medal from the American Ceramic Society and the Humboldt Prize from the Federal Republic of Germany. Professor Hasselman has published some 300 technical papers and has made numerous invited technical presentations worldwide. He plans to remain active in research in his laboratory in Holden Hall. We wish him a long and productive retirement.

In this issue you will find a feature article about Virginia Tech's Honors Program highlighting MSE participation. A faculty profile is given of Professor Norm Dowling, who is jointly appointed with the Engineering Science and Mechanics Department and who has led a significant effort in continuing education with Volvo in Dublin. Finally, MSE honors graduate, Billy Abernathy, is profiled. Billy is about to begin a tour in the Peace Corps.

## DEPARTMENT NEWS

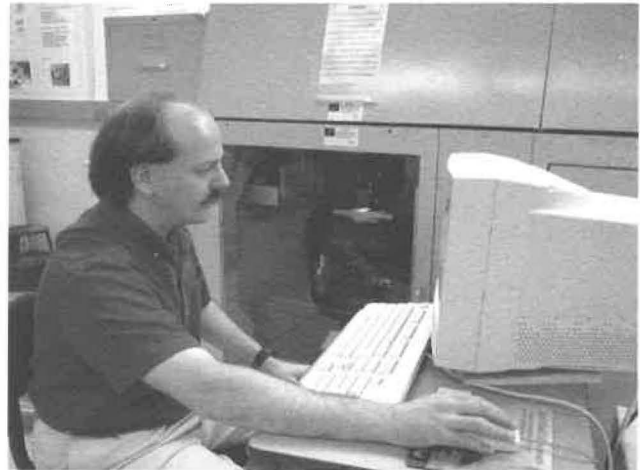
### New Equipment in the Center for Power Electronic Systems (CPES) Packaging Lab

Robert Fielder

Dr. G.Q. Lu (MSE-EE faculty) heads the power electronics packaging lab in the Center for Power Electronic Systems (CPES). The lab currently supports two major research projects: Power Electronic Building Block (PEBB) packaging, funded by the Office of Naval Research (ONR), and Integrated Power Electronic Modules (IPEM), funded by the National Science Foundation (NSF). The lab is staffed by three graduate students, one visiting scholar, and one undergraduate.

Power electronic devices are typically built on ceramic substrates. To enhance the lab's ability to process ceramic materials, a new laser machining system was purchased and installed last fall. The system, dubbed "Pentawave," is a prototype system from Photomachining Inc. The Pentawave is a two-laser system consisting of a 100-watt CO<sub>2</sub> laser and a 50-watt Nd:YAG laser. It is capable of delivering five different wavelengths: 10 μm from the CO<sub>2</sub>, and 1064, 532, 355, and 266 nm from the YAG. The system is computer operated and can be programmed using CAD drawings.

Currently, the system is used for machining complex shapes from alumina, aluminum nitride, and ferrite substrates. The PEBB project requires the gold sputtering of insulated gate bipolar transistors (IGBT's) in die form. Sputtering contact masks for IGBT's have been made from high purity alumina, with feature sizes of less than 1.0 mm. This level of precision is virtually impossible with mechanical machining methods. High power devices for the IPEM project are usually made from thick (10 mil) copper plates directly bonded onto 25 mil thick alumina substrates. After the desired patterns are chemically etched in the copper, the alumina is trimmed using the CO<sub>2</sub> laser. With this 100-watt laser, the trimming process takes only a few minutes, whereas mechanical machining with a diamond saw may take several hours.



Robert Fielder (MSE '00) operates the Pentawave laser machining system.

Ferrite substrates are also used in integrated magnetic components. Ferrite is extremely brittle and difficult to machine using traditional, contact processing methods. Using the Pentawave system, these substrates can be machined quickly with very high precision. Via holes less than 10 mils can be drilled in ferrite or alumina substrates, and complex shapes can be cut from ferrite.

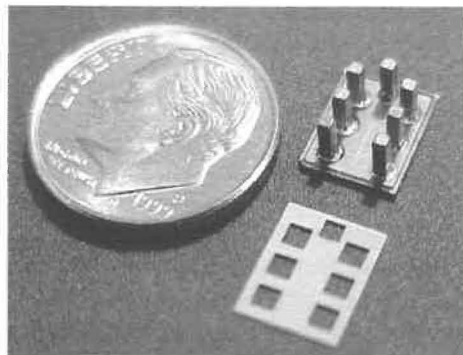


Photo courtesy Robert Fielder

Sputtering contact mask with IGBT

The packaging lab is rapidly moving into hybrid circuit processing. Traditional circuits utilize discrete resistors which are soldered in place. In a hybrid circuit, resistors are printed in very thin layers, thus decreasing the volume that the resistor occupies. After processing, the resistors must be laser trimmed to the correct resistance value. In future projects, the laser system will be used to machine small diameter via holes

in PCB board and to create sputtering masks from stainless steel.

The laser system is currently operated and maintained by MSE undergraduate, Robert S. Fielder. Robert has been working at the power electronics packaging lab since January 1998. ♦

## Microelectronics Laboratories and Programs

*Robert Hendricks*

Throughout the world and at Virginia Tech, microelectronics technology is advancing through work in many disciplines, including electrical and computer engineering (ECpE), materials science, chemical engineering, industrial and systems engineering, and physics. This year, the ECpE Department, in collaboration with the Materials Science and Engineering Department and under the leadership of Professors Rick Claus and Bob Hendricks, is involved in developing new advanced education and research laboratories and a curriculum to reflect a multidisciplinary approach. This endeavor is being coordinated in a statewide effort with our sister institutions in support of the burgeoning microelectronics industry in Virginia.

Thanks to a generous \$1.35 million equipment gift from Motorola, state funds through the Virginia Microelectronics Consortium for Education and Research (VMEC), and additional funds from Motorola and the Pratt Foundation, new laboratory space is under construction in Whittemore, Hancock, and Holden Halls. A teaching laboratory with a Class 1000 processing clean room and packaging/hybrid facilities will provide students with introductory experience in fabrication of simple devices. Additional Class 1000 and Class 100 clean rooms will provide advanced device fabrication facilities for processing and characterization for use by advanced undergraduate and graduate students.

The laboratories will provide opportunities for faculty members from several departments to teach and collaborate on microelectronics research. Areas of investigation include microelectronic materials, such as wide-bandgap materials and electronic ceramics as well as novel devices, including power devices, high-frequency/high-speed devices, optoelectronics, MEMS, and organic light-emitting devices. Additional investigation areas involve process technologies, such as nanotechnology, advanced lithography, plasma-aided processing, and micromachining; and circuits, systems, and design work, such as VLSI/ULSI, RFICs/MMICs, sensors/actuators, mixed-signal, mixed-technology, and system-on-a-chip.

In collaboration with ECpE, the MSE Department will be recruiting two joint faculty members in the microelectronics area. ♦

MSE Professors **Ron Gordon** and **Ron Kander**, along with Professors Malcolm McPherson (COE) and John Novak (CE), were featured in an article in *Prism*, the magazine for the American Society for Engineering Education (January 1999). The article discussed the College of Engineering's Green Engineering program, referring to it as a leader in the country, and the efforts of these four professors were highlighted. ♦

Congratulations to **Brian Love**, who has been promoted to Associate Professor with tenure. Dr. Love has established a solid record of teaching, student advising, research, scholarship, and service in MSE. He has become a leader in College of Engineering efforts to establish major programs in biomedical engineering. Working with colleagues in ESM and other departments, Love has played a key role in the COE decision to allocate \$600,000 to this effort over the next four years.

Dr. Love will spend a good portion of this summer in Europe. First, in Lyon, France, he will conduct research and experiments to support the work of graduate student, Sumitra Subrahmaynan. The French government will sponsor his visit under a visiting professor program.

Dr. Love will also travel to Sweden and the United Kingdom to gather information on "comparative biomedical device regulatory processes" as an enhancement for MSE 4574, a course in biomaterials. The goal will be to "provide students with an understanding of key differences leading American companies to shift their focus from U.S. to European biomedical development, along with data on engineering ethics as a component of medical research currently practiced in the United Kingdom and Scandinavia." Dr. Love received a minigrant from the University Office of International Programs and the Center for Excellence in Undergraduate Teaching. Very few of these grants are given out to engineering overall. ♦

**Rick Claus** (EE & MSE) co-chaired a session entitled "Organic Nonlinear Optical Materials and Devices" at the Materials Research Society meeting in San Francisco in April. He also presented papers with colleagues from the university and from industry. ♦

**Norm Dowling** (ESM & MSE) has been appointed to the editorial board of the *International Journal of Fatigue*, along with Jack Lesko of the ESM Department.

The second edition of Dr. Dowling's textbook, *Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue*, was recently published by Prentice-Hall. The book is aimed at juniors, seniors, and first-year graduate students. ♦



## The Heart of a Servant Billy Abernathy (MSE '98)

***"The final test of a leader is that he leaves behind him in other men the conviction and the will to carry on." Walter Lippmann, New York Herald Tribune, April 14, 1945***

For Billy Abernathy, service has become a way of life that he learned from his grandparents. Billy has a quiet confidence and a subtle energy that allow him to move ahead, to step in and make sure that things are done correctly. His awareness of the world around him exceeds his years. Where many students are justifiably intent on forging ahead toward degree completion and finding that first job, Billy takes the time to look around and examine the state of the world and to think about what he could be doing to improve it. During his years at Virginia Tech he has continually sought out ways to help other people.

As an honors student, Billy has been heavily involved with the University Honors Associates, a service organization within Tech's Honors Program. A chance to explore service opportunities was what first attracted him to the Honors Program. "My freshman year, I was a very dedicated student." Billy said he entered college with some trepidation, with visions of becoming a number in classes that moved too quickly taught by professors who didn't care. "So I basically locked myself in my room. I did every problem in the chemistry book, worked every problem in the calculus book. Classes were easy, but I thought they were easy because I was missing something." When a good friend from high school suddenly died, Billy realized it was time to reprioritize and not concentrate solely on schoolwork. So when he received an invitation to join the University Honors Associates during his second semester at Tech, he unlocked his door and joined the world outside his dormitory.

Billy finds ways to serve that are beyond what the average student would attempt, such as a study group project designed to assist students who have been placed on academic probation. Billy got together with fellow honors students to design a program and he wrote a proposal to get funding, which is typically a faculty endeavor. The program involved setting up study groups centered around specific problem courses, with honors students serving as mentors for each group. Billy acted as the project administrator, which meant handling paychecks for the mentors and making sure textbooks and supplies were available. He also planned training sessions for the mentors, lining up speakers from counseling services or



the Sporn award winner for that year, who discussed teaching concerns and how to best help students in academic trouble. In addition to helping students with problem courses, Billy arranged to teach them study skills and relaxation techniques.

A second undertaking, also a faculty-oriented area, was for Billy to organize an honors colloquium. He didn't actually teach, Billy said, but rather put together a seminar series on professional ethics and arranged for weekly speakers. "I wanted to use the class as an opportunity for students to learn to see through the stereotypes of other professions and to see some of the decisions other professions make" as well as the impact of those decisions on people inside and outside that particular profession. The course covered twelve areas, including law, business, genetics, engineering, journalism, and education. Billy credits Dr. Jack Dudley, Director of the University Honors Program, with giving him the encouragement to design this colloquium.

Another area of service for Billy over the last three years has been the YMCA After School Program, which provides a safe, structured environment for children between the ages of four and ten who are living in subsidized housing. Volunteers play games with the children, plan field trips, do arts and crafts, or bring in an educational speaker on occasion. When the program nearly fell through a couple of years ago for lack of a leader, Billy stepped in and not only kept things going but expanded the program to cover an additional site. "I always try to leave things better than I found them."

Billy does not think of himself as a leader, but through the Honors Program he has learned that he does, indeed, possess leadership skills. According to Barbara Cowles, Associate Director for the Honors Program, "a leader is somebody who organizes a group to accomplish a goal, and Billy has done this over and over and over again." Billy is uncomfortable with receiving attention for his accomplishments. To his way of thinking, one should be out *doing* and not taking time out for pats on the back. However, his peers in the University Honors Associates (UHA), as well as Drs. Dudley and Cowles, believe that recognition is in order. By recognizing an exemplary student, explains Dr. Cowles, "we're trying to encourage other people to have the same vision." In 1997, the UHA members got together and raised money to establish a leadership award to recognize outstanding leadership and service among honors students. To Billy's surprise, they established the award in his name and presented the first one to him. The Harry Wilson Abernathy Award is presented each spring to a UHA member who "exhibits a higher dedication of service to the Honors Program, Virginia Tech, or the community."

Another facet to this multitalented MSE graduate is his dedication to music, which began at the age of nine, when his sister took up the saxophone. "I always wanted to do everything my sister did." Such a desire can be dangerous, Billy discovered, when he followed his sister into a dance class. Dance lasted only a year, but playing the French horn stayed with him. He came close to majoring in music in college, but he decided to choose something not so close to his heart. "Music is a very personal experience," he explained. "I like to share the experience," but he did not want to attach a paycheck to his love of music. "I felt it would lose a lot of the emotion if I had to depend on feeding myself and my family upon my ability to play."

One reason he chose Virginia Tech was because he knew he could continue his musical endeavors while studying engineering. He has maintained a heavy music schedule over the last four years, performing with the New River Valley Symphony, and, three years ago, founding the Virginia Tech Horn Quartet with three fellow horn players. Since its inception, the quartet has had six members, and all have been engineers. Billy acted as the director for the group, choosing music, booking performances, etc. Last fall, he presented an impressive senior recital, performing a variety of challenging works for the French horn. As is typical for Billy, he planned the entire program, which meant obtaining approvals, choosing the pieces, finding other musicians to perform with him at different parts in the program, and scheduling rehearsals and the performance date.

Finally, Billy is also a materials engineer, an area he chose because of his interest in chemistry. Based on his co-op experience at Argonne National Laboratories in Illinois, he is interested in fuel cell systems and energy technology, especially "power sources that are compact and environmentally friendly." He would like to be able to bring technology into remote areas without the need for a large supportive infrastructure.

***"A leader is somebody who organizes a group to accomplish a goal."***

Billy completed his bachelor's degree in MSE in December with a concentration in ceramics and minors in chemistry and environmental policy and planning. In June he is scheduled to embark on a two-year assignment with the Peace Corps. He will travel to Benin, a small African country nestled between Nigeria and Togo. Benin is one of the poorest countries in the world but a fairly stable one since the 1970s. Following three months of training, which will include intensive language study, Billy will begin teaching secondary mathematics in French. For the next two years, he will live in a hut without running water or electricity. Besides becoming fluent in French, he will probably need to learn Fon, which is the predominant tribal language in Benin. Benin is known for spreading the practice of voodoo to the Caribbean by way of the slave trade, and today, most of the population are animists, meaning they attribute a soul or consciousness to natural phenomena and natural objects.

Billy chose to join the Peace Corps because he says college taught him *how* to do engineering but not *why*. More specifically, his concern is that while ethics stipulates that work should improve public welfare and safety, college does not define key public welfare issues that an engineer can address. "Everyone has a responsibility to contribute to society and you have to figure out what your role is going to be. We never talk about that in engineering." Thus Billy is taking time out "to see what some of the real problems are and see if my background can in any way be applied to solving those problems." Rather than simply going after the highest paying job, "I want to make sure that what I am doing has some merit to it, that it is beneficial to society."

Long term, Billy envisions himself in a position to set policy, perhaps through a government position as a science advisor or head of an organization like the Department of Energy. Chances are he'll succeed. "Billy just quietly goes about doing his thing," says Dr. Dudley. "People join in. He's that kind of leader. Absolutely superb."

## STUDENT AND ALUMNI NEWS

**David Arnold** (METE '62) presented a seminar in the MSE Seminar Series on March 26 entitled "Driving Forces and Technological Trends in Metalworking Manufacturing." Mr. Arnold is the Vice President and Chief Technology Officer for Kennametal Inc. in Latrobe, Pennsylvania. He joined Kennametal in 1979 as vice president and director of corporate technology. He became director of international technology in 1983 and chief technology officer in 1988. Prior to joining Kennametal, Mr. Arnold served as the manager of materials and process technology laboratories, Aircraft Engine Group, General Electric Company, Evendale, Ohio. He has also worked for Fansteel and for DuPont, both in Baltimore, Maryland. Mr. Arnold is a Fellow in the American Society for Metals, a member of the Industrial Research Institute and the Manufacturers' Alliance for Productivity and Innovation, and he serves on the Research Council of the Center for Robotics and Manufacturing Systems. He also serves on the advisory committees of the Pittsburgh High Technology Council - Laurel Valley Extension and the Chief Technology Officers Peer Network. He is currently Vice Chairman of the Board for Innovation Works, Inc. ❖

Another alumnus, **Mike Bremser** (MSE '94), gave a seminar last spring in the seminar series. His talk covered "Industrial Applications of Metalorganic Chemical Vapor Deposition." Mike received his Ph.D. from North Carolina State University in 1997, and he is employed by AIXTRON Inc., a wholly owned subsidiary of AIXTRON AG (Aachen, Germany). Mike spends a great deal of time traveling internationally, and *The World of Materials* hopes to catch up with him soon for an interview. ❖

**Kelly Renshaw** (MSE '00) and **Melinda Guinn** (MSE '01) will participate in undergraduate research this summer in the Center for Adhesive and Sealant Science. This research will be sponsored by Michelin Corporation. ❖

**Keith Knipling** (MSE '98) recently hiked the entire Appalachian Trail! He covered 2,160 miles in about 5 and 1/2 months. Watch for a feature article on Keith in the fall issue. ❖

**Jeff Schultz** (MSE '99) placed first in the SAMPE Student Poster Contest for his senior design project, "Polymer and Polymer-Based Composites for Selective Laser Sintering." This win places him in the semi-finals for selection to attend the national SAMPE conference in Long Beach, California on May 25. ❖

**James Campbell** (MSE '91) recently completed his Ph.D. in MSE at North Carolina State University in Raleigh. He is currently interviewing for post-doctoral positions. ❖



Left to right, Bob Hendricks, Ron Gordon, David Arnold (METE '62), Guo-Quan Lu

**Allan Ward** (B.S. EE '90, M.S. MSE '92, Ph.D. MESC '96) is a research scientist and engineer at the Naval Research Laboratory (NRL) in Washington, D.C. Allan works in the Microwave Photonics section, where electronic microwave signals are converted to photonic (lightwave) signals for transmission and signal processing. This conversion results in a system that is quieter, smaller, and much more efficient. In addition, by converting the signals optically, fiber optic technology can be used to transmit these signals long distances (20 km or more compared with 100 meters or less for electronic microwaves).

Most applications at NRL involve communications, electronic warfare, radar signal processing, space technology and antenna remoting. To develop these applications, research is needed to increase understanding of how photons and high frequency electrons interact with materials and how these specialized materials behave under various operating conditions. This research is directed at developing not only those systems listed above, but also the system components such as semiconductor lasers, EDFAs (erbium doped fiber amplifiers), optical fiber lasers, lithium niobate electro-optic modulators, specialty optical fibers, and high frequency photodetectors. Allan's research focuses on the design and characterization of microwave photodetectors, the evaluation and application of electro-optic modulators, and the design and engineering of microwave photonic systems.

Aside from work, Allan enjoys flying airplanes (he received his private pilot's license at the Virginia Tech airport), most outdoor sports (softball, rollerblading, hiking, etc.), and watching the Orioles play in Baltimore. In January he became engaged to Cathy Berzins, and a June 2000 wedding is in the forecast. ❖

## Plant Tour Inspires Aspiring Metallurgists

*Kevin Cherry*

The Allvac specialty alloy plant outside Charlotte, North Carolina, is usually filled with the sounds of metal being made, but for one Friday in March a different sound filled its cavernous halls. A group of students in the Metals and Alloys class, taught by Professor Robert Crowe, toured the facility along with Professor Stephen Kampe. The students were allowed to see firsthand the care and detail that go into the production of high performance alloys. The products made at the Allvac plant go into gas turbines for power generation, jet engines for transport, as well as a number of environments where nickel or titanium's corrosion resistance and good high temperature strength are needed. The students were able to meet working metallurgists, to see firsthand what they do, and how they apply their education.

An interesting note about the Metals and Alloys class is that Dr. Crowe is based out of the Northern Virginia Research Center in Alexandria, but the class meets in Blacksburg. He is able to do this using advanced teleconference technology available at Virginia Tech and the use of the Internet. This will allow students in Northern Virginia to take MSE classes that will still be available to students in Blacksburg. ♦

**Kelly Leese** (MSE '00) has been named the national president of Kappa Theta Epsilon, the co-op honors society, at KTE's recent convention held at Texas A & M University. She was elected by unanimous consent from each of the 8 chapters represented. Kelly, along with fellow Tech students, was privileged to meet former President Bush outside the George Bush Library located on the Texas A & M campus. He autographed a KTE pamphlet for the group and spent a few minutes talking with them about the organization and about their visit to Texas. ♦

**Julie Martin**, a doctoral candidate in MSE, won first place in the regional graduate paper presentation competition held by the Society for the Advancement of Material and Process Engineering (SAMPE) at the University of Maryland in February. Her paper was entitled "Mechanical Alloying High Performance Polymer Blends." This qualifies her as a finalist in the SAMPE Student Symposium, which will be held May 25 as part of the 44th International SAMPE Symposium and Exhibition in Long Beach, California. Her win marks the third year in a row for Virginia Tech (and MSE) to win in this division. **Jud Marte** (M.S. '96, Ph.D. pending) and **Jen McPeak** (Ph.D. candidate) won the two previous years. ♦

**Jennifer McPeak** has been selected as a finalist for the May 25 SAMPE Student Symposium in Long Beach. Monetary prizes will be awarded based on oral presentation of research. Last year, Jen won third place (\$400) out of eight students in the Ph.D. category.

Jen also took second place (\$200) for a poster in the physical sciences and engineering category at the 15th Annual Research Symposium, presented by Virginia Tech's Graduate Student Assembly in March. Her poster explained research on the solvent effects on the absorption, crystallization, and mechanical properties of the polymer Poly(ether ether ketone) (PEEK). According to Prof. Malcolm McPherson, a judge for the poster session, posters must present information in a tight format with emphasis on importance of the work, methodology, and results. ♦

Two 1986 Hokie MATE alumni were surprised to learn they have landed at the same employer when they ran into each other in the cafeteria. **Claudia Rawn** (B.S. '86) and **Mike Brady** (B.S. '86) were both recently hired as R&D staff members in the Metals and Ceramics Division at Oak Ridge National Laboratory. Mike came to Oak Ridge after a post-doc at NASA's Lewis Research Center in Cleveland, Ohio. Claudia took the more exotic route and did a post-doc in the Ceramics Department of the Institute Jozef Stefan in Ljubljana, Slovenia (a small independent republic that was once part of the former Yugoslavia, located between Italy and Austria). Claudia is a member of the Diffraction and Thermo-physical Properties Group and Mike is jointly a member of the Alloying Behavior and Design Group and the Corrosion Science and Technology Group. They are both looking forward to a possible MATE alumni conference at Virginia Tech, an event that hasn't been held since 1985 (hint to the present undergraduate class). ♦

**Judson Marte** defended his doctoral dissertation in January, and he recently joined General Electric's Corporate Research and Development Center in Schenectady, New York. In addition to responsibilities as a staff metallurgist, Jud is in charge of the Metals Processing Area. He plans and coordinates traditional "heat and beat" metallurgy, where thermomechanical processing of materials is done, ranging from aerospace alloys to steel to Indium.

MSE extends warm wishes to Jud and his new bride, Michelle Lyn Bodine. Michelle is a graduate of Pennsylvania State University and she recently completed a Master's in counseling at Virginia Tech. ♦



### Moving On

As many of you know, last fall I decided not to seek a third term as the MSE department head when my term expires later this year. This decision was announced in February. On July 1, I will complete 10 years of service as head of the department. My plan after stepping down was to take a sabbatical year in the MSE Department at the University of Utah before returning to the faculty ranks at Virginia Tech. In the meantime, an opportunity came my way that was very attractive and matched to an extraordinary degree my educational background, experience, and research interests in ceramics. It is with some reluctance that I announce that I have accepted the position as Dean of the School of Ceramic Engineering and Materials Science (CEMS) at the New York State College of Ceramics at Alfred University in Alfred, New York. I will be leaving Virginia Tech on August 9 and assuming full-time duties at Alfred on August 16. JC and I have made many friends in Blacksburg and we will miss them all.

CEMS at Alfred has 22 faculty (with expectations for significant growth in the general materials field) and a total enrollment of approximately 280 undergraduates and 60 graduate students. ABET accredited undergraduate degree programs are offered in ceramic engineering, glass engineering science, and materials science and engineering. Graduate degrees are offered in ceramic engineering, ceramics, glass science, and materials science and engineering. The School has excellent facilities and outstanding programs in ceramics and glass. CEMS also wishes to expand its educational and research programs into the general field of materials while maintaining its strengths in ceramics and glass. A companion school in the College of Ceramics is the prestigious School of Art and Design with a total enrollment in excess of 500 students. The New York State College of Ceramics, a statutory college of the State University of New York (SUNY), was

established in 1900 by an act of the New York State Legislature for the purpose of advancing both the art and science of ceramics.

Alfred University, founded in 1836 as the first co-educational institution of higher learning in New York State, is a private university with an enrollment of approximately 3,500, including students in the New York State College of Ceramics. It offers undergraduate degree programs in the arts, sciences, business, engineering, and professional studies. Alfred University administers the State College of Ceramics on behalf of SUNY and provides students in the College of Ceramics instruction in mathematics, science, and the humanities. The Provost of Alfred, W. Richard Ott, is an alumnus (Class of '64) of the former Ceramic Engineering Department at Virginia Tech (one of our two predecessor departments).

I have had an exciting and rewarding tenure as the MSE department head. It has been my pleasure to work with the faculty, staff, students, and alumni of this department over the past ten years. With their help and dedication, we have been able to bring the department to a new level of recognition and we have achieved many significant accomplishments and milestones since 1989. The MSE Department has the potential to become a nationally competitive materials program. Dean Stephenson will be naming an interim department head to ensure a smooth transition in leadership this summer. I believe he will also be appointing a faculty committee to conduct a national search for a permanent department head.

I would like to thank the faculty, staff, students, alumni and friends of the MSE Department for their support over these past ten years. We have shared many successes, endured a few disappointments, and have forged many friendships. I will be watching with pleasure from Alfred as the MSE Department at Virginia Tech continues its progress on the road to the next level of academic excellence. I bid you all a fond farewell.



### Department News continued

**Alfred E. Knobler** (CERE '38) has endowed a second \$25,000 undergraduate scholarship in MSE this past year. Knobler is the Chairman and CEO of Pilgrim Glass Corp. He was profiled in the Winter 1998 issue of *The World of Materials*. ♦

**Diana Farkas** has been honored with the 1999 Excellence in Research Award by the College of Engineering. This marks four years in a row that MSE faculty have received Excellence Awards. ♦

**Ron Kander** has been selected to receive a 1999 Diggs Teaching Scholar Award. This award has been presented annually for the last 8 years by the Academy of Teaching Excellence in recognition of "outstanding teaching and exceptional contributions to the teaching programs and learning environment at Virginia Tech." Dr. Kander is 1 of 3 professors receiving the award this year out of 28 nominations. ♦



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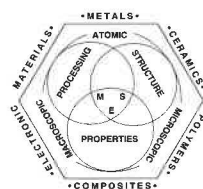
## Student and Alumni News continued

Congratulations to **Liz Myers Vailhé** (MSE '92) and **Christophe Vailhé** (M.S. '92, Ph.D. '96) on the birth of their daughter, Madeline Kay. Madeline was born January 27, 1999 and weighed 6 pounds, 12 ounces, and was 19 inches long. ◆

**Julie (Runyan) Kokan** (MSE '92) received her Ph.D. last September from Georgia Tech in MSE. She is now an engineering consultant with Synaps, Inc. in Atlanta, Georgia. ◆

*We always enjoy hearing from you. Let us know what you've been up to. Please send news and updates to LeeAnn Ellis, MSE Dept., 213 Holden Hall (0237), Blacksburg, VA 24061. E-mail: mse@vt.edu*

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