The World of Materials

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

Spring 1997

Greetings From the Department Head
Ronald S. Gordon

As we come to the close of another academic year, I would like to share with you current information about the students, faculty, and some of the programs of the Materials Science and Engineering (MSE) Department.

The department continues to make progress on increasing its undergraduate enrollment. Under the leadership of Drs. Eric Pappas and Ron Kander and with the help of our students and many faculty members, the department's freshman orientations this past fall and spring for new MSE majors have been very innovative and successful. At this stage of the recruitment process, we have commitments from approximately 25 students for the incoming sophomore class. By the fall semester this year, it is reasonable to expect the incoming class to be in excess of thirty students. Combining this number with 28 juniors and 23 seniors, the MSE 97/98 undergraduate enrollment is likely to exceed eighty students. Of these, we anticipate that up to a third will be involved in cooperative education. Currently, we have more CO-OP openings than we have students willing and able to participate in the program. In this newsletter we will describe Virginia Tech's cooperative education program, which currently enrolls 22 MSE students. One MSE CO-OP employer (AK Steel) will also be profiled. The rapidly increasing enrollment in the CO-OP program has delayed the graduation of some students such that we will only be graduating 11 B.S. students in 96/97. As the students work through the pipeline, the number of B.S. degrees should increase to over 20 in 97/98.

Undergraduate enrollment is on the rise

This spring semester 51 graduate students enrolled in MSE, 24 M.S./M.Eng. and 27 Ph.D. We anticipate granting 14 master's and 8 doctoral degrees in the 96/97 calendar year. Total research expenditures for the 95/96 calendar year were approximately $2.6 million. Overhead earned by the University from MSE research contracts was nearly $400,000 during this period. Of this amount, approximately $140,000 is returned to the department and the faculty.

New Master of Engineering Program

The MSE Department, under the leadership of Professor Robert Hendricks, is participating in the new Practice Oriented Masters Degree (POMD) Program. This twelve-month interdisciplinary program, which is described in this edition of the newsletter, emphasizes engineering design and leads to a Master of Engineering degree.

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Congratulations to Mike Stawovy and Rebecca Hermann, both MSE graduate students, who were married in the fall. Rebecca completed her master's last fall, and Mike will complete his Ph.D. this summer

COOPERATIVE EDUCATION AND MATERIALS SCIENCE AND ENGINEERING

A recent MSE alumni survey sparked interest in cooperative education. Alumni who had participated in the cooperative education program considered their experiences to be invaluable in terms of finding employment and enhancing their engineering knowledge and work skills. Growing numbers of MSE students are taking a serious look at cooperative education, and nearly 35% of our undergraduates are participating this spring.

Amy McPherson, who has been the MSE cooperative education coordinator for the past two years, has seen an increase in the number of industry requests for MSE students. During the past year, Ms. McPherson has consistently received more requests for MSE students than she is able to fill, and she commented that students interested in metals are in high demand.

History of Cooperative Education at Virginia Tech

Cooperative education at Virginia Tech dates back to 1952 when "The Engineering Cooperative College-Industry Plan" centered around six engineering curricula. Within ten years, the program grew to encompass the entire College of Engineering and some science and business programs. In 1968, the program became the University Cooperative Education Program (CO-OP), and it now includes fifty-three curricula administered by six colleges within the university.

Philosophy

Cooperative education acts as an extension of classroom learning. Students acquire one year of career-related experience through a combination of classroom theory and progressive work assignments. The program structure follows a pattern of alternating semesters of course work and industry work after the freshman year. Although this schedule transforms a four-year degree program into a five-year program, there are many advantages for both students and employers.

"This experience will enhance my job prospects."
Steven

Benefits

For students, the benefits of cooperative education include:[1,2]

- An opportunity to combine classroom theory with practical applications;
- Opportunities to observe and work with people of varied backgrounds and disciplines;
- Greater knowledge of the workplace;
- A competitive edge when seeking permanent employment;
- Greater appreciation for and interest in the total academic program;
- Rapid development of maturity and personal characteristics needed for pursuit of a successful career;
- Financial remuneration which allows the CO-OP student to defray a portion of his/her college expenses.

"DO IT! Diversify yourself."
Mary Ann

For employers, cooperative education offers the following advantages:[3]

- A source of a superior labor supply and better quality permanent employees;
- Opportunity to pre-train employees in company policies and practices;
- Continual contact with the University and access to other potential recruitment;
- Relief of seasonal labor demands without employing full-time personnel;
- Improved cost-benefits in recruitment and training;
- Longer average retention of full-time employees;
- Improved relationships with colleges and the community.

From the students' point of view, an important benefit to cooperative education is the mandatory paycheck. Many students become involved in the CO-OP program to help finance their education. Ms. McPherson has observed that salaries, especially in technical fields, can equal entry level salaries for bachelor's degree graduates.

Another serious advantage is that students gain a wealth of industrial experience. The CO-OP position must be related to the student's field of study, thereby serving to enhance the student's academics. Ms. McPherson points out that employers are looking for experience when they interview graduating seniors, and cooperative education provides an excellent opportunity to gain that experience.

"CO-OP allowed me to continue to fund my college career without incurring any debt."
Jeff

"CO-OP is not only a way to learn about your field of study, but...more importantly, about yourself."
Michael

MSE Department Head, Dr. Ronald Gordon, views cooperative education as a critical aspect of a college education and job placement. However, he points out that participation in CO-OP can give the department a smaller appearance. Because CO-OP extends the time in school by one year, graduation rates can be lower in a given year.

How it Works

A key element in the success of the CO-OP program is the requirement that the three scheduled work periods be spent with the same company. Ms. McPherson explains that the rationale behind this requirement is that during the first semester of work, the student will undergo training and orientation, learning basic procedures within the company. The student then returns to the classroom and increases his/her knowledge. When the student returns to the work assignment, the company will often place him/her immediately at a higher responsibility level. By the third work term, students often are given their own projects and have opportunities to make presentations to the board of directors or senior management. "Those are the companies we love, because they really are in the flow with cooperative education." These companies see the student as more than labor for a certain time period. While they are seeking productivity, they are also interested in complementing the student's education.

Cooperative education at Virginia Tech provides an excellent learning and growing opportunity for students. Ms. McPherson points out that CO-OP experience helps students recognize their potential, which in turn often motivates them toward higher achievement back in the classroom. Jeff Haeberle, a junior in MSE, offers these thoughts, "CO-OP is good experience. I think everybody should do it. It gets you into industry and shows you what is really out there."

References

1. *Career Services Manual*, 1996-1997, Career Services, Virginia Tech.
2. *Virginia Tech CO-OP Student Brochure*, Career Services, Virginia Tech.
3. *Cooperative Education Employer Brochure*, Career Services, Virginia Tech.

MSE CO-OP Students 96-97

Acadia Polymers
Jeffrey Quinn
Timothy Evans
Jamie Yeakle
Christopher Bouthiette
Jeffrey Schultz

AK Steel
Jeffrey Haeberle
Susan Holt
Kurt Eaton

Allied Chemical Corporation
Kelly Leese

Allied Signal Engineered Materials
Daniel Ruddick

Argonne National Laboratory
Harry Abernathy

Brenco Inc.
James Myers

Des Champ Laboratories
Kenneth Jennings

E I DuPont Denemours
Brett Hull

GE Power Generation
Joshua Luszcz

Goodyear Tire & Rubber
Justin Barker

Norfolk Southern Corporation
Nathan Rippel
Justin Gravatt

Republic Engineered Steels
Michael Craven
Tracy Jones
Keith Knipling

Siecor Corporation
Kelly Renshaw

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Joint Appointments

I am pleased to announce that three joint (50/50) appointments between the Electrical Engineering and Materials Science and Engineering Departments have been finalized for Professors Richard Claus, Seshu Desu and Guo-Quan Lu. Professors Desu and Lu were originally full-time with the MSE Department and Professor Claus was full-time in Electrical Engineering. Professor Lu has recently been promoted to Associate Professor with tenure effective August 15, 1997. These joint faculty appointments formalize links between the two departments in line with Dean William Stephenson's desire that the MSE Department become more of an interdisciplinary unit in the College. Additional joint faculty appointments are anticipated between the two departments in the near future, particularly as joint programs are developed for the Virginia Microelectronics Consortium (VMEC) mentioned in the last newsletter.

MSE is becoming more interdisciplinary through joint appointments

Preliminary discussions have been conducted this year between the Mechanical Engineering (ME) and the MSE departments related to the development of joint faculty appointments and cooperative programs. A committee composed of faculty from both departments has identified potential areas of education and research where interactions can take place.

Renovations

The College of Engineering has allocated $250,000 to the MSE Department for the upgrade and reorganization of facilities in Holden Hall. These funds were allocated from a capital improvement account funded from a portion of the research overhead which was returned to the College. Over the last five years, all departments in the College were recipients of funds from this account with the MSE allocation this year completing the first cycle of allocations. Over the next two years, all offices and many laboratories in Holden will be air conditioned with the chilled water system in the building. Several faculty offices are being reorganized and/or enlarged. The fourth floor 'penthouse' is being redesigned for use by the undergraduate and graduate students as a lounge and student meeting place, student society office space, and study carols. Power will be upgraded on the third floor and a department conference room is being set up on the second floor in my former office. I have moved my office into space formerly occupied by the College Development Office on the second floor. The MSE Writing and Communications Center under the direction of Professor Pappas will be relocated to expanded space in the basement. The University installed a handicap elevator in the building this year which can also be used as a freight elevator. In partial compensation for the inconvenience caused by the remodeling associated with the installation of the elevator, the University has freshly painted the halls and stairwells on all floors in the building.

MSE students find new space in Holden Hall

Alfred E. Knobler Scholarship

The Department was the recipient this year of The Alfred E. Knobler Materials Science and Engineering Scholarship. This $25,000 undergraduate scholarship endowment was graciously donated by Mr. Alfred E. Knobler, class of 1938. Mr. Knobler, an alumnus and long time friend of the department, is Chairman and CEO of the Pilgrim Glass Corporation with a plant located in Ceredo, West Virginia and Corporate Offices in New York City. Pilgrim Glass products include decorative/art Cameo Glass, which is renowned throughout the world. Income from this endowment will provide approximately $1000 of annual support to a deserving MSE undergraduate student. We anticipate making the first award from this endowment in the fall.

An exhibit of Pilgrim Cameo Glass will be on display at Squires Student Center between September 2 and October 12. The MSE Department is currently planning a permanent display of Pilgrim Cameo Glass in the lobby entrance of the Department in Holden Hall.

Outcomes Assessments

The Department was required this year to submit a report on outcomes assessment for its undergraduate and graduate degree programs. This report was submitted to the Dean of Engineering and to the University Administration for eventual submission to the State Council of Higher Education of Virginia (SCHEV). To assist in the preparation of this document, alumni surveys were completed for both the undergraduate and graduate degree programs. In a previous issue of the newsletter, we reported on the results of the undergraduate survey. We recently completed the first MSE graduate alumni survey. A detailed report on the results of this survey will be given in the next issue of the newsletter. The survey was sent to 92 graduate alumni who had received masters or doctoral degrees since 1989, and 26 responses have been received to date. I would like to thank all of our graduate alumni who have responded to the survey and encourage alumni who have not yet responded to seriously consider returning the survey form. Alumni input is important to the department, and it has a major impact on improvements which are made in our educational programs.

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PRACTICE-ORIENTED MASTER'S DEGREE AT VIRGINIA TECH

The Materials Science and Engineering Department is one of five engineering departments participating in the new Practice-Oriented Master's Degree (POMD) Program launched at Virginia Tech last fall. This twelve-month, interdisciplinary program emphasizes engineering design and leads to a Master of Engineering degree.

Motivation for the program stems from a growing need in industry for engineers with a broader knowledge and experience base that will lead to more comprehensive participation in the design process.

Course work focuses on skills and information that industry representatives have stressed as essential for design engineers. Along with design methodology, emphasis is placed on writing and communication skills and understanding business practices. Two core engineering courses cover a variety of topics, which are listed below.

Team work features heavily in the degree requirements for the POMD. Rather than writing a thesis, students work with team members from various engineering disciplines on a specific design project. Faculty advisors and industry sponsors interact with each team throughout the year. Final designs are being presented to faculty, students, and industry, and a written report documents each project.

Jason Taylor and J.R. Nordby are two MSE students participating in the POMD program this year. Jason has been working with students from Mechanical and Electrical Engineering to design a light source for display lighting in a wet environment. J.R's team, which includes students from Aerospace and Mechanical Engineering, is designing oxygen masks for the Air Force. These design teams have faced many challenges, including laboratory management, patent searches, and product liability. J.R. stresses the importance of communication in working with a team. Trust and diplomacy are crucial elements in keeping the project running smoothly.

Jason has found the POMD program helpful in presenting concrete management and engineering issues. He points out that engineers often become involved in managerial jobs where they are responsible for laboratories and the supervision of technicians.

Dr. Ronald Gordon, MSE Department Head, commends the POMD program while emphasizing that industrial sponsors are essential to its success. Cost to students is a major issue since a practice-oriented master's degree is a non-thesis, non-research program. There are presently few funding opportunities for students, which means most students will choose a research option to avoid financial constraints. Dr. Gordon suggests that industry stipends are needed to encourage participation in the POMD program. The ability to offer assistantships similar to those available for M.S. candidates will play an important role in making the program feasible for wider student participation. Alumni with interest in providing suitable projects and funding should contact Professor Hendricks at 540-231-6917.

Departments involved with the program, along with department coordinators, are listed below:

Aerospace & Ocean Eng.	Prof. W.H. Mason
Eng. Science & Mechanics	Prof. R.W. Landgraff
Industrial & Systems Eng.	Prof. W.G. Sullivan
Materials Science & Eng.	Prof. R.W. Hendricks
Mechanical Eng.	Prof. N.S. Eiss

You can visit the POMD website at:

http://www.eng.vt.edu/POMD

Table 1
POMD Core Engineering Courses

Modern Engineering Design Practice

Product Realization Process	Life Cycle Cost
Design Theory and Methodology	Concurrent Engineering & Collaborative Design
Creative Problem Solving	Survey of Design Tools/Techniques
Role of Specifications/Standards	Team Design Project

Professional Issues in Engineering

Professionalism/Ethics	Professional Organizational Design
Global Engineering	Business Aspects of Engineering
Intellectual Properties	Communications
Product Liability	Technology Leadership
Environmental Issues	Life-Long Learning
Team Building	

Up Close With Professor Robert Hendricks

Professor Robert Hendricks joined the MSE department in 1986 after a 25-year career in research, development, and product management. Since arriving at Virginia Tech, Dr. Hendricks has been heavily involved in revising and upgrading the undergraduate curriculum.

Dr. Hendricks grew up in a mining town in British Columbia, where his father worked as a metallurgical engineer. After graduating from high school, he left Canada to attend Cornell University in Ithaca, New York, where he majored in metallurgical engineering. During his fifth year at Cornell, a young assistant professor encouraged Dr. Hendricks to apply for graduate school. He remained at Cornell for another five years to complete his Doctorate in metallurgical engineering, materials science, and solid state physics. That young assistant professor, Chester Spencer, eventually became the MSE department head at Virginia Tech and ultimately offered Dr. Hendricks the opportunity to join the Tech faculty in 1986. He notes that "Dr. Spencer, more than anyone, influenced me to go to graduate school, which totally changed my life."

From Cornell, Dr. Hendricks moved to Oak Ridge National Laboratory in Tennessee, where he worked in the Metal and Ceramics Development group for 17 years in the areas of x-ray and neutron diffraction. He became an expert in small-angle scattering as applied to a wide range of technologically important problems, some of which include the study of voids in neutron-irradiated metals, phase transformations in alloys, the structure of fluids, the morphology of semicrystalline polymers, and the nature of flux lines in type-II superconductors. He was associate director of the NSF-funded National Center for Small-Angle Scattering Research. During his tenure at ORNL, he was responsible for the design and construction of the ORNL 10-m SAXS and 30-m SANS facility.

In 1981, he left Oak Ridge to join a small, high-tech firm as a product manager, and he returned to school for an MBA. This experience helped to shape Dr. Hendricks' teaching philosophy. "The function of our department as an engineering department is to train engineers who can manage successful businesses," success being defined as the manufacture of quality products that are in demand. He believes that engineering professors should acquire a solid industrial background before entering the university to teach.

In fact, his view of a Virginia Tech engineering education reaches beyond producing an engineer to encompass the entire body of work accomplished while in school. The importance of education lies in the realm of teaching students to think logically, to analyze problems, and to communicate effectively. If students learn these lessons well, then they can succeed in whatever field they choose.

Dr. Hendricks has spent much of his time at Tech immersed in undergraduate curriculum concerns. With many research years behind him, he entered the university environment prepared to emphasize teaching rather than research. "I came to the university because I felt I had something to offer the students." Teaching has presented an opportunity for him to repay his mentors by helping students as he once was helped.

One undergraduate concern that has been of primary interest to Dr. Hendricks as a teacher has been writing and communication skills, and he played a major role in creating and establishing the "Writing Across the Curriculum" program in MSE. His interest in writing grew from his work at ORNL, where his group leader reviewed all written work before releasing it to the public. Hendricks was fortunate, he says, to have a group leader who was an excellent technical writer and who spilled many ounces of red ink on his behalf. It was during his time at Oak Ridge that Hendricks learned that the ability to write clearly and logically is indispensable. This skill carried over into many areas, especially in business where writing sales literature, proposals, and equipment instruction and user's manuals were of critical concern to he success of the firm.

Another undergraduate project under Prof. Hendricks' supervision involved the renovation of the Electronic, Magnetic, and Optical Materials Teaching Laboratory. When he inherited this MSE course he began an extensive overhaul which included rewriting the lab manual, developing new experiments, and obtaining donations of equipment from industrial sponsors.

Dr. Hendricks has also been heavily involved in the creation of the MSE Department's Web pages for the Internet. "You can't do x-ray diffraction without computers, and so I have been up to my ears in computers my entire career." He has worked in scientific computing from the earliest days of computers, from vacuum tube machines to personal computers. Because of his interest in computers, he has built several user-dedicated, computer-controlled machines throughout his career. This work has afforded him many opportunities to work in a wide range of materials areas. Although he is primarily known as a metallurgist, he has written and collaborated on over 100 papers in chemistry, polymers, ceramics, electronic materials, and biophysics.

The new Practice-Oriented Master's Degree (POMD) program initiated in the College of Engineering this year is the latest project in which Dr. Hendricks has played a significant role. He comments that when he attended Cornell, it was one of five universities in the country that required a five-year program for a B.S. in engineering. He found this extra year very valuable. "I don't feel that a four-year degree is an adequate degree, and so I encourage as many of our students as possible to continue on with a master's degree." The new POMD program addresses the deficiencies of the four-year degree.

Dr. Hendricks maintains a research program centered around x-ray and neutron diffraction, and he is writing a multimedia textbook on electronic materials that he hopes to complete sometime in the future. In the meantime, he will continue to search out ways to improve engineering education at Virginia Tech.

MSE Writing and Communications Program Update

Eric Pappas

The Materials Science and Engineering Writing and Communications Program is now in its fourth year of operation. The recent addition of instruction in engineering ethics is supplementing existing instruction in discipline-specific technical writing, public speaking, and workplace interpersonal communication. Instruction in teamwork, added to the program last winter, has been according to many students, a welcome and practical addition.

During the past few months, educational grants from AlliedSignal Corporation and Ford Motor Company have provided the necessary support to integrate new instructional topics into the communications curriculum. Current proposals to AlliedSignal, Ford, and Virginia Tech's Center for Excellence in Undergraduate Teaching are currently being considered for funding.

Program director, Dr. Eric Pappas, made a presentation on the communications program to the College of Engineering Committee of 100 during October. The presentation was enthusiastically received, especially the short address given by Ms. Jennifer Roeder, a 1995 MSE graduate who is currently employed by Pittsburgh Plate Glass (PPG) in Cleveland. Ms. Roeder described in some detail how the writing and communications instruction she received in MSE continues to be extremely important to her work at PPG. She noted that her supervisor had singled out her recent research report as "exemplary engineering work." After one year at PPG, Ms. Roeder has received a promotion and is currently being groomed for a managerial position.

In October, the Journal of Engineering Education published a lengthy history and description of the program (authored by program founder and MSE professor, Dr. Robert Hendricks, and Dr. Eric Pappas). Currently, Drs. Hendricks and Pappas, along with MSE professor Alex Aning, are preparing an article on faculty participation in the communications program. On campus, widespread publicity of the program in the Engineering Fundamentals Division of the College of Engineering may be partly responsible for the increase in the number of freshmen choosing MSE as a major.

Engineering Dean F. William Stephenson has pledged his continuing support for the program and envisions the MSE program as a model for programs in other Tech engineering departments. Currently, programs based on the MSE model have been initiated in the Engineering Science and Mechanics Department and the Mining Engineering Department. Other departments are considering establishing writing and communications programs, and most have asked for occasional assistance or used MSE program instructional materials.

With continued support from the university, the College of Engineering, and MSE department head Ronald Gordon, the continued success and influence of the program seem certain.

FACULTY NEWS

Joint Appointments Strengthen Cooperative Ties Between Engineering Departments

Liz Crumbley

The departments of Electrical Engineering (EE) and Materials Science and Engineering (MSE) have approved joint appointments for three faculty members, Richard Claus, Seshu Desu, and G.Q. Lu. All three teach and conduct research in areas important to both engineering disciplines.

"Significant opportunities exist for collaboration between EE and MSE in the areas of electronic materials, fiber optics, and computers," said College of Engineering Dean F. William Stephenson. "These joint appointments help lower boundaries between departments and simplify the pursuit of interdisciplinary activities."

Claus, a professor and eminent scholar of EE and founding director of the university's Fiber & Electro-Optics Research Center, specializes in the design and use of optical systems for the characterization of materials; the development of optical fibers and optical and electronic-sensor instrumentation systems, and the development of other "smart" materials and structures.

Desu, a professor of MSE and director of the Center for Advanced Ceramic Materials, works in the processing, modeling, and characterization of multi-component oxide thin films, fibers, and fine powders and their applications in electronic and optical devices.

Lu, an assistant professor of MSE, specializes in the processing and characterization of electronic materials for packaging applications, co-sintering of metal/ceramic multi-layer substrates, stresses in constrained sintering materials, crystal growth of semiconductor, and optical measurements.

Ronald S. Gordon, MSE department head, said the joint faculty members will have full rights and responsibilities in both departments. Claus, Desu and Lu will develop courses to be taken jointly by EE and MSE students. Interdisciplinary cooperation in research and outreach also is expected to result from the joint appointments. "We want our departments to grow cooperatively rather than competitively," Gordon noted. "We need faculty working on both sides of the aisle."

Leonard A. Ferrari, EE department head, said the collaboration between the two departments "will enable Virginia Tech to be more responsive to the educational needs of students and of companies such as Motorola, IBM, Toshiba, and Siemens, which are leading the rapid expansion of Virginia's microelectronics industry."

The joint appointments also will be the underpinning for EE/MSE cooperative efforts in working with the Virginia Microelectronics Consortium (VMEC), a research-and-education program developed by Virginia Tech, the College of William and Mary, George Mason University, Old Dominion University, University of Virginia and Virginia Commonwealth University, Motorola, Dominion Semiconductor and White Oak.

Future joint appointments between EE and MSE are anticipated, Gordon added, particularly as they relate to the growing VMEC initiative in the state.

Reprinted from SPECTRUM, April 10, 1997

Dr. Robert Hendricks will join his colleagues as the fourth faculty member jointly appointed in the MSE and EE Departments. This appointment was finalized in early May.

New MSE Technology/Facilities Manager

The MSE Department is pleased to announce the appointment of **Dr. Carlos Suchicital** as the Technology/Facilities Manager for the Department. He also joins the MSE faculty as a research assistant professor. Dr. Suchicital comes to this new position with over eight years of experience in research, teaching, technology and facilities management, and general administrative experience in ceramics, electronic materials, and materials processing with a significant record of publication. He received his doctorate in materials science and engineering from the University of Illinois in 1988. He also holds M.S. and B.A. degrees in solid state physics. Since 1994, Dr. Suchicital has been the Technology Manager for Professor Seshu Desu's Thin Films Laboratory and the Center for Advanced Ceramic Materials in the MSE Department.

Dr. Suchicital's duties will include research, teaching, and facilities management. He will become the department's safety compliance officer and assume the duties formerly performed by Dr. George Knobl, who retired in November. Suchicital will handle the operation and maintenance of all instructional laboratories in the undergraduate program and will participate as an instructor in one or more MSE undergraduate laboratory courses from time to time.

Volvo Short Course

Under the direction of Prof. Norman Dowling, several MSE faculty members taught a short course at Volvo GM Heavy Truck, in Dublin, Virginia, as part of an outreach program to area industries. The course, entitled "Failure Analysis of Components," was taught from late September through mid-December with weekly three-hour sessions. A combined lecture and workshop format was used in sessions taught on site at Volvo, and three sessions were held on campus involving laboratory work and demonstrations. The topics covered were tailored to Volvo needs and included materials testing, statistics, fracture of materials, NDE, microscopy, residual stresses, fatigue life prediction, materials selection and processing, and environmental fracture. Emphasis was placed upon identifying the causes of failure related to loading history, materials behavior, and environmental influences. Methods for characterizing failed components and design methodologies for improving component performance were also covered. In addition to Prof. Dowling, instructors for the course included MSE Professors R.W. Hendricks, J.C. Duke, S.L. Kampe, and R.W. Landgraf of ESM. Dr. Gang Chen, Joe Price-O'Brien, Mac McCord, and Bob Simms assisted with lab instruction. MSE plans to teach the course again next year and similar courses will be offered to other industries, tailored to the particular needs and circumstances in each case.

State Industrial Open House

The MSE Department will participate in the College of Engineering "State Industrial Open House" on June 5. Participating departments will open their doors for laboratory tours and offer free consulting clinics on a wide range of engineering topics. State and regional industries will be invited to visit campus for one day to tour our capabilities and discuss relevant technical problems with participating faculty.

MSE would like to invite our alumni to participate in this event and visit campus to see how the MSE department may be able to help you and your companies.

Among the MSE professors presenting clinics and supervising laboratory tours are Norm Dowling, Ron Kander, Brian Love, and Al Loos. MSE clinic topics will include "Fracture, Fatigue and Deformation;" "Polymer Materials Testing and Design;" and "Composites and Processing/ Manufacturing."

If you would like more information on MSE's participation in this Open House, or would like to be included in future mailings concerning this event, please contact Dr. Ronald Kander in the MSE Department by e-mail (rkander@vt.edu) or phone (540-231-3178).

Kander Appointed Green Engineering Director

The College of Engineering has appointed Prof. Ron Kander as the first director of its Green Engineering Program. Green, or sustainable, engineering encompasses all engineering disciplines and incorporates attitudes, values, and principles that lead to improving the quality of the environment. The goal is to increase awareness among engineering students of environmental issues and the effects of engineering systems on the environment.

Dr. Kander will work with the College's Green Engineering Steering Committee to further develop and incorporate the program philosophy into the engineering curriculum. For his first year as director, Dr. Kander believes that a major objective will be "to work with the departmental green coordinators in developing the College's Green Engineering Minor." In addition, he will work to develop the vision, goals, and objectives for the program.

Other responsibilities will include maintaining liaisons with environmental studies in other colleges and universities; leading the College of Engineering in participation in national student competitions dealing with environmental/engineering concerns; organizing environmental seminars that will spotlight government, academic, and industrial speakers; and initiating an undergraduate and graduate society that will focus on environmental issues.

Dr. Guo-Quan Lu has been promoted to Associate Professor with tenure, effective August 15.

Congratulations to Dr. Deidre Hirschfeld, who has been promoted to the rank of Associate Professor with tenure in the Engineering Fundamentals Department. Dr. Hirschfeld continues to collaborate on various projects within the MSE Department.

A Dean's Award for Excellence in Teaching has been awarded to Prof. Ron Kander for the 96/97 academic year.

Dr. Bill Reynolds and his wife, Mariko, announce the birth of their daughter. Jennifer Mika Reynolds was born at Tsukuba University Hospital in Tsukuba, Japan on May 3. The Japanese middle name, Mika, means beautiful flower.

In November, the department bid farewell to George Knobl, Safety Compliance Officer. George and his wife, Ivy, have ventured into the wilds of central Florida. Good luck and best wishes from MSE!

CO-OP Company Profile
AK Steel, Ashland Works

Throughout the year, MSE co-op students can find a niche among the more than 1500 employees at AK Steel's Ashland Works plant in Kentucky. This plant houses primary steelmaking operations and is a principal source of quality slabs for AK Steel's hot strip mill in Middletown, Ohio.

The Middletown Works, one of the largest and oldest continuously operating steel plants in the country, began melting steel in 1900. AK Steel acquired the Ashland Iron and Mining Company in 1921 and that plant became the Ashland Works.

AK Steel produces its own coke, which marks the beginning of the steelmaking process. Metallurgical grade coal is heated in coke ovens at temperatures reaching 2400°F to eliminate gases, oils, tar, and other contaminants. This process transforms coal into coke, which then becomes the primary fuel in producing iron. The coke is combined with iron ore and limestone and placed in a blast furnace, where an intensely hot blast of air removes oxygen from the ore and burns the coke, causing it to release heat and gas.

The resulting purified molten iron is combined with scrap steel in a basic oxygen furnace. Here, oxygen is injected into the furnace and the iron is refined into steel. A vacuum degasser removes carbon from the molten steel, allowing the development of several grades of steel.

In 1992, AK Steel became one of the first integrated steel producers to become 100% continuous cast. The caster solidifies molten steel in water-cooled copper molds. Slabs of steel are then taken to the hot strip mill where thickness is gradually reduced. A 9-inch thick by 30-inch long slab of steel will travel along a route of millstands, emerging as a flat rolled strip of steel that can reach 80 inches wide and 1 mile long.

Steel production continues through different levels of tempering, coating, and other operations designed to produce a final product that meets customer specifications.

Co-op students at AK Steel's Ashland Works are involved in a variety of tasks. These include analyzing processes using personal computers and mainframe data collection systems; assisting process engineers in running new materials on trial; assisting with planning, designing, and installation of new equipment or modification of old equipment; running various product tests; and writing procedure documentation.

Jeff Haeberle, a junior in MSE, has spent three terms working for AK Steel and will return for a fourth term this summer. Jeff works in quality control, mainly with the hot-dip galvanizing line maintaining final product quality. "AK Steel is a good company to work for. They always try to accommodate you." AK Steel staff are willing to work with students and help them realize their goals. "There is a lot of communication between the students and the management—it's a good situation."

Greetings continued from page 4

As you can see, many good things have been happening in your department since we last communicated. In this newsletter we will be profiling one of our faculty members, Professor Robert Hendricks, two of our students, Virginie Vaubert and Vacarro Williams, and one of our alumni, William Halley. You will also find articles on the writing and communications program, cooperative education, and the new Practice-Oriented Master's Degree program, along with other department news. Your comments related to the newsletter and the MSE programs are always welcome. If you are in the area, please stop by and visit your department. Many changes have been made and more are being contemplated.

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A Japanese Sabbatical

Bill Reynolds is spending a sabbatical year at Kinzoku Zairyou Gijyutsu Kenkyujyo (the National Research Institute for Metals, NRIM) in Tsukuba, Japan. He is collaborating with Dr. Kazuhiro Hono of NRIM on research that seeks to map the atomic-scale chemistry of alloys using a Field Ion Microscope/Atom Probe (FIM/AP). The research stay, which is supported by the U.S. National Science Foundation and NRIM, seeks to determine how alloying elements rearrange during thermal processing. Such information eventually may help solve problems related to the hardenability of steels, the quench sensitivity of aluminum alloys, and the design of more stable high-strength alloys. The sabbatical provides Prof. Reynolds a unique opportunity to use new experimental equipment unavailable at Virginia Tech. In addition to the FIM/AP instruments, NRIM is also equipped with a complete array of metallurgical processing, testing, and characterization equipment.

As the name implies, the FIM/AP combines two types of instruments: a microscope and a mass spectrometer. The microscope portion is based upon a principle exploited by Muller in the early 1950s. The idea is similar to the concept behind a lightening rod. In a Field Ion Microscope, a positive voltage is applied to a sharp needle surrounded by an inert gas. The electric field near the needle varies with the radius of the needle's tip: the sharper the tip, the higher the field. For very sharp needles (tip radii around 5 nm), moderate voltages can produce high enough electric fields to ionize the imaging gas. When an imaging gas atom gives up an electron to the needle, it becomes positively charged and is rapidly accelerated away from the tip by the electric field. Streams of imaging gas ions develop along the lines of force of the electric field (just as streams of ionized molecules develop at the tip of a lightening rod), and the field can be mapped by placing a phosphor screen or other suitable detector a few centimeters away from the needle tip. Because the electric field varies locally with the positions of the individual atoms in the needle tip and it diverges from the tip, it is very easy to "see" individual atoms on the detector with a typical image magnification of about 10 million times.

The Atom Probe is a time-of-flight mass spectrometer used in conjunction with the Field Ion Microscope. The imaging gas in the microscope is removed and the voltage on the needle is increased enough to cause the metal atoms in the needle tip to ionize. Once ionized, the metal atoms are also accelerated away from the tip by the electric field. The identities of individual atoms (even their isotopes) can be determined by measuring the time it takes the ions to travel the known length of flight tube. Newer instruments, such as the Tomographic Atom Probe or the Position Sensitive Atom Probe (both available at NRIM) are able to combine the spatial information of the Field Ion Microscope with the chemical analysis information from the Atom Probe to identify the type and location of a substantial portion of the atoms in a region roughly 10 x10 x10 nm in size.

Dr. Hono and his group are experts at applying FIM/AP to the study of metals and oxides. Prof. Reynolds is collaborating with them on some of their projects as well as extending some of his earlier projects. For example, one project is underway to measure the concentration of alloying elements within the boundary between ferrite and austenite in alloy steels. It has been suspected for a number of years that some elements have a particularly potent influence on hardenability because they segregate to this type of boundary. However, the extremely small width of the boundary (a couple atom diameters) stymied earlier efforts to test this theory.

In a separate project, FIM/AP is being applied to help understand why music wire (the steel used for piano and guitar strings) is so strong. This class of material is used in large quantities for the cables of suspension bridges and for the cords in steel belted radial tires. The wire-making process increases the strength of most metals by refining the metal's microstructure, but there is a limit to the amount of refinement that can be obtained in most alloys. For reasons that we seek to identify, a far greater amount of refinement can be achieved in the plain carbon steels used to make music wire. Other current FIM/AP projects include investigations of element distributions in amorphous and nanocrystalline aluminum alloys, in nanocrystalline alloys for magnetic applications, and in precipitation hardening alloys (steels and aluminum).

Descriptions of the lab and the activities underway there are available via the World Wide Web at:

http://inaba.nrim.go.jp/apfim/

Of course, Prof. Reynolds is enjoying other benefits of a sabbatical stay in Japan in addition to the technical exchanges. Liberal irrigation with the native beverages and foods and lively cultural exchanges with the locals ensure he will return to his classes in Blacksburg this fall rejuvenated and more enthusiastic than ever.

Materials Science and Engineering Scholarship Recipients 1996-97

Joe Mix and Tiffany Brunetti

Jeff Haeberle

Matt Gordon

Justin Gravatt, Mike Craven, Beth Oborn, Rob Becker, Prof. Ron Kander

Billy Abernathy and Jeff Haeberle

Dan Ruddick

Kevin Cherry, Jason Midkiff, Jereh Yue

Scholarship Sponsors and Recipients

Anderson (John A.)
Kevin Cherry ('99)

Foundry Education Foundation
Jeffrey Haeberle ('98)
Daniel Ruddick ('97)

John H. Kroehling
Matthew Gordon ('99)

MSE Supplemental
Tiffany Brunetti ('99)
Kevin Cherry ('99)
Jeffrey Haeberle ('98)
Kelly Leese ('99)
Joshua Luszcz ('98)
Jason Midkiff ('99)
Elizabeth Oborn ('98)
Daniel Ruddick ('97)

Seay (Gilbert and Lucille
Tiffany Brunetti ('99)
Kevin Cherry ('99)
Kelly Leese ('99)
Joshua Luszcz ('98)
Jason Midkiff ('99)
Elizabeth Oborn ('98)

Stroyan
Harry Abernathy ('98)
Robert Becker ('97)
Michael Craven ('98)
Justin Gravatt ('98)
Brent Hull ('98)
Joseph Mix ('98)
Jireh Yue ('99)

❊❊ Student and Alumni Notes ❊❊

Congratulations to MSE junior, **Vacarro Williams**, who has been selected as a National Society of Black Engineers (NSBE) Fellow. Approximately 75 students throughout the U.S. receive this award each year. Students are selected based on high scholastic standards, dedication of service to the Society and other organizations, and demonstration of high professional promise. The award serves to encourage NSBE members to continue to aim for academic excellence while developing themselves through worthwhile organizations and community involvement.

Vacarro has maintained high academic standards and demonstrated leadership skills throughout her high school and college careers. She graduated from Baltimore Polytechnic Institute in 1994, a high school for math, science, and engineering students, which prepared her well for Virginia Tech. In addition to her NSBE activities, Vacarro is serving a second year as a Black Engineering Support Team (BEST) Leader. Through this program, she serves as a mentor and role model, offering encouragement and help to black engineering freshmen. Vacarro points to her faith in the Lord and her supportive family as key anchors in her life. "I am truly grateful to have a praying, Bible believing, supportive family. They have been my extra push during my troubling times." After graduation, Vacarro plans to work in industry for a few years and to obtain an MBA. She would like to one day start her own engineering consulting firm. ❊

Bill Halley (MSE M.S. '90, MESc '95) works as a Senior Customer Technical Service Engineer for Armco Steel in Butler, Pennsylvania. Armco is a major supplier of flat rolled specialty steels including stainless and electrical steels. Armco is the largest supplier of ferritic stainless steel to a wide range of markets, such as aerospace, appliance, food and beverage processing equipment, and medical industries. They also supply electrical steels for high efficiency transformers and electric motors.

Dr. Halley handles customer problems in forming, welding, and/or tube manufacturing and use. His field visits to industry range from kitchen sinks to caskets, with the majority being in the automotive exhaust industry. He has been involved in a number of continuous improvement teams at different customer sites.

Dr. Halley has made a significant contribution to the department, which has been matched by Armco. MSE very much appreciates Bill Halley's continued interest and support. ❊

Kevin Kit (MSE '90) completed his Ph.D. in materials science and engineering at the University of Delaware last fall. He is an assistant professor in MSE at the University of Tennessee in Knoxville, Tennessee. e-mail: kkit@utk.edu ❊

Richard Clark (MSE '91) recently completed his Ph.D. in MESc and has accepted a post-doctoral position with the NSF Science and Technology Center for High Performance Polymeric Adhesives and Composites at Virginia Tech. He is working in the area of Polymeric Adhesive Durability. ❊

Shari Feth completed her Ph.D. in December. She is working as a research associate in Fisk University's NASA Center for Photonic Materials and Devices in Nashville, Tennessee. Her area of research is crystal growth and characterization of optical and electrical properties of crystals. ❊

Jim Trexel (MSE '86) is an account manager with The Timken Company in their Detroit sales office in Bingham Farms, Michigan. ❊

Rola Hamandi completed her Masters last fall and is in Chicago, Illinois. She has accepted a position with General Binding Corporation, where she is working with adhesives and ink. ❊

Jose Escobar successfully defended his thesis in November. He has returned to Costa Rica, where he has accepted a job as a quality engineer with Baxter, a multinational company that manufactures intravenous products for medical purposes. ❊

Deborah Fourney (MATE '87) received an M.S. in materials science and engineering from the University of Virginia and recently accepted a position as Project Engineer with Law Engineering and Environmental Services in Jacksonville, Florida. ❊

Andrea Kay (MSE '93) completed her M.S. in materials science and engineering at Ohio State University last August. She is employed by G.M. Powertrain in Toledo, Ohio. ❊

Linda Vick completed her doctorate last summer. She is working as a Design Engineer for Electro Tec in Blacksburg, Virginia. ❊

Douglas Fleming (MSE '95) is a Senior Engineer for Automation Creations in Christiansburg, Virginia.

Jaecheol Bang completed his doctorate last summer and is an assistant professor in the MSE Department at Soonchunhyang University in Chungnam, Korea. ❊

Robbie Cunningham (MSE '91) has accepted a position with Howmet in Hampton, Virginia. He is working in the rocket group of Howmet's structural casting operation. ❊

Meet Virginie Vaubert

Anyone who spends time at Virginia Tech will soon discover the international flavor permeating the campus. Walk through Squires Student Center or downtown Blacksburg and you may catch snippets of indecipherable conversations. You will meet students from many countries who have gathered in this small town in Southwestern Virginia to continue their education.

Virginie Vaubert arrived at Virginia Tech in 1994 as part of an exchange program with the University of Technology of Compiegne (U.T.C.) in France. She recently completed her Master's degree in Materials Science and Engineering and plans to remain in the U.S. for a few years, hopefully working in the area of biomaterials.

Virginie comes from Gif sur Yvette, a region of France with a decidedly scientific population. She is the youngest in a family of engineers. Her father and sister are electrical engineers, and her mother is a chemical engineer. Virginie attended the University of Paris XI in Orsay, where she received a two-year diploma in math and science. She then received a mechanical engineering degree from the University of Technology of Compeigne (U.T.C.) where she became interested in materials science.

Her research on the durability and aging of dental sealants has received considerable recognition over the last year. Last spring, Virginie was one of three MSE graduate students who received the Paul E. Torgersen Distinguished Research Award for excellence in graduate research. Her advisor, Dr. Brian Love, suggests that Virginie's research received so much attention because it is down to earth, something the average citizen can understand and appreciate. Any parent of young children is concerned about preventing cavities. Virginie studied specifically the factors leading to loss of dental sealants applied to children's teeth. As part of her research, Virginie studied the durability of sealants applied to the teeth of pigs with the help of Professor Hugo Veit in the College of Veterinary Medicine.

Aside from research, Virginie enjoys traveling, sailing, and sculpture. She serves as the treasurer for the French Ship Club on campus, a club for French speaking students. She is also the Chairman for the Biomaterials Society at Virginia Tech.

Student and Alumni Notes Continued

Congratulations to **Mitch Jackson**, MESc doctoral student, who won a third place award in the 13th Annual Graduate Research Symposium, sponsored by the Graduate Student Assembly. Mitch's presentation, "Performance of Water-Based Epoxy in Circuit Board Applications," focused on replacing solvent-based epoxy-resin with more environmentally benign water-based systems. More than 70 posters were presented in several divisions with 3 cash awards given in each division. ❊

Pam Sadler-Hom (B.S. '84) is a senior materials engineer with Lockheed Martin Advanced Technology Center in California. ❊

Grayson W. Marshall (METE '65) is program director for an NIH-sponsored dentist-scientist program at the University of California, San Francisco. He has also been elected to the board of directors of the American Association for Dental Research. ❊

Kedzie Davis has completed her MSE Master's degree under Prof. Alfred Loos and is now pursuing a Ph.D. in ESM. ❊

Congratulations to **Celine Mahieux** (M.S. '97), who received the 96/97 Paul E. Torgersen Distinguished Research Award for excellence in graduate research. Her research focuses on high temperature polymer composites related to the aircraft and aerospace industry. ❊

Michelle Gallagher, upcoming senior in MSE, has been awarded a summer internship with the Texaco Company in El Dorado, Kansas. ❊

Catherine Barron (MATE '88) completed her Ph.D. at Penn State in Polymer Science in 1994. She currently works for the Boeing Defense and Space Group in Seattle, Washington, as a Senior Specialist Engineer, where she is conducting failure analysis of airplane parts. ❊

Please address information requests and alumni updates to
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E-mail: mse@vt.edu, phone: 540-231-6777,
Fax: 540-231-3028.

Congratulations 1997 Graduates!

B.S. Degrees
Rob Becker
Susana Castro
Jeff Clinedinst (Fall '96)
Paul (Ike) Eichenlaub
Drew Galloway (Fall '96)
Richard Hudgins (Fall '96)
Jason Montaner (Summer '96)
Anita Noble (Summer '97)
Nathan Rippel
Dan Ruddick
Viktor Simkovic
John Stuecker

M.S. Degrees
Rob Carter
James Clarke
Kedzie Davis
Jose Escobar
Levon Fattal
Thomas Kuhr
Sam Liao
Yangsheng Lu
Celine Mahieux
Jud Marte
Jonathan Medding
Nikhil Miraj
David Teter
Virginia Vaubert
Shaokai Yang

Ph.D. Degrees
Jacheol Bang
Richard Clark
Shari Feth
Qiang Liang
Batsi Mutasa
Julia Panova
Linda Vick
Allan Ward
Weigun Gu

B.S. Graduates, left to right: John Stuecker, Rob Becker, Nathan Rippel, Anita Noble, Daniel Ruddick, Susana Castro, Ike Eichenlaub

Viktor Simkovic

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