ENGINEERS' FORUM

VOLUME 20 • NO 2 APRIL 2001

Sensor research at Virginia Tech is internationally recognized

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A Magazine For Engineering Students At Virginia Tech

ENGINEERS' FORUM

VOLUME 20 • NO 2 APRIL 2001

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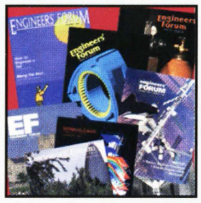

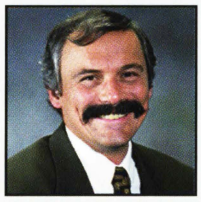

editorial

Looking for a Few Good Engineers (and money is available!)

by Lynn Nystrom

Almost 20 years ago, an aerospace student named Niall Duffy walked into my office and told me he would like to start a magazine for the engineering students. Niall did not have a communications background, but he had a drive to obtain a leadership position, and he had an interest in writing.

He also wanted to overcome what most folks in industry say about engineering students — that they are not able to communicate well.

Niall started the *Engineers' Forum*. He generated enthusiasm among a core of students and together they were able to publish several magazines that academic year.

On the business front, he had the help of the Engineering College Magazine Associated (ECMA), a group of about 50 publications in the early 1980s. One advertising agency sold ads for the ECMA members, and this was how the *Forum* afforded printing costs.

Today, we still retain the assistance of an advertising agency, Pentagon Publishing. With their excellent selling powers, the *Forum* has been able to print four colors issues each year, and still have money in its bank account. The *Forum* receives no financial assistance for printing from the College of Engineering, either today or at any time in its history.

In other words, the students who operate the *Engineers' Forum* are running a business! Being a member of this staff provides a valuable experience for entry into the professional world after graduation.

With the excess income generated over the years for the *Forum*, we have just accomplished something very exciting. We have endowed our own scholarship so that we can award the editor-in-chief a $1000 scholarship. This scholarship is available annually. We decided to name it in honor of Niall Duffy who is now working at MIT.

The *Forum* has many opportunities, and we are in the process of rebuilding. We need another Niall Duffy! If you are interested, please contact me at 231-4371.

feature

A Blueprint for Successful International Study

by Liz Crumbley

My intentions were always to study abroad — it was really just a matter of where, when and what," says Jennifer Leister, a Virginia Tech junior majoring in both industrial systems engineering (ISE) and German.

Leister has aggressively pursued those intentions, participating in the "Maymester" study abroad program, finding her own internship with BMW in Germany, and currently studying engineering at the Technical University of Munich.

"Maymester was a great experience," she says. "How often does one have the opportunity to visit universities and industries in Europe to learn about their school systems and engineering background?"

Leister was one of nine rising sophomores in May 1999 to complete three hours worth of credits by studying European edu-cational and engineering practices while traveling through France, Germany and Switzerland. The College of Engineering and the Department of Foreign Languages and Literature sponsored the pilot program.

"After the Maymester trip, I knew I would study abroad during my junior year," Leister remarks. "It was only a question of where."

She entered the Global Engineering Education Exchange (Global E3), an international study program aimed at helping engineering students prepare for careers in the global marketplace and administered at Virginia Tech by Carlene Arthur, student services specialist for the College of Engineering's Enrichment and International Programs.

Through Global E3, Leister enrolled at the Technical University of Munich (TUM) in Germany for the 2000-2001 academic year.

At the same time, Leister wanted to test her career goals of working in the automotive industry and of living abroad in the future, so she began looking for an internship in Germany for the summer of 2000.

Most students intern abroad through arrangements made by their universities, but Leister took matters into her own hands. First she researched the websites of DaimlerChrysler, BMW, Porsche, Audi and Volkswagen to find contacts. She sent a resumé and cover letter — both written in German — to those contacts and received two offers from BMW and one from Porsche.

Jennifer Leister, front row, third from right, poses with her Maymester group in Paris.

Leister credits Derek Geiger, who majors in aerospace and ocean engineering and German at Virginia Tech, with the motivation for finding an internship. "He had already worked at Daimler Aerospace and he helped me realize that I could find the sort of job I wanted in Germany."

"My job was just like any internship in the U.S.," says Leister, "except for the fact that it was classified as a Praktikum, which is a required internship for a student's course of study. Since I was already enrolled in the summer session at TUM, it was much easier to receive a work permit while doing a Praktikum instead on an independent internship."

During her summer with BMW, she worked on cost analyses of dies in the automaker's press shop and of a new technology for a small series production. She also helped with research on new materials for parts and on steel die inserts.

The internship offered another perk for Leister — she became more fluent in German and was better prepared for classes at TUM.

"At TUM I'm considered an exchange student, so I can take classes within various courses of study," Leister notes.

During this spring semester she's taking classes similar to ISE's courses in work measurements and methods engineering, work design, introduction to human factors engineering, theory of organization, and industrial automation and robotics. Her grades won't transfer, but she will receive credits toward graduation.

Leister says she's glad that she entered TUM through the Global E3 pro-gram. "The major benefit is that I'm not part of a huge group of American stu-dents studying abroad together. Because of this, I've not spoken much English and my German has rapidly improved."

She lives in a complex operated by the student housing authority in Munich. "I actually lucked out, as I am living in the newest complex in a single apartment. I have my own little kitchen, bathroom, and even my own phone."

Leister values her temporary isolation from compatriots. "I'm the only person from the U.S. in this complex, so I speak German all the time. Also, I've met students from Italy, Spain, Morocco, Sweden, Peru and Japan — it's been great to learn about their cultures."

By the time Leister leaves Germany in August, she will have worked and studied there for 14 months. After fall semester 2001 at Virginia Tech, she hopes to intern with a U.S. automaker during spring 2002.

"As for my career plans, I'm still very optimistic about working abroad," she notes. "I've continued working part-time for BMW while taking courses at TUM. One attraction I feel to Germany is that the work atmosphere here is healthy —there are many laws protecting employees from unhealthy work habits and conditions, and companies seem to look out for the well-being of workers. I'm eager to compare that to the atmosphere at a U.S. automaker." EF

scholarships

Green Engineering Offers Scholarships, Opportunities

Several new activities are planned for the college's Green Engineering Program, including a national conference to be held at the Hotel Roanoke and Conference Center July 29-August 1.

The conference, Green Engineering: Sustainable and Environmentally Conscious Engineering, will feature speakers from government, industry and academia as well as technical paper sessions and workshops.

Mike Gregg, associate professor of engineering fundamentals and current director of the Green Engineering Program, said the program also offers undergraduate scholarships. Twenty scholarships worth $500 each were available in 2000 for students taking at least one of the program's core courses, and 10 scholarships worth $1,000 each will be offered for fall semester 2001.

Virginia Tech was one of the first engineering schools in the nation to have a green element in its curriculum.

Other innovations include new and revamped environmental engineering courses, a Green Engineering Lecture Series featuring speakers from industry, and a minor in green engineering.

Virginia Tech was one of the first engineering schools in the nation to have a green element in its curriculum. The primary goal of the program is to ensure that every engineering student learns about the environmental consequences of engineering activities. The College of Engineering and corporate sponsors including Raytheon support this program.

More information about the program and the conference is available at http://www.eng.vt.edu/eng/green.

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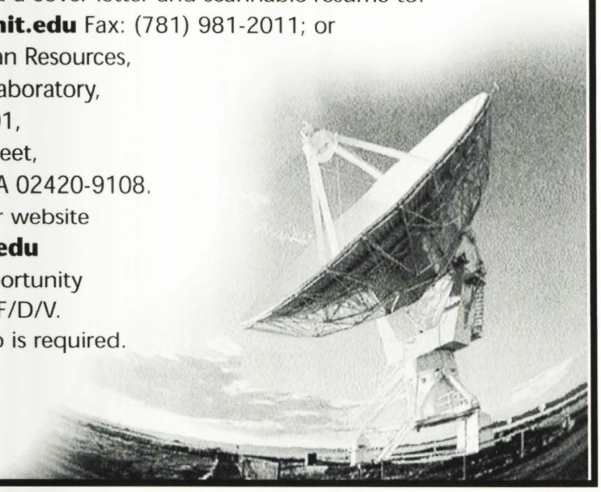


endowment

Program in Construction Engineering endowed

The family of the late Leo Vecellio, Sr., former head of Vecellio and Grogan, Inc., of Beckley, West Virginia, has provided a $1 million endowment for the Construction Engineering and Management Program in Virginia Tech's Via Department of Civil and Environmental Engineering (CEE).

The endowment will fund a number of research and education activities, including the Vecellio Professorship in Construction Engineering and Management; undergraduate scholarships and graduate fellowships for students who demonstrate academic and leadership ability; and a lecture series, sponsoring visits to Virginia Tech by leading national construction experts.

Vecellio, a 1938 civil engineering graduate of Virginia Tech, became president and CEO of Vecellio and Grogan, a construction firm founded by his father, Enrico Vecellio, and Eugene Grogan. Vecellio and Grogan became one of the largest highway construction and mining companies in the East, with more than 1,200 employees and headquarters in Beckley and West Palm Beach, Florida.

An active supporter of Virginia Tech, Vecellio was one of the early members of the College of Engineering Committee of 100. The college honored him in 1988 as the Distinguished Alumnus for that year, and in 1999 he was inducted posthumously into CEE's Academy of Distinguished Alumni.

Vecellio and his wife, Evelyn, were active in several philanthropic activities and, in 1972, they helped establish the Vecellio Family Foundation, Inc. The foundation provides grants for higher education, employee scholarships, youth and social service agencies, art groups, health services, and church support.

The endowment to Virginia Tech is provided by the foundation and several family members: Leo Vecellio, Jr., a 1968 civil engineering graduate of Virginia Tech and head of Vecellio and Grogan Subsidiaries, and his wife, Kathryn; his sister, Patricia Vecellio, a former post-doctoral fellow and adjunct professor in biology at the university; and his son, Michael Vecellio, who received his B.S. in business from Virginia Tech in 2000 and will soon enter the family business.

"The Vecellio family and our corporation have been involved in heavy and highway construction for over 100 years," said Leo, Jr. "Construction is an ever-evolving field that needs high quality research, education and well-trained personnel. Virginia Tech has a great program that answers many of the industry's needs, and we hope that our endowment will boost the program to greater heights."

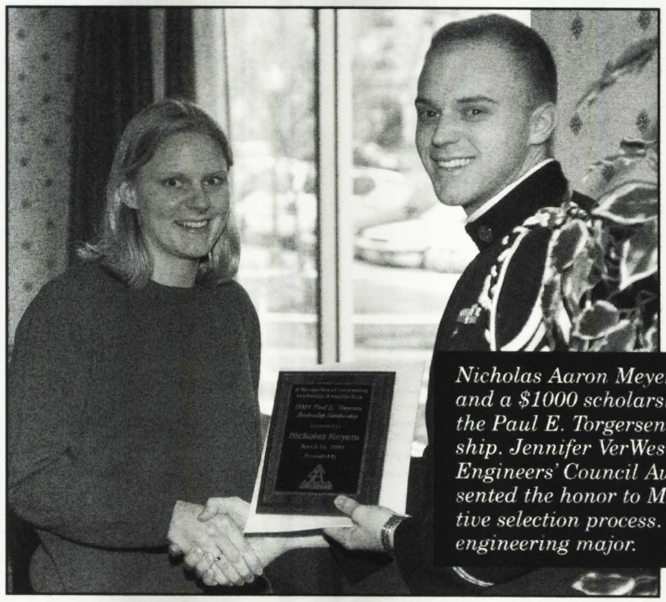
"Giving back to our communities where we work and to the institutes that trained us has been a long tradition in our family," he added.

CEE Professor Michael C. Vorster, director of the program, said the endowment will help attract the best graduate students and faculty. The Vecellio Lecture Series, he noted, will provide an opportunity for faculty and students to interact with industry leaders of international stature.

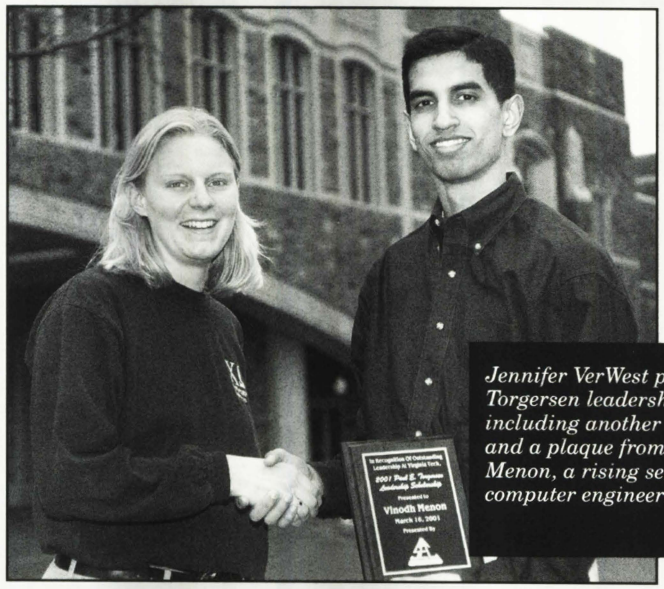
"We are extremely grateful to the Vecellio family for the vision and leadership they have shown in the establishment of this endowment," said CEE Department Head William R. Knocke.

"The Vecellio Program in Construction Engineering and Management is one of only three endowed and named construction engineering programs in the United States," Knocke added. "The resources provided through the endowment will greatly enhance an already superb construction engineering and management program and make it one of the very best in the nation." EF

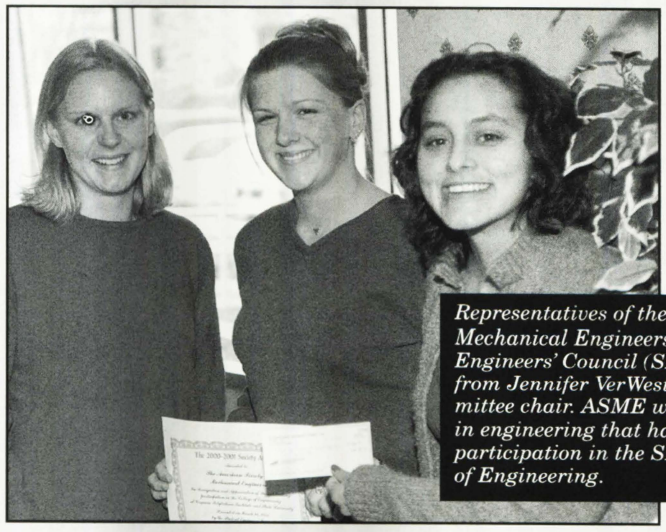
SEC Makes Presentations



Nicholas Aaron Meyers receives a plaque and a $1000 scholarship as a recipient of the Paul E. Torgersen leadership Scholarship. Jennifer VerWest, chair of the Student Engineers' Council Awards Committee, presented the honor to Meyers after a competitive selection process. Meyers is a computer engineering major.



Jennifer VerWest presents a second Torgersen leadership Scholarship, including another $1000 scholarship and a plaque from the SEC, to Vinodh Menon, a rising senior in electrical and computer engineering.



Representatives of the American Society of Mechanical Engineers receive the Student Engineers' Council (SEC) Society Award from Jennifer VerWest, SEC Awards Committee chair. ASME was named the society in engineering that has shown outstanding participation in the SEC and in the College of Engineering.

recognition

Claus Receives Outstanding Scientist Award

A new process to manufacture thin films has "environmental, economic, manufacturing, and productivity implications for the multi-billion microelectronics industry," says F. William Stephenson, dean of the College of Engineering where the process was fabricated.

The work was done at the University's Fiber and Electro-Optics Research Laboratory, directed by Rick Claus, a distinguished professor in the electrical and computer engineering department.

This work, in part, secured Claus' receipt of Virginia's Outstanding Scientist Award for 2001, and announced in February of this year. Claus was specifically cited for his work in fiber optics and nanotechnology, as well as in microelectronics. Stephenson nominated Claus for the award.

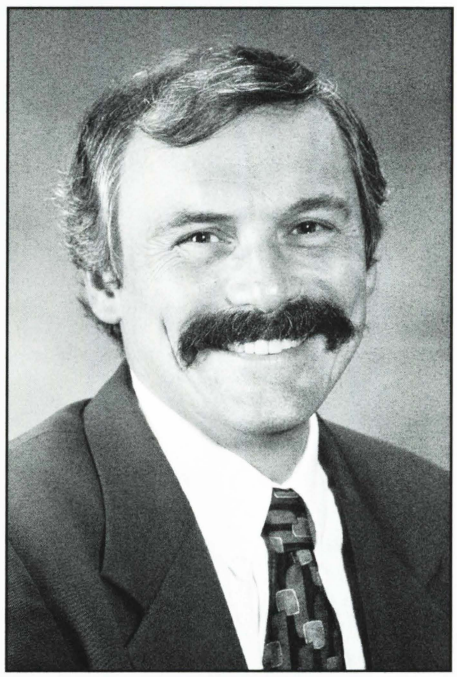
The thin films were made using a novel self-assembly process.

These piezoelectric/electrostrictive films have the potential to be used to design microelectronic mechanical systems (MEMs) devices and sensors.

Claus explains that these films have a number of advantages over previous technologies. Primarily, they can be synthesized at room temperature and pressure, resulting in very low cost manufacturing. This process is also environmentally friendly, leaving no volatile organic compounds and consuming negligible power.

These near perfect thin-films can be used in numerous applications, including integrated circuit devices, power distribution and control devices, communication devices and networks, transportation systems, computer hardware systems, biosensing devices, and eyeglass lenses.

Regarding this last application, Jim Barney, Vice President, Account Management, The Magnum Group, who supported Claus' nomination for the award, says "A market need exists in the eyecare industry for improved methods for thin-film coating of spectacle lenses with anti-reflective properties, cosmetic tints and protective coatings, among others.



Rick Claus

"Dr. Claus was invaluable in evaluating the specific optical industry needs and applying his research in nanotechnology that will represent a significant advance in the performance of organic/inorganic thin films."

Claus, who received his doctorate in electrical engineering from The Johns Hopkins University in 1977, and his co-workers have also been successful in making their nanoassembled first light emitting diodes. And FEORC's group has also achieved the manufacturing of uniformly sized nanoparticles at the two nanometer dimension, not the broad 10-20 nanometer distributions of nanosized materials typically cited in the literature.

Nanostructured materials — in the form of an alloy such as a metal or a ceramic are made of the same atoms as their more common forms, but the atoms are arranged in nanometer-size clusters that become the building blocks of the new materials. These new small particles have remarkable electronic, optical, mechanical and other properties in comparison to larger bulk materials of the same molecular composition. But the trick in making them useful is to collect very large numbers of the nanoclusters and then be able to form them into larger physical systems, with control at the molecular level.

Within the past year, Claus also received the award for innovative technology development at the New Century Technology Council's Tech Nite 2000. Claus was named the region's top developer of commercial viable technology. This award highlighted his work in nanotechnology. He has also founded NanoSonic Inc., a Blacksburg, Va. based company, created in 1998 in cooperation with Virignia tech, the state's leading research university and with the state of Virginia.

FEORC, the first Center for Innovative Technology Technology Development Center in Virginia, established in 1985, has a proven track record for providing both the science and engineering aspects of new technology. Within FEORC, and as its director, Claus has submitted more than 100 patent disclosures and published more than 800 papers in lightwave technology and applications. FEORC is also currently supported by more than 30 research sponsors.

Among its major contracts, FEORC received a $6.5 million contract from the U.S. Department of the Navy in 1994 to study a whole

Continued on page 16

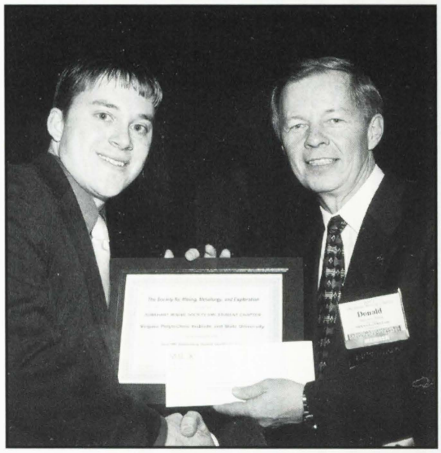
Burkhart Mining Society Named Outstanding Chapter

Virginia Tech's Burkhart Mining Society was named the 2000 Outstanding Student Chapter by the Society for Mining, Metallurgy, and Exploration, Inc. (SME).

This is the second year in a row and the third time in the past four years that the Virginia Tech chapter has won this award, said faculty adviser Greg Adel, professor of mining and minerals engineering (MinE).

One activity that makes the Virginia Tech chapter stand out is its Government, Education and Mining (GEM) program. Since 1996, Burkhart members have visited public schools throughout southwest Virginia to teach about mining, minerals, geology and related earth sciences. Many of the materials devised by the Burkhart members are aimed at helping students in different grades prepare for the Standards of Learning tests now required in Virginia.

The Burkhart Society, which includes the majority of undergraduates and many graduate students in MinE, is one of the largest SME student chapters in the world. EF



Virginia Tech's Burkhart Mining Society President, Jason Davis, receives the national Outstanding Student Chapter Award from the Society of Mining Engineers' President, Donald Ranta.

Since 1996 the students in Virginia Tech's Burkhart Mining Society have visited students at the local elementary, middle, and high schools. They speak about the importance of mining engineering, and provide activities such as informative videos and hands-on equipment demonstrations.

research

New Sensing Device Lessens Dependence On Energy Needs

by Lynn Nystrom

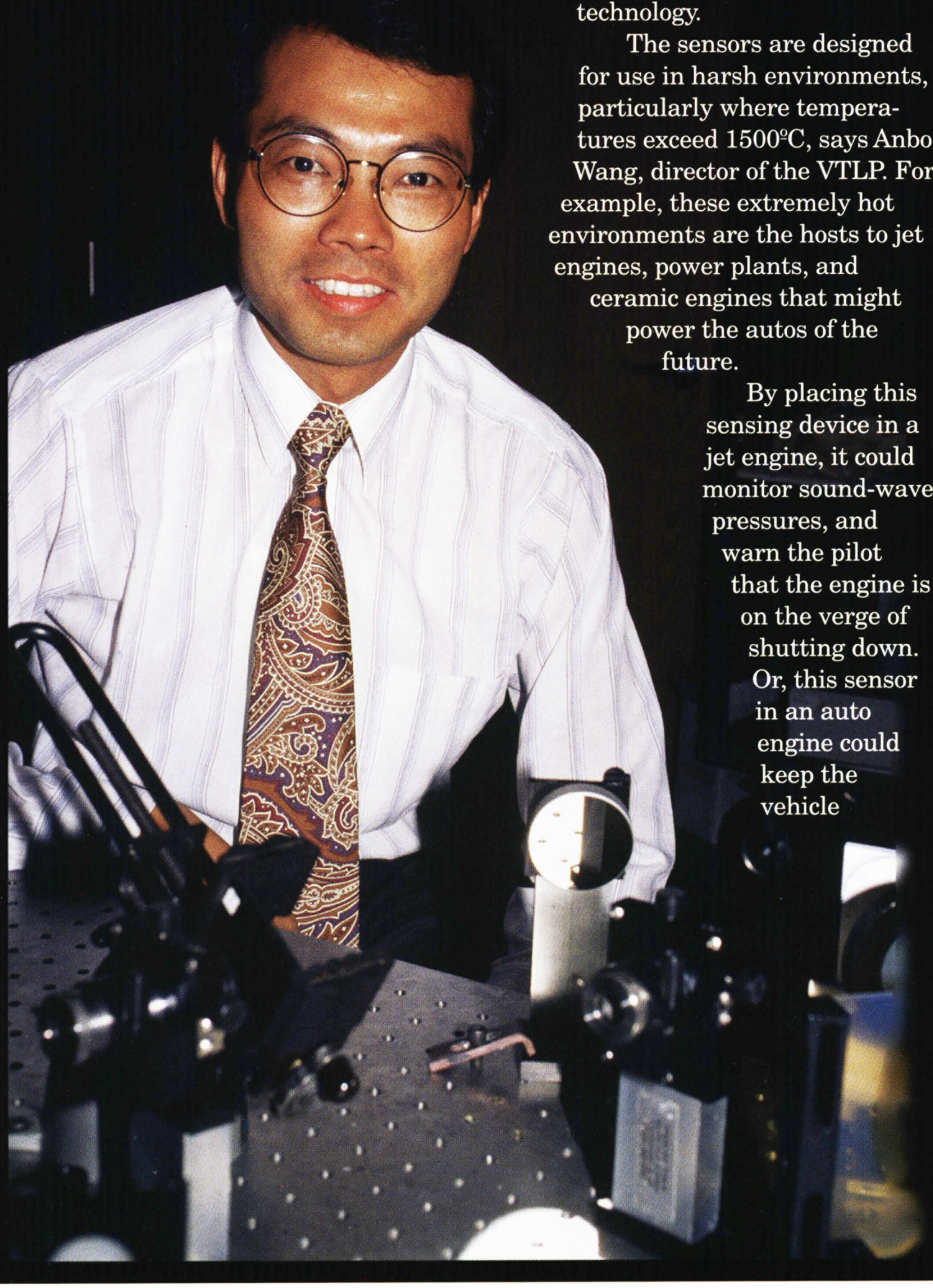
With the use of a new sensing device developed by Virginia Tech electrical engineers, energy intensive industries, including companies that specialize in transportation, power, glass, steel, and aluminum, should find that they can become less dependent on energy needs.

The use of these sensors should also reduce the emissions of pollutants.

Honeywell (formerly AlliedSignal), ABB, Howmet, and Corning are a few of the companies that have teamed with the Virginia Tech Photonics Laboratory (VTPL) and Oak Ridge National Laboratory to help commercialize the new sensing technology.

The sensors are designed for use in harsh environments, particularly where temperatures exceed 1500ºC, says Anbo Wang, director of the VTLP. For example, these extremely hot environments are the hosts to jet engines, power plants, and ceramic engines that might power the autos of the future.

By placing this sensing device in a jet engine, it could monitor sound-wave pressures, and warn the pilot that the engine is on the verge of shutting down. Or, this sensor in an auto engine could keep the vehicle operating at its most efficient temperature and pressure.



The industries VTPL has teamed with are logical choices. Honeywell is the leading producer of gas turbine engines and Corning is the leading manufacturer of optical fiber, cable and photonic products for the telecommunications industry. ABB is the world's largest manufacturer of power generation equipment. Howmet leads the industries in the manufacturing of precision investment castings of aluminum, titanium, and superalloy for aircraft, turbine engines, and aerospace needs.

In the past, industry has primarily relied upon semiconductor pressure sensors that have several major drawbacks. These include a limited maximum operating temperature of 482ºC, poor reliability at high temperatures, severe sensitivity to temperature changes, and susceptibility to electromagnetic interference.

The Tech engineers produced the new sensor by combining several key technologies into a single sensor system. They focused on the advantages of each technology and significantly minimized the disadvantages.

In addition to the advantage of working in very high temperatures, the new sensor, called the self-calibrated interferometric/intensity based (SCIIB) sensor, is smaller in size, has higher resolution and accuracy, and a higher frequency response than its precursors. It is also immune to electromagnetic interference, has a strong resistance to chemical corrosion, is self-calibrating, and provides for an absolute measurement.

Another key to the success of the new sensor is one of the materials the engineers have chosen. They are

Continued on page 16

research

Coal Production Techniques More Environmentally Friendly

by Lynn Nystrom

As energy crisis continues, burning coal may become cheaper and more environmentally friendly, thanks to Virginia Tech engineers.

The U.S. Department of Energy (DOE) has awarded a $7.9 million contract to Virginia Tech's Center for Coal and Minerals Processing (CCMP) to demonstrate the commercial potential of new coal production techniques, announced Ninth District Congressman Rick Boucher.

Although companies have mined coal on a large scale since the Industrial Revolution, they still must discard a significant portion of the coal fines generated during the mining operations due to the difficulty in cleaning and handling.

The DOE estimates that more than 2.5 billion discarded tons of fine coal sits in various impoundments around the country.

The DOE – Virginia Tech contract provides for industry to test two different processes that may solve this major environmental problem.

The technologies, developed by minerals engineers at Virginia Tech, will be tested at four locations, including one of the largest coal preparation plants in the U.S., owned by CONSOL Energy.

"Our dewatering technology allows coal companies to recover coal from waste products. We kill two birds with one stone. The process recovers valuable coal from waste and, at the same time, eliminates fine coal impoundments that are a significant environmental concern," says Roe-Hoan Yoon, Virginia Tech mining and minerals engineering (MinE) professor and CCMP director.

"The technology we developed here can help companies reduce the costs of producing coal and thereby help increase the use of coal," Yoon adds.

Processing fine coal is the most difficult and costly part of producing the solid fuel, Yoon says. Impurities such as sulfur and other mineral matter are removed from the coal by washing it in water. However, the cost of separating water from the fine coal particles made during processing is too high. Consequently, many coal producers are forced to discard the fines to impoundments and recover only the coarse coal.

Virginia Tech's new technologies will now allow coal companies to remove the water from fine coal efficiently, and to recover high-quality solid fuels from the waste streams.

"The costs of implementing the new technologies are low," Yoon says, "and their commercial application will not entail environmental problems."

Yoon's prediction of a low cost for implementation is based on case studies performed by his research center during the Phase I portion of this work, funded also by DOE.

One Phase I case study conducted on a Virginia coal company showed that it could increase its revenue by $3.4 million a year using the new technology by removing only one third of the water left in the fine coal. If one half of the water is removed, that number jumps to $4.6 million.

The new funding award to Virginia Tech is a continuation of the DOE's Solid Fuels and Feedstocks Grand Challenge program, aimed at "developing innovative technical approaches to ensure a continued supply of environmentally sound solid fuels for existing and future combustion systems with minimal incremental fuel cost." The Solid Fuels and Feedstocks Program is managed by the Energy Department's National Energy Technology Laboratory, the government's lead fossil energy research facility. EF

Virginia Tech's Center for Coal and Minerals Processing hopes to make the burning of coal cheaper and more environmentally friendly.

Dr. Roe-Hoan Yoon is the center director.

Claus *Continued from page 11*

range of fiber optic applications as they related to military and commercial uses. In 1998, FEORC received a $9.6 million grant from the Naval Research Laboratory (NRL) for an Optical Sciences Research program. Nanotechnology was included in the research focus of this proposal.

"Dr. Claus, as a recognized leader in his field, has secured more than $33 million during his 22-year career in academia. His work has contributed greatly to Virginia Tech's listing as the only top 50 research university in the state," Stephenson says.

"Dr. Claus has quite possibly set a record for the number of spin-off companies from one research center. Since his initial funding from the CIT in 1985, 18 different companies have been spun off from his work with students. These companies employ more than 200 people in Virginia and they represent a number of high-tech jobs. Dr. Claus is helping to keep Virginia's best scientists in this field as residents of the Commonwealth," Stephenson adds. EF

Wang

Continued from page 13

using fibers made of single-crystal sapphire. According to Wang, "sapphire is an excellent material for the construction of harsh environment sensors due to its high melting point, excellent transparency, and well-documented resistance to corrosion." But the sapphire has been limited in its uses due to some technical constraints.

Based on VTPL's past success in developing the self-calibrating temperature and pressure sensors, the U.S. Department of Energy has just awarded $1.8 million to continue its work in this area. The Virginia Tech principal investigators on this program are Wang, Gary Pickrell and Russell May, all from the Photonics Laboratory.

In addition, the DOE awarded VTPL's partner, Oak Ridge National Laboratory an additional $180,000 to collaborate on the project, and work towards the commercialization of these sensors. Oak Ridge maintains a internationally recognized sapphire material processing and fabrication facility.

The award will be divided over a three year period.

Some of the initiatives they will be working on, Wang says, include the use of a commercially available gold coated fiber with the SCIIB sensors. They will also investigate different polymer coatings that will withstand the higher temperatures. EF

NORTHROP GRUMMAN

priorities^3 challenges^3 technologies^3 opportunities^3

Set your career sights on a higher degree of professional and personal satisfaction with Northrop Grumman...the watchword in defense, aerospace and cyberspace.

With a 60-year track record of innovation, ES^3 - the Electronic Sensors and Systems Sector - has a diversified portfolio that includes more than 4500 active contracts spanning a wide variety of defense electronics and systems, precision weapons, and airspace management/marine/automation/information systems. Headquartered in Baltimore, Maryland, we have locations throughout the U.S.

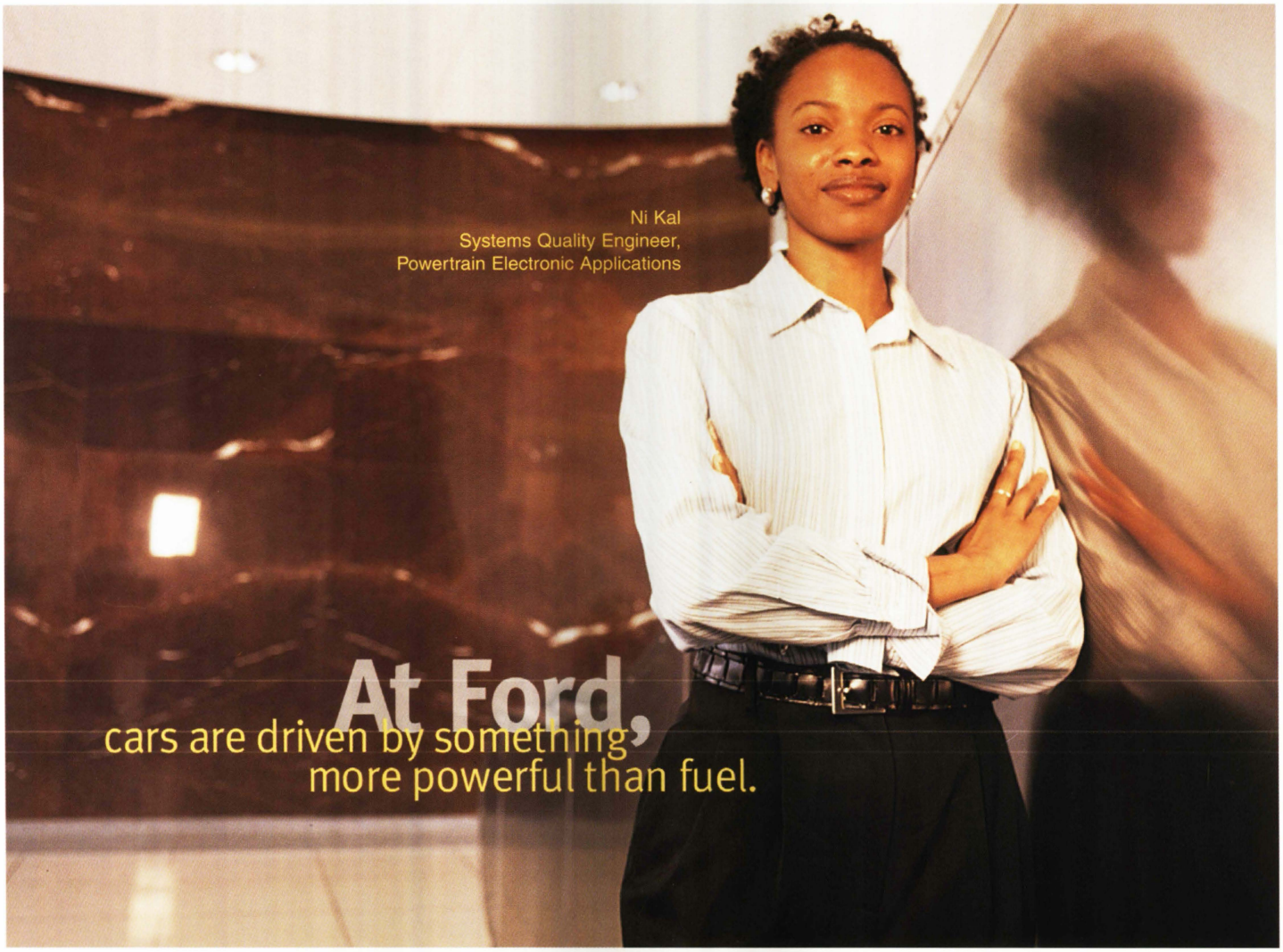
We offer new graduates a wealth of career opportunities. For example, our new Graduate Professional Development Program provides an exciting, challenging rotational option to participants with majors in Engineering, Business/Accounting/Finance and Information Systems.

- **Accounting/Finance**
- **Business Administration**
- **Computer Engineering**
- **Computer Science**
- **Electrical Engineering**
- **Manufacturing Engineering**
- **Management Information Systems**
- **Mechanical Engineering**

If you relate to our degree of interest in your talents, visit your placement office or send your resume to: **Northrop Grumman, ES^3, National Resume Processing Center, Source Code: VTEF0201, P.O. Box 367, Burlington, MA 01803. E-mail: northgrum@rpc.webhire.com Fax: 800-281-7914.** Please use Source Code above on the "Subject" line of all correspondence.

www.northgrum.com or
sensor.northgrum.com

U.S. Citizenship is required for most positions. EOE M/F/D/V.



Just ask Ni Kal.

She tackled a cross-functional assignment in Brand Management to launch the new 2000 Taurus. Her ideas have resolved assembly issues at one of our major manufacturing facilities. And currently, she's leading a team of engineers focused on improving Powertrain Control Modules.

An impressive career for anyone. What's more impressive is the fact that Ni Kal accomplished all of this and more in just two years.

That's what the Ford College Graduate Program is all about. It gives recent graduates the opportunity to make important contributions - right from the start. Even better, it will give you the chance to create your own unique world within Ford. What do you want to accomplish in your career? Where do you want your talent to take you? The Ford College Graduate Program will give you the experience you need to find the answers.

It's a remarkable journey. And for Ni Kal, it's just beginning. For more information about the Ford College Graduate Program and current career opportunities, visit us at mycareer.ford.com. By choice, we are an Equal Opportunity Employer committed to a culturally diverse workforce.

Ford Motor Company

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