Volume 51 – Number 2
Wednesday – September 20, 2006

TechTalk
SERVING THE MIT COMMUNITY

MIT center to tackle energy crisis

MIT President Susan Hockfield has announced the establishment of the MIT Energy Initiative (MITEI), in line with the recommendations of an Institute-wide group of faculty convened in June 2005 to help MIT understand how best to tackle the world's energy crisis.

Hockfield thanked the members of the Energy Research Council (ERC) for articulating recommendations that will allow MIT, with its unique talents and capabilities, to address what she called "one of the most urgent challenges of our time."

According to Hockfield, in a Sept. 20 letter to the MIT community, MITEI will address "the science, technology, policy, and systems design required to meet the global energy challenge." As a "virtual center," it will progressively build focused research programs, coordinated educational offerings and the necessary campus infrastructure, leading over several years to the establishment of a new interdepartmental laboratory or center that will involve researchers from all five schools.

Hockfield noted that the breakthrough contributions of MIT faculty and students to energy issues will have even greater impact as parts of a coherent answer to the world's energy problems. "When MIT focuses on large issues of great public importance, we are able to get things done," she said.

Commenting that "vision and direction will be critical to the success of this effort," Hockfield announced that MITEI will be led by Ernest J. Moniz, the Cecil and Ida Green Professor of Physics and Engineering Systems and co-director of the Laboratory for Energy and the Environment, and Robert C. Armstrong, the Chevron Professor and head of the Department of Chemical Engineering.

Moniz and Armstrong, who served as co-chairs of the ERC, will be director and associate director, respectively, of MITEI. They will coordinate existing energy activities across the Institute and guide the development of relationships with other institutions, industry and government agencies, Hockfield said.

"Organizationally, the scope and reach across the Institute of the new center envisaged by the ERC are unprecedented, so careful planning and coordination are required at many levels of the MIT administration," according to Vice President for Research and Associate Provost Claude R. Canizares, to whom MITEI will report.

Moniz and Armstrong will play key roles in developing both the agenda and the resources needed to build a major center on campus, said Canizares.

An Energy Council made up of faculty from all five schools will help implement the research and educational goals outlined in the ERC report. Hockfield said its membership would be announced later this semester.

Additionally, two new task forces will focus on education and campus operations. The Energy Education Task Force will work closely with the dean for undergraduate education and academic department chairs to coordinate cross-listed educational offerings, recommend new sub-

See **ENERGY**
Page 6

PHOTO / **DONNA COVENEY**

Hot new technology

MIT researchers working on the next generation of nuclear technology test-fit a prototype fuel capsule using the manipulators of a hot box at MIT's Research Reactor. They are, from left, graduate students Tyler Ellis and David Carpenter; Pavel Hejzlar, principal research scientist; Gordon Kohse, principal research engineer, nuclear reactor lab; and Professor Mujid Kazimi. Story on Page 4.

Hockfield unveils major campus building program

MIT President Susan Hockfield has announced a major campus development program that will invest approximately $750 million dollars in new and renovated facilities on the Institute's 154-acre Cambridge campus.

The initiative includes the construction of three major academic buildings—a new building that will house the Center for Cancer Research and related bioengineering laboratories; a new home for the MIT Sloan School of Management; and a building that will extend the existing Media Laboratory—as well as housing for more than 550 graduate students.

"MIT's new capital projects will allow our faculty and students to do their very best work while continuing to strengthen the life of the Institute community," Hockfield wrote in a Sept. 13 letter to the Institute community.

"Our investments will amplify our work in critical, high-impact areas of education and research—fields that will improve human health, strengthen entrepreneurship and economic growth, and address pressing social needs. Private philanthropy is absolutely essential for ambitious projects such as these; we are profoundly grateful to the many alumni and friends who have already committed their generous support," she said.

The new Center for Cancer Research facility will be located next to the David H. Koch Biology Building and across Main Street from the Eli and Edythe L. Broad Institute. It will house "life scientists and engineers working at the frontiers of cancer research. They will build on recent advances in cancer biology, diagnosis and therapy and help to develop emerging areas at the interface of science and engineering, including nanotechnology and computational and mathematical modeling

See **BUILDING**
Page 3

Materials scientists tame tricky carbon nanotubes

Deborah Halber
News Office Correspondent

Based on a new theory, MIT scientists may be able to manipulate carbon nanotubes—one of the strongest known materials and one of the trickiest to work with—without destroying their extraordinary electrical properties.

The work is reported in the Sept. 15 issue of Physical Review Letters, the journal of the American Physical Society.

Carbon nanotubes—cylindrical carbon molecules 50,000 times thinner than a human hair—have properties that make them potentially useful in nanotechnology, electronics, optics and reinforcing composite materials. With an internal bonding structure rivaling that of another well-known form of carbon, diamonds, carbon nanotubes are extraordinarily strong and can be highly efficient electrical conductors.

The problem is working with them. There is no reliable way to arrange the tubes into a circuit, partly because growing them can result in a randomly oriented mess resembling a bowl of spaghetti.

Researchers have attached to the side walls of the tiny tubes chemical molecules that work as "handles" that allow the tubes to be assembled and manipulated. But these molecular bonds also destroy their conductivity.

Now Young-Su Lee, an MIT graduate student in materials science and engineering, and Nicola Marzari, an associate professor in the same department, have identified a class of chemical molecules that preserve the conductivity.

Using these molecules as handles, Marzari and Lee said, could overcome fabrica-

See **NANOTUBES**
Page 4

RESEARCH

SYSTEMATIC APPROACH
A tool developed at MIT helps take the guesswork out of cost estimating.
Page 2

HELP FOR EPILEPTICS
Researchers are developing a device that would sense oncoming seizures and perhaps prevent them.
Page 4

NEWS

STRATEGIC THINKING
As part of MISTI Week, Professor Richard J. Samuels will discuss the challenges facing East Asia.
Page 3

COMFORT ZONE
President Susan Hockfield dedicates the new student lounge adjacent to Lobby 10.
Page 3

PEOPLE

NO HORSING AROUND
Sloan students do some serious work for Polo Ralph Lauren.
Page 8

MUSICAL FIRSTS
Works by MIT composers Evan Ziporyn and Christopher Adler premiere at Carnegie Hall.
Page 8

Faculty appointed to 17 named professorships

Seventeen faculty members have been appointed to named professorships. All appointments are for three-year terms and became effective July 1 unless otherwise noted.

Assistant Professor Regina Barzilay of electrical engineering and computer science has been selected to hold the Douglas T. Ross Career Development Professorship of Software Technology.

Suzanne Berger, professor of political science, and Dick Yue, associate dean of engineering, have been named to two-year terms as Class of 1960 fellows.

Andrea Campbell, associate professor of political science, has been chosen for the Alfred Henry and Jean Morrison Hayes Career Development Professorship. The professorship was established by Alfred Henry Hayes, who received a degree in chemical engineering from MIT in 1929, and his wife.

Christopher Capozzola, associate professor of history, has been selected as the inaugural holder of the Lister Brothers Career Development Professorship. This professorship was established by two brothers who graduated from MIT—Gordon Lister, Class of 1930, and Donald Lister, Class of 1934.

Jianzhu Chen, professor of biology, has been named to the Ivan R. Cottrell Professorship for a five-year term. The Cottrell Professorship was created in 1991 through a bequest from Ivan R. Cottrell to fund research in immunology.

Kerry Emanuel, professor of meteorology, has been chosen to hold the Breene M. Kerr Professorship for a five-year term. This chair was established through gifts from Breene M. Kerr to honor distinguished professors at MIT.

Dennis Kim, assistant professor of biology, has been selected to hold the Robert A. Swanson Career Development Professorship in the Life Sciences. The chair was established in 1986 by Robert A. Swanson, a 1969 graduate of MIT and the co-founder and chief executive officer of Genentech.

Associate Professor Young Lee of physics has been named to the Mark Hyman Jr. Career Development Professorship. This chair was established in 1998 through a bequest from Mark Hyman Jr., Class of 1939.

Assistant Professor Retsef Levi of the Sloan School of Management has been named to the Robert N. Noyce Career Development Professorship.

Stuart Licht, assistant professor of chemistry, has been selected to hold the Samuel A. Goldblith Career Development Professorship. The chair was established by friends of Samuel A. Goldblith, a longtime MIT professor and administrator.

Assistant Professor David McAdams of the Sloan School of Management has been chosen to hold the Cecil and Ida Green Career Development Professorship. Cecil Green was a member of the Class of 1923 and founder of Texas Instruments.

John Ochsendorf, assistant professor of architecture, has been named to the Class of 1942 Career Development Professorship.

Asuman Ozdaglar, assistant professor of electrical engineering and computer science, has been selected to hold the Class of 1943 Career Development Professorship.

James Paradis, head of the Program in Writing and Humanistic Studies, will be the next Robert M. Metcalfe Professor of Writing. The chair was established in 1986 by Metcalfe, Class of 1968, and a member of the Corporation. It is located in the School of Humanities, Arts and Social Sciences and is intended for faculty members of distinction who have a strong commitment to writing instruction.

Rosalind Williams, director of the Program in Science, Technology and Society, has been named to the Bern Dibner Chair in the History of Science and Technology for a five-year term.

Lizhong Zheng, associate professor of electrical engineering and computer science, has been chosen for the KDD Career Development Professorship in Communications and Technology. This chair was established in 1983 by the Kokusai Denshin Denwa Co. of Tokyo.

MIT tool aids cost estimates for complex projects

Michelle Gaseau
Lead Aerospace Initiative

Consider the following scenario: A project manager at a major aerospace company is about to bid on the development of a new air fighter for the U.S. Air Force.

The bid must bring the project in on time, on budget and meet all the government's requirements. If the bid is too low, the project will miss these markers; too high and the company will be seen as wasteful or inefficient and may disqualify itself from the competition.

Now a new, first-of-its-kind systems engineering cost- estimation model developed by an MIT researcher can ensure that the bid is right on target, which means project risk (and costs) can be reduced. The model allows companies and organizations to develop more accurate bid proposals, thereby eliminating excess "cost overrun" padding that is often built into these proposals.

The Constructive Systems Engineering Cost Model (COSYSMO), now available commercially, helps eliminate the guessing game played by many large corporations in planning and executing large systems in many different industries. It also helps government agencies evaluate proposals from contractors with a more objective approach.

"In the past, a program manager would look at an earlier aircraft program and estimate by analogy, but now we can

See **PROJECTS** Page 7

PHOTO / **GRAHAM RAMSAY**

Front row: Kathy Boisvert, program coordinator; Sora Song; Lu Yi; Jeanne Lenzer. Back row: Clark Boyd; Boyce Rensberger, director; Lila Guterman; Elizabeth Howton; Zheng Yu; Herton Escobar; Richard Friebe; Stephanie Nano; Molly Seamans, administrative assistant; Wycliffe Muga; Tetsuro Yamada.

Knight Fellows arrive on campus

Twelve science journalists from five countries, plus the United States, have begun exploring the classrooms and laboratories of MIT as part of the 24th year of the Knight Science Journalism Fellowship. This is the largest group of Knight Fellows in 14 years.

Together they reach the greatest number of readers and listeners ever represented by a class of Knights. The print publications have a combined circulation of around 15 million. In addition, the two news agencies represented—Associated Press and the New China News Agency, or Xinhua—are the two largest in the world, each supplying many hundreds of news outlets.

The MIT community is invited to meet the new Knights at a reception today from 4 to 6 p.m. in the Faculty Club. The event is sponsored by Technology Review magazine, the MIT News Office and the Knight Fellowships.

The Knight Fellowship is funded chiefly by an endowment from the John S. and James L. Knight Foundation. For more information about the fellows, visit web.mit.edu/newsoffice/2006/knight.html.

DIGITALK: WHERE IT'S AT

E-mail quota doubled

In response to requests from the MIT community, Information Services and Technology (IS&T) has doubled the e-mail quota from 500 MB to 1 GB. All accounts that receive e-mail at MIT post office servers po9, po10, po11, po12 and po14 will benefit from this increase. The new quota enables the community to keep pace with the increasing volume, size and variety of e-mail exchanged in today's collaborative work environments.

In conjunction with the e-mail quota increase, IS&T encourages you to review e-mail management recommendations related to spam, backup, WebMail and managing your inbox. For more information, go to web.mit.edu/ist/topics/email/quota-upgrade.html.

Updates to system software

Automatic updates ensure that your computer is running the latest system software with the most current security updates. This makes your machine less vulnerable to break-ins and resulting disruptions of service. IS&T strongly recommends that all community members configure their machines for automatic updates, which are provided at no charge. Here are the key details for Windows, Macintosh and Linux users.

On Windows computers, use MIT's Windows Automatic Update Service (WAUS) for critical patches and service packs. WAUS includes Windows Server Update Services (WSUS), which deploys updates for the Windows Operating System and Microsoft Office products. WSUS also adds support for 64-bit Microsoft Windows operating systems.

This automatic update service may be used by MIT faculty, staff and students on MIT-owned and personal machines. Computers in the win.mit.edu domain are subscribed to WAUS by default. For more information and configuration instructions, see the WAUS documentation at web.mit.edu/ist/topics/windows/updates/.

Apple's Software Update checks for Mac OS updates weekly by default. It's available through System Preferences or, if you run Mac OS X 10.3 or later, from the Apple menu. Through Software Update's Preferences, you can switch to daily checks and choose to download important updates in the background. If you have questions about setting up the Software Update, refer to the Apple page at docs.info.apple.com/article.html?artnum=106704.

MIT community members with machines running Red Hat Enterprise Linux can use IS&T's Red Hat Network (RHN) Service to automatically update their systems. Since the Red Hat Enterprise Linux operating system has fully integrated RHN support, there is no software to download. However, you do need to register for the service; for details, go to the Red Hat Network page at web.mit.edu/ist/topics/linux/rhn.html.

To minimize security risks, all users should also configure their computers to receive automatic virus definition updates. To learn more, see the Virus Protection at MIT page at web.mit.edu/ist/topics/virus/.

Barker's new media suite

Beginning this fall, members of the MIT community will be able to use a new media suite in Barker Library for viewing visual media and conducting group meetings, instruction sessions and presentations. The suite, on the fifth floor of Building 10, is equipped with a 48-inch plasma screen, a VCR/DVD player, and laptop and computer station connections. It's ideal for viewing selections from Barker's collection of more than 200 engineering-related DVDs and videos, and it's also web- and cable-accessible. The room can be reserved for groups of up to 15 people by calling the Barker Service Desk at x3-5661 or sending e-mail to barker-circ@mit.edu. Barker Library will host an open house in the suite on Thursday, Oct. 12 from 4 to 6 p.m.

Digitalk is compiled by Information Services and Technology.

HOW TO REACH US

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Telephone: 617-253-2700
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Office of the Arts
http://web.mit.edu/arts

Printed on recycled paper

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Tech Talk is published by the News Office on Wednesdays during term time except for most Monday holiday weeks. See Production Schedule at http://web.mit.edu/newsoffice/techtalk-info.html. The News Office is in Room 11-400, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307.

Postmaster: Send address changes to Mail Services, Building WW15, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307.

Subscribers may call 617-252-1550 or send e-mail to mailsvc@mit.edu.

Tech Talk is distributed free to faculty and staff offices and residence halls. It is also available free in the News Office and the Information Center.

Domestic mail subscriptions are $25 per year, nonrefundable. Checks should be made payable to MIT and mailed to Business Manager, Room 11-400, MIT, 77 Massachusetts Avenue, Cambridge, MA 02139-4307.

Periodical postage paid at Boston, MA. Permission is granted to excerpt or reprint any material originated in Tech Talk.

Japan expert plans talk for MISTI Week

Samuels to discuss East Asia 'challenge'

Kathryn M. O'Neill
News Office Correspondent

The power and influence of the United States may be felt all over the world, but Japan is already preparing for the decline of its major military ally.

"Although the United States will undoubtedly remain the world's pre-eminent military power for decades more and possibly longer, Tokyo already sees U.S. diplomatic vigor, moral authority and economic allure waning," according to Richard J. Samuels, MIT's Ford International Professor of Political Science and director of the Center for International Studies.

Samuels will talk on "Amassing Power That Is Not Too Hard and Not Too Soft, but Just Right: The Goldilocks Challenge in East Asia" at noon on Sept. 22 in Room E51-095. The talk is a featured event of MISTI Week, which celebrates MIT International Science and Technology Initiatives (MISTI).

Richard J. Samuels

Samuels, who directs the MISTI Japan program, recently outlined Japan's strategic thinking in an essay that appears in the autumn 2006 issue of The Washington Quarterly. The essay is derived from his upcoming book, "Securing Japan."

Samuels describes the evolution of Japan's strategy from the immediate postwar period to the present, outlining the reemergence first of Japan's economic strength and more recently of its military capability. "Japan may still be punching below its weight in world affairs, but it has been bulking up in preparation for new bouts," Samuels writes.

That bulking up began after the collapse of the Soviet Union and was spurred by four factors, Samuels asserts: "1) a rising China, 2) a miscreant regime in North Korea, 3) the possibility of abandonment by the United States, and 4) the relative decline of the Japanese economy."

More recently, Japan has been repositioning itself with an eye toward the relative decline of the United States and the increasing might of China.

"The extent to which China displaces the United States as a target for investment and as a market for goods and services will determine whether the China threat gives way to a China opportunity and, possibly, to progress toward a regional economic bloc," Samuels writes.

In cozying up to its neighbors, however, Japan has so far been seriously hampered by its imperial history. For example, Samuels writes, "A mutually acceptable Pacific War narrative between Japan and its neighbors has been impossible. Japan's unwillingness or inability to confront its history squarely is undoubtedly the largest single constraint on its diplomacy."

And Japan doesn't just make its neighbors nervous. "Any overt sign of Japanese ambitions for great-power status and for a fully autonomous security posture is bound to stimulate balancing behavior by Japan's neighbors and undoubtedly opposition from the United States as well," he writes.

Samuels concludes that Japan will therefore hedge its bets going forward — "Japan will be neither too close to China nor too far from the United States. We await the appearance of Japan's Goldilocks, the pragmatic leader who will get security just right," he writes.

Nominations open for Doherty chair

Nominations are now open for the Doherty Professorship in Ocean Utilization. Endowed by the Henry L. and Grace Doherty Charitable Foundation, the two-year chair opens the way for promising, non-tenured professors to undertake marine-related research. Any aspect of marine use and/or management may be addressed, whether social, political, environmental, economic or technical.

Those appointed to the chair will receive $25,000 per year for two years, beginning July 1, 2007.

All non-tenured MIT faculty members from any department are eligible. Department heads may submit one nomination per year. The deadline for nominations is Oct. 31, and the new Doherty Professor will be announced in early 2007.

Anyone wishing to be nominated should contact his or her department head for procedures and selection criteria. For more information, contact Kathy de Zengotita, Room E38-300, x3-9305, kdez@mit.edu.

BUILDING —

Continued from Page 1

of key cancer pathways," Hockfield wrote.

Located just to the east of the current MIT Sloan headquarters at 50 Memorial Drive, the School of Management's new home will extend from Memorial Drive to Main Street.

The Sloan project, designed by Moore Ruble Yudell Architects & Planners in association with Bruner Cott/Architects, will support "new curricular directions that emphasize collaboration and teamwork, and will serve as an incubator for innovative teaching and research," Hockfield wrote.

The new Media Lab building, designed by Pritzker Prize winner Fumihiko Maki, in association with Leers Weinzapfel Associates, will be adjacent and connected to the existing Wiesner Building. The complex will bring together the lab, the School of Architecture and Planning—including the Design Lab, the Center for Advanced Visual Studies and the Visual Arts Program—and MIT's Program in Comparative Media Studies.

Continuing projects include the Vassar Street West project, designed by Carol R. Johnson Associates, landscape architects; new and newly renovated space, designed by Payette Associates, for the Departments of Physics and Materials Science and Engineering and for the Institute's Spectroscopy Laboratory; consolidation of the research laboratories of the pioneering Harvard-MIT Division of Health Sciences and Technology; as well as laboratories for MIT's Department of Earth, Atmospheric and Planetary Sciences, in facilities renovated to designs by Imai Keller Moore.

To read the complete text of President Hockfield's announcement, please go to web.mit.edu/campus/.

PHOTO / **DONNA COVENEY**

President Hockfield welcomes students to the new lounge near Lobby 10.

New student lounge dedicated

Sasha Brown
News Office

With musicians providing an appropriate lounge-music soundtrack, students, faculty and staff lingered last Friday afternoon to celebrate the opening of the new community lounge, located off the Infinite Corridor near Lobby 10. The space was formerly occupied by the cashier's office.

President Susan Hockfield and Chancellor Phillip Clay each spoke briefly during the Sept. 15 dedication ceremony.

Hockfield praised the lounge's location, describing it as "at the very heart of the MIT campus," and encouraged students to use the lounge as a meeting place and to share ideas.

"The quantity of great ideas that come out of here is directly proportional to how often we run into each other," Hockfield said.

The space is meant to be an impromptu social gathering space. Green couches form a figure eight so that people can face one another; sunlight streams through giant windows overlooking Killian Court. More windows on the back wall provide a view of the Infinite Corridor.

The idea for the lounge started germinating in late 2004 when a committee formed to look at the cashier's space noted that there "should be something to support the community," said Phillip Walsh, director of the campus activities complex.

"We wanted a lounge that was very bright and open and had a view of the river and Killian Court," Walsh said. The Class of 2005 made the lounge its senior class gift. There is a plaque to the left of the lounge entrance thanking the class for its generosity.

"It is a gift that will leave a lasting impression on the MIT community," Hockfield said, acknowledging the Class of 2005 and its generosity.

A small controversy arose last year when some students expressed concern over the floor-to-ceiling mural of a U.S. one-dollar bill that once covered the outside of the cashier's office.

The student-created mural was painted during the Vietnam War when students were offered the opportunity to change dull points on the hallways. Although there were other murals, the dollar bill was the most visible to the whole community.

Over the years, it became a sentimental part of the campus as well as the scene of the first "hack" on President Hockfield when hackers replaced George Washington's face on the mural with Hockfield's.

In order to preserve the integrity of the memory, an etching of the dollar bill remains in one of the panels of glass between the Infinite Corridor and the lounge. There is also a detailed history of the dollar bill and its part in MIT's history.

In his short talk, Chancellor Clay linked the dollar bill mural to the Class of 2005's gift, stating: "The original spirit of student participation in shaping spaces was not lost in this generation."

The community lounge is now open for use 24 hours a day.

Other campus changes include the revamped reading room in the Student Center, which now features 6,000 square feet of space for students to gather, work independently or study collaboratively. The new study space opened on Sept. 1.

Also new this year is the full-menu Dunkin' Donuts on the first floor of the Student Center, which opened in late August.

Hockfield urges math panel to invest in K-12

Deborah Halber
News Office Correspondent

MIT President Susan Hockfield told a national panel last Thursday that the future of the economy is at stake if the United States doesn't beef up the number of college students majoring in math and better prepare high school graduates for college-level classes.

Hockfield addressed the National Mathematics Advisory Panel created in April by President Bush to advise the president and the secretary of education "on the best use of scientifically based research to advance the teaching and learning of mathematics."

"It could not be more clear that we are now in an era where technical and scientific literacy are as critical as language literacy," she said. "Technology increasingly drives today's economy, which simply requires the skills based on mathematics."

> *Technology increasingly drives today's economy.*
>
> **Susan Hockfield**
> MIT president

Hockfield pointed out that only 6 percent of U.S. undergraduates are likely to pursue careers in engineering, compared with more than 40 percent in China. "We need to fix the K-12 pipeline that feeds higher education, and we need to support investments in students. Other countries have already figured this out and are building up their human capital.

"To succeed in the workplace and to participate as citizens in society, high school graduates need the ability to think analytically and solve problems creatively," she said. "Science and math education are prerequisites for innovation."

Hockfield gave examples of MIT initiatives that help secondary school educators, including OpenCourseWare, which now has more than 36,000 people reviewing its content daily, and MIT iLabs, which allows students to conduct real laboratory experiments remotely from any Internet browser. She also encouraged the panel to consider computer-based simulations and other tools as supplements to the classroom environment.

The 17-member panel met Sept. 13-14 at the Broad Institute of MIT and Harvard. Speakers included mathematics teachers, members of the National Science Foundation and textbook publishers. Hockfield gave opening remarks at the beginning of the second day, which featured comments from participants and the public.

PHOTO / **DONNA COVENEY**

Graduate student Sung Joong Kim, left, and research scientist Thomas J. McKrell inspect the test section of the nanofluid critical heat flux facility. Lab work on nanofluids holds promise for improving nuclear power generation.

Innovative projects aim to boost safety, efficiency of nuclear power

Deborah Halber
News Office Correspondent

With U.S. electricity demand projected to increase by nearly 50 percent over the next 25 years, the Bush administration and others see nuclear power as an increasingly attractive energy option.

Nuclear power has the potential to help make the United States less dependent on foreign fuel and to cut the carbon dioxide emissions that contribute to global warming.

Pilot models of next-generation nuclear plants are being built around the world, but such plants are not likely to produce consumer electricity in the United States for 20 years or more, said Pavel Hejzlar, a principal research scientist in MIT's Department of Nuclear Science and Engineering.

In the meantime, MIT researchers are working on several innovations that could make existing plants more efficient and safer to run. These include a new fuel and a way to boost the cooling capability of ordinary water.

New fuel

In a nuclear power plant, the fission of uranium atoms provides heat to produce steam for generating electricity. While nuclear plants are already energy intensive—one pickup-truck full of uranium fuel can supply enough electricity to run a city for a year—Hejzlar and Mujid S. Kazimi, the TEPCO Professor of Nuclear Engineering, professor of mechanical engineering and director of the Center for Advanced Nuclear Energy Systems, wanted to make the fuel go even further.

Uranium fuel typically is formed into cylindrical ceramic pellets about a half-inch in diameter. The pellets look like a smooth, black version of food pellets for small animals.

In a three-year project completed recently for the U.S. Department of Energy, Hejzlar and Kazimi teamed up with Westinghouse and other companies to look at how to make a fuel for one kind of reactor, the pressurized water reactor (PWR), 30 percent more efficient while maintaining or improving safety margins.

They changed the shape of the fuel from solid cylinders to hollow tubes. This added surface area that allows water to flow inside and outside the pellets, increasing heat transfer.

The new fuel turned out even better than Hejzlar dared hope. It proved to be easy to manufacture and capable of boosting the power output of PWR plants by 50 percent.

The next step is to commercialize the fuel concept, which will include testing a limited number of rods filled with the new pellets in an operating reactor and examining the results to ensure the safety and performance of the new fuel.

Spiked water

Water is used in many nuclear reactors to help generate electricity and to ensure safe operation. Now Jacopo Buongiorno, assistant professor of nuclear science and engineering, has come up with a way to change water's thermal properties. This change may contribute to plants' safety while boosting their power density, or the amount of energy they can pump out.

In these reactors, energy released from fission of the fuel's atoms is harnessed as heat in water, which creates steam that drives turbines and produces electricity. In both PWRs and their close cousin, the boiling water reactor (BWR), that steam is turned back into water and reused. Water also is used as a coolant in the reaction process and in safety systems.

The efficiency of PWRs and BWRs is limited to around 33 percent, because water can be heated to only a certain temperature and only a certain amount of heat can be taken out of water. If that limit were pushed higher, more heat could be extracted, and the plant would generate

See **NUCLEAR** Page 7

Epilepsy breakthrough on horizon

MIT developing device to detect seizures

Anne Trafton
News Office

Researchers at MIT are developing a device that could detect and prevent epileptic seizures before they become debilitating.

Epilepsy affects about 50 million people worldwide, and while anticonvulsant medications can reduce the frequency of seizures, the drugs are ineffective for as many as one in three patients.

The new treatment builds on an existing treatment for epilepsy, the Cyberonics Inc. vagus nerve stimulator (VNS), which is often used in patients who do not respond to drugs. A defibrillator typically implanted under the patient's collar bone stimulates the left vagus nerve about every five minutes, which has been shown to help reduce the frequency and severity of seizures in many patients.

The MIT researchers and colleagues at Beth Israel Deaconess Medical Center (BIDMC) seek to improve the treatment by combining it with a detector that measures brain activity to predict when a seizure is about to occur. The new device would sense the oncoming seizure and then activate the VNS, in principle halting the seizure before it becomes manifest.

"Our contribution is the software that decides when to turn the stimulator on," said John Guttag, MIT's Dugald C. Jackson Professor in the Department of Electrical Engineering and Computer Science. Guttag developed the system along with Ali Shoeb, a graduate student in the Harvard-MIT Division of Health Sciences and Technology.

"Our colleague Dr. Steven Schachter, professor of neurology at Harvard Medical School and epileptologist at BIDMC, suggested hooking our detector up to the VNS," he said. MIT and BIDMC researchers plan to test the new device in epilepsy patients this fall. If it seems effective, more comprehensive trials will be launched.

A look at brain patterns

The detector works by measuring brain activity with electrodes placed on the patient's scalp. In its current form, the patient wears something resembling a bathing cap, in which electrodes are embedded. In order to adapt the detector to work with the VNS, researchers connected wires from the cap to a laptop computer or microprocessor that activates the implanted defibrillator.

Guttag said he believes the technology could be refined so the electrodes could be worn inside of a headband or baseball

See **EPILEPSY** Page 6

NANOTUBES

Continued from Page 1

tion problems and lend the nanotubes new properties for a host of potential applications as detectors, sensors or components in novel optoelectronics.

Marzari and Lee use the fundamental laws of quantum mechanics to simulate material properties that are difficult or impossible to measure, such as molten lava in the Earth's core or atomic motion in a fast chemical reaction. Then they run these simulations and use the results to optimize and engineer novel materials.

With the help of a powerful algorithm created by Lee and published last year in Physical Review Letters, the theorists focused on solving some of the problems of working with carbon nanotubes.

Like fuzzy balls and Velcro, the hexagon of carbon that makes up a nanotube has a predilection for clinging to other hexagons. One of the many challenges of working with the infinitesimally small tubes is that they tend to stick to each other.

Attaching a molecule to the sidewall of the tube serves a double purpose: It stops nanotubes from sticking, and it allows researchers to control and change the tubes' electronic properties. Still, most such molecules also destroy the tubes' conductance because they make the tube structurally more similar to a diamond, which is an insulator.

Lee and Marzari used Lee's algorithm to identify a class of "molecular handles" (carbenes and nitrenes) that stop this from happening. "We now have a way to attach molecules that allows us to manipulate the nanotubes without losing their conductance," Marzari said.

Carbenes and nitrenes work by breaking a molecular bond on the nanotube's wall while creating their own new bond to the tube. This process—one bond formed, one bond lost—restores the perfect number of bonds each carbon atom had in the original tube and "conductance is recovered," Marzari said.

IMAGE COURTESY / **MARZARI LAB**

MIT researchers have discovered that certain molecules can attach themselves to metallic carbon nanotubes without interfering with the nanotubes' ability to conduct electricity. At left, the high-conductance state has two molecular orbitals, shown in green. At right is the poor-conductance state. Some molecules even allow the nanotubes to switch between states.

This work is supported by the MIT Institute for Soldier Nanotechnologies and the National Science Foundation.

Knotty problem puzzles protein researchers

Anne Trafton
News Office

MIT researchers are trying to unravel why some proteins are tied up in knots.

An MIT team has discovered the most complicated knot ever seen in a protein, and they believe it may be linked to the protein's function as a rescue agent for proteins marked for destruction.

"In proteins, the three-dimensional structure is very important to the function, and this is just one example," said Peter Virnau, a postdoctoral fellow in physics and an author of a paper on the work that appears in the Sept. 15 issue of the Public Library of Science, Computational Biology.

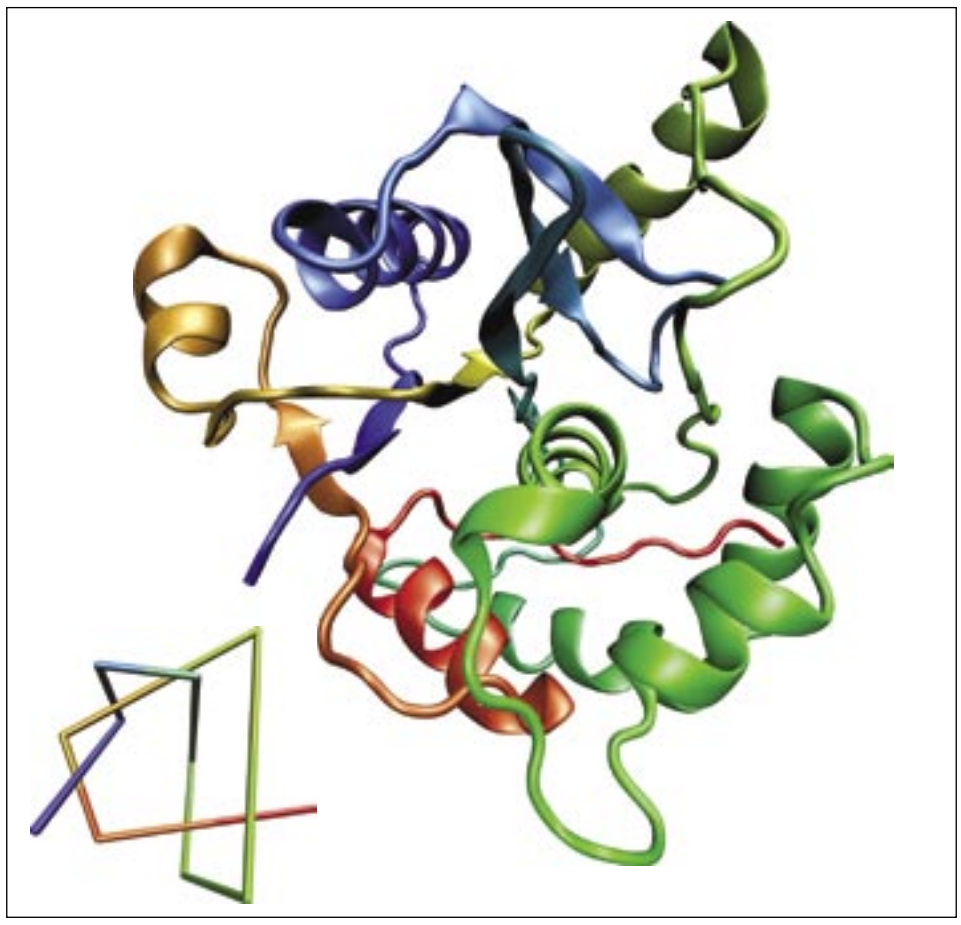
Knots are rare in proteins—less than 1 percent of all proteins have any knots, and most are fairly simple. The researchers analyzed 32,853 proteins, using a computational technique never before applied to proteins at this scale.

Of those that had knots, all were enzymes. Most had a simple three-crossing, or trefoil knot, a few had four crossings, and the most complicated, a five-crossing knot, was initially found in only one protein—ubiquitin hydrolase.

That complex knot may hold some protective value for ubiquitin hydrolase, whose function is to rescue other proteins from being destroyed—a dangerous job.

When a protein in a cell needs to be destroyed, it gets labeled with another protein called ubiquitin. "It's a death mark for the protein," said Leonid Mirny, an author of the paper and an associate professor in the MIT-Harvard Division of Health Sciences and Technology.

Once the "death mark" is applied, proteins are shuttled to a cell structure called a proteasome, which pulls the protein in and chops it into pieces. However, if ubiquitin hydrolase intervenes and removes the ubiquitin, the protein is saved.



IMAGES COURTESY / **PETER VIRNAU**

MIT researchers recently found that human ubiquitin hydrolase, shown here, has the most complicated knot ever observed in a protein. The simplified diagram, inset, shows the knot in the protein, which crosses itself five times.

The complicated knot found in ubiquitin hydrolase may prevent it from getting sucked into the proteasome as it works, Mirny said. The researchers hypothesize that proteins with complex knots can't be pulled into the proteasome as easily, and the knots may make it harder for the protein to unfold, which is necessary for degradation.

The same knot is found in ubiquitin hydrolase in humans and in yeast, supporting the theory that there is a connection between the knot and the protein's function. This also seems to suggest that the knot has been "highly preserved throughout evolution," Virnau said.

Until now, scientists have not paid much attention to knots in proteins, but the MIT researchers hope their work will ignite further interest in the subject. "We just hope this will become a part of the routine crystallographers and NMR spectroscopists do when they solve a structure," Mirny said.

Virnau is working on a computer program and a web server, soon to be publicly available, that can analyze the structure of any protein to see if it has knots, which he believes could be helpful to researchers in structural genomics. (Structural genomics aims to determine the structure of all proteins produced by a given organism.)

Since their initial screening, the researchers have discovered five-crossing knots in two other proteins—a brain protein, whose overexpression and mutations are linked with cancer and Parkinson's disease, and a protein involved in the HIV replication cycle.

They have also found examples of proteins that are closely related and structurally similar except for the presence or absence of a knot. Two versions of the enzyme transcarbamylase, from humans and certain bacteria, catalyze different reactions, depending on whether or not there is a knot. The researchers speculate that somewhere along the evolutionary line, the sequence that allowed a protein to form the knot was added or deleted.

The third author on the paper is Mehran Kardar, an MIT physics professor. The research was funded by the National Science Foundation and the German Research Foundation.

Tiny gas turbine on a chip promises to best the battery

Nancy Stauffer
Laboratory for Energy and the Environment

MIT researchers are putting a tiny gas-turbine engine inside a silicon chip about the size of a quarter. The resulting device could run 10 times longer than a battery of the same weight—powering laptops, cell phones, radios and other electronic devices.

It could also dramatically lighten the load for people who can't connect to a power grid, including soldiers who now must carry many pounds of batteries for a three-day mission—all at a reasonable price.

Researchers say that in the long term, mass-production could bring the per-unit cost of power from microengines close to that for power from today's large gas-turbine power plants.

Making things tiny is all the rage. The field—called microelectromechanical systems, or MEMS—grew out of the computer industry's stunning success in developing and using micro technologies. "Forty years ago, a computer filled up a whole building," said Professor Alan Epstein of the Department of Aeronautics and Astronautics. "Now we all have microcomputers on our desks and inside our thermostats and our watches."

While others are making miniature devices ranging from biological sensors to chemical processors, Epstein and a team of 20 faculty, staff and students are looking to make power—personal power. "Big gas-turbine engines can power a city, but a little one could 'power' a person," said Epstein, whose colleagues are spread among MIT's Gas Turbine Laboratory, Microsystems Technology Laboratories, and Laboratory for Electromagnetic and Electronic Systems.

How can one make a tiny fuel-burning engine? An engine needs a compressor, a combustion chamber, a spinning turbine and so on. Making millimeter-scale versions of those components from welded and riveted pieces of metal isn't feasible. So, like computer-chip makers, the MIT researchers turned to etched silicon wafers.

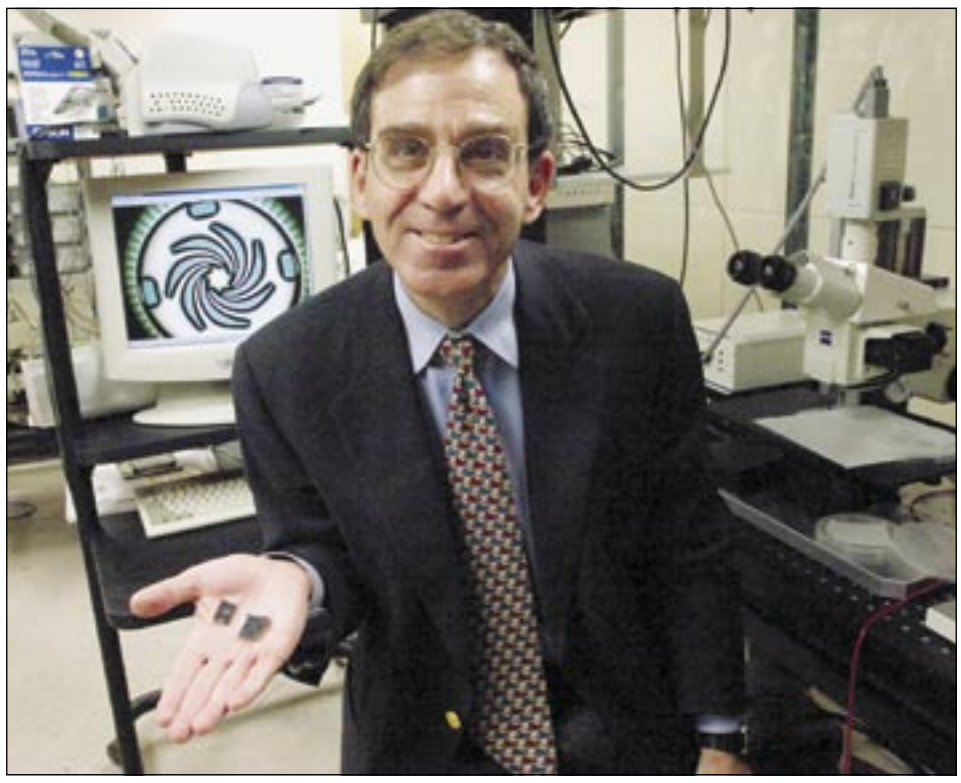


PHOTO / **DONNA COVENEY**

Professor Alan Epstein and his team have been using computer-chip fabrication techniques to make a gas-turbine engine that fits in the palm of his hand.

Their microengine is made of six silicon wafers, piled up like pancakes and bonded together. Each wafer is a single crystal with its atoms perfectly aligned, so it is extremely strong. To achieve the necessary components, the wafers are individually prepared using an advanced etching process to eat away selected material. When the wafers are piled up, the surfaces and the spaces in between produce the needed features and functions.

Making microengines one at a time would be prohibitively expensive, so the researchers again followed the lead of computer-chip makers. They make 60 to 100 components on a large wafer that they then (very carefully) cut apart into single units.

The MIT team has now used this process to make all the components needed for their engine, and each part works. Inside a tiny combustion chamber, fuel and air quickly mix and burn at the melting point of steel. Turbine blades, made of low-defect, high-strength microfabricated materials, spin at 20,000 revolutions per second—100 times faster than those in jet engines. A mini-generator produces 10 watts of power. A little compressor raises the pressure of air in preparation for combustion. And cooling (always a challenge in hot microdevices) appears manageable by sending the compression air around the outside of the combustor.

"So all the parts work…. We're now trying to get them all to work on the same day on the same lab bench," Epstein said. Ultimately, of course, hot gases from the combustion chamber need to turn the turbine blades, which must then power the generator, and so on. "That turns out to be a hard thing to do," he said. Their goal is to have it done by the end of this year.

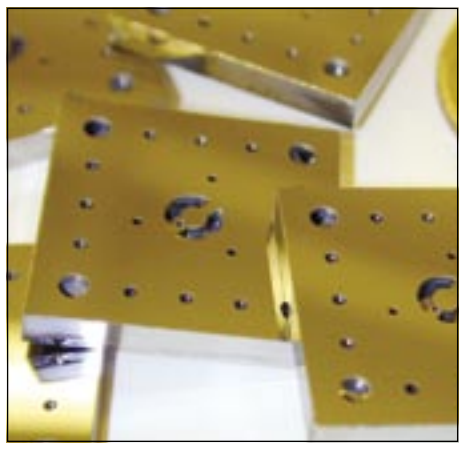


PHOTO / **ALAN EPSTEIN**

One of the components of MIT's micro gas-turbine engine.

Predicting how quickly they can move ahead is itself a bit of a challenge. If the bonding process is done well, each microengine is a monolithic piece of silicon, atomically perfect and inseparable. As a result, even a tiny mistake in a single component will necessitate starting from scratch. And if one component needs changing—say, the compressor should be a micron smaller—the microfabrication team will have to rethink the entire design process.

For all the difficulties, Epstein said the project is "an astonishing amount of fun"—and says MIT is the ideal place for it. "Within 300 feet of my office, I could find the world's experts on each of the technologies needed to make the complete system," he said.

In addition, the project provides an excellent opportunity for teaching. "No matter what your specialty is—combustion or bearings or microfabrication—it's equally hard," he said. "As an educational tool, it's enormously useful because the students realize that their success is dependent upon other people's success. They can't make their part easier by making somebody else's part harder, because then as a team we don't succeed."

This research was funded by the U.S. Army Research Laboratory.

PHOTO / **STEVE ROSENTHAL**

This photo of Eastwood, a housing project on Roosevelt Island in New York City, is part of a current exhibit at the Wolk Gallery. The development, designed by Sert, Jackson & Associates, was built in 1974.

Urban housing showcased

The Wolk Gallery (Room 7-338) opens its 2006-07 season with an exhibition of past and current housing programs for people of limited income. "Policy and Design for Housing: Lessons of the Urban Development Corporation, 1968-1975" documents one of the most innovative and effective housing programs ever developed in the United States.

An opening reception will be held today from 5:30 to 7:30 p.m.

Launched by Gov. Nelson A. Rockefeller, the New York State Urban Development Corporation (UDC) was given both broad political powers and financial resources to fulfill its mandate—improving the physical environment for low- and moderate-income families. The UDC built 33,000 units of housing and three new communities that are still in existence today.

The MIT exhibition showcases the UDC's legacy and its effectiveness, exploring selected projects that demonstrate housing set in various contexts—urban and suburban, high- and low-density—and built according to various social and design guidelines—mixed income; high-rise and low-rise. UDC structures also employed various building materials and technologies.

The show runs through Dec. 22 and is open weekdays from 9 a.m. to 5 p.m.

EPILEPSY

Continued from Page 4

cap, making the device less obvious to observers.

Each epilepsy patient has different brain activity patterns, so the detector is programmed to measure an individual's patterns to determine what the precursors to a seizure look like for each patient.

"It's quite tricky to try to detect very early signs of seizures because there are abnormal electrical signals that don't evolve into seizures," Guttag said. "If we can learn what the right profile is for an individual, we can build a seizure onset detector that works really well for that person."

Ideally, when the device senses an impending seizure, it sends a magnetic signal to the implanted stimulator, which in turn activates the left vagus nerve. The vagus nerve sends electrical signals up to the brain as well as down toward the viscera, controlling heart rate, gastrointestinal peristalsis, sweating and keeping the larynx open for breathing. The mechanism by which VNS prevents seizures is not known, but the technique has been FDA approved to treat epilepsy for about 10 years.

About 32,000 epilepsy patients already have VNS implants, according to Guttag. Some of them are able to use a handheld magnet to activate the VNS on demand, but many cannot. If the new detection device is successful, it would allow many more patients to use the VNS on demand.

The device could also be adapted to provide warnings for patients who don't need or want VNS implants. Once the device alerts the patient that a seizure is imminent, that person could take steps to minimize injury, such as sitting down or moving away from potentially dangerous objects, such as a hot stove.

"If you could just give someone a little bit of warning they're about to have a seizure, it could be hugely valuable," Guttag said. "The seizures themselves aren't usually damaging to the brain in the long term. It's mostly about the collateral damage."

Although the seizure detector could have a huge impact on epilepsy patients, there are plenty of other potential applications for technology that analyzes electrical activity in individual brains, Guttag said. Depression, schizophrenia and attention deficit disorder are just a few of the conditions that could be studied.

A paper describing the seizure-detection technology was published in the August 2004 issue of Epilepsy & Behavior.

This work was funded by the Center for Integration of Medicine and Innovative Technology, the U.S. Army and MIT's Project Oxygen.

ENERGY

MIT experts explore life 'beyond carbon'

Continued from Page 1

jects and begin designing possible core subjects from the undergraduate core to graduate level.

The MIT Energy Management Task Force will provide a venue to connect the research and educational activities of faculty, students and staff to MIT's own physical plant. An External Advisory Committee of industry, academia and government leaders will provide guidance, advice and direction to the leadership of MITEI and to the vice president for research, Hockfield wrote. The heads of both task forces will serve on the Energy Council.

The ERC released its report (web.mit.edu/erc/docs/erc-report-060502.pdf) in May 2006. The report, which culminated almost a year of effort by 16 faculty members from all five MIT schools, called for an energy-focused laboratory or center with its own research space to be established within five years, and an independent steering organization to carry out MIT's new energy initiatives.

In developing its recommendations, the ERC solicited input from faculty members, students and staff, as well as from alumni and key industry leaders. An Industrial Liaison Program Industry Energy Workshop in December 2005 provided information on how MIT can best work with industry on energy-related topics.

"The need for new global supplies of affordable, sustainable energy is perhaps the single greatest challenge of the 21st century," the report stated.

"Increasing tension between supply and demand is exacerbated by rapidly escalating energy use in developing countries, security issues facing current energy systems and global climate change. These converging factors create an unprecedented scenario requiring a multifaceted approach to increasingly urgent energy issues."

For more information on the MIT Energy Initiative, please go to: web.mit.edu/newsoffice/2006/energy-initiative.html.

Anne Trafton
News Office

If all nations burned gasoline for transportation at the same rate as the United States, world gasoline consumption would rise nearly 10-fold, with a corresponding hike in the concentration of greenhouse gases.

That's just one reason why it is imperative that nations work to create a more sustainable transportation system, says John Heywood, director of MIT's Sloan Automotive Lab and the Sun Jae Professor of Mechanical Engineering.

"As the countries in the developing world rapidly motorize, the increasing global demand for fuel will pose one of the biggest challenges to controlling the concentration of greenhouse gases in the atmosphere," Heywood writes in "Fueling Our Transportation Future," an article he wrote for the September issue of Scientific American.

Heywood is one of three MIT professors who tackle energy in the magazine's September issue, whose cover proclaims the theme "Energy's Future: Beyond Carbon."

While Heywood's article focuses on improving transportation efficiency, MIT Professors John Deutch and Ernest Moniz explore the possibilities of expanding nuclear power to reduce emissions of greenhouse gases.

All three professors are members of MIT's Energy Research Council, which issued a report in May exploring how MIT can help solve the global energy crisis.

Improving transportation efficiency will be a critical part of any energy strategy, says Heywood, because transportation accounts for 25 percent of worldwide greenhouse gas emissions. In his piece, Heywood outlines four options for improving transportation sustainability: "We could improve or change vehicle technology; we could change how we use our vehicles; we could reduce the size of our vehicles; we could use different fuels. We will likely have to do all of these to drastically reduce energy consumption and greenhouse gas emissions."

John Heywood

John Deutch

Ernest Moniz

New technologies could further reduce fuel consumption. Heywood estimates that within five years, new technologies such as gasoline hybrids, turbocharged gasoline engines and low-emissions diesel could produce market-competitive vehicles. Hydrogen fuel cell technology will take longer to reach consumers.

Other alternative fuels, including biomass-based fuels such as ethanol and biodiesel, are already being produced but have not made much of an impact in the United States yet.

Heywood suggests that new regulatory and tax policies will be needed: raising fuel-efficiency requirements, charging a fee to consumers who purchase high-fuel-consumption cars and offering rebates to those who buy efficient models could all help achieve a more sustainable transportation system.

Another promising way to cut carbon emissions is to rely more heavily on nuclear power, according to Moniz and Deutch.

Moniz, co-director of MIT's Laboratory for Energy and the Environment and Cecil and Ida Green Professor of Physics, co-chairs MIT's Energy Research Council. Deutch, also a member of the energy council, is an Institute Professor at MIT.

"With growing worries about global warming and the associated likelihood that greenhouse gas emissions will be regulated in some fashion, it is not surprising that governments and power providers in the U.S. and elsewhere are increasingly considering building a substantial number of additional nuclear power plants," Deutch and Moniz write in their Scientific American article, titled "The Nuclear Option."

Deutch and Moniz suggest that a government-imposed "carbon tax" could raise the cost of generating electricity from coal or natural gas, making nuclear energy more attractive to power companies.

They also propose that the federal government establish consolidated interim storage as part of the nation's nuclear waste management strategy.

Threats of nuclear proliferation could be countered by establishing relationships in which countries such as the United States, Russia and France would lease nuclear fuel to countries that want to develop nuclear power plants. The United States would then reclaim the spent fuel and dispose of it, eliminating the risk that countries could secretly develop weapons programs under the guise of generating nuclear power.

Although the challenge is great, Deutch and Moniz believe success is attainable. Since 2000, more than 20,000 megawatts of nuclear capacity have come online.

The Scientific American issue on energy can be found at www.sciam.com/issue.cfm.

‘Making Comics’ author decodes cartoons

Stephanie Schorow
News Office Correspondent

ILLUSTRATION / **SCOTT McCLOUD**

A cartoon by Scott McCloud, above, serves as an online logo for his current speaking tour/family road trip, called the ‘Making Comics’ 50-State Tour.

In a dissection worthy of a science lab, comic book artist Scott McCloud analyzed the dynamics of action frames and word balloons, showing the conventions of comics to be as complex as those of any art form.

“Comics are a slightly artificial medium. They take a lot of participation on the part of the reader to come alive,” McCloud told a packed audience at the Bartos Auditorium on Thursday, Sept. 15, in an appearance sponsored by MIT’s Program in Comparative Media Studies.

Yet comics can open new windows into our world, he said.

“It’s our birthright to create new worlds for us to step into, and a lot of what’s happening — and about to happen — in the 21st century is creating new worlds. Because, damn it, one is not enough.”

McCloud is both a practitioner and a pundit. As author of “Understanding Comics,” (1993) and “Reinventing Comics” (2000), McCloud “has transformed the way many of us look at comic books as a medium,” said MIT media studies professor Henry Jenkins. McCloud produced his own series, Zot!, from 1984 to 1991 for Eclipse and has worked for major comics companies such as DC.

He has just published a how-to guide, “Making Comics,” and has launched a yearlong, nationwide tour with wife Ivy and daughters Sky and Winter.

“I was brought up on how to draw comics the Marvel way,” said McCloud, who grew up in Lexington, Mass. However, “comics have been going through a lot of mutations lately. The traditional comic strips and comic books have been joined by the literate graphic-novel movement and comics coming in from Europe and an influx of Japanese comics, manga, and this explosion of Web comics.”

When “teaching how to make comics in 2006, you have to come up with principles that apply to all these different types of comics. The most constructive way to think of creating comics (is) as a series of choices.”

With an engineer’s precision, McCloud — armed with the inevitable PowerPoint presentation—dissected these choices: moment, frame, image and flow, plus the words selected to go with the drawings.

New technologies—like multimedia CD-ROMS, 3-D modeling and Flash software—and the Internet are changing the relationship between artist and reader, McCloud said. Traditionally, “space equals time” as the eye moves from one panel to the next.

“The early comics owed a lot to vaudeville,” with their sense of creating a front row seat at a stage, he noted. Scrolling and hypertext change this convention, as McCloud demonstrated with examples of online Web comics.

Yet, as McCloud’s slides of Egyptian wall paintings and Mayan glyphs showed, the art of comics is thousands of years old. He looks ahead to a time when virtual reality and iPod screens may change the medium again. “I wonder if the idea of really small canvases and really big middle men is not the way we want to go in the long run,” he said.

He stressed, however, the need to adapt to change. Some of his early Web comic inventions indicated “I was not really adapting to the environment I was on. It was as if I had created a flying squirrel capable of jumping from tree to tree on a planet covered with molten lava.”

PHOTO / **JAN WAMPLER**

Graduate student W. Victoria Lee’s design for a North End rooftop house is among the architectural models on display in the Wiesner Gallery of the Student Center. The tall center tower belongs to another model on exhibit, built by senior Harini Rajaraman.

Student design exhibit highlights creative process

Sasha Brown
News Office

With models that include a homeless shelter created from a used billboard and a children’s AIDS center in Zambia, the MIT Undergraduate Architectural Design Program’s exhibit, “Process of Designing,” now on display in the Wiesner Gallery in the Student Center, showcases how architects can explore social issues through their designs.

“We want to get them thinking socially and politically as well as architecturally,” said Professor Jan Wampler, director of the Undergraduate Architectural Design Program.

The first of its kind, the exhibit officially opened Sept. 8 with a packed reception in Wiesner and speeches from Wampler as well as Professor Les Norford of the Department of Architecture and J. Kim Vandiver, dean for undergraduate research. “We wanted to give some life to the student center,” said Wampler, who was pleased with the turnout at the reception. “We had a very good opening.”

The exhibit was created by Wampler along with Rebecca Luther, a lecturer in architecture; Chris Dewart, a technical instructor in architecture; and architecture student Victoria Lee.

More than 20 students contributed work from their 2005-2006 courses for the exhibit, which shows more than just the finished design model. Most of the models feature the designer’s process, the series of steps each followed to arrive at the final product, Wampler said.

The exhibit features the process Wampler calls “a building up of design.” Wampler said he wants to move away from the idea that design is “a flash of brilliance in the middle of the night.”

For many of the students whose work is featured, the projects were about more than design. Wampler tries to expose the students to more international work. In that vein, one student created a quick-build shelter for victims of the 2005 earthquake in Pakistan.

Before the student could design the shelter, she had to study the region and its problems. She had to research feasibility and how it might work.

For Wampler, this is the direction in which he hopes to see the program move. In his foreword to the exhibit, he mentions that he wants MIT’s undergraduate architecture students to be known as creators, collaborators, translators, craftspeople, designers and communicators.

“Our students, who are the best and brightest in the world, need to have opportunities to explore ideas that are truly creative,” Wampler said.

The “Process of Designing” exhibit will be on display at least through the middle of October in Wiesner Gallery in the MIT Student Center.

PROJECTS

Continued from Page 2

go beyond that and use parametrics to go beneath the surface to the underlying reasons why a certain aircraft costs what it does to develop,” said Ricardo Valerdi, a researcher at MIT’s Lean Aerospace Initiative, who developed the new model.

Validated with assistance and historical data from seven major aerospace companies, COSYSMO can be adapted to systems-engineering programs in many different industries.

“The inputs to the COSYSMO model are generic, they are not domain specific, so it could be used in estimating effort associated with waste management systems or building new highway tunnels in Boston,” said Valerdi.

Computer hardware and software cost-estimation tools help companies estimate costs specifically associated with developing and designing computer hardware and software components and platforms. The costs associated with systems engineering are more difficult to estimate because the discipline deals with multiple factors in the big picture, such as system design and customer needs.

COSYSMO helps companies estimate “person-months” specifically associated with a systems-engineering effort and costs—such as how many people it will take to develop a command and control system in an aircraft and meet all the customer requirements.

According to Valerdi, the failure to adequately plan and fund systems-engineering efforts appears to have contributed to a number of cost overruns and schedule slips, especially in the development of complex aerospace systems.

NUCLEAR

Continued from Page 4

more energy at a lower cost.

This may soon be possible, thanks to Buongiorno.

His laboratory works on nanofluids — base fluids such as water interspersed with tiny particles of oxides and metals only billionths of a meter in diameter. Buongiorno’s nano-spiked water, transparent but somewhat murky, can remove up to two times more heat than ordinary water, making it an ideal substance for nuclear plants.

The nanoparticles “change some key properties of the way water behaves when it boils,” Buongiorno said, improving its heat transfer capabilities.

The spiked water could provide an extra measure of protection in the event of a nuclear meltdown. In a meltdown, molten nuclear fuel sinks to the bottom of the big stainless steel pot containing it, which sits in a cavity of cooling water. If the excess heat is not removed, the molten fuel could breach the pot.

Nanoparticles in the water that cools the outer surface of the vessel raise the amount of heat that can be drawn away from the core, making the plant less susceptible to the negative repercussions of a possible meltdown.

The key issue to be resolved before nanofluids can be used in nuclear plants, Buongiorno said, is the stability of the nanoparticles, which could agglomerate and settle quickly if appropriate chemical and thermal conditions are not carefully maintained.

This work is funded by the Idaho National Laboratory, the nuclear energy vendor AREVA and the MIT Nuclear Reactor Laboratory.

PHOTO / **CHRISTINE SOUTHWORTH**

MIT music professor Evan Ziporyn's new composition, 'Sulvasutra,' was commissioned by cellist Yo-Yo Ma's ensemble to premiere in Carnegie Hall last weekend.

MIT prof, alum premiere works

Lynn Heinemann
Office of the Arts

The Silk Road Ensemble, cellist Yo-Yo Ma's multicultural music ensemble, performed new works by two MIT-affiliated composers in New York's Carnegie Hall on Sept. 16 and 17. The pieces were world premieres for MIT composers Evan Ziporyn and Christopher Adler.

Ziporyn, the Kenan Sahin Distinguished Professor of Music, was one of three established composers commissioned by Carnegie Hall to write new works for Silk Road, whose members play various string and percussion instruments indigenous to cultures around the world.

Adler (S.B. 1994) was one of two emerging composers commissioned to write for the weekend festival, "Tradition and Innovation," held in Carnegie's Zankel Hall.

The concerts were a culmination of a two-part workshop in which Ziporyn and Adler joined Ma, Silk Road Ensemble members and musicians from Azerbaijan, China, India and Iran to explore musical traditions and innovation through the study of existing and newly commissioned works.

Launched by the internationally acclaimed cellist Ma in 1998, the Silk Road Project seeks to revitalize the musical and other artistic cultures along the ancient trading route between China and the Mediterranean.

Ziporyn, who has been involved with Balinese gamelan since taking a Fulbright Fellowship in Indonesia in 1987, is internationally recognized for his works combining Balinese gamelan with Western instruments and electronics. He founded the MIT-based Gamelan Galak Tika in 1993 and continues to direct the ensemble, which toured Bali in 2005.

Adler, one of Ziporyn's first students at MIT, was active in Galak Tika as one of its three original members. Since graduating with joint degrees in math and music, Adler has become an accomplished composer and a foremost performer of new and traditional music for the khaen, a free-reed mouth organ from Laos and northeast Thailand.

"His talent and passion for music were absolutely evident even then," Ziporyn said of his former student, now an associate professor at the University of San Diego. "I now consider him a friend and colleague."

Ziporyn's Silk Road composition, "Sulvasutra," was written specifically for two master musicians, Indian tabla player Sandeep Das and Chinese pipa virtuoso Wu Man, and a string quartet. Ziporyn based his work on an ancient Sanskrit treatise giving the mathematical rules for the proper construction of sacred Vedic altars.

"I was asked to pick an ancient story and I chose one about math and engineering," says Ziporyn, who learned that "without the proper proportions, the temples cannot be considered sacred and, more to point, won't do the job."

Currently on sabbatical, he will premiere his bass clarinet concerto, "Big Grenadilla," with the American Composers Orchestra in Carnegie Hall on Oct. 13.

Adler's composition, "Music for a Royal Palace," pays homage to Thailand's Bang Pa-In Palace, an opulent 19th-century juxtaposition of Thai, Chinese and Western architectural styles.

NEWS YOU CAN USE

Student life grants

The Graduate Students Office is seeking proposals for Graduate Student Life Grants. Grants will be awarded for creative ideas for enhancing the graduate student experience. The deadline for proposals is 5 p.m. on Oct. 13. More information is available at web.mit.edu/gso/community/grants.html.

Travel Vendor Fair

The Eighth Annual Travel Vendor Fair will be held on Tuesday, Sept. 26, in Lobby 13 from 10 a.m. to 2 p.m. Individuals who travel on MIT business or are responsible for making travel arrangements will find this event informative.

AWARDS & HONORS

Mujid Kazimi, director of the MIT Center for Advanced Nuclear Energy Systems, will be honored at the inaugural gala of the American Task Force on Palestine. The Oct. 11 gala in Washington, D.C., will recognize the accomplishments of leading Palestinian Americans in government, commerce and industry, and scholarship.

Erich P. Ippen, the Elihu Thomson Professor of Electrical Engineering and professor of physics, has been awarded the Frederic Ives Medal/Jarus W. Quinn Endowment by the Optical Society of America. Ippen received the award, the highest conferred by the society for overall distinction in optics, for laying the foundations of ultrafast science and engineering and providing vision and sustained leadership to the optics community.

Sloan MarketLab ponies up ideas for Lauren's Polo

Sasha Brown
News Office

Last semester, four MIT Sloan students found a way to bring some of Polo Ralph Lauren's many Internet shoppers back to the high-end designer's retail store: They devised an interactive kiosk that remembers consumers and addresses them personally.

"It is a new kind of customer experience," said Petra Gospodnetic, a Sloan student and one of four M.B.A. candidates who worked for Ralph Lauren during their spring semester as part of MarketLab, a program run by the Sloan Marketing Club.

MarketLab students work in teams on marketing-related consulting projects for partner companies. The students gain experience and sponsorship money or academic credit.

This was the first year that Polo Ralph Lauren (PRL) retailers, a luxury line of clothing, fragrance and more, signed on to be part of the MarketLab. Jeffrey Steinberg (M.B.A. 1991) is the vice president of database marketing and the chief privacy officer for the label.

"It is great that Sloan alumni come back to work with Sloan students. It was a very encouraging environment," said Daya Fields, another member of the PRL team. "It says a lot about the Sloan program."

The team of four, which also included Sloan students Marshall Einhorn and Priya Gandhi, was tasked with finding a way to use interactive kiosk-stations featuring touch screens and computer technology to draw more customers to the store.

The MIT Sloan team was asked to focus on the development of a transactional kiosk that would increase customer loyalty, provide a source of entertainment for customers and increase sales.

The team traveled to a number of sites, including New York, Chicago, Rhode Island and Boston. They looked at Polo Ralph Lauren stores, but they also looked at the way different kinds of stores used kiosk technology.

"We watched people at kiosks in stores that sell groceries, discount items, luxury cars, home décor, office supplies, electronics and more," said Fields. "We gathered a lot of information by visiting sites."

They looked at the size of the kiosks, their locations in the store, their capabilities, even the way they blended in with the surrounding motif. After extensive research, the team summarized its findings and presented its recommendations to senior management at PRL in New York. Their suggestions included a wide range of ideas, including the use of "virtual clothing models" (VCM) that the customer can build at the kiosk. The VCMs would simulate each customer's body shape so he or she can "virtually" see how selected clothing styles would look.

"It cuts out a lot of the try-on time," explained Gospodnetic. Additional suggestions included using the kiosk to highlight the fall line during the summer, when only summer clothes are in the store. To build brand loyalty, the team suggested a point system that would allow customers to earn shopping points every time they purchase from the Ralph Lauren family of brands. Customers could use the kiosks to check their points.

Overall, the PRL senior management was very encouraging, said Fields and Gospodnetic. In fact, the PRL brand has incorporated many of their suggestions into a kiosk in one of its retail locations.

PHOTO / **PATRICK McGARVEY**

Sloan MarketLab students Daya Fields (left) and Petra Gospodnetic spent last semester on a volunteer marketing project for the luxury brand Polo Ralph Lauren.