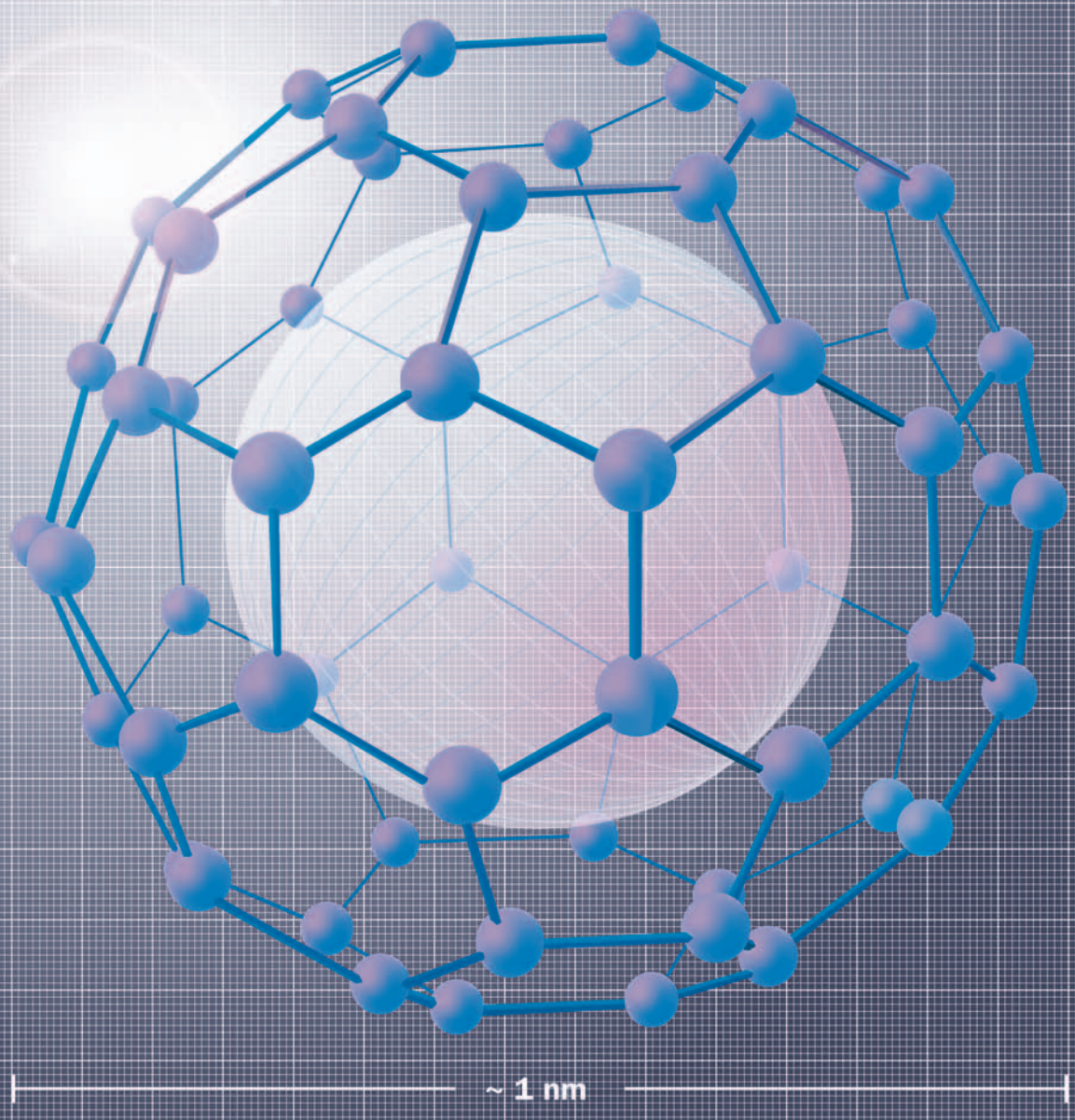
University of Houston Cullen College of Engineering

[ParamETErs]

Fall 2004



nanotechnology

DEAN'S MESSAGE

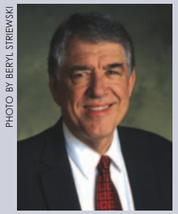


PHOTO BY BERYL STRIEWSKI

As we near the end of 2004, we can look back on a year of accomplishment, a year that moved us to a higher level of excellence across a wide breadth of areas, from research and academic leadership to staff and facility enhancements.

In the dean's office, we've added Frank J. "Fritz" Claydon as associate dean for undergraduate programs. For the past five years, Fritz has provided excellent leadership as chair of the Department of Electrical and Computer Engineering. He brings a capability to our office of accelerating our undergraduate student recruiting and improving the overall quality of our student body. He and Stuart Long, associate dean for outreach educational activities, have already received more than $3 million in funding from federal, state and local groups in support of our outreach efforts in high schools.

Another change in the dean's office is the appointment of Larry Witte as the associate dean for graduate programs. Larry is also committed to improving the number and quality of our student body at the graduate level. We also recently hired David Starnes as our new development director. An experienced development officer, David has worked at Texas Tech and other universities, and we're very happy to have him on board.

The college launched the Engineering Career Center last year under the direction of Vita Como, and the students really appreciate the new support Vita and her office provide. Although the program is still in its early stages, Vita and her group are already receiving highly positive feedback from the students and companies related to their activities. The college has needed a career center for some time, and we are pleased that its initiation has been so positive.

Our communications group under Angie Shortt continues to be a great strength to the college. The group recently completed our first in-house video on the college. I recommend you view it online at www.egr.uh.edu/about/?e=video.

In this issue of *Parameters*, the spotlight is on our research in nanotechnology and materials science engineering, an area in which the university is widely recognized as a national leader. We have an impressive engineering group in this area, and with our new faculty hires, our expertise continues to grow.

The college has added seven new faculty members this year, and we expect to add several more in 2005. More than 35 percent of the faculty members represent "new faces" over the past six years. Overall, the excellence and performance of our faculty have been significantly improved with these new hires.

On the horizon, we have plans for a new facility to replace the old Y Building. When the new Science and Engineering Building is completed in 2006, the university will tear down the old Y Building. In its place we plan to construct a student learning and design center which will house student centered educational and other activities (student advising, computational labs, design labs, career services, student organizations, classrooms, conference rooms, study areas, eating facilities and more). The new building will be paid for with private gifts and university funds and will be the new "front door" to the college. A 10-member committee made up of alumni and supporters has been formed to lead the project.

Overall, I am very pleased with the developments in the college. We have made significant improvements over the past few years, and with your continued interest and support and the quality work of our faculty and staff, we will continue to make advances and improve the educational and research opportunities for our students.

Sincerely,

Raymond W. Flumerfelt, *Dean*
Elizabeth D. Rockwell Endowed Chair

pa·ram·e·ter

Pronunciation: pə-'ram-ə-tər
Function: noun
Etymology: New Latin, from para- + Greek metron measure
Date: 1656

1: *a.* an arbitrary constant whose value characterizes a member of a system (as a family of curves); also: a quantity (as a mean or variance) that describes a statistical population
b. an independent variable used to express the coordinates of a variable point and functions of them — compare PARAMETRIC EQUATION

2: any of a set of physical properties whose values determine the characteristics or behavior of something
<parameters of the atmosphere such as temperature, pressure and density>

3: something represented by a parameter: a characteristic element; broadly: CHARACTERISTIC, ELEMENT, FACTOR
<political dissent as a parameter of modern life>

4: LIMIT, BOUNDARY — usually used in plural
<the parameters of science fiction>

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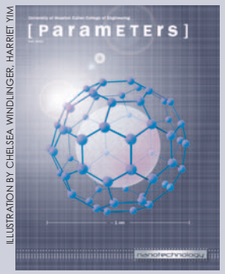


ILLUSTRATION BY CHELSEA WINDLINGER; HARRIET YIM

Nanotechnology
The incredible shrinking world of nanotechnology has ushered in a new era in science and engineering, one that points to the day when tiny miracles of invention will be constructed with atomic precision. UH engineering faculty and alumni are national leaders in this effort, and much of their work on the "dry" side of nanotechnology is featured in this issue of *Parameters*. The "wet" or bio-nanotechnology research at the college will be featured in future issues.

UH Diesel Vehicle Research and Testing Facility Unveiled

The UH Diesel Vehicle Research and Testing Facility, initiated in advance of the Bush administration's Clean Air Nonroad Diesel Rule signed by the EPA in May, was unveiled to the public in June during a ribbon-cutting ceremony with Houston Mayor Bill White.

In an effort to improve the region's air quality, the City of Houston is providing $3.8 million to UH to test new technologies that will help reduce emissions from the city's diesel fleet of 2,800 vehicles. The focus of the five-year project, headed by the Department of Chemical Engineering, is to conduct diesel testing and data analysis, emission research and technology development. Cash and in-kind contributions from the university bring the total project cost to nearly $5 million.

"Technologies emerging and being researched at our facility are beginning to offer promising possibilities for reducing the polluting emissions found in diesel engine exhaust," said Michael Harold, professor and chair of the Department of Chemical Engineering and the principal investigator on the air quality project.

"Our task is to systematically evaluate the effectiveness of these technologies, especially in reducing nitrogen oxides and particulates. The project is part of a larger UH Cullen College of Engineering effort to develop cleaner engine technology."

Nitrogen oxides (NOx) are precursor chemicals that react in the atmosphere to form ozone, a key component of smog. Common sources of NOx include cars, trucks, marine vessels, power generation and industrial processes. When the EPA announced in April its determination of the air quality in communities across the nation, the Houston-Galveston nonattainment area did not meet the stricter national standard for ozone.

Scientists are expecting measures such as the new EPA rule and the new UH facility to have as big a health benefit as removing lead in gasoline and installing catalytic converters on cars. The UH facility includes what is essentially a treadmill for heavy-duty trucks and a state-of-the-art emission analysis system that will put diesel-powered vehicles through a series of tests under simulated driving conditions.

"With the notable shortage of facilities to test diesel emission control technologies for their effectiveness, UH fills a need in Southeast Texas," Harold said. "By analyzing data taken before and after the vehicles are modified, we can evaluate how effective the new devices are in reducing emissions, thereby helping the city make informed decisions about how to invest taxpayer dollars in technologies to reduce emissions in its fleet."

For the full story, visit www.egr.uh.edu/news/0604/?e=dieselfacility.

PHOTO BY JEFF SHAW

Houston Mayor Bill White is greeted by Michael Harold, principal investigator on the air quality project, at the UH Diesel Vehicle Research and Testing Facility, which had its official ribbon-cutting ceremony June 28. Also pictured are Pamela Berger (left), director of the Mayor's Office of Environmental Policy, and Arthur Vailas (center), UH vice president for research and intellectual property management.

More Computers For Students

The Engineering Computing Center (ECC) opened a new 32-station PC laboratory within the ECC complex Oct. 1. The computers, which operate in the Windows XP and LINUX environments, were funded in part with Undergraduate Equipment Access Fees and College of Engineering Technology Fees. In March, a new 30-station computer classroom will open in a newly renovated lab building next to the Y Building. This renovation project is funded through the Provost's office and student fees. Both efforts are part of the college's plan to enhance the overall engineering student experience and environment.

UH Hosted SECME Summer Institute

The SECME Summer Institute brought together a cross-section of more than 650 educators, students, parents, mentors, members, directors, sponsors and friends to the UH campus last summer to participate in an array of hands-on workshops, classes and special presentations. The 28th edition, "SECME: The Global Road Map To Success," was hosted by the UH Cullen College of Engineering.

PHOTO BY JEFF SHAW

Nisarg Patel, Michael Lieder and Nickolaus Schlegel from Basha Elementary School in Arizona participated in a Mousetrap Competition June 28 at the SECME Summer Institute.

UH Students Compete in Shell Campus Pit Stop Challenge

In a new recruitment and awareness effort, Shell brought their Pit Stop Challenge to UH in front of the Y Building, and more than 100 students participated in the event. Students had the opportunity to change a tire on a Ferrari Formula One racecar, in teams of three, to compete for the lowest time.

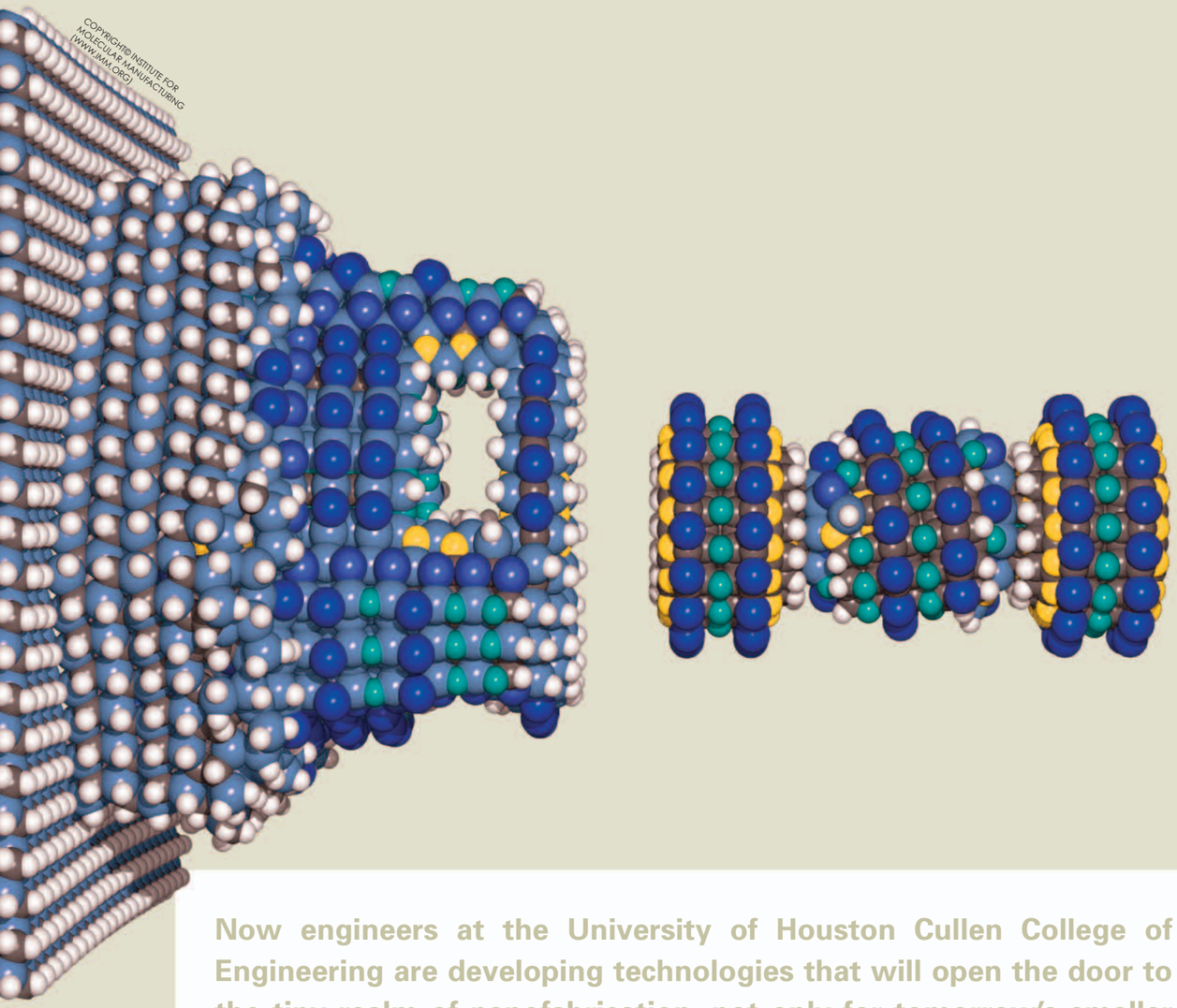
"We had 40 teams of three people each participate," Shell Attraction and Recruitment Coordinator Julie Hur Pascoe said. "We didn't have an official count, but through the day there were always students and others just observing."

Because the Challenge is a pilot program, Shell and Hur Pascoe had a special investment in the event's success. "We've done this at large trade shows or at industry events like the Offshore Technology Conference where there is still a student audience, but this is the first time that Shell Campus Recruiting is bringing this to students," Hur Pascoe said.

Hur Pascoe said that UH had the highest participation yet of any university Shell visited. The event was co-hosted by the UH chapter of the American Society of Mechanical Engineers and the Department of Mechanical Engineering.

PHOTO BY KRISTEN ORTWERTH / THE DAILY COUGAR

Team Chuck E. Cheese, made up of industrial engineering seniors Charles Anyanwu and Michael Kalita and chemical engineering senior Andrew Chen, had the lowest time at 5.33 seconds at the Shell Pit Stop Challenge and each won a scale model remote controlled Ferrari.



Now engineers at the University of Houston Cullen College of Engineering are developing technologies that will open the door to the tiny realm of nanofabrication, not only for tomorrow's smaller integrated circuits but also for a variety of other applications, such as water filtration and power generation. How small is the nano-realm? A nanometer (nm) is one billionth of a meter. To put things in perspective, consider that current features on today's microchips and magnetic storage devices range down to the upper end of the nano-realm, just below 100 nm. UH engineers are working toward the fabrication of features near 4 nm, possibly smaller.

—PUSHING DEEPER INTO THE REALM OF THE INFINITESIMAL

FEATURES BY BRIAN ALLEN, PHOTOS BY JEFF SHAW

Forty-five years ago, theoretical physicist Richard P. Feynman gave a visionary talk titled "There's Plenty of Room at the Bottom" in which he laid out the roadmap for what we now call nanotechnology. Since 1959, engineers and scientists have made huge strides toward the miniaturization of technology. Integrated circuits have gotten smaller and smaller. Features on magnetic storage devices, such as hard disk drives, have also been shrinking at a rapid rate.

Now engineers at the University of Houston Cullen College of Engineering are developing technologies that will open the door to the tiny realm of nanofabrication, not only for tomorrow's smaller integrated circuits but also for a variety of other applications, such as water filtration and power generation. How small is the nano-realm? A nanometer (nm) is one billionth of a meter. To put things in perspective, consider that current features on today's microchips and magnetic storage devices range down to the upper end of the nano-realm, just below 100 nm. UH engineers are working toward the fabrication of features near 4 nm, possibly smaller.

UH engineers are also major players in bio-nanotechnology, what engineers refer to as the "wet" side of nanotechnology, but the focus in the following pages will be on the "dry" side—nanofabrication, lithography, etching, self-assembly, and other techniques that are being explored and perfected at the college. Nationally funded research in the departments of electrical and computer engineering, chemical engineering and mechanical engineering spotlight a recent surge in research activity aimed at further understanding the unique ways in which materials change properties in the nano-realm, and how those changes can be used to advance technology. UH engineers are harnessing the power to achieve new feats of engineering.

Feynman, who won the Nobel Prize in Physics in 1965, was without a doubt a true visionary, and now, in part because of the efforts of UH engineers and their colleagues and partners in industry, engineering research is at the threshold of a whole new era in technological advancement. And part of the excitement is in the unknown, in the discoveries that today lie just beyond our grasp, but soon will be well within our reach.

UH TECHNOLOGY HOLDS PROMISE FOR

MULTIBILLION-DOLLAR DATA STORAGE INDUSTRY

Imagine storing the entire Library of Congress on a Palm Pilot, or storing 1,000 movies on a 2-inch disk.

These are the kinds of the futuristic goals that could become feasible if UH engineers are successful in their bid to create the first nano-patterned medium recording (N-PMR) at the scale of one terabyte per square inch and explore the physical limits of magnetic data storage in units only 4 nanometers in size.

DMITRI LITVINOV, associate professor of electrical and computer engineering, is the principal investigator of this new research project that recently received funding of $1.1 million from the National Science Foundation. The project could enable the multibillion-dollar magnetic data storage industry to continue its record-setting growth rate for the next 10 to 15 years, says Litvinov, who is working closely with co-principal investigator Jack Wolfe, professor of electrical and computer engineering.

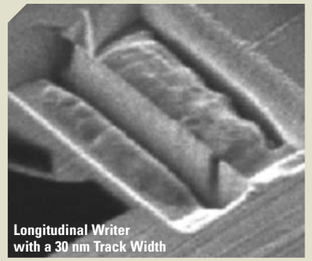
Wolfe's recent innovations in atom beam lithography will provide much of the nanoscale precision needed for the project. His new technology, dubbed "massively parallel direct-write atom beam lithography," delivers highly reliable, inexpensive sub-10 nm resolution. The theoretical limit of this new technology ranges between 1 and 2 nm, only one order of magnitude above the atomic level.

"If we can make this work, this could be something really big for the data storage industry," Litvinov says. "The data density of magnetic hard drives has doubled every year for the past five years. But that impressive growth rate is now threatened because they're running out of options. They're running into some fundamental limits. Our system will allow them to extend this limit by a factor of 10. Maybe more."

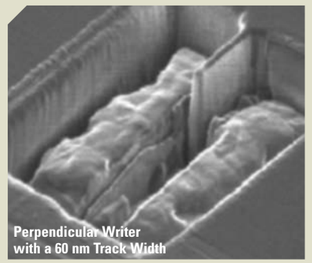
The fundamental limit that Litvinov refers to is called the super-paramagnetic limit, a predicament that will bring the industry's impressive growth rate to halt by as soon as 2007, Litvinov says. This limit has to do with the relationship between the density of each crystallite and the magnetic and thermal energy necessary to read and write onto the medium. Currently, there are only two options for meeting the challenge of the superparamagentic limit, thermally assisted recording, which would be extremely complicated and expensive, and N-PMR, which is the technique Litvinov and his colleagues are developing.

"The big difference between current practices and what we are proposing is, we want to record on a single crystallite," Litvinov says. "Right now, we record on 50 to 100 crystallites, because you need that many to have a high signal-to-noise ratio. You suppress noise by averaging many of them. Now if we could design things so that each crystallite is located in a specific place—in a lithographically defined place—then we can record on individual crystallites." ››

Examples of NANOSCALE TRANSDUCERS made with a focused ion beam



Longitudinal Writer with a 30 nm Track Width



Perpendicular Writer with a 60 nm Track Width

Darren Smith, electrical engineering senior, makes observations through the window of an AJA International Sputtering System in the Nanomagnetics Laboratory.

» As the project moves forward over the next four years, engineers plan to extend the technology to the 4 nm limit using self-assembled nanoparticle masks confined by lithographically defined tracks, and then test the N-PMR "islands" using a read-write head on a scanning probe. Next, they will fabricate flyable disks for spin-scan testing of signal-to-noise ratio, bit error rates and thermal stability. Corporate partners with testing and other aspects of the project include Seagate Technologies; Molecular Imprints, Inc.; LBNL and Euxine Technologies LLC.

One key to the project's success will be the work of UH collaborator T. Randall Lee, professor of chemistry and chemical engineering, who will lead the effort to create masks using self-assembling nanoparticles.

"Our job is to make nanoparticles in such a way that they all have the same size and shape," says Lee. "We are going to focus on ways to do that extremely well, at the forefront of technology, because to do the sort of patterning we want, we need to have particles that have uniform size and shape. If we can make these particles, then we're going to use them as part of the templating process for growing patterns. For example, we will take the particles and coat them with an organic film, an organic monolayer that has a certain composition, and that composition will dictate how the nanoparticles arrange themselves in a two-dimensional grid."

When the nanoparticles arrange themselves the way Lee wants them to, they will form a mask for use in lithography. He uses self-assembly to coat the gold nanoparticles with the appropriate functional groups, and then uses those functional groups to assemble the particles into an array that will form a specific pattern, a patterned mask. Lee and his associates hope to reach down to the 10 nm scale.

"The trick is getting the nanoparticles prepared in a fashion where they're all the same size and shape, and then getting them coated with the appropriate material so that you can get them to assemble in a regular pattern," he says. "What we bring to the table is expertise in nanoparticle synthesis and coatings technology. Our group has for 10 years now been working in self-assembled thin films. We know how to make these coatings so that we can tailor the properties very specifically. The challenge is to avoid defects."

Litvinov's co-principal investigators include Wolfe; Lee; Dieter Weller, executive director of media research at Seagate Technologies; and C. Grant Willson, engineering professor at the University of Texas at Austin and co-inventor of step-and-flash imprint lithography. ■

Nanotechnology Experts To Gather in Houston in April 2005

World experts in nanotechnology will gather in Houston to attend the Second Conference on Nanoscale Devices and System Integration (NDSI'05) sponsored by IEEE Nanotechnology Council and the University of Houston Cullen College of Engineering. The NDSI'05 will be held at the Warwick Hotel on April 4–6, 2005.

Professors Dmitri Litvinov, program co-chair, and Jack Wolfe, local chair, are heading the conference organization efforts. NDSI has a single session format with all the invited talks forming the body of the conference. Contributed work is showcased at the poster sessions. High quality of the technical program is ensured by the broad participation of the nanotechnology leaders from both the industry and academia.

"This nationally recognized conference is a chance for the University of Houston to step into the spotlight among the world's leading researchers in nanotechnology," Litvinov says.

The last conference in Miami drew more than 160 participants from 14 countries, and featured nationally recognized university scholars as well as scientists and engineers from major corporations such as NEC, IBM, Toshiba, AMD, Samsung, Seagate and Veeco.

The 2005 conference will be a highly interactive meeting, which will serve as an open forum to identify priorities in today's broad range of nanoscale technologies. Major topics related to device fabrication/synthesis at nanoscale and integration of nanoscale technologies into functional systems will be covered, including

- » Nanoelectronics
- » Nanomagnetics and spintronics
- » Nanophotonics
- » Nano/bio inspired devices and system
- » Nanorobotics
- » Materials for nanotechnologies
- » Fabrication for nanoscale
- » Metrology

Work presented at the conference is eligible for consideration in a special issue of *IEEE Transactions on Nanotechnology*. For more information, visit www.nanointernational.org or contact Dmitri Litvinov at 713-743-4168 or dlitvinov@uh.edu.

Houston

Electrical engineering Ph.D. student Mansi Bhargava and professor Jack Wolfe work with the Reactive Ion Etching Module in the Nanosystems Manufacturing Laboratory.

UH ENGINEER *Develops* NEW TECHNOLOGY *for* PRINTING WORLD'S SMALLEST PATTERNS

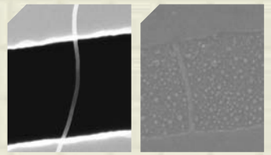
Isaac Newton told his close associates that he finally realized how to describe gravity when he watched an apple falling from a tree in his garden. This tale reminds us how we have all recognized scientific truth by seeing everyday events with new eyes.

Such was the case with JACK WOLFE, professor of electrical and computer engineering at the UH Cullen College of Engineering. In 1998, Wolfe and his colleagues were having trouble removing atoms from an ion-beam lithography experiment when it occurred to Wolfe that perhaps the atoms were the answer, not the problem.

Today, Wolfe's work in atom beam lithography is the enabling technology behind multiple projects at the college, one of which recently received more than a million dollars in funding from the National Interdisciplinary Research Team (NIRT) program of the National Science Foundation. Using atom beam lithography, Wolfe is printing patterns that are unmatched anywhere in the world in terms of quality and size.

"It's like stencil printing where the stencils are thin silicon membrane with fine, etched openings, and the paint that we print with is a beam of helium atoms," Wolfe says. "The atoms don't actually color the substrate, but what they do is change its solubility, which enables us to remove those areas and reveal the printed pattern on the film."

What makes atoms the preferred particle for this process? "They are not affected by electric or magnetic fields, particularly the fields generated by charges on the mask," Wolfe says. "Because the atoms stay on course more effectively than charged particles (ions or electrons) as they travel between the mask and substrate, we can print with much greater precision and at much smaller scales than previously achieved."



The scanning electron micrograph at the left shows a 20 nm wide carbon nanotube draped across the opening of a silicon stencil mask. The image on the right shows an atom beam print of the nanotube etched into a (rather grainy) film of silicon dioxide. The copy is about 15 atoms wider than the original. "We are scurrying to improve on this," Wolfe says.

Why is it important to be able to print so small?

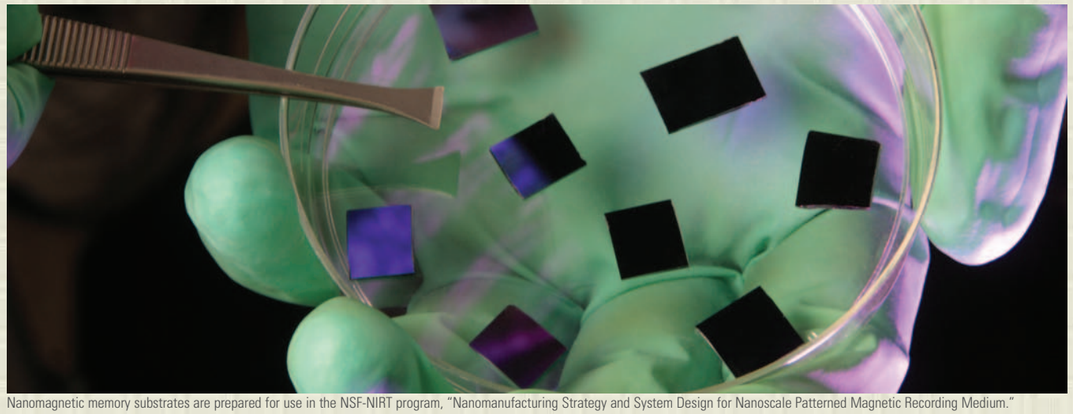
"One has to do with magnetic devices," Wolfe says. "They're very simple, just an array of square dots with a little bit of space in between. And it turns out that you would expect to be able to make each dot a bit of magnetic memory—not right now, but soon—and that means if the dots are 10 nm, then we can make memory that is 50 times more dense than today's."

The manufacturing of better, more dense magnetic devices, such as hard drives in personal computers, could be possible within a few years, which is why Wolfe and his colleague, Dmitri Litvinov, were successful in obtaining the NIRT grant from NSF.

Wolfe says taking his technology to the next level will hinge on two things:

» The ability to perform ultra-clean etching with his new state-of-the-art clean room and vacuum-sealed two-chamber etching process
» The completion of a new charged selected atom source that will improve the quality and the speed of the printing process

"In the past, we've had only one etcher to work with, and that reduced our ability to produce the precision results we are ultimately aiming for," Wolfe says. "Now, with the addition of a second etcher and a new $40,000 turbine pump, we expect to take our printing and our images to a whole new level." ▪



Nanomagnetic memory substrates are prepared for use in the NSF-NIRT program, "Nanomanufacturing Strategy and System Design for Nanoscale Patterned Magnetic Recording Medium."

UH ENGINEERS INVENT TECHNIQUE TO IMPROVE

ENERGY CONVERSION

FOR NASA'S DEEP SPACE PROBES

APERTURE ARRAY LITHOGRAPHY PROCESS ALSO IMPROVES WATER FILTRATION SYSTEMS

Using a low-cost, high-resolution printing process that somewhat resembles the way semiconductors are manufactured for computers, PAUL RUCHHOEFT (1998 MSEE, 2000 PhD EE), assistant professor of electrical and computer engineering at the UH Cullen College of Engineering, has made important strides in aperture array lithography that may have opened the door to a low-cost energy source and a more effective way to purify water.

Working in the Nanostructures Laboratory within the college's Nanosystem Manufacturing Center, Ruchhoeft and his associates have invented a quick, flexible and inexpensive way to make infrared filters, a key component in an energy conversion method that converts heat to electricity. The method, known as thermal photovoltaic energy conversion (TPV), captures the infrared light emitted from any burning fuel source and converts it to electricity. Although the method itself is not new, the ability to manufacture the nanoscale opening on the infrared (IR) filter in a quick and inexpensive process is a major step forward.

"Thermal photovoltaic energy conversion has been studied since the sixties," says Ruchhoeft. "The idea is that a very hot surface will emit a lot of radiation, as does, for instance a burner at home on your range. In TPV, you convert this thermal radiation to electricity using photocells."

The problem is that most of the photons, most of the energy coming out of the thermal core, cannot be converted by the currently available photocells. With the addition of an infrared filter between the heat source and the photocell that recycles the energy that would otherwise be lost, the efficiency of the system rises to somewhere between 20 and 30 percent. The filter is an array of cross-shaped openings in a thin gold film supported by a transparent substrate of glass. The result is an energy conversion system that rivals others, with the added value of enhanced reliability and low noise levels.

"Our system is approaching the point of the efficiency of other technologies," Ruchhoeft says, "like using an internal combustion engine to drive a generator. It's approaching the energy efficiency of fuel cells as well."

Ruchhoeft and his collaborators—electrical and computer engineering professors Ji Chen and Jack Wolfe—have been partnering with EDTEK Inc. under a grant from NASA to create a system that will work on deep-space missions that will last 10 to 20 years. The TPV system is particularly attractive because of its high reliability. It has no moving parts and is therefore less likely to malfunction than other energy conversion systems. Past versions of the TPV system have been cost-prohibitive because creating tiny openings in the filter to allow IR photons to pass through has been a very slow and expensive process—until now.

"Our main accomplishment to this point has been to develop the ability to make IR filters easily and at low cost," Ruchhoeft says. "The plus-shaped pattern of the filter is the key. That pattern is what enables the system to work because it allows the bands that can be converted by the photocell to pass through while blocking the others and sending them back to the thermal radiator to keep the source hot."

While the initial results are extremely positive, the long-term future is also glowing with promise.

Electrical engineering graduate student Sri Charan Vemula and doctoral candidate Ariel Ruiz (2001 BSEE, 2004 MSEE) work with professor Paul Ruchhoeft (center) during an experiment in the Nanostructures Laboratory.

"What we're hoping is that our research leads us to a simple and reliable power source that initially serves the need of NASA for their deep-space missions and later serves the needs of more common applications, where you need a portable quiet and reliable power source," Ruchhoeft says.

The aperture array lithography is also the underlying technology behind Ruchhoeft's efforts to create a better water filter than those commercially available.

"It all started with IR filters, but water filtration membranes became another application for which our technology seemed well suited," Ruchhoeft says. "Now we're trying to create water filters with uniform, high-density pores."

The current, commercially available nuclear pore filters are created by irradiating a polymer with very high-energy particles, a process that damages a track in the polymer that can be etched to fabricate very fine pores. However, this process does not allow engineers to control where the ions land. The result is a random pattern, and a significant probability that some of the pores will overlap, creating larger pores that could potentially allow the targeted pathogen to slip by.

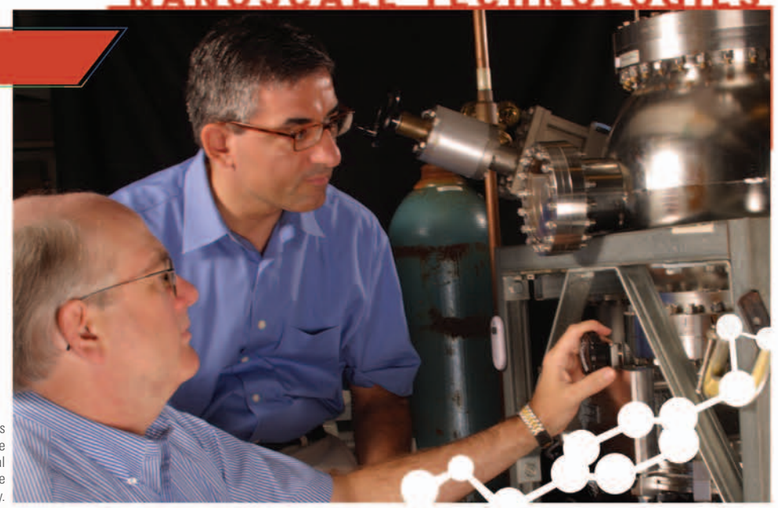
"We saw this as an opportunity to apply our manufacturing technique, where size and position are well controlled," says Ruchhoeft, who has been working with professor Shankar Chellam, associate professor of civil and environmental engineering and chemical engineering, to test the performance of the filters. "Some of the applications of this technology may lie in pharmaceutical, bio-detection or DNA sequencing separations. Anytime you need to separate particles of one size from another, these filters become very useful."

The first stage of the research, which was funded by a grant from the State of Texas, was to show that the filters could be manufactured and that the improvement in flow rates was realized. "We are currently producing filters with 100 nm pores, and we would like to go to 50 nm very soon. The challenge is maintaining high throughput as the pore size decreases, so that large-area filters can be fabricated economically. Our emphasis is on making very small things at a very high speed."

How small are these tiny openings? "The arms of the IR filter pattern are 100 nm wide, and about 450 nm long. At the corners of the plus sign, we have to maintain a radius of less than 25 nm. So even though the structure is at the upper bounds of what you would call the realm of nanotechnology, which is around 100 nm, the fidelity of the pattern needs to be at the lower end of the nanoscale spectrum." ■

SHRINKING WORLD OF INTEGRATED CIRCUITS

PROMPTS UH ENGINEERS TO DEVELOP NANOSCALE TECHNOLOGIES



Chemical engineering professors Vincent Donnelly and Demetre Economou work with a neutral beam etching apparatus in the Plasma Processing Laboratory.

As the dimensions of today's microelectronic devices continue to shrink, the industry has begun to bump up against some big new problems that could compromise the continuation of miniaturization. Two University of Houston chemical engineers are working on ways to solve some of the most vexing difficulties with new technologies that operate in the realm of the nanoscale, but show big-time promise for future generations of integrated circuit (IC) manufacturing.

DEMETRE ECONOMOU and VINCENT DONNELLY are collaborating on projects that will capitalize on the properties of particles, either fast neutrals and ions, to deliver previously unattainable precision in etching of large-area silicon wafers, as well as the deposition and assembly of particles at the nanoscale.

One problem that looms larger for the IC industry, especially as the dimensions grow smaller, is the charging damage from ion and electron bombardment of the silicon wafer during the etching process, or what engineers and scientists call "plasma processing." Because the current industry standard uses plasmas to etch patterns into the wafer, the walls of the pattern can become charged and deflect the reactive ions from their downward direction. This causes damage to the sidewall, bowing or notching, and decreases the effectiveness of the intended etching at the target point, which lies at the bottom of a tiny cavern or hole in the wafer.

"If you think of a film undergoing etching," says Economou, Moores Professor of Chemical Engineering, "there is a mask on top and then another layer underneath, and this mask may be charging, and there is also charging of the sidewalls. And what happens is that the ions coming from the plasma hit the sidewall and damage it instead of hitting the bottom."

The ions are drawn to the sidewall because they are positively charged, while the walls are negatively charged. The distance from one sidewall to another is about 90 nm. And the aspect ratio is very high—anywhere from 2-to-1 all the way up to 7-to-1—which means these holes have a very small width and are much deeper than they are wide.

"We want the ion to go vertically and never hit the sidewalls to prevent any notching or bowing," Economou says. "Our solution is to use neutral particles instead of ions because neutrals do not react to any charges on the surface. They're entirely unaffected by the charge, meaning they can come vertically down and not hit the sidewalls."

The main thrust of the project, which is funded for two years by the State of Texas Advanced Technology Program, focuses on the creation of a neutral beam etching process that has superior characteristics to reactive ion etching used in today's commercial industries. "The next step is to characterize this neutral beam," says Donnelly, professor of chemical engineering. "We don't know the energy of the beam and that energy determines the rate of the reaction, the etching rate. Also, the angle of the beam will determine the directionality, which is critical for not etching the sidewalls. So the next step is to thoroughly characterize this beam and see what we get for different operating conditions."

The plasma is the source of the ions, and is generated by supplying power to a pair of electrodes in a vacuum that dissociates and ionizes the gas—in this case, oxygen. As the gas is ionized, a plasma sheath begins to form around the outer boundary. That sheath is a region of high electric fields that accelerates the ions vertically and sends them directionally down onto the wafer, says Economou.

"You could think of it as initially equal amounts of positive ions and electrons," Donnelly says. "The electrons are light and move fast, so they start to escape but then the collective charge of the positive ions prevents the remaining electrons from escaping. So you have a net positively charged region and then all the surrounding surfaces are negative with respect to that positive charge. This holds most of the electrons in, but at the same time it is pushing the ions out."

How do they go from ions to neutrals?

At the bottom of this plasma reactor, there is a metal grid with holes that are much longer than they are wide. UH engineers developed the hypothesis that because there is always some angle of distribution, most of the ions would suffer a grazing angle collision with the walls of the grid and convert into fast neutrals as they exit the grid and bombarded the wafer beneath. The fast neutrals (with about 100 electron volts of energy) can cause etching of a film on the wafer. The entire process happens over a time period of about a minute.

Another project, one involving nano-pantography, has been funded by a four-year, $1 million grant from the National Science Foundation. This project puts a reverse spin on the charging problem. "When you're trying to etch a feature and you don't want to gouge the sidewalls out, you want to get rid of the charge," explains Donnelly. "But if you could actually control the way charged particles move when they go into a feature, then you could use the ability to deflect ions to your advantage, which would enable you to actually machine much smaller features inside a bigger feature."

What the chemical engineering professors hope to have in four years is a controlled way to move the ion beam around, so that within a hole, they would be able to write a nano-pattern that could be turned into some kind of nano-circuit. "We'd like to try to make carbon nanotubes inside these holes in precise locations," Donnelly says. "This would be a way of making nano-size patterns over large areas, wafer size areas. We're focusing on etching silicon or depositing metals, such as nickel, which would then catalyze the growth of the nanotubes."

Paul Ruchhoeft, assistant professor of electrical and computer engineering, is collaborating with Economou and Donnelly on the project. ▪

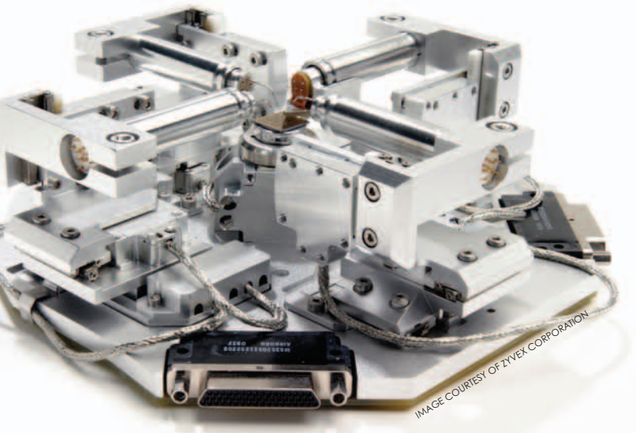


IMAGE COURTESY OF ZYVEX CORPORATION

The Zyvex S100 Nanomanipulator System is a manipulation and testing tool used with a scanning electron microscope (SEM) for micro- and nanoscale research, development and production applications.

UH ALUMNUS JOHN RANDALL *DIRECTS* NANOTECHNOLOGY *AT* ZYVEX

JOHN RANDALL (1975 BSEE, 1977 MSEE, 1981 PhD EE) spent his entire collegiate career at the University of Houston Cullen College of Engineering. Today, Randall makes good use of his extensive education as chief technical officer of Zyvex, one of the leading commercial nanotechnology companies in the world.

Zyvex has charged onto the nanotechnology scene in dramatic fashion, offering products in nanomanipulation, nanomaterials and micro-assembly while integrating its advances in constant pursuit of its ultimate goal: the development of atomically precise manufacturing across all size scales. Their emerging success story has been cited in numerous publications, including *Business Week*. Zyvex will have more than doubled its revenue for each of the past three years.

"What we are trying to do is take advantage of the quantized nature of matter," says Randall, who holds 20 patents and has published more than 100 articles in refereed scientific journals. "This particular approach that we're working on now is to build things one atom at a time by combining two known experimental procedures."

The first step is atomic layer epitaxy, a chemical vapor deposition process designed to grow materials literally one atomic layer at a time. The second involves the use of a scanning tunneling microscope to selectively pattern silicon in atomically precise locations. Ultimately, the goal is to make the process "massively parallel," meaning the patterning takes place simultaneously instead of serially, then to deliver an atomically precise manufacturing process that can operate across all size ranges, from atomic to macro.

"This is going to require a true revolution in the ability to do this atomic precision in a heroically parallel fashion," Randall says. "And there is a number of ways to potentially get there."

Fueled in part by multimillion dollars in grants from the National Institute of Standards and Technology, NASA, the Defense Advanced Research Projects Agency, and the Department of Energy, the company is developing novel technologies that are already enjoying commercial success, including micro-assembly, and nanomaterials and nanomanipulation.

"We realized that if we are successful with the atomically precise manufacturing, we still need to be able to take the parts that were made and assemble them into larger structures," Randall says. "To oversimplify things, what we're trying to do with this program is to do again what was done by Jack Kilby and Robert Noyce. Kilby invented the integrated circuit (IC); Noyce invented the planar processing that allowed people to make things in parallel and provide a downscaling path. We want to do assembly in parallel, and by using MEMS (Micro Electro Mechanical Systems) technology based on IC processing technology we can also provide a downscaling path. It's not as easy to assemble arbitrary things as it is to make CMOS (Complementary Metal Oxide Semiconductor) circuits, but I think that analogy is still there, and I'm excited about the mid-term product. What we are now calling 'atomic precision manufacturing' is what will one day make Zyvex a multibillion-dollar company. But I think we become a billion-dollar company on micro-assembly."

The company's biggest revenue stream is currently being generated in the nanomanipulation area, but the average person will more likely come in contact with Zyvex through its nanomaterials area, where the company is having a significant impact on the way carbon nanotubes are used in composite materials. "Our guys have come up with a way to change the surface chemistry of the nanotubes in a non-damaging way that also exfoliates or breaks up the bundles, makes them soluble in organic solvents," Randall says. "What we've got is the world's best way of improving the ability to process nanotubes and get them into polymer composites."

With three UH degrees to his credit, Randall's connection to the engineering college runs deep. He entered the UH Honors College in 1970 and graduated *cum laude* with a bachelor's degree in electrical engineering. He thought about going elsewhere for graduate school but a chance to work with a new and powerful scanning electron microscope helped sway him to stay at UH.

"Professor A.B. El-Kareh had just gotten one of the last NSF grants where they were just buying people scanning electron microscopes (SEM), which were pretty new in 1974. El-Kareh asked me if I wanted a job in his laboratory, helping run the microscope. So I ran and maintained the SEM for the departments of chemistry, physics, mechanical engineering, electrical engineering, and geology, and we had lots of outside users. It was actually a great education, just running this microscope."

Randall went on to complete his master's and doctoral degrees under the direction of professor Poen Ong, but he also worked closely with professor Jack Wolfe during his Ph.D. studies. Later, when Randall joined Texas Instruments, he ordered a hydrogen beam line, a proton beam line—a $350,000 piece of equipment—and it was essentially completed but not yet delivered when his job at TI changed and he no longer needed the equipment. "I tried to get the equipment to follow me to my new job, but it's a rather large piece of equipment and laboratory space was really tight. I wasn't able to do that and my new lab director said, 'Well, look, just figure out a way to give it to some university.' So I thought, 'Well, I'll bet Jack Wolfe can put this to good use.'"

In the end, TI gave Wolfe a grant in the amount needed to buy the equipment, a strategy that allowed the company to avoid paying sales tax. "And eight percent of $350,000 is not a trivial amount of money. It was a lot of work, but it worked out pleasantly and Jack has made excellent use of the equipment."

After graduating, Randall married a fellow UH engineering alumna, Patrice Stepchinski (1980 BSChE). "I met her while she was a senior and we started dating, got engaged while she was working and I was still in grad school," Randall recalls. "We didn't get married until just after I went to work at Lincoln Laboratory."

Following graduation, Randall accepted a position at Massachusetts Institute of Technology's Lincoln Laboratory in Boston, where he worked for four years on ion beam and x-ray lithography. He then accepted a position at TI in Dallas, where he worked for 15 years in high resolution processing for integrated circuits, MEMS and quantum effect devices. He joined Zyvex in 2001. ▪

UH alumnus John Randall is chief technical officer at Zyvex.

SUCCESSFUL NANOTECHNOLOGY SPIN-OFF COMPANY

Launched by ENGINEERING FACULTY

"You know what happened to the telecom industry over the past few years: AOI survived the down turn, while most of its competitors folded," says STEVEN PEI with a smile. "There is a lesson to be learned from AOI."

Pei, associate dean for research at the UH Cullen College of Engineering, was referring to the UH spin-off company, Applied Optoelectronics, Inc. (AOI), which was founded by former UH research assistant professor Thompson Lin. Prior to joining the UH faculty, Pei had already collaborated with Lin and his advisor when he was still the head of the Materials and Processing Research Department at Bell Laboratories in New Jersey. Lin joined Pei's UH research group at the Space Vacuum Epitaxy Center (SVEC) when they moved to Houston in 1994. Together they pioneered the mid-infrared semiconductor laser technology, which led to the spin-off of AOI, of which Lin is the president and CEO. »

Hong-Wen Ren, MBE manager, works with a molecular beam epitaxy chamber at AOI.

FACULTY PROMOTIONS

Shankar Chellam (CEE, ChE) was promoted to associate professor.

Frank J. "Fritz" Claydon (ECE) was named associate dean for undergraduate programs and computer facilities, where he will be in charge of all undergraduate recruitment and retention programs, college-level advising, summer camps for high school students and teachers, scholarship programs, PROMES and engineering computing facilities. Previously, he was the department chair of ECE for the past five years.

Karolos Grigoriadis (ME) and **Richard Willson** (ChE) were promoted to full professor.

Yi-Lung Mo (CEE) and **Peter Vekilov** (ChE) received tenure.

Haluk Ogmen (ECE) was named interim chair for the Department of Electrical and Computer Engineering. He is also the director of the Center for Neuro-Engineering and Cognitive Science.

Larry Witte (ME) was named associate dean for graduate programs. Previously, he was the associate dean for undergraduate programs.

NEW FACULTY

Tiravat Assavapokee joined IE as an assistant professor. He received a Ph.D. and M.S. in industrial engineering from the Georgia Institute of Technology in 2004 and 2001, respectively.

Omer Bilgin joined CEE as an assistant professor. Previously, he was an Exponent Failure Analysis Associate Engineer in Los Angeles. He received a Ph.D. in civil engineering from Cornell University in 1999, M.S. in civil engineering from Oklahoma State University in 1995 and B.S. in civil engineering from Middle East Technical University in Ankara, Turkey in 1991.

Yuhua Chen joined ECE as an assistant professor. Previously, she was a research associate in the Department of Computer Science and Engineering at Washington University in St. Louis. She received a D.Sc. in electrical engineering, M.S. in computer science and M.S. in electrical engineering from Washington University in St. Louis in 2003, 1998 and 1997, respectively. She also received a B.S. in electrical engineering from Fudan University in 1995.

Valery Kalatsky joined ECE as an assistant professor. Previously, he was a postdoctoral fellow in the Keck Center for Integrative Neuroscience at the University of California, San Francisco and in the Materials Science Division at National Argonne Laboratory. He received a Ph.D. in physics from Texas A&M University in 1999, and M.S. and B.S. in applied physics and mathematics from Moscow Institute of Physics and Technology in 1994 and 1991, respectively.

Kirill Larin joined BioE and ME as an assistant professor. Previously, he was a senior research associate at the Center for Biomedical Engineering at the University of Texas Medical Branch in Galveston. He received a Ph.D. in biomedical engineering and M.S. in physiology and biophysics from UTMB Galveston in 2002 and 2001, respectively. He received his M.S. in laser physics and mathematics and B.S in physics with an emphasis in optics from Saratov State University in Russia in 1995 and 1994, respectively. He received the 1997 Yeltsin Presidential Award for young scientists.

Jinho "Gino" Lim joined IE as an assistant professor. Previously, he was a postdoctoral research associate in the Computer Sciences Department at the University of Wisconsin-Madison, where he received a Ph.D. and M.S. in industrial engineering in 2002 and 1998, respectively. He received his B.S. in industrial engineering from Korea University in 1994.

Bhavin Sheth joined ECE as an assistant professor. Previously, he was a research scientist at the California Institute of Technology. He received a Ph.D. in cognitive neuroscience from the Massachusetts Institute of Technology in 1996. He also received his M.S. in electrical engineering and M.S. and B.S. in computer science from the University of Southern California in 1991 and 1989, respectively.

Veronique Tran joined BioE and ChE as an assistant professor. Previously, she was a postdoctoral associate in the Biomedical Engineering Department at Yale University. She received a Ph.D. in biomedical engineering from the University of Texas Southwestern Medical Center at Dallas in 2002. She worked at Shell Oil Company after earning her B.S. in chemical engineering from UH in 1991.

COLLEGE-WIDE HIRES

David Starnes joined the college as senior director of development. As the chief development officer for the college, he will spearhead major gifts efforts and lead the engineering development team. He has over 17 years experience in higher education and non-profit fundraising. He received a BBA in marketing management from Baylor University in 1980 and is a certified fundraising executive.

Julie Trenor joined the college as an adjunct assistant professor and director of undergraduate recruitment, where she is in charge of recruitment efforts for the college and teaches some of the freshman-level courses. Previously, she was a visiting assistant professor in the Division of Engineering Fundamentals at Virginia Tech, where she taught freshman level general engineering courses and senior level polymeric materials class in materials science and engineering. She was a post-doctoral researcher in the Department of Bioengineering at Clemson University. She received a Ph.D. in materials engineering from Virginia Tech in 2001 and B.S. in materials science engineering from the North Carolina State University in 1996.

Chad Wilson joined the college as director of technical communication instruction. He is a participant in the newly established engineering communications across the curriculum program. He will emphasize technical writing and presentation skills. Previously, he was an assistant professor at Prairie View A&M University. He received a Ph.D. in literature from UH in 2004, M.S. and B.S. in English from Clemson University in 1998 and 1996, respectively.

FACULTY AWARDS

Richard Bannerot (ME) received the Claude Wilson Award for Life Time Achievement as an Engineering Educator from the South Texas Section of the American Society of Mechanical Engineering.

Shankar Chellam (CEE, ChE), **Ji Chen** (ECE), **Stanley Kleis** (ME) and **Kishore Mohanty** (ChE) received the Outstanding Teaching Awards from the college.

Christopher Chung (IE) received the George Magner Award for Excellence in Undergraduate Academic Advising from UH.

Dennis Clifford (CEE) received the Best Paper Award from the American Water Works Association Water Science and Research Division for the paper "Arsenic Removal Using Ion Exchange with Spent Brine Recycling." In late 2003, he was inducted into the Michigan Technological University Distinguished Academy of Chemical Engineering.

Ovidiu Crisan (ECE) received the Outstanding Branch Counselor Award from the Institute of Electrical and Electronic Engineers (IEEE) Region Five.

Charles Dalton (ME) received the Enron Teaching Excellence Award from UH.

Vincent Donnelly (ChE) received the 5th Annual PSTD Prize for Science and Technology from the Plasma Science and Technology's Division of the American Vacuum Society.

Mickey Fleischer (ChE) and **Marvin Karson** (IE) received the Outstanding Lecturer Awards from the college.

Matthew Franchek (ME) received the 2002 Best Paper Award from the *ASME Journal of Dynamic Systems, Measurement and Control.*

Fazle Hussain (ME) was inducted as a fellow of the Bangladesh Academy of Sciences. He also received the IEB Medal from the Institution of Engineers, Bangladesh, which was presented by the country's prime minister. He also received the BSME Gold Medal from the Bangladesh Society of Mechanical Engineers, which was presented by the country's minister of science and information technology.

David Jackson (ECE) received the Best Paper Award from the Institute of Navigation GPS

Stefan Murry (1994 BS Physics, 1998 MS Physics, 1999 PhD EE), director of sales and marketing at AOI, worked with Pei and Lin to develop the manufacturing technique that helped launch the company. In particular, a more precise method of manufacturing the single crystal semiconductor layers used in diode lasers, a method that enables the creation of more complicated structures with far greater precision than the rival methodology used by AOI's primary competitors. The AOI process is called molecular beam epitaxy (MBE), the growth of single crystal materials by depositing layers with atomic precision with a molecular beam. The competing technology relies on a vapor deposition process.

Today, Pei and his colleagues at UH are still building layer structures with the epitaxy process. Epitaxy is perhaps an arcane term to many, but Pei explains the basics of MBE using a simple example with marbles. "Think about atoms as marbles," he says. "You try to build layers of marbles. The layers would not be in perfect order if you just dump different sizes of marbles onto a rough surface. But suppose you lay down a layer of perfect marbles of identical sizes in perfect order, perfectly packed. Then add a few marbles on top and shake them. The shaking provides marbles with a little bit of mobility, then they will fall into the right position to form perfectly ordered layers. It works the same way when growing single crystal layers with atoms. The heated substrate provides atoms the thermal energy and, therefore, the needed mobility. The ultra high vacuum allows a slower deposition rate without allowing the residual gas (i.e., impurities) in the chamber to be absorbed by the layers. Bingo!"

Nanotechnology and MBE are not new to Pei, professor of electrical and computer engineering and physics. Nano-lithography was part of his graduate research work in the 1970s. He also led the AT&T, Hughes and McDonnell-Douglas team to transfer the MBE technology to the AT&T pilot production facility under a Defense Advanced Research Program Agency program in the mid-1980s. "Nano and MBE have been around for quite a while." Pei says, in a matter-of-fact way. "It made major impacts to the optoelectronics and telecommunications industry in the 1970s, when people were able to build single crystal layer structures with semiconductors."

Pei and his research team at UH pioneered the development of mid-infrared semiconductor lasers operating at the 3–5 micron wavelength and achieved the first mid-infrared semiconductor laser operating at near room temperature in 1995. Why do you want to develop devices at mid-infrared wavelengths? "Because if I look at all the biomolecular absorption spectrum, its primary absorption spectrum is between two microns and 20 microns," explains Pei.

Bio-sensors based on absorption spectroscopy, which are needed for health and homeland security applications, require compact laser devices that operate at the mid-infrared wavelengths, but another application may be equally important.

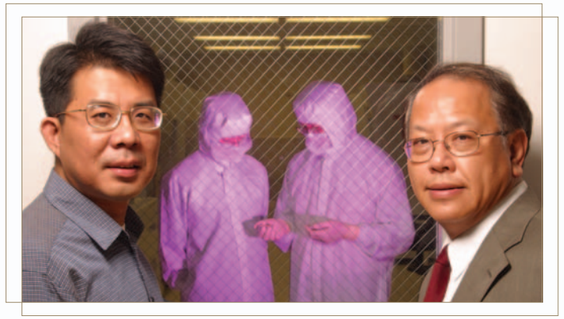
"Water vapor absorbs at 2.7 and 6 microns and very little in between," Pei says. "Why is that important? It means between 3 microns and 5 microns, there is a transmission window that allows you to see through the clouds. You can see through the fog. If I have a heat-seeking missile, that's the wavelength I want to operate at to get the maximum range. Now you need a counter measure to jam my heat-seeking missile, to make it go away." There is a demand for high brightness and compact mid-infrared sources for space exploration, environmental monitoring, trace gas detection, medical diagnostics and biodefense applications. This was how AOI was started in 1997.

AOI raised its first venture capital investment and built its manufacturing facility in Sugar Land, Texas in 2000. The same year it was named the "Sensors and Instrumentation Technology of the Year" by *NASA Tech Briefs* magazine. The company has more than 225 customers in 22 countries and employs more than 125 people, including more than 20 UH alumni, primarily from Pei's research group.

The core of the business is now in cable TV lasers, and its success lies in the company's ability to respond to its customers' needs quickly and accurately, says Murry. "We have great researchers here, a better product, and we know what our customers want. Our sales staff all hold degrees in engineering, so we've been able to capitalize on communication between the sales staff, who have direct knowledge of the customers' needs, and the researchers, who respond by developing solutions targeted especially for our customers. It's a very efficient system, and it gives us a huge advantage."

When Murry was working towards his Ph.D. degree in engineering, he participated in the "Cross Campus Partnership to Create, Protect and Commercialize Intellectual Properties Program," funded by Shell Foundation. He and other science and engineering graduate students worked with their counterparts from the UH Bauer College of Business and UH Law Center to conduct market studies and to develop business plans for technologies developed by researchers at SVEC. The students were under the supervision of Pei and professors Alex Ignatiev of physics, Paul Janicke of law and Bob Hill of business. This is where Murry picked up some of his business skills. When he got his Ph.D. degree in 1999, he was hired immediately by AOI to lead the sales and marketing efforts.

"Research universities in the U.S. are facing new expectations beyond their original mission of creation and dissimilation of knowledge," says Pei. "We are under pressure to assume more responsibility as the engine of economic development. To be successful in the global economy today, we have to maintain and improve our creativity and innovation competitiveness. Furthermore, we also need to train more 'business savvy engineers' like Stefan Murry." ■



Thompson Lin, president and CEO of AOI, and Steven Pei, associate dean for research at the UH Cullen College of Engineering, are outside the MBE clean room at AOI in Sugar Land.

Faculty & Staff Notes

Conference. Co-authors of the conference paper were Lori Basilio and Jeffery T. Williams. He also received the W. T. Kittenger Teaching Excellence Award, the most prestigious teaching award given by the college.

Anne Jaap Jacobson (ECE) was named associate committee chair of the 2005 Society for Philosophy and Psychology Conference. She has been appointed to a three-year term on the American Philosophical Association's Committee on the Status and Future of the Profession, and gave a keynote address at the Feminist Epistemologies, Methodologies, Metaphysics and Science Studies Conference at the University of Washington.

Stanley Kleis (ME) received one of NASA's highest honors, the Public Service Medal, at the NASA Honor Awards Ceremony at the Johnson Space Center in August. The award recognizes exceptional contributions to the mission of NASA by those who are not government employees.

John Lienhard (ME) published his latest book that celebrates the inventive energy that made early 20th-century America modern. Just as "Inventing Modern: Growing up with X-Rays, Skyscrapers, and Tailfins" hit the newsstands, he was named September Author of the Month with a reception, discussion and book signing at the Barnes & Noble Bookstore in Town and Country Village.

Stuart Long (ECE) was named director-elect in a worldwide election to the board of directors of IEEE representing Division IV, the Electromagnetics and Radiation technical area.

Dan Luss (ChE) received the 2003 Best Paper Award entitled "Pollutant Destruction in a Reverse Flow Chromatographic Reactor" from the South Texas Section of the American Institute of Chemical Engineers.

Y. L. Mo (CEE) was named fellow of the American Concrete Institute.

Kishore Mohanty (ChE) was named *Chemical Weekly's* Padmashri Dr. G. P. Kane Chemcon Distinguished Speaker Award from the Indian Institute of Chemical Engineers. He was also selected as the 2004 recipient of the Sigma Xi Faculty Research Award from the Houston chapter of the organization and the Senior Faculty Research Award from the college.

Haluk Ogmen (ECE) was named fellow of the Hanse-Wissenschaftskolleg (Hanse Institute for Advanced Study), Germany.

Benjamin Ostrofsky (IE) received the Eccles Medal from the Society of Logistics Engineers.

Paul Ruchhoeft (ECE) received the Junior Faculty Research Award from the college.

Kamel Salama (ME) and his team at the Texas Center for Superconductivity and Advanced Materials (TcSAM) had their work featured on the cover of the journal "Superconductor Science and Technology" in February and April 2004.

David Shattuck (ECE) received the Outstanding Engineering Educator Award from IEEE Region Five.

Leang-San Shieh (ECE) received the Fluor-Daniel Faculty Excellence Award from the college.

Veronique Tran (BioE, ChE) received The Whitaker Foundation Teaching Materials Award in support of the textbook she is co-authoring with W. Mark Saltzman at Yale University. The introductory biomedical engineering textbook, "Biomedical Engineering: Bridging Medicine and Technology," will be published by Cambridge University Press in 2005.

Richard Willson (ChE) and **Jason Murphy** (2002 PhD ChE) were awarded a U.S. patent for a new process for the separation and assay of biochemical cultures by compaction agents. The U.S. Patent 6,605,470 is expected to have a substantial impact on the production of DNA and other nucleic acids, a multi-million dollar enterprise.

STAFF AWARDS

Brian Allen, **Jeff Shaw**, **Angie Shortt** and **Harriet Yim**, in Engineering Communications, received 14 recognition awards for college publications, website, photography and other materials. The Public Relations Society of America (PRSA/Houston) presented the two Excalibur Awards to the college for the High School Initiative program. The International Association of Business Communicators (IABC/Houston) also presented a Bronze Quill Award to the college for the High School Initiative program. From the Council for Advancement and Support of Education (CASE) District IV, the college won three Gold/Grand Awards of Excellence for the college's logo design, PROMES brochure and High School Initiative program. A Special Award was also received for *Engineering the Environment* as a scientific writing collection. The University Photographers' Association of America (UPAA) presented three awards to the college for research photos and portraits. UPAA also awarded the college a third place award in its Monthly Image Competition in May for a graduation illustration and three awards in their March competition.

Sharon Gates, ChE advising assistant, received the UH Staff Excellence Award.

Mary Schulz, college academic advisor, was elected as an academic affairs representative to UH Staff Council.

Cullen College of Engineering faculty and staff were awarded with the "Most Dollars Raised" award for participation in the State Employee Charitable Campaign (SECC).

STUDENT AWARDS

Mansour AbdulBaki (ChE) and **Adrian Morales** (ChE), the first UH students to ever enter the AIChE ChemE Car Competition, captured a second-place finish.

Dorota Bernatek (EE) and **Eduardo Herrera** (ME) were named Outstanding Junior and Senior in the UH Cullen College of Engineering. Both students were recognized Feb. 25 at the Engineers Week Student Luncheon.

Sandra Geffert (ME) took home multiple wins for the third consecutive year in the 2004 World Karate Championships in Limerick, Ireland. She competed in seven events and captured five medals, including silver medals in soft kata and musical kata, and bronze medals in team kata, team fighting and musical weapons.

Chidiogo Madubike (ECE) received the UH Graduate Teaching Assistant Award.

Cindy Mitchell (ChE) won second prize for her poster presentation entitled, "Single Walled Carbon Nanotube Based Polyester Nanocomposites," at the 2004 Texas Institute for Intelligent Bio-Nano Materials and Structures for Aerospace Systems (TIIMS) Annual Review Meeting. The co-author of the poster was Ramanan Krishnamoorti.

Okechukwu Ofili (ME) was crowned Homecoming King. Last year, **Xavier Cano** (IE) received the same honor and **Morolake Kuyeti** (IE) was on Homecoming Court.

Keith Stephens (ME) performed with the Cougar Marching Band during the half-time performance at the Super Bowl at Reliant Stadium.

The **UH student branch of IEEE** received top billing at the recent IEEE Region Five Conference, garnering seven awards, including Best Large Student Branch. In the robotics contest, 28 teams competed in a qualifying round and three heats. Only six teams advanced, and all three UH teams earned a place in the finals. George Abinader, German Colin, Nathan Howard, and Eduardo Villareal captured second-place, the highest showing among UH students. Finishing in fourth place were Cherrylyn Aranas, Michel Ho, Pavlos Georgas and Tommy Dufour. Sixth place was claimed by Blanca Padilla, Hung Huynh, Steve Kenessey and Ben Magwe. Nnamdi Bnabuihe rounded out the winner's circle with the Outstanding Student Award.

KEY:

BioE	*Biomedical Engineering*	***ECE***	*Electrical & Computer Engineering*
ChE	*Chemical Engineering*	***IE***	*Industrial Engineering*
CEE	*Civil & Environmental Engineering*	***ME***	*Mechanical Engineering*

ALUMNI PROFILE

UH Alumnus Enjoys Many Roles:

As PHYSICIAN, RESEARCHER and ENGINEERING PROFESSOR

PHOTO BY JEFF SHAW

BY BRIAN ALLEN

He had no intention of practicing medicine. Back in 1970, when AKHIL BIDANI (1975 PhD ChE) arrived at the University of Houston from India, he was focused solely on research.

"It was never a fantasy of mine to be a physician," Bidani says from his office near the center of the Texas Medical Center. "Mine was a different calling. Science and research were what drew me."

Today Bidani, a native of India, says caring for patients has been the most deeply rewarding experience of his professional life. The UH alumnus is director of pulmonary and critical care at the University of Texas Medical School at Houston, where he also operates labs and conducts nationally funded research into lung cell research and the detailed biophysics of the breathing process.

The UH Cullen College of Engineering is delighted to welcome back Bidani, who is playing a valuable role assisting the college in successfully deploying a new undergraduate program in bioengineering. Last year Bidani accepted an appointment to the UH faculty as an adjunct professor of chemical engineering, and he now lectures students in the new program. He also shares a doctoral fellow with Vemuri Balakotaiah (1982 PhD ChE), Moores Professor of Chemical Engineering.

"It's like coming back home when I give a seminar at UH," Bidani says. "This is where my journey started, and now my journey is ending up back in engineering. I like that part a lot. It's very fulfilling for me to come back here and work with people at UH."

A Long and Fruitful Journey

When Bidani arrived at UH more than 30 years ago, he was in the first leg of a journey that has taken him from the intellectual high country of mathematical modeling to the emotionally charged arena of caring for some of the most severely ill patients imaginable. Along the way, he has made his mark as a scientist and engineer, as well as a practicing physician. He has directed millions of dollars worth of nationally funded research, published more than 200 papers and received numerous honors, including being elected as a fellow of the American Society of Clinical Investigation in 1991 and the American College of Chest Physicians in 1989. He also claimed first place in the Department of Internal Medicine Faculty-Alumni Society Teaching Award in 2000.

But it all began at the University of Houston.

"I came here in January of 1970," Bidani recalls. "I applied to lots of places, and I had choices to go to several places but I chose Houston largely because the chemical engineering department was very well known, and also because I had a support system. My brother was here, and just to have someone you know is very important."

Once he arrived, Bidani realized that UH provided him with a remarkable opportunity to learn new things and meet with people from all over the world.

"It has a very international flavor. That is one of the gifts of UH. I enjoyed meeting people from France, Russia, China, Yugoslavia, all over the world."

In 1975, a young doctor of chemical engineering packed his car headed for Philadelphia to learn how to do biological experiments at the University of Pennsylvania. Bidani had just completed his doctorate at UH, where he discovered his passion for applying mathematics to biological systems. But he might never have made that journey were it not for the influences of his mentor, Raymond W. Flumerfelt, professor of chemical engineering.

"Dr. Ray Flumerfelt was my mentor," Bidani recalls. "I had come across this paper and I said, you know, I want to work on this and he said he was not pursuing it at this moment but that if I wanted to do it he would be supportive. I don't

PHOTO BY JOHN GLOWCZWSKI / UTMB

Quality is not just a performance goal for the physicians and nurses who staff intensive care units like this one at the University of Texas Medical Branch in Galveston. In 2000, Akhil Bidani (far right) led the ICU team at UTMB, which was named one of the Top 100 Hospitals for intensive care in an independent study of survival rates of ICU patients.

think I could have completed the journey without that kind of support."

Of Math and Men

Flumerfelt remembers when Bidani came to him about the papers he had written with Ed Crandall when he was a graduate student at Notre Dame. "Crandall and I were good friends," recalls Flumerfelt, "and we decided we wanted to branch out into a new field, so we picked biomedical engineering. We looked around and we really liked studying the respiratory system—how the gas enters the lungs, but also how the gas gets transported all the way into the cells in the body. And that's what Bidani saw, some early papers on that."

That was a turning point for Bidani, who seized the topic with exceptional dedication, as Flumerfelt recalls. "You see all these books here?" Flumerfelt says as he points to a row of volumes along the top shelf of a bookcase in his office. "These are all my students' theses. Whose is the biggest one? Bidani's, because Akhil was thorough. His thesis was on Respiratory System Dynamics, and he not only dealt with the lungs, he dealt with the internal exchange of the gas from the blood to the tissue. When he finished, we had the most complete respiratory simulator algorithm that existed at that time."

When Bidani completed his Ph.D. exam, the committee members were very impressed with his work, says Flumerfelt. "But they were a little bit unhappy with me because I didn't have him squeeze his thesis down to a size that they were used to reading. But they saw that he really did a great piece of work."

After completing his doctoral work at UH, Bidani went to Philadelphia to do a two-year postdoctoral fellowship at the University of Pennsylvania. He wanted to learn how to do biological and physiological experiments, and for two years he lived by himself while his family stayed behind in Houston.

Exploring Nature's Grand Design

"It was a new world, a world of learning how to do biology experiments, and how to generate data," says Bidani. "Mathematical models are good, but biological systems are already engineered. In fact they're masterpieces of engineering. That's why we use reverse engineering—to figure out how those systems are designed."

Did Bidani's engineering education come into play as he studied biology and physiology? "Yes," Bidani says. "The whole systems analysis approach was very helpful. There's a lot of methodology in chemical engineering, and ultimately the body is chemistry and physics, bonds between proteins and chemicals that follow the laws of physics. Sometimes the laws seem elusive, seem very mysterious. But even at the molecular level, they all follow physics."

Bidani's postdoctoral work was quite successful. He published eight papers during those two years at Penn, and made several presentations nationally. Bidani admits he was making a bit of a splash: "In that field at that time, because the work was kind of basic and controversial and exciting. I was challenging some concepts, such as the old concept about how oxygen gets into the lungs and how carbon dioxide leaves the blood when we breathe. I questioned how the whole process occurred. How fast was it, did it get finished while the blood was in the lungs? Or was there an inefficiency in the system?"

But when he went to these meetings in biology, he still felt like an outsider. "I was an engineer saying things about complex matters. I was not a biologist. I was viewed as an outsider, and that takes away some of your credibility. I applied to Ph.D. programs in physiology but was turned down because I was viewed as over-qualified. So my mentor Ed Crandall suggested that I go to medical school to learn biology. And that's what I did."

Becoming a Practicing Physician

Bidani attended medical school at the University of Texas Medical Branch at Galveston (UTMB), and says the experience was different from any of his previous scholastic endeavors. It required enormous powers of retention of new knowledge, information and complex terminology. His wife, Sudha, was already a doctor working as an anesthesiologist at the Texas Medical Center, and her support was vital to his success. "There's no way that I could have done it without her," he says.

Bidani's mentor and advisor at Galveston was John Remmers, who was chief of pulmonary medicine at UTMB, and it was he who convinced Bidani to explore the clinical side of the profession more deeply.

"My advisor said to me, 'you're a sensitive man. Why don't you learn how to take care of patients? It'll help give you more options in life,'" Bidani recalls. "So I did my training in medicine at Galveston, and those were the most difficult but the most satisfying years of my life. I found some deeper satisfaction in taking care of patients."

Even as a resident, Bidani published numerous papers. After his residency, Bidani and Crandall worked together for one year at the University of California at Los Angeles before going separate ways again, Crandall to Cornell and Bidani back to Galveston to be chief of pulmonary medicine. He served in that capacity for 16 years, living in Houston and commuting to Galveston every day. After a few years, Bidani wanted to get back into bioengineering, so he started working with John Clark, professor of electrical and computer engineering at Rice University, on mathematical models of complex physiological systems.

"UH has a whole engineering school with superb people, and we want to make this medical center accessible to engineers who want to do biological research," Bidani says.

"Along the way I started to apply my engineering skills to cells," Bidani says, in describing his more recent research in that area. "It involved a lot of cellular biology and cellular physics. We're trying to understand how cells maintain their own environment. How do they live? How are they able to cope with all the changes around them? How do they regulate their internal environment? How do these cells regulate their pH, their calcium, their volume and their membrane potential?"

A Return to Engineering

Now Bidani has returned home to the UH Cullen College of Engineering to help bridge the gap between engineering and medicine. "It's very important for engineers to have access to biological questions, biological data," Bidani says. "UH has a whole engineering school with superb people, and we want to make this medical center accessible to engineers who want to do biological research."

Bringing two sometimes very different worlds together is something Bidani has plenty of experience with. "When you try to live in two worlds, you some times end up wondering whether you're good enough for either. I try to do research, I'm a clinician and I managed divisions at two institutions (UTMB and the University of Texas Health Science Center at Houston). That's my life: There are always prices to pay… I feel privileged and fortunate that I am able to participate in totally different worlds—in science, in engineering and in medicine, each with their unique complexities and demands."

Flumerfelt, now dean of the college, feels the UH Cullen College of Engineering is fortunate to have Bidani as one of its graduates: "He's certainly making a mark, and we're extremely proud of him." ■

PHOTO BY JEFF SHAW

Dr. Akhil Bidani (center) with postdoctoral fellows Saikat Chakraborty (2003 PhD ChE) and D. Sundarsingh Daniel.

::::: 1940's :::::

OMER POORMAN (1949 BSCE) celebrated his 80th birthday on Feb. 21. He retired in 1986 after 38 years with the Texas Department of Transportation. One of his last projects was to begin construction on the Fred Hartman Bridge in Houston. His son, Wayne, writes that his father has been proud of his degree, and has helped many UH engineering graduates start their careers.

::::: 1970's :::::

LAMBERT AUSTIN (1970 BSME) was recently named chief engineer for Boeing NASA Systems. He joined the Boeing Program Integration Office in March 2004 after retiring from NASA with 37 years of service. At the January 2004 retirement ceremony recognizing his Space Shuttle Program career accomplishments, he was presented with the NASA Distinguished Service Medal.

FRANK J. LOCH (1970 MSEE) was recently named to the Technical Advisory Board for Orion Security Services, Inc. He has over 30 years experience in the Aerospace industry, in both Systems Engineering and Systems Development programs. He was on the NASA Apollo mission team where he earned a patent for developing a communications systems enhancement technique. Loch also worked as a manager of a Systems Analysis Staff in a large government Intelligence Community program office. In 1985, he left government service to join Stanford Telecom where he built and managed a $30 million Systems Engineering/Systems Development business. In 2000, he joined Booz-Allen Hamilton as a senior associate. Loch also has degrees from Kings College and Penn State University, and is an alumnus of the Harvard University Kennedy School of Government Senior Executive Fellowship program.

IMRAN (RON) TOUFEEQ (1976 BSME, 1978 MME, 1980 MBA) has been named the vice president of Engineering and Technical Services for Pride International Inc., one of the world's largest drilling contractors. He will manage the completion of Pride's three remaining deepwater platform rig construction projects currently being built on behalf of two major oil company customers. Previously, he worked 20 years for R&B Falcon, ultimately serving as senior vice president of operations. Most recently, he served in an advisory capacity to other companies in the drilling industry.

::::: 1980's :::::

RANDY FOUTCH (1983 MSPE) serves as chairman, president and chief executive officer of Latigo Energy. The Tulsa oilman led the formation, development and sale of two successful oil and gas exploration companies. His third company, Latigo Petroleum Inc., is his biggest venture. Backed by $300 million from Warburg Pincus LLC and J.P. Morgan, Foutch established Latigo in late 2002. In 1997, he founded Lariat Petroleum Inc., and then sold the company to Newfield Exploration. Foutch built Lariat by capitalizing on the oil crisis of 1998–1999, buying up properties at bargain-basement prices. In addition, he took advantage of 3D seismic technology to pinpoint untapped reserves. Colt Resources Inc., which he co-founded in 1991 with little or no investment, sold for $33.5 million in 1996 with a working interest in more than 300 wells. In 1991, Foutch lost his job as vice president of exploration for Tulsa-based Dyco Petroleum Corp. after the company was sold. That's when he and two other oilmen founded Colt Resources. His drive to find oil and gas is just as strong as his commitment to preserve the environment. He served 10 years on the Oklahoma Energy Resources Board, a state agency that uses industry dollars to clean up abandoned oil well sites and educate the public about the industry. Foutch is credited with establishing OERB's energy education programs, which are used in classrooms statewide. About 3,000 Oklahoma teachers have been trained to use the curriculums offered by the organization.

GARY W. GREGORY (1983 BSCE) has been named president of Atmos Energy Corporation's Texas Division in Lubbock. Since 2000, he was vice president of technical services, of Atmos Energy's Colorado-Kansas Division in Denver. He joined Atmos Energy as an engineering manager for Energas Company in 1995, the predecessor to the company's Texas Division. Previously, he worked in various engineering and operations positions at Entex in Houston. He currently serves as chairman of Atmos Energy's Utility Operations Council, which coordinates company-wide operational matters. Atmos Energy Corporation is one of the country's largest natural gas utilities.

GEORGE A. SALAZAR (1983 BSEE) graduated in May with a master's degree in systems engineering from Southern Methodist University. Since 1983, he has been employed at NASA Johnson Space Center in Houston in the Avionics Systems Division developing flight computer systems for the Space Shuttle and Space Station. He is a registered professional engineer in Texas. He and his wife, Lydia, have two children, Patricia and Victoria. George can be reached at gsalazar@ems.jsc.nasa.gov.

DJ BELARBI (1986 MSCE, 1991 PhD CE) was selected as the winner of the 2004

ALUMNI NEWS BRIEFS

Homecoming 2004

Over 100 engineering alumni, faculty and friends gathered early on Nov. 6 for a Homecoming Brunch honoring alumni from the Classes of 1954 and 1979. The Engineering Alumni Hall of Distinction, which showcases portraits of all Distinguished Engineering Alumni Award recipients, was also rededicated at the event.

Following the brunch, engineering alumni, faculty, students and friends came out to the Engineering Alumni Association's annual Homecoming tailgate party under the newly constructed pavilion in Tailgate Alley on the west side of Robertson Stadium to eat barbecue and reunite with old classmates. The highlight of the afternoon was the raffle of dozens of UH items and kids jumping in the moonwalk.

For its active involvement, EAA received the Houston Alumni Organization's 2004 Red Banner Year Award. This was the sixth year that EAA has won this prestigious award.

PHOTOS BY JEFF SHAW

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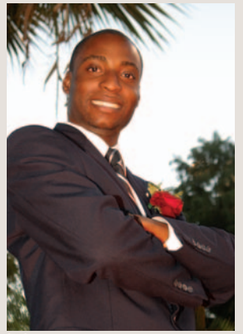
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[1] EAA received the Houston Alumni Organization's 2004 Red Banner Year Award for the sixth year in a row. Pictured are EAA board members Bob Woodward (1997 BSIE), Cynthia Coleman (1971 BSChE), Pam Maniscalco (1991 BSEE, 2001 MEE), Justin DeClue (1999 BSIE, 2003 MSME) and Israel Castellanos (2002 BSCE).

[2] Jim Greer (1954 BSCE) and Raymond Watkins (1954 BSPE) from the Class of 1954 were recognized at the Engineering Homecoming Brunch in celebration of their 50th anniversary.

[3] Graduates from the Class of 1979 were also recognized at the Engineering Homecoming Brunch in recognition of their 25th anniversary. Pictured are (front row) Professor Fazle Hussain, Monica Chauviere (1979 BSME), Professor Charlie Dalton (1960 BSME, 1962 MSME), Ray Scheliga (1979 BSME) and daughter Ann, (back row) Martin Sowell (1979 BSCE), Tony Catalano (1979 MSChE), Tom Fagan (1979 BSEE), Pankaj Desai (1976 MSChE, 1979 PhD ChE), Professor Larry Witte, Paul House (1979 BSME), John Coleman (1979 BSME) and Greg Williams (1979 BSME).

[4] Bob Belden (1958 BSME) with wife Joan (left) and Harry Farley (1965 BSME) with wife Carol reunite at the Homecoming tailgate party.

[5] At the Homecoming tailgate, current Engineering Alumni Association President Pam Maniscalco (1991 BSEE, 2001 MEE) was joined by past presidents Tom Sofka (1975 BSCE), Mike Lacy (1985 BSCE) with daughters Brenna and Kaitlyn, Ray Scheliga (1979 BSME) with daughter Ann, and Bill Fendley (1971 BSCE).

[6] Okechukwu Ofili, mechanical engineering senior, was named UH Homecoming King during the half-time festivities of the UH vs. East Carolina football game.

[7] Mike Lacy (1985 BSCE) stands with his daughters Kaitlyn and Brenna and wife Rebecca in front of the newly constructed engineering pavilion.

Chi Epsilon Excellence in Teaching Award for the Central District as well as the prestigious James M. Robbins Excellence in Teaching Award. He received the college's Distinguished Young Alumnus Award in 1999. Belarbi was a student of UH Professor Tom Hsu.

GARRY WARD (1987 MSPE) has been named senior vice president for engineering at Far East Energy Corp. Previously, he served as reservoir manager for 3TEC Energy Corp., and as vice president of engineering and production for Floyd Oil Co., where he was involved in the evaluation of coalbed methane prospects, primarily in the San Juan and Powder River basins. With offices in Beijing and Kunming, China, Far East Energy is focused on exploration and production of coalbed methane through partnerships with ConocoPhillips Co. and China United Coalbed Methane Co.

::::: 1990's :::::

CARLOS ORTIZ-LONGO (1993 MSMatE, 2000 PhD MatE) manages a team of more than 30 people who keep the International Space Station's exercise equipment tuned. The team works closely with the astronauts to ensure equipment operates correctly in space and provides maintenance procedures for keeping equipment running. He is studying Russian, and is fluent in Spanish, a skill he uses in his spare time to provide math tutoring for Spanish-speaking students who have just come to America. Ortiz-Longo moved from Puerto Rico to the U.S. in 1983, when he joined NASA as a cooperative education student. He worked closely with astronauts Owen Garriott and Robert Parker, helping train them for the first Spacelab mission, a science laboratory that was carried aloft numerous times in the Space Shuttle payload bay. He graduated from the University of Puerto Rico in 1984 and joined NASA full-time as part of JSC's engineering directorate. Before joining the Space Station program in 2002, he served as the Space Shuttle Division Chief Engineer for structures, mechanics and materials. In 1996, he was selected as a finalist in the astronaut selection program.

MAJOR PETER J. RAYNA (1997 MIE) was mobilized to active duty from the Army Reserve on May 3. He is currently working in Winchester, Virginia at the Army Corps of Engineers Transatlantic Programs Center, which provides personnel, logistical and project management support to the corps' efforts to rebuild Iraq and Afghanistan. Peter is a licensed professional engineer and can be reached at peter.j.rayna@us.army.mil.

::::: BIRTHS :::::

BOB WOODWARD (1997 BSIE), wife Shari (1990 BBA) and big brother Ryan welcomed home Evan Ann on April 29. She weighed seven pounds, eight ounces and measured 19.5 inches long. Bob is working on his master's degree in civil engineering at UH and can be reached at bswoodward@sbcglobal.net.

PAUL RUCHHOEFT (1998 MSEE, 2000 PhD EE), wife Jenny (Svoboda) (1998 MEd) and big sister Emma welcomed home Liam Henry on March 4. He weighed 10 pounds and four ounces and measured 21 inches long. Paul is an assistant professor in the UH Department of Electrical & Computer Engineering and can be reached at pruchhoeft@uh.edu. Jenny is the educational grants manager for the college and can be reached at jennyr@uh.edu.

::::: DEATHS :::::

TRAVIS LEE KING (1949 BSPE) died Feb. 11 at the age of 81. Travis served in the Marine Corps in the South Pacific during World War II. After the war and then graduating from UH, he worked the next 40 years as a petroleum engineer for Pan American Production Company, Austral Oil Company, Marion Corporation, ENI Exploration Company and PetroCorp. In 1989, he retired as the operations manager for PetroCorp. Travis was a registered professional engineer in Texas. He was preceded in death by his first wife, Jane, and is survived by his second wife, Doris, two children, Connie H. King and Travis L. King, Jr., and a granddaughter, Nancy E. King. His daughter and son are both engineers and his granddaughter is majoring in engineering.

JOE EDWARD COMPTON (1951 BSIE) died April 29 at the age of 80. He served his country with distinction in the 184th AAA Gun Battalion in World War II. In the European Theater of Operations, he was awarded six battle stars, including Normandy and Ardennes-Alsase (the Battle of the Bulge). One of his many vivid memories of World War II was that of seeing the horrors of the Buchenwald Concentration Camp. After the war, he earned a degree from UH. His distinguished career in industry spanned some 40 years, including serving as president of Mundy Service Corporation and vice-president of Riggers and Constructors and REF-CHEM Corporation. He was a registered professional engineer in Texas and a

ALUMNI NEWS BRIEFS

2004 Distinguished Engineering Alumni Awards

PHOTO BY JEFF SHAW

2004 Distinguished Engineering Alumni Awards honorees John W. Rouse, Tanya Dugat Wickliff, William C. Miller Jr., Elizabeth D. Rockwell and Dan Luss.

The Engineering Alumni Association honored William C. Miller Jr. (1955 BSPE) and John W. Rouse (1973 BSCE) as Distinguished Alumni at the 2004 Distinguished Engineering Alumni Awards Dinner on June 4 at the Four Seasons Hotel. Tanya Dugat Wickliff (1989 BSME) received the Distinguished Young Engineering Alumna Award; Elizabeth D. Rockwell received the Roger Eichhorn Leadership Service Award; and chemical engineering professor Dan Luss received the Abraham E. Dukler Distinguished Engineering Faculty Award. Harris County Judge Robert Eckels gave the keynote address. For more information about the honorees or to nominate someone for the 2005 awards, visit www.egr.uh.edu/alumni/?e=awards.

WILLIAM C. MILLER JR. (1955 BSPE)

[Distinguished Engineering Alumnus Award]

William C. Miller Jr. graduated from high school when he was 16 and served three years in the Army in World War II. He returned to Teague briefly to the farm and then made his move to Houston to work for Texaco. He enrolled at UH, inspired by Professor Charles Kirkpatrick, to become a petroleum engineer. In 1955, Miller graduated from UH and returned to Texaco as a petroleum engineer. Five years later, he became chief engineer of Blanco Oil Company and in 1967, he became an independent oil operator and actively remains so today. Miller has been a Shriner since 1956. He is a member of AIME and API and has been recognized as one of the top independent oil producers in the San Antonio South Texas Area. He has been a member and officer of the San Antonio Petroleum Club.

JOHN W. ROUSE (1973 BSCE)

[Distinguished Engineering Alumnus Award]

John W. Rouse graduated from UH and has spent most of his professional life in the oil and gas industry, working more than 28 years with Transocean, the world's largest offshore international drilling contractor. He has worked in numerous engineering and project management positions. Rouse recently retired as vice president of engineering and construction from Transocean. He is now owner of JR Consulting, which provides technical expertise and project management for the oil and gas industry. Rouse is a registered professional engineer, past president of the UH Engineering Alumni Association, past chair of American Petroleum Institute of Working Group and past chair of Det Norske Veritas Mobile Offshore Drilling Unit Committee. He is a Life Member of the Houston Alumni Organization. He received the International Association of Drilling Contractors Special Service Award and the first to receive the Roger Eichhorn Leadership Service Award in 1987 from the UH Cullen College of Engineering.

TANYA DUGAT WICKLIFF (1989 BSME)

[Distinguished Young Engineering Alumna Award]

Tanya Dugat Wickliff graduated from UH, then received her MBA in executive management from the University of Texas in Dallas in 2000, and is a Ph.D. candidate in engineering at Texas A&M University having completed all but her final defense. She is principal owner of Tancoe Resources Unlimited, a consulting firm. Wickliff started with Motorola as project engineer and was quickly promoted to DSP Final Test Production Manager. She has also worked for Conoco and Texas Instruments in management positions. She is founder of "Project Fresh Start" Youth/Young Adult Outreach Program, which has been recognized and adopted by the National Society of Black Engineers for its effectiveness in raising awareness and motivating young students to pursue engineering, technology and the sciences. She has received numerous awards and recognition including *Career Engineer Magazine's* Engineer of the Year Award for Emerging Leaders in 2000 for her career achievement. Wickliff is a published writer and her debut work can be found in national radio and television personality Tavis Smiley's inspirational book, Keeping the Faith.

ELIZABETH DENNIS ROCKWELL

[Roger Eichhorn Leadership Service Award]

Elizabeth Dennis Rockwell, a fourth generation Houstonian, is an expert in retirement, estate, investment and tax planning. Rockwell's business career spanned leadership roles at several Houston corporations, culminating with her position as executive director, Private Client Division of CIBC Oppenheimer Corp., from which she partially retired. Rockwell serves on the Board of Governors Executive Committee for the Houston Forum, advisory council of the Greater Houston Women's Foundation, Houston Educational Excellence Foundation Board, UH Cullen College of Engineering's Leadership Board, finance committee of the Houston Alumni Organization and the UH Foundation Board. Rockwell has remained close with UH since she was a student. She has received an Honorary Doctorate of Humane Letters from UH and the Dean's Circle Award from the Cullen College of Engineering. Most recently, Rockwell has endowed a chair for the deans of the M.D. Anderson Library and the Cullen College of Engineering and has committed to endowing a chair for the dean of the College of Education.

DAN LUSS

[Abraham E. Dukler Distinguished Engineering Faculty Award]

Dan Luss received his bachelor's and a master's degrees from the Technion, Israel, and a Ph.D. from the University of Minnesota. He joined UH in 1967 and served as chair of the Department of Chemical Engineering for more than 20 years (1975–1995 and 1999–2000). Under his leadership, the chemical engineering department was elevated to be one of the Top 10 in the nation, and still maintains a high rank. His professional accomplishments were recognized by his election to the National Academy of Engineering in 1984. He has also received the Colburn Award in 1972 from the American Institute of Chemical Engineers, which also honored him with the Professional Progress Award in 1979 and the Wilhelm Award in 1986. He received the Lectureship Award from the Chemical Engineering Division of the American Society for Engineering Education in 1985, and the Research Award of the Alexander von Humboldt foundation (Germany) in 1996. He was named as a fellow of AIChE in 1990. Dan has published over 250 papers, has delivered hundreds of technical presentations in national and international symposia and was invited more than 100 times to present his work in academic institutions around the globe.

member of several other professional organizations. He was active in the Texas Association of Business and had served as a member of its statewide board of directors and as the Houston chapter president. He served 14 years on the board of directors of the Twelve Oaks Hospital in Houston including four years as chairman. He was a Life Member of the Houston Alumni Organization. In 1996, he was honored with the college's Distinguished Engineering Alumnus Award. He was a Master Mason, and was also a 32nd degree Mason of the Scottish Rite. He was a member of St. Stephen's United Methodist Church. He is survived by his wife of 57 years, Arlyn Pauline Compton, two children, two grandchildren and numerous relatives in the Henderson, Texas area.

WILLIAM H. (BILL) PERKINS (1953 BSIE) died Feb. 13. He was a member of the Sugar Land First United Methodist Church, Sigma Nu Fraternity and the American Association of Appraisers and Realtors. He served in the Army Air Corps during World War II. Survivors include his wife of 50 years, Betty, two daughters and five grandchildren.

LYNN EDWARD ARMSTRONG (1958 BS Math, 1959 BSME) died April 21 at the age of 72. He worked as a professional engineer in the Houston area. He designed and constructed many buildings in the southern part of the U.S. Lynn was influential in air conditioning the Houston area. During his lifetime, he was a founding member of the First Presbyterian Church of Pearland, a Sunday school teacher, served on the Pearland School Board, a charter member of the Hobby Area Exchange Club, and a member of the Exchange Club of Pearland. He is survived by his wife, Mary, seven children, 13 grandchildren and one great grandchild.

LONDON T. "LT" ENGLAND, JR. (1970 BSME) died May 30 at the age of 62. A native Houstonian, he graduated from UH and served in the U.S. Marine Corps where he fought in the Vietnam War. He was the project contracts manager for many years at FMC/Sofec, Inc. He was a registered professional engineer in Texas. He is survived by his wife of 39 years, Doreen, son, father, sister and numerous relatives and friends.

MARK K. SHELLY (1971 BSEE) died April 9 at the age of 71. Through his life, he had many proud accomplishments. Mark earned three degrees; he graduated from the University of Texas, UH and Lamar University. He was also a registered professional engineer in Texas. During his career, he worked for many international engineering corporations and worked on projects throughout the world. His proudest accomplishments were related to his family. During the early years, he thoroughly enjoyed coaching his children and spent many years at ballparks. In his later years, he enjoyed watching his grandchildren play soccer and t-ball. He is survived by his devoted wife of 38 years, Rita Lechinger Shelly, two daughters, a son and four grandchildren.

Key:
AeroE — Aerospace Engineering
BioE — Biomedical Engineering
ChE — Chemical Engineering
CE — Civil Engineering
ComE — Computer Engineering
EE — Electrical Engineering
EnvE — Environmental Engineering
IE — Industrial Engineering
ME — Mechanical Engineering
MatE — Materials Engineering
PE — Petroleum Engineering

CLASS NOTES

Send us your alumni news about new jobs, promotions, honors, moves, marriages, births, etc. Attach additional news clips or photos separately. Please include a self-addressed stamped envelope if you want your photos returned.

All Class Notes should be sent to:
Parameters Magazine, UH Cullen College of Engineering
E316 Engineering Bldg 2, Houston, TX 77204-4009
E-mail parameters@egr.uh.edu or visit www.egr.uh.edu/parameters

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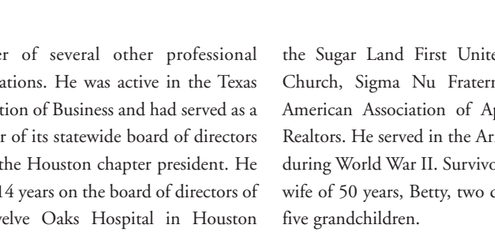
PHOTOS BY JEFF SHAW



UH Engineering Alumnus Is Brewing Up a Bright Future for Houston's Coffee Industry

BY BRIAN ALLEN

Coffee is big business. How big?

More than 500 *billion* cups of coffee are consumed worldwide every year. In fact, coffee is so big that it ranks second — behind oil — as the most heavily traded commodity in the world.

These facts are not lost on UH graduate **Carlos de Aldecoa Bueno** (1997 BSIE), the man who recently led the successful efforts to perk up Houston's economic outlook for coffee trading and processing.

Four years ago, Aldecoa, president and owner of Houston's Cadeco Industries, Inc., recognized the potential for Houston to become a major player in the coffee business. Enlisting the support of the Port of Houston, Aldecoa founded the Greater Houston Coffee Association and, as president, led the initiative to amend the Texas state constitution in order to change the tax laws on coffee inventories and, thus, to obtain certifications that were necessary for Houston to realize its potential as a major coffee port.

"We brought together the Port of Houston, some of the coffee companies we work with here in Houston, plus many of the related service companies. We then formed the Greater Houston Coffee Association," Aldecoa says. "We now have 50-plus members ranging from small roasters to large corporations and organizations like Maxwell House, Sara Lee, the Port of Houston, steamship lines, trucking companies and other warehouses."

Since that time, the association has enjoyed two important victories. One was leading a successful lobbying effort with the state legislature and in a general election to pass a constitutional amendment eliminating an end-of-year inventory tax on green coffee in Harris County, something that had prevented Houston from competing on an even playing field with other port cities that had no such tax.

"We showed how the elimination of that tax would increase the amount of commerce relating to the trade of coffee in Houston and would more than offset any reduction of revenue that they had from that inventory tax," Aldecoa says.

The other important victory was helping Houston receive certification from the New York Board of Trade as a "certified exchange port." Houston is now a certified green coffee port and will officially begin delivery of certified coffee in its warehouses in March 2005.

Born in Cordova, a small "coffee town" in the Veracruz province of Mexico, Aldecoa is now a 31-year-old entrepreneur who relies on his UH engineering education to solve problems.

"Industrial Engineering seemed to have a balance between the business side and the engineering side. The combination of cost accounting, operations research and the wide range of engineering classes taken allowed me to balance the degree as a strong foundation for the day-to-day operations in the business world."

Aldecoa, whose family has been in the coffee business in Mexico and Spain since the early 1920s, applied his business savvy when he chose to buy an Uncle Ben's® rice processing facility and convert it into a coffee warehouse and processing plant. He then applied his technical engineering skills by drawing up the retrofitting himself, without hiring an outside engineering firm.

"We found this facility when Uncle Ben's® had just shut down this plant," Aldecoa recalls. "We made them an offer and said we'll take it 'as is.' They were still removing rice and equipment, and we said 'You guys can just stop what you're doing and here's the offer.' We took rice out of this place for months."

Aldecoa then took out the rice conveying system and replaced it with new, modern systems suited for coffee. He also designed and installed all new electrical control systems, motor control centers and all of the instrumentation. Aldecoa's operation on Clinton Drive is truly a world-class "one-stop shop" for roasters and traders, unique in North America.

"It's a facility where anybody in the coffee world can come and do business," he says. "Whether they want the beans stored, cleaned, blended, steamed, decaffeinated, roasted, packaged, this is a one-stop facility able to offer medium, small and large-sized roasters any service they might need. We process an average of 1.5 million pounds of coffee per day, and have additional capacity to double the volume."

Aldecoa credits his father, Carlos P. de Aldecoa, who owns the largest independent decaffeinating facility in the country, for giving him his start in the coffee business. Two of Aldecoa's four sisters are also UH graduates: Larissa de Aldecoa-Matta (1994 BBA) and Carla de Aldecoa (1995 BS HRM).

GREASE AVENGER CLEANS UP MESSY SEWER SPILLS IN LOS ANGELES AREA

BY BRIAN ALLEN

Imagine yourself walking along the beach in Southern California, sipping a cool glass of water and jangling the abundant loose change in your pocket.

If this were you, you might owe a big thank you to an unlikely superhero: The Grease Avenger!

Who is this blue-clad, caped wonder?

He is UH engineering alumnus ADEL HAGEKHALIL (1986 BSCE, 1988 MSCE), division manager of wastewater engineering for the City of Los Angeles, and his programs are reducing sewer spills at area beaches, conserving water and saving the taxpayers money.

In fact, the beaches are not the only cleaner places in LA. Thanks to the efforts of Hagekhalil and his staff, sewer spills all over the city have been reduced by nearly 50 percent in just two and a half years.

"A lot of restaurants and homes discharge grease without knowing that it has a huge impact on clogging sewer pipes—just like plaque clogs arteries," explains Hagekhalil. "The grease accumulates until the sewage can no longer pass through it, and then it comes out on the street, ends up in the ocean, on the beach or backs up into someone's home. So one of the major causes of spills is grease blockage, and we have more than 14,000 restaurants in the City of Los Angeles."

In 1998, Hagekhalil realized it was not efficient for the city to keep cleaning the same thing over and over again. "I recommended we take on a grease control program for restaurants, that we not only clean the sewers but control the source, which is the discharge of grease."

After three years of navigating the politics involved, Hagekhalil helped the City of Los Angeles adopt an ordinance requiring all restaurants to either install a grease interceptor to capture the grease or to dispose of grease in containers outside. "They can no longer just put grease down the drain," he says. "We also banned all garbage grinders from restaurants because they're the biggest source of grease. And we provide them with kitchen practices, such as how you wash your dishes, to prevent getting grease into sewers."

How did the superhero concept evolve and what role did it play?

"The Grease Avenger idea was developed when I was pushing hard for this program," says Hagekhalil. "It started with a sketch from my staff, actually, where they sketched me in this superhero outfit trying to stop grease. I took a look at it and I said this is a great opportunity. We can use this as our logo or mascot to improve our outreach. If we can get some outreach educational materials in place, I'm willing to put my costume on and go to committee meetings, public events, schools and really get the message out. And I did."

The Avenger was not only popular with residents and children; his work was also recognized professionally when he received the 2003 Water Quality Award from the Los Angeles Regional Water Quality Control Board.

Now the SUPERHERO is working on a new 20-year facilities plan for the whole City of Los Angeles for wastewater.

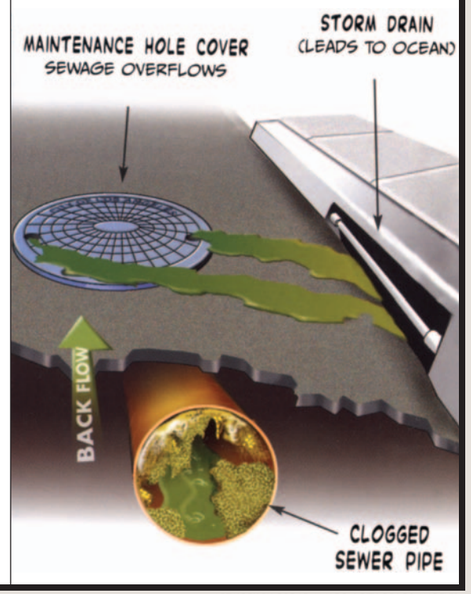
Using a visionary approach that involves the residents from the beginning and features cross benefits for related areas such as urban runoff, water conservation, multifunctional facilities and efficient maintenance schemes.

"We want to involve the public early in the process in developing the options and selecting the options before we go to the environmental review process," Hagekhalil says. "The community is part of this process because what we are doing here is for the community and by the community. When we do planning, when we improve the infrastructure, when we upgrade our sewer system, we are doing it for the community. It's for them. It's not for us. So that's how we approach it."

Hagekhalil, who was born in Lebanon and immigrated to the U.S. in the mid-1980s, says that being an engineer is all about serving the public: "The bottom line is

PHOTO BY JEFF SHAW

how can we make this a better place? And that applies anywhere in the world. If you are here, the thing we need to talk about as engineers, as lawyers, as doctors, as people, is how can we leave this a better place. As engineers, we do a lot of that, and sometimes we don't get recognized for it. Our profession needs to do a better job in letting people know about us. When it comes to protecting the public health and safety, who is on the line? Who is making the difference to allow us to sustain as a community, as a nation, as a world?"



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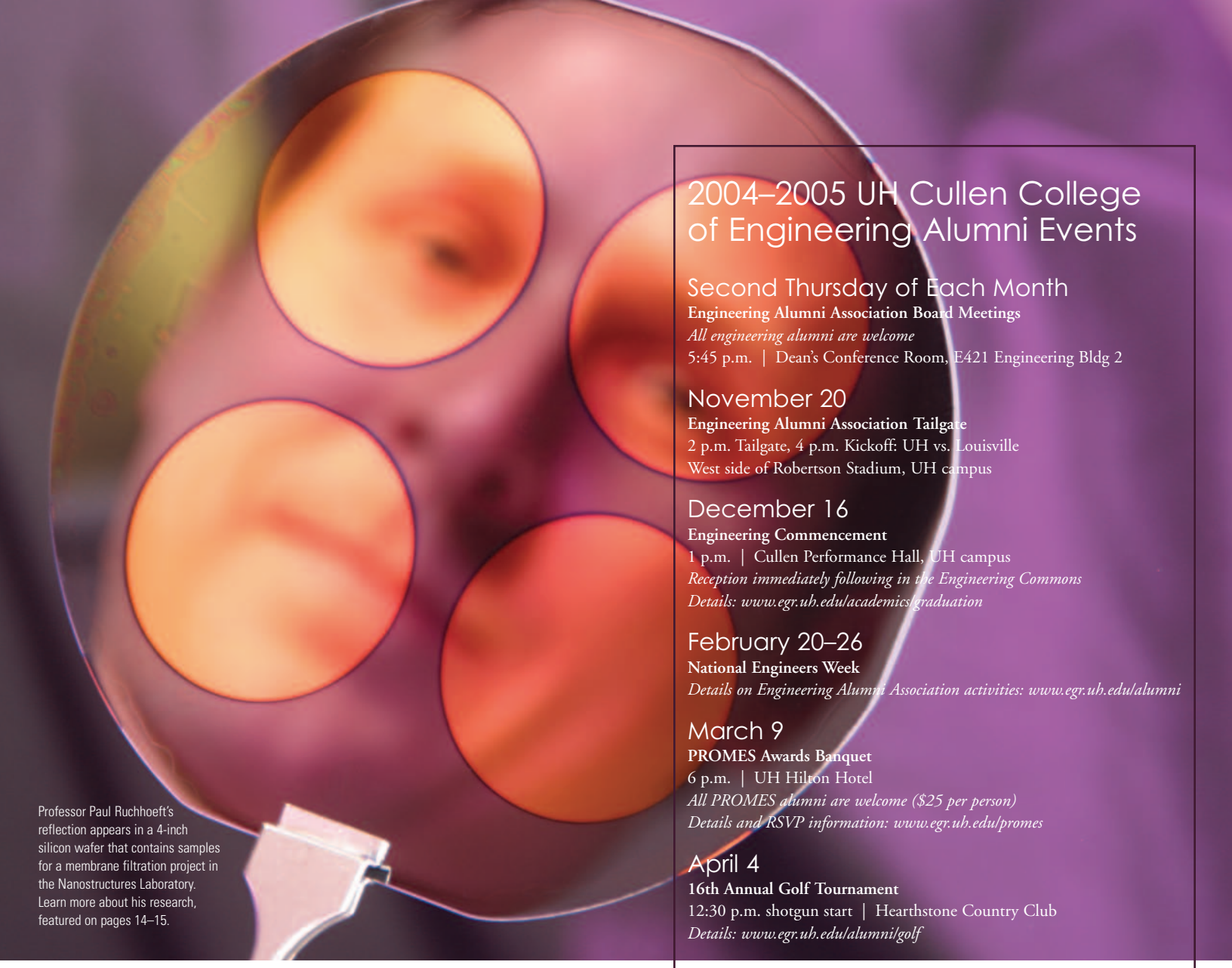

Professor Paul Ruchhoeft's reflection appears in a 4-inch silicon wafer that contains samples for a membrane filtration project in the Nanostructures Laboratory. Learn more about his research, featured on pages 14–15.

2004–2005 UH Cullen College of Engineering Alumni Events

Second Thursday of Each Month

Engineering Alumni Association Board Meetings
All engineering alumni are welcome
5:45 p.m. | Dean's Conference Room, E421 Engineering Bldg 2

November 20

Engineering Alumni Association Tailgate
2 p.m. Tailgate, 4 p.m. Kickoff: UH vs. Louisville
West side of Robertson Stadium, UH campus

December 16

Engineering Commencement
1 p.m. | Cullen Performance Hall, UH campus
Reception immediately following in the Engineering Commons
Details: www.egr.uh.edu/academics/graduation

February 20–26

National Engineers Week
Details on Engineering Alumni Association activities: www.egr.uh.edu/alumni

March 9

PROMES Awards Banquet
6 p.m. | UH Hilton Hotel
All PROMES alumni are welcome ($25 per person)
Details and RSVP information: www.egr.uh.edu/promes

April 4

16th Annual Golf Tournament
12:30 p.m. shotgun start | Hearthstone Country Club
Details: www.egr.uh.edu/alumni/golf

For more information about any of these events, call 713-743-4200, e-mail alumni@egr.uh.edu, or visit www.egr.uh.edu/events.

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