MASSACHUSETTS
INSTITUTE
OF TECHNOLOGY

Chemical Engineering Alumni News

Spring 2009
Course X

Room 66-350 · Fax: 617.258.8992

FROM THE HEAD OF THE DEPARTMENT...

Professor Klavs F. Jensen
Head, MIT
Chemical Engineering

Welcome to the Spring 2009 edition of the Alumni Newsletter. It is a pleasure to have this opportunity to update you on the Department and to seek your input on how we can improve our educational programs. The Department continues to maintain its leadership role in the profession as the top ranked undergraduate and graduate programs, with high productivity and visibility in teaching and research.

This past summer **Paula Hammond** assumed the position of Executive Officer as **Greg Rutledge** stepped down for a well deserved sabbatical leave. Over the past four years, Greg has been a terrific Executive Officer, handling teaching and space assignment with fairness and consideration for the Department needs as well as the wishes of the faculty. He has expertly guided renovation projects while redefining and invigorating the undergraduate committee. Importantly, Greg, with the help of Barry Johnston, did a tremendous job leading the Department successfully through the ABET accreditation process. Our two main undergraduate degrees, Courses X and X-B, have both been accredited for another six years. This is the first accreditation for the new X-B program, chemical-biological engineering. The Department is grateful to Paula for taking on the important Executive Officer function. She brings a long list of accomplishments, experiences, and personal skills to the job, including chairing the Institute's Initiative on Faculty Race and Diversity.

The ability to attract the very best graduate students is critically important to the Practice School and doctoral programs. Thanks to the efforts of **Arup Chakraborty** and the graduate committee, we had an excellent year recruiting a large and talented class of graduate students. The generous external support of these programs through graduate fellowships is an essential asset in our effort to attract the very best students. Beyond its value as a recruiting tool, funding for graduate fellowships is an essential element of our graduate educational philosophy. By providing fellowship support for Practice School students and first year doctoral students, we enable the students to focus on the core subjects of chemical engineering and explore the breadth of research opportunities before choosing a thesis topic. The Department also enjoyed a successful year of recruiting new faculty who will join the Department in 2010 after completing their postdoctoral work. **Brad Olsen** will bring expertise in the fields of polymer physics, functional polymer nanopatterning and self-assembly. He did his PhD on copolymers at Berkeley with Rachel Seagelman, and he is currently doing his postdoc with David Tirrell at Caltech. **Yuri Roman-Leshkov** conducted his graduate work on catalytic conversion of biomass with Jim Dumesic at the University of Wisconsin, and he is currently doing a postdoc with Mark Davis, also at Caltech.

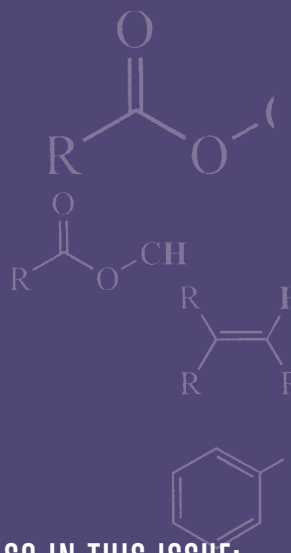
Congratulations to **Bernhardt Trout**, who was promoted to Full Professor February 2008. Since being granted tenure, Bernhardt has made highly recognized contributions to new research directions, specifically nucleation, reaction coordinates in complex systems, and protein stabilization. He has led the formation of the Novartis MIT Center for Continuous Manufacturing and also played a leadership role in the establishment of the Singapore MIT Program in Chemical and Pharmaceutical Engineering, which he co-chairs.

Congratulations also goes to **Patrick Doyle**, who was awarded tenure in July of 2008. Since joining the Department, Pat has developed an exciting, broad, and cutting-edge research program in polymer and colloidal particle dynamics aimed at understanding the dynamics of single polymers and colloids when subjected to hydrodynamic flow and electric or magnetic fields. In addition, he has invented a new technique that elegantly combines microfluidics and lithography to create complex materials/microparticles.

Continuing the Department's long tradition of providing leadership to the Institute, **Karen Gleason** was named the School of Engineering's first Associate Dean for Research. She will be the first faculty member to occupy the position. As Associate Dean, Karen will coordinate the research activities of the school's academic units, centers, laboratories, and programs. The School of Engineering faculty oversee approximately $250 million of research activity each year, about three-quarters of which is administered by the school's nine academic units and 15 centers, laboratories, and programs.

see page 15

In Memoriam: Professor Emeritus Jack Howard, 1937-2008 (Page 20).



ALSO IN THIS ISSUE:

Practice School News

By Professor T. Alan Hatton

The **David H. Koch School of Chemical Engineering Practice** continues to be a dynamic and unique educational opportunity within the department, attracting top students from around the country and the world. This past year, The Practice School operated stations at a number of companies at various locations. For our Fall 2007 session, we sent two groups of students to stations for the first time. Also for the first time, each of the two groups included three students working towards a dual master's degree from MIT and the National University of Singapore. Thank you to all our host companies who have helped provide the kind of education that only these hands-on, real-world challenges can offer.

First, I'd like to tell you about our students' experiences during the summer of 2007. Seven students interned at the Cargill Station (Wayzata, Minn.) in June and July 2007. Our host organization at Cargill continues to be the Process Solutions Technology Development Center, a group that specializes in process simulation, economic estimation, and new technology and product development. The students performed projects in the areas of process development (cost analysis of a potential business, lab work to support a proposed process change, exploration of a novel sidestream treatment, flowsheet for raw material recovery, lab work on alternative purification schemes) and tool development (creating a unit operation model for the simulator library). In June and August, the students traveled to Cabot, where the students made extensive use of their training in fluid mechanics, heat and mass transfer, kinetics, and separation processes. In one project the students modeled the flow patterns and temperature profiles in a novel, high-temperature reactor using both computational fluid dynamic models, and classical fluid flow and heat transfer calculations. The second project involved the chemical modification of carbon black and the separation of unreacted treating agent, by-products, and salts from the treated carbon black. For the third June project, the students modeled the temperature and moisture content of product throughout a pilot-scale mixer-dryer and predicted the performance of a larger production model.

The three Cabot projects in August again involved three very different and technically challenging tasks that called upon the students to use their training and to learn new skills. In one, students explored ways to transfer solid nanoparticles, dispersed in an aqueous phase, to an organic phase without aggregation. On the second project, the students deduced the size of aggregates dispersed in different liquids using a high-shear viscometer. For the third project, the students developed a model of a roll mill, used to treat a rubber product, and correlated its performance to incoming material properties, and the geometry of the roll mill and its operating conditions.

For the Fall of 2007, our students in Group 1 traveled to BASF in Ludwigshafen, Germany, and worked under the supervision of director Robert Laurence. This was the first station ever held at BASF Ludwigshafen, one of the largest chemical production facilities in the world. Eight students participated in two sessions containing three projects each. In the first session, the first project dealt with devolatilization of lattices, a second covered the development of a model for production of lower olefins via Fischer-Tropsch, while the third was on the development of a VBA tool as a front end for Aspen simulations to study parametric sensitivity of processes. The results of this last project were used in the second session to quantify Process Over-design, while the other projects dealt with an integrated model for two-phase dispersions, and acetylene production from sodium carbide.

For the second station, they moved to GlaxoSmithKline in Raleigh-Durham, N.C., supervised by Claude Lupis. This was the third station at GSK, but the first at the company's Research Triangle Park site. Two of the projects conducted lasted the two sessions of the station. The first project was on continuous blending in solid dose product manufacture. Compared to the traditional batch processes of the pharmaceutical industry, continuous processes offer distinct cost advantages. The students developed a model to quantify and optimize the blending operation and their experimental validation of the model yielded encouraging results. In the second project, also lasting eight weeks, the students developed an improved thermodynamic model to guide GSK's film coating operations. The third project in the first session was on tablet characterization by near-infrared spectroscopy, while the third project of the second session was on the analysis of a high-shear blending operation.

Our second group began their Practice School experience at General Mills in Plymouth, Minn., under director Robert Fisher's supervision. GM's Big G division has provided numerous Practice School projects over the years focused on improvements in these recognized cereal brands. These most recent efforts were based at their James Ford Bell Technology Center (JFB TC) in Golden Valley, Minn.; a suburban area in close proximity to center city Minneapolis, and with the Riverside TC, a Pillsbury facility in downtown Minneapolis on the Mississippi River front.

The GM projects continued to focus on process intensification and technology assessment efforts requiring a thorough understanding and application of fundamental chemical engineering principles. Transport mechanisms and temperature profiles within the multiple components

of a food matrix comprised two projects. Another project involved technology assessment of a continuous fermentation system. The operational principles are confidential; however, I can say that various growth kinetics models were evaluated, as was the stability of the multiple steady states. The remaining projects involved coating operations with subsequent drying and crystallization.

Group Two then traveled to Singapore, where they worked under Director Gregg Beckham's supervision at both GlaxoSmithKline and Shell. At GSK, the first project was a quantitative assessment of practices and methods used during the manufacturing of an active pharmaceutical ingredient. The second project evaluated technical options for recovering a valuable solvent from a new manufacturing process. During the second session at GSK, the project involved a detailed technical and economic evaluation of VOC processing and treatment for the entire site.

The Shell station in Singapore was based at the refinery on Pulau Bukom, an island approximately five kilometers south of Singapore, accessible by ferry. The first project, conducted by two students, comprised an extensive literature review along with preliminary techno-economic analysis of biological routes of sulfur removal from heavy components of crude oil. The second projects consisted of a detailed evaluation of the technical recommendations of the previous project and a comprehensive examination of the impact of upstream sulfur removal on the operations and economics of the refinery.

Spring 2008 marked our fifth station at Novartis Pharmaceuticals in Basel, Switzerland, where the students worked under the direction of Claude Lupis. Seven students attended and worked on two projects. The first was on the technical assessment of continuous manufacturing technologies in the pharmaceutical industry. Novartis is pioneering the development of continuous manufacturing to replace batch processing, as evidenced by its commitment to the Novartis-MIT Center for Continuous Manufacturing, a 10-year research collaboration aimed at transforming pharmaceutical production. The students examined both traditional operations such as crystallization, solids filtration, granulation, and blending as well new innovative operations and techniques. The second project conducted feasibility studies for several specific drugs developed by Novartis and included varying process flow sheets with associated capital and operating costs. The compositions of the teams working on the two projects were changed in the second four-week session.

This group journeyed on to their next station at BP in Naperville, Ill., where they were supervised by Robert Fisher.

The Spring 2008 Novartis Practice School Group takes a break in Colmar, France: from L to R: Daniel Trahan, Michael Harper, Minglin Ma, Jen Seto, Claude Lupis (director), Jing Tang, and Amanda Engler.

Six projects with the Chemicals (A&A) division comprised this eight week endeavor. The projects focused on process intensification and technology assessment.

One was directed to determining the viability of implementing a zero liquid discharge (ZLD) concept to a proposed facility in a water stressed area. The other five involved use of Aspen (EO & CM) software to predict performance for alternative separation system reconfigurations and the assessment of competitor technologies.

Once again, we held an Awards Banquet for the Practice School in the fall of 2007, attended by about 180 diners, including industrial sponsors, MIT administration officials, and students, faculty and staff from the department. Following a very entertaining and educational presentation by our after-dinner speaker, Monty Alger, we presented a number of awards to students for outstanding performance in the Practice School projects. The recipient of the Vivian Award was Tanguy Chau. Christopher Marton was rewarded for his enthusiasm for the program by receiving the Tester Award. Abhinav Akhoury was recognized for his personal generosity, integrity, and commitment to the program through the Wojtowicz Award. Finally, Daniel Trahan and Michael Harper shared the Rousseau Award for Leadership and Ethics in Chemical Engineering Practice.

I'm proud to share with you our students' successes; the 2007-2008 academic year continued our tradition of innovative approaches to chemical engineering education. We could not do this without the partnership and enthusiasm of our host organizations. Not only do they help to reinforce chemical engineering applications, but they exemplify the passionate and collegial culture of our discipline. We look forward to future industrial collaborations!

A preview of what's to come: Fall 2008 marked a milestone for the Practice School. For the first time, we opened a station in India, at Mawana Sugars in Delhi and directed by William Dalzell. I look forward to the next newsletter, and sharing with you their work and adventures. ☐

2007 Chemical Engineering Fellowships

A Star Graduate Fellowship
Thuy tram Dang
Univ. of IL Urbana-Champagne

Alkermes Fellows
Qing Han
Tsinghua Univ.
Matthew Stuber
Univ. of MN Minneapolis

Amoco Graduate Student Support
Justin Quon
Univ. of Delaware

Atofina Chemicals Graduate Support
Stephen Chapin
Yale Univ.

Bayer Professorship
Bradley Niesner
Rice. Univ.

Frederic A. L. Holloway '39 Fellow
Ardemis Boghossian
Univ. of MI Ann Arbor

Kwanjeong Educational Fund
Ki Wan Bong
Seoul Nat'l Univ.

Samsung Fellowship
Jinyoung Baek
Seoul Nat'l Univ.

ChE Practice School Fellows
Shreerang Chhatre
IIT Bombay
Joshua Moskowitz
Cornell Univ.
Christopher Pritchard
Oxford Univ.
Jose Rodriguez Vasquez
Univ. Nac. San Agustin
Jit Hin Tan
Cornell Univ.

Edwin R Gilliland '33 Fellow
Irene Chen
Univ. of WI Madison

William & Margaret Rousseau Fellows
Johsua Middaugh
PA State Univ.

David H. Koch (1962) Fellows
Blair Brettmann
Univ. of TX Austin
Woo Chung
Northwestern Univ.
Adel Ghaderi
Virginia Tech
Rajat Suri
Univ. of Waterloo

Haas Family Fellows
Gerald Adler
MIT
Jinyoung Baek
Seoul Nat'l Univ.
Thuy tram Dang
Univ. of IL Urbana-Champagne
Yuan Gong
CA Inst. of Technology
Patrick Heider
Rensselaer Polytechnic Inst.
Jason Moore
GA Inst. Of Technology
John Rhoden
NC State Univ.
Jingqing Zhang
Tsinghua Univ.
Yuxi Zhang
Univ. of CA Berkeley

Robert T. Haslam (1911) ChE Fellows
Yang Chen
Tsignhua Univ.
Yin Fan
Tsinghua Univ.
Huai-ying Hsi
Nat'l Taiwan Univ.
Brad Leonhardt
Univ. of FL
Byron Masi
Johns Hopkins Univ.
Sandra Tjokro rahardjo
Univ. of CA Berkeley
Pedro Valencia
Univ. of WI Madison
Sze Wong
Univ. of CA San Diego

George M. Keller (1948) Chevron Fellow
Adekunle Adeyemo
Univ. of Lagos

Landau ChE Practice School Fellows
Tobias Sidelmann Christensen
Technical Univ. of Denmark
Adam Madlinger
MIT
Miguel Modestino
MIT
Yee Lin Pow
Univ. of IL

R. C. Reid (1954) & G. Williams Fellow
Joshua Allen
Univ. of MN Minneapolis

H. (1953) & L. Stern Prac. School Fellow
Brian Downs
Auburn Univ.

Tae-Sup Lee Graduate Fellow
Ki Wan Bong
Seoul Nat'l Univ.

Jerry (1940) & Geraldine Mcafee Fellows
Jaisree Iyer
IIT Bombay
Adebola Ogunniyi
Rutgers Univ.

MITSCEP 1936 Course Xa Fellow
Himanshu Dhamankar
Univ. of Mumbai

Robert J. Richardson (1954) Fellow
Rajat Suri
Univ. of Waterloo

Charles & Hilda Roddey Fellow
Vikramaditya Yadav
Univ. of Waterloo

Keith & Helen Rumbel Fellow
Vinay Raman
IIT Madras

Adel F. Sarofim (1962) Fellow
Emily Chang
Univ. of PA

Arch Chilton Scurlock (1943) Fellow
Michael Petr
IA State Univ.

Frank Hall Thorp Fellow
Adel Ghaderi
Virginia Tech

Wechsler Graduate Fellow
Rebecca Ladewski
Univ. of Notre Dame

Rosemary Wojtowicz Fellow
Blair Brettmann
Univ. of TX Austin

David S. Y. Wong (1962) Fellow
Jingqing Zhang
Tsighua Univ.

DuPont Fellow
Emily Chang
Univ. of PA

Lemelson Presidential Fellow
Jennifer Njoroge
Carnegie-Mellon Univ.

GEM Fellow
Jennifer Njoroge
Carnegie-Mellon Univ.

John C. Sluder (1941) Fellow
Shujauddin Changi
Mumbai Univ. Inst. Of Chemical Tech.

George M. Keller (1948) Fellow
Sarah Bashadi
Univ. of KY

John Henry Grover (1948) Fellow
Jyoti Goda
IIT Bombay

Robert T. Haslam (1911) Presidential Fellows
Patrick Heider
Rensselaer Polytechnic Univ.
Rebecca Ladewski
Univ. of Notre Dame
Justin Quon
Univ. of Delaware
John Rhoden
NC State Univ.

Walsh (1937) Memorial Presidential Fellows
Joshua Allen
Univ. of MN Minneapolis
Stephen Chapin
Yale Univ.
Thuy tram Dang
Univ. of IL Urbana-Champagne
Yuan Gong
CA Inst. of Technology
Jason Moore
GA Inst. of Technology
Michael Petr
IA State Univ.
Yuxi Zhang
Univ. of CA Berkeley

NSF Fellows
Rebecca Ladewski
Univ. of Notre Dame
John Rhoden
NC State Univ.

Practice School Awards for Outstanding Performance

Rosemary J. Wojtowicz Award
Abhinav Akhoury

J. Edward Vivian Award
Tanguy Chau

Jefferson W. Tester Prize
Christopher Marton

William C. Rousseau Award for Leadership and Ethics
Daniel Trahan
Michael Harper

Awards Day

By Mary Wesolowski, Graduate Student Coordinator

The Department Awards Ceremony took place on May 12, 2008, in the Gilliland Auditorium of the Ralph Landau Building. We are pleased to recognize this year's recipients of the Outstanding Faculty Awards: **Professor Daniel Blankschtein** was the graduate students' choice and **Barry Johnston** and **Professor Herbert Sawin** were selected by the undergraduate students.

The Edward W. Merrill Outstanding Teaching Assistant Award was presented to graduate student **Patricio Ramirez Munoz** for his work in 10.490 and 10.493 Integrated Chemical Engineering. It was also presented to **Jit Hin Tan** for his work in 10.10 Introduction to Chemical Engineering. The Outstanding Graduate Teaching Assistant Award was presented to **Salmaan Baxamusa** for his service to 10.34 Numerical Methods Applied to Chemical Engineering and to **Amanda Engler** for her work in 10.40 Chemical Engineering Thermodynamics.

Chemical Engineering Special Service Awards were conferred to the members of the Graduate Student Council: **Amanda Lanza, Mahriah Alf, Miles Barr, Daniel Bonner, Tanguy Chau, John De Rocher, Michael Johnson, Ben Lin, Jordi Mata-Fink, Nicholas Musolino, Kevin Nagy, Arvind Prabhakar, Joseph Scott, Anita Shukla, Kevin Soloman, Su Kyung Suh** and **Mitchell Tai**. In addition, **Kevin Krogman** was awarded the Chemical Engineering Rock for outstanding athleticism and **Amanda Lanza** was recognized for her year as president of the Student Chapter of the American Institute of Chemical Engineers. All third-year graduate students are required to present a seminar on the progress of their research, and the two recipients of the Award for Outstanding Seminar were **Melanie Chin** and **Daniel Klein-Marchuschamer**.

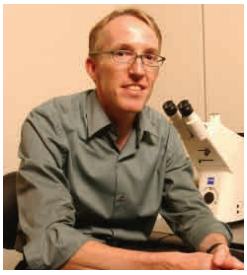
Our undergraduates also earned numerous accolades over the course of the year. The Merck Fellowship Award was presented to **Jennifer Yeh** in recognition of her scholastic excellence. **Jennifer Yeh** was also the recipient of the National Goldwater Scholarship Award. **Jennifer Resvick** was presented with the Cunningham Scholar Award, given to promote women in engineering. The Robert T. Haslam Cup, which recognizes outstanding professional promise in chemical engineering, went to **Nina Mann**. The department's oldest prize, the Roger de Friez Hunneman Prize, is awarded to the undergraduate who has demonstrated outstanding achievement in both scholarship and research; this year it went to **Darren Verploegen**.

Department Head Klavs Jensen presents the Haslam Cup to Nina Mann.

The department is quite pleased to recognize **Linda Mousseau** and **Barbara Driscoll** as the Department's Outstanding Employees of the Year for their dedication and exceptional service to faculty, staff, and students. The School of Engineering Infinite Mile Award went to department member **Steve Wetzel**, Manager of Engineering Facilities.

New Faculty Appointments

In the Department of Chemical Engineering



Professor Patrick S. Doyle Earns Tenure

Congratulations to **Professor Patrick Doyle**, who was awarded tenure in July 2008. Professor Doyle is a chemical engineer with a very broad and deep background in the areas of complex fluids, specifically polymer and colloidal dynamics, and microfluidics. His Brownian dynamics research modeling polymer molecules as Kramers chains is very well known in the non-Newtonian fluid mechanics literature and is already considered as a classic reference work in that area.

Since joining the department, Professor Doyle has developed an exciting, broad, and cutting-edge research program in polymer and colloidal particle dynamics aimed at understanding the dynamics of single polymers and colloids when subjected to hydrodynamic flow and fields (electric or magnetic). His research in the field of polymer and colloidal particle dynamics has had significant impact by developing new spring-based models for modeling polymers and developing micro/nano-fluidic technologies in order to map single DNA molecules and to understand fundamental issues concerning confined polymers. In addition, he has invented a new technique that elegantly combines microfluidics and lithography to create complex materials/microparticles; and on the basis of this method, he developed new approaches to perform highly multiplexed biomolecule detections using barcoded microparticles.

Professor Doyle has made several educational contributions to the department and to MIT. He has offered a new freshman-sophomore IAP subject on microfluidics (Hands-on-ChE: An Introduction to ChE Using Microfluidics), and developed a new undergraduate subject on "Molecular Engineering." In all of his teaching, he has played a key role in bringing molecular understanding to the students.

We applaud Professor Doyle for this well-deserved promotion.

Professor Bernhardt Trout promoted to full professor and named director of the Novartis-MIT Center

In February 2008, **Professor Bernhardt Trout** '90 was promoted to full professor. Professor Trout is unique in chemical engineering by spanning molecular structure computations and statistical mechanics. He develops and applies the necessary range of techniques required for a particular study of fundamental phenomena and practical applications representing hard, important problems. He emphasizes the need for verifiable and predictive theories/computations and has close collaborations with experimentalist as well as his own experimental program.

Since tenure, Professor Trout has made outstanding, highly recognized contributions to new research directions, specifically nucleation, reaction coordinates in complex systems, and protein stabilization. He has a balanced educational presence ranging from conducting freshman advising seminars, to developing an advanced graduate elective and mentoring a large group of doctoral and UROP students. He has also been an active leader in shaping the new curriculum in chemical engineering. He played an important role in the establishment of the SMA 2 program in chemical and pharmaceutical engineering, which he co-chairs.

On September 28, 2007, Dr. Daniel Vasella, Chairman and CEO of Novartis, and MIT President Susan Hockfield inaugurated the Novartis-MIT Center for Continuous Manufacturing, and named Professor Trout as the director. The Center combines the industrial expertise of Novartis with MIT scientific and technological innovation with the aim of transforming conventional batch-based systems in the pharmaceuticals industry to continuous manufacturing processes. Novartis will invest $65 million in research activities at MIT over the next 10 years. Professor Trout led the formation of the center, while the initial research projects involve additional faculty from chemical engineering (**Charlie Cooney, Alan Hatton, Klavs Jensen, Greg McRae**) and chemistry (Steve Buchwald).

Professor Karen K. Gleason becomes School of Engineering's first Associate Dean for Research

In April 2008, **Professor Karen Gleason** was named MIT's first associate dean of engineering for research by Dean Subra Suresh.

As reported by MIT's *TechTalk*, Professor Gleason, '82, SM '82, will be the first faculty member to occupy the position, which was created in response to the strong recommendation last year from the faculty search advisory committee for the dean of engineering. In this capacity, she will coordinate the research activities of the school's academic units, centers, laboratories, and programs and will also serve as the school's administrative contact person for interfaces with the research units administered by the Office of the Vice President for Research.

School of Engineering faculty oversee approximately $250 million of research activity each year, about three-quarters of which is administered by the school's nine academic units and 15 centers, laboratories, and programs.

"I look forward to working with Karen and with the School's faculty to improve and enhance the School's research effectiveness," Dean Suresh said.

Professor Gleason is an internationally recognized expert in chemical vapor deposition of polymer thin films by plasma enhanced and hot-filament methods. Her pioneering research makes it possible to tailor coatings for new functionality on a wide variety of both new and traditional substrates for diverse applications. She is also an international leader in the development of solid-state nuclear magnetic resonance spectroscopy and its applications in microscopic characterization of solid-state materials. ⊡

Blast from the Past

Below are photos culled from the MIT Chemical Engineering archives. Are you or anyone you know in them? Email ***melmils@mit.edu*** if something is familiar!

A special thank you to **Ed De Sa (SM '59)** for pointing himself out in his Practice School Group photo in the Spring 2007 Newsletter!

Faculty Awards Highlights

In the Department of Chemical Engineering

Kristala Prather named Technology Review Young Innovator

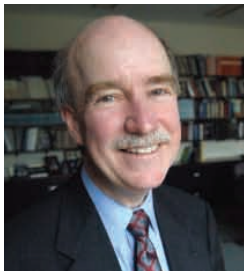
Professor Kristala Jones Prather '94 was named one of Technology Review's Young Innovators under 35 for 2007, for her strategic work in the biological synthesis of commercial molecules. The magazine stated that "Such techniques could provide environmentally cleaner ways to manufacture everything from biofuels to drugs, avoiding the harsh solvents and toxic by-products associated with more conventional synthesis."

Alumnus Chris Loose (PhD '07) also won this award.

Arup Chakraborty receives IIT Kanpur Distinguished Alumnus Award

Professor Arup K. Chakraborty received the 2007-2008 Distinguished Alumnus Award (DAA) of the Indian Institute of Technology Kanpur (IIT) for his "outstanding contributions to the field of Chemical Engineering."

The IITK DAA is the highest award given by the Institute to its alumni in recognition of their achievements of exceptional merit. Other recipients for 2007-2008 include Dr. Ravi Seth, President of Avaya Laboratories, and Professor Ashok Sinha, Chairman of Bharat Petroleum.



Robert C. Armstrong elected to National Academy of Engineering

Professor Bob Armstrong was recognized for conducting outstanding research on non-Newtonian fluid mechanics, co-authoring landmark textbooks, and providing leadership in chemical engineering education.

Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to "engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature," and to the "pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education."

Klavs F. Jensen garners two national awards

In October 2007, **Professor Klavs Jensen** was named a Fellow of the American Association for the Advancement of Science. He was cited for "the elegant use of detailed simulations of reactive systems to gain new insight into the underlying basic physical and chemical rate processes."

Professor Jensen was also deemed a 2008 Fellow of the American Academy of Arts and Sciences. His fellowship class included Michael Dell, James A. Baker III, Ethan and Joel Coen, and B.B. King.

Michael Strano receives 2007 Unilever Award

Professor Michael Strano received the 2007 Unilever Award for Outstanding Young Investigator in Colloid & Surfactant Science. The Unilever Award is presented annually by the ACS Colloid & Surface Chemistry Division to recognize and encourage fundamental work in surface or colloid chemistry carried out in North America by researchers in the early stages of their career. The prize consists of $3,000, a plaque, and $1,000 for travel expenses to the meeting where the award is presented.

Professor Strano's research focuses on synthesis, characterization, and separation of carbon nanotubes for their ultimate assembly into systems and devices for specific applications. He delivered a talk, "Understanding and Exploiting the Surface Chemistry of Single-Walled Carbon Nanotubes," at the 81st Colloid & Surface Science Symposium in June 2007 at the University of Delaware.

Professor Strano also won the Materials Society Young Investigator Award, was named an Office of Naval Research Young Investigator, and is a Sloan Research Fellow.

Robert S. Langer wins four major awards

Institute Professor Bob Langer was recognized throughout 2007 and 2008 for his work in drug delivery. He was awarded the National Medal of Science by President Bush; the 2007 Max Planck Award, Germany's highest science prize; the 2008 Prince of Asturias Award for Technical and Scientific Research for the "creation of new materials for the benefit of mankind;" and the 2008 Millennium Technology Prize.

Professor Langer is renowned for his revolutionary work on new and different ways to administer drugs to cancer patients. At MIT, he runs the largest biomedical engineering lab in the world. He holds more than 550 issued and pending patents and has written some 900 research papers.

Greg Stephanopoulos wins 2007 AIChE Founders Award

The 2007 American Institute for Chemical Engineer's (AIChE) Founders Award for Outstanding Contributions to the Field of Chemical Engineering went to **Professor Greg Stephanopoulos**, in recognition of his outstanding contributions in the chemical engineering field.

The AIChE Founders Award is presented annually to a member of AIChE who has had an important impact on chemical engineering and whose achievements, either specific or general, have advanced this profession in any of its aspects. The recipient has a long and distinguished record of service to the profession, including both technical and professional activities.

Professor Emeritus János Beér given top Hungarian honor

In March 2008, **Professor János Beér** received the award of The Knight's Cross of the Order of Merit of the Hungarian Republic. This award of the President of Hungary was given at the joint recommendation of the Academy of Sciences and the Hungarian Electric Power Generating Industry in recognition of his many contributions to combustion and international cooperation. Professor Beér traveled to his former hometown of Budapest to receive the award. ⊡

Faculty Distinctions

In the Department of Chemical Engineering

Professor Robert Armstrong serves as Deputy Director of the MIT Energy Initiative (MITEI) and worked with the Director, Ernest Moniz, in launching the research, educational, campus, and outreach components of the initiative over its first full year of operation. Nine companies were recruited to sponsor research as members in MITEI. MITEI has raised more than $130 M in research support and 175 graduate fellowships in energy in the first year of its operation. In 2008, Professor Armstrong was elected to the National Academy of Engineering. During this past academic year he gave the Presidential Lecture at the American Dermatological Association and the Barnett F. Dodge Distinguished Lecture in Chemical Engineering at Yale University. He serves on the advisory boards of chemical engineering departments at Georgia Tech, Northwestern University, the University of Washington, the University of Tennessee, and the University of Wisconsin.

Professor Emeritus János Beér continued his membership of the National Coal Council, Advisory Council to the US Secretary of Energy. He was an invited lecturer at the World Conference on the Future of Science in Venice, Italy, at the Hungarian Academy of Sciences in Budapest, at Maryland University's Leaders of Engineering Lecture Series, and at the University of Utah's Conference on the Future of Coal. He received the Hungarian President's Award: *The Knight's Cross of the Order of Merit of the Hungarian Republic*, for his contributions to higher education and research, international cooperation in energy technology, and his lifelong technical scientific achievements in clean combustion of fossil fuels.

Professor Daniel Blankschtein's research group conducts fundamental theoretical and experimental research in the area of Colloid and Surfactant Science, with emphasis on industrial and biomedical applications. Professor Blankschtein's teaching responsibilities included the core graduate course 10.40, Chemical Engineering Thermodynamics, and the interdepartmental graduate course 10.44J, Statistical Thermodynamics of Complex Liquids. Professor Blankschtein and his students delivered talks and presented posters at the 2007 American Institute of Chemical Engineers (AIChE) Annual Meeting, at the 2007 American Association of the Pharmaceutical Scientists (AAPS) Annual Meeting, at the DuPont Experimental Station, at Procter & Gamble, and at the 9th US-Japan Symposium on "Drug Delivery Systems" held in Maui. Professor Blankschtein continues to serve on the Editorial Board of Marcel Dekker's Surfactant Science Series.

Professor Arup Chakraborty's group made significant advances in understanding the adaptive immune response to pathogens, particularly in the area of T cell receptor (TCR) development. Three papers from this research are currently under various stages of review at *Cell* and *PNAS*. In 2008 he received the Distinguished Alumnus Award by the Indian Institute of Technology-Kanpur, the highest award given to its alumni in recognition of their achievements of exceptional merit. His teaching responsibilities included the mandatory graduate course, Chemical Reactor Engineering, and the interdepartmental graduate course, Statistical Thermodynamics with Applications to Biological Systems. Professor Chakraborty served as the Chair of the Graduate Admissions Committee for Chemical Engineering, and was also Chair of the Strategic Planning Council for the School of Engineering. Outside of MIT, he served as Chair of the National Research Council's Committee on Biomolecular Materials and Processes, and delivered over 20 invited lectures.

In December 2007, **Professor Robert E. Cohen** and his team of collaborators from MIT and Edwards Air Force Base published a paper in *Science* that evoked immediate recognition from his peers and a great deal of attention in the popular press. "Designing Superoleophobic Surfaces" (Science **318**, 1618, 2007) demonstrated for the first time robust resistance to wetting by low surface tension liquids such as alcohols and oils. He participated in the organization of novel educational workshops: "MIT-Princeton Microsymposium on Polymers" and "Diverse Leaders of Tomorrow", the latter a 2.5 day event providing mentoring to minority students with aspirations towards academic careers. Cohen continues to administer the activities of the DuPont MIT Alliance.

Professor Charles L. Cooney continued as the Faculty Director of the Deshpande Center for Technological Innovation and chaired the Center's Annual IdeaStream Symposium in May 2008. He continued to serve as the co-lead, representing the School of Engineering, in developing the MIT BP Projects academy, in partnership with the Sloan School of Management. He traveled with the MIT President and others on the MIT India visit in November 2007. Professor Cooney launched the International Innovation Initiative in the Fall of 2007. He is a member of the MIT Community Service Fund Board, the Lemelson MIT Screening Committee, the MIT Committee on Intellectual Property, the Faculty Committee on Staff and Administration,

the steering committee of the Bioengineering section of the MIT Portugal Program, the steering committee of the Novartis MIT Center for Continuous Manufacturing, the Executive Committee at the MIT-Masdar Institute of Science and Technology and the Legatum Center, the Global Studies Committee, and served on the Search Committee for the Dean of Sloan School. He was director of the Downstream Processing Summer course held through the Professional Institute. Professor Cooney is also an Overseer of the Boston Symphony Orchestra and a Trustee of Boston Ballet.

Professor Patrick S. Doyle continued work in the area of fundamental studies of complex fluids in microfluidic flows and fields. He delivered invited lectures at various locations including Cornell and Harvard University, Luminex Corporation, Agilent Corporation, and Kodak. His work on developing a new method for multiplexed detection of biomarkers using barcoded particles continues to advance and was recognized by being denoted a Deshpande Lemelson Foundation Project which has valuable societal impact. He developed and co-taught a new short course on Microfluidics at the Society of Rheology Annual Meeting and he was the program chair for the fluid dynamics section of the American Institute of Chemical Engineering. Lastly, he was a founding Scientific Advisory Board Member of Genome Corporation.

Professor Karen K. Gleason was appointed Associate Dean of Engineering for Research, effective April 2008. This new role follows the completion of a three-year term as the Associate Director of MIT's Institute for Soldier Nanotechnologies (ISN). Last June, she represented the ISN at Emerging Defense Technologies in Paris, France. Her group's research on chemical vapor deposition (CVD) technology of polymeric coatings was the subject of a featured article in the journal, Advanced Functional Materials. Prof. Gleason gave invited presentations in Taipei and Tokyo, as part of the MIT ILP-Epoch Taiwan Symposium and MIT in Japan: 10th Annual Symposium, respectively. Additional invited presentations were given at the 16th European Conference on Chemical Vapor Deposition, held in Den Haag, Netherlands, the American Vacuum Society Meeting in Seattle, Washington, the University of Calgary, the University of Michigan, and Drexel University. She also continued on as Chief Scientific Advisor to GVD Corporation, a start-up company she co-founded seven years ago. Professor Gleason chaired the 5th International Conference on Hot-Wire CVD to be held in Cambridge in August 2008.

Professor William H. Green chairs the steering committee for the MIT Energy Initiative's major project on Conversion with CO_2 sequestration, and is the principal investigator for several other energy research projects. He welcomed eight new members into his research group and published more than a dozen major journal papers in 2008. He continues as the associate editor of the International Journal of Chemical Kinetics, and as the organizer of the sessions on Combustion Reaction Engineering at the national meetings of the AIChE. He served on search committees for faculty positions in three departments, and on the committee which recommended improvements in MIT's Environmental programs.

In the past academic year, **Professor Paula T. Hammond** has published two key research papers that describe electrochemically triggered responsive drug release films and polyelectrolyte multilayer thin film membranes that provide significant improvement in the performance of Nafion in methanol fuel, both of which were featured in the *Technology Review, Materials Today* and in other venues. She was the 2007 Lucy Pickett Lecturer at Mt. Holyoke College, the 2008 Karl Kammermeyer Distinguished Lecturer in Chemical and Biochemical Engineering at the University of Iowa, and the WISEST Visiting Lecturer at the University of Illinois, Chicago. Professor Hammond has also become an Associate Editor for the new American Chemical Society nanomaterials-focused journal, *ACS Nano*, which has just completed its first year of publication. She has given invited talks at several institutions and conferences, including the Foundations of Nanoscience Conference in Snowbird, Utah, the Second US-Poland Workshop on Polymer Science in Gdansk, Poland, and the Koch Institute for Cancer Research 2008 Summer Symposium. Professor Hammond has agreed to serve as the Chemical Engineering Department's new Executive Officer, succeeding Professor Greg Rutledge, as of July 2008. Professor Hammond has also been engaged in several activities directed toward increasing diversity at MIT. She is currently the Chair of the Initiative on Faculty Race and Diversity, which seeks to investigate and address MIT's ability to recruit and to retain underrepresented minority faculty. As the former Chair of the MIT Summer Research Program (MSRP) Redesign Team, she and her fellow committee members, including Assistant Dean Christopher Jones, received the 2008 Irwin Sizer Award for Significant Improvements to MIT Education, presented at the MIT Awards Convocation in May 2008. The MSRP Redesign Team worked to restructure the MSRP program to make it a more effective mentorship and recruiting tool for prospective graduate students at MIT.

Faculty Distinctions

Professor T. Alan Hatton continued to serve as the Director of the David H. Koch School of Chemical Engineering Practice, where he has strived to maintain the international flavor of the program by placing student teams at host companies in Switzerland, Germany, and Singapore; a new station is planned for India this fall. He is also an active participant in the SMA program on Chemical and Pharmaceutical Engineering, and the Novartis-MIT Center for Continuous Manufacturing. Professor Hatton held an appointment as an Honorary Fellow of the University of Melbourne, and is a member of the Scientific Advisory Board of the Particulate Fluids Processing Center at that University, a member of the Advisory Board of the Department of Chemical and Biological Engineering at Tufts University, and a member of the Chemical and Biomolecular Engineering Departmental Review Board for the University of Maryland. Over the past year, he has given a number of invited lectures at ACS and AIChE meetings, and seminars at GE Healthcare (Uppsala, Sweden), University of Waterloo, and DuPont. One of his papers topped the list of most-accessed papers in Langmuir for 2007, and another was among the top 100 most cited in I&EC Research. Professor Hatton chaired a conference on "The Role of Structure in Chemical, Biological and Environmental Separations" (Costa Rica, January 2008), co-organized a symposium at the ACS meeting in Boston, is on the Organizing Committee of the International Solvent Extraction Conference ISEC '08 (Tucson 2008), and on the International Advisory Committees for the Polymer Networks Group (Cyprus 2008) and "International Symposium on Colloids and Surface Science" (Kolkata 2007). He was the Chief Guest at this latter conference, at which he also presented a plenary lecture, in addition to presenting the first in a series of 'Visionary Lectures' at the ISI in Kolkata. He gave a keynote talk at the 'Magnetic Fluids Conference' in Kosice, Slovakia (2007). He is on the Editorial Board of the journal 'Current Opinion in Colloid and Interface Science' and co-editor of the section on 'Applications', and sits on the Board of Engineering Conferences International (ECI).

Professor Klavs F. Jensen continues his research on functional micro- and nano-structured materials and devices for chemical, optical, and electronic applications. With collaborations in chemistry and biology, he has explored a wide range of microfabricated systems for chemical and biological applications with particular emphasis on systems for which microfabrication provides unique process advantages. These systems also form the basis for continuous flow synthesis and separation developments as part of the new Novartis-MIT Center for Continuous Manufacturing. The ability to operate at high pressure and temperature conditions not easily achieved in batch is being exploited in the synthesis of nanoparticles for optical and catalytic applications relevant to energy conversion. During the past academic year, he gave invited/plenary lectures at: the Gordon Conference on Physics and Chemistry of Microfluidics, the Third International Conference on Bioengineering and Nanotechnology, the First European Process Intensification Conference, and the AIChE Annual Meeting. He chaired the international evaluation committee for chemical engineering at Technical University of Denmark, and he continued to serve on the scientific advisory board for the Singapore A*STAR Institute for Nano and Biotechnology, the international advisory panel for Danish research infrastructure, and the steering committee for the International Conference on Miniaturized Chemical and Biological Systems. He was made a fellow of the American Academy of Arts and Sciences and elected to the American Association for the Advancement of Science.

In 2007, **Institute Professor Robert S. Langer** received the National Medal of Science, the Herman Mark Award, the Chemistry of Materials Award from the American Chemical Society, the Wening Memorial Award, and was elected to the Biotechnology Hall of Fame. He received an Honorary Doctorate from Yale University, was named the Alexander Rich Lecturer at MIT, the Shucart Lecturer at Tufts University, the Findling Lecturer at the Mayo Clinic, the Keck Distinguished Lecturer at Lehigh University, and the Ford Lecturer at Case Western University. In 2008, Langer received the Max Planck Research Award, the Acta Biomateriala Gold Medal and was named as a Millennium Technology Prize Laureate. He was also awarded the 2008 Prince of Asturias Award for Technical and Scientific Research by the Fundación Príncipe de Asturias. This is the top award any Spanish institution grants to any citizen, and it is often called the "the Spanish Nobel Prize." He was also the Rohm and Hass Lecturer at the University of California, Berkeley, and the Invitrogen Lecturer at the University of California, San Diego.

Professor J. Christopher Love joined the faculty in September 2007, and established his research laboratory in January 2008. His research is focused on the development of micro- and nanotechnologies for quantitative analysis of immune responses. The lab's first manuscript describing a technique for profiling blood cells from Type I diabetic patients is in press. He delivered invited lectures at Merck & Co., GlycoFi (a Merck subsidiary) and Harvard University. He also participated on the US team of the NSF-MEXT US-Japan Young Researchers Exchange in the area of nanotechnology and was invited to the National Academies Keck Futures Initiative conference on aging, longevity, and healthspan.

Professor Kristala Jones Prather continued research in the areas of metabolic engineering and synthetic biology. She gave invited lectures at the University of Rochester and Carnegie Mellon University, and was the keynote lecturer at the 2nd Annual Fellows Symposium of the Institute for Genomic Biology at the University of Illinois at Urbana-Champaign. She also visited the MIT Club of South Texas (Houston) as their annual Institute lecturer. Professor Prather was awarded one of the first seed grants from the MIT Energy Initiative for the microbial synthesis of new biofuels, and was selected as a Technology Review "TR35" Young Innovator.

Professor Gregory C. Rutledge was named the Lammot du Pont Professor of Chemical Engineering in 2007. He continued his role as the Executive Officer of the Department of Chemical Engineering, with responsibility for space and undergraduate programs in the department. This year he oversaw the first review for accreditation of the new degree program in chemical-biological Engineering (10B) and for re-accreditation of the chemical engineering degree program (10) by the Engineering Accreditations Commission of ABET. He continued to serve on MIT's Computer Space Task Force and is an advisory board member of MIT's High Performance Computing Center Project. He is a member of the editorial board of *Polymer* and is a founding editor of the *Journal of Engineered Fibers and Fabrics*. He delivered invited lectures at the 50th Anniversary Symposium of the Discovery of Polymer Single Crystals in Boston, MA, the Nanostructured Materials and Membrane Modeling and Simulation Workshop in Patras, Greece, and Macro 2008: Polymers at Frontiers of Science and Technology, the world polymer congress of the International Union of Pure and Applied Chemistry, in Taipei, Taiwan, in addition to lectures presented in academia and industry. His research involves the molecular engineering of soft matter through the development of molecular simulations, materials characterization, and electrospinning of polymer nanofibers.

Upon his return from his sabbatical leave at the ETH Zurich, **Professor Gregory Stephanopoulos** continued his research activity as Director of the Laboratory of Bioinformatics and Metabolic Engineering with increased emphasis on biofuels research. Seminal research from previous years is finding its way into critical applications for the efficient production of biofuels from renewable resources. Professor Stephanopoulos also continued his service on the Advisory Boards of six academic institutions and the Managing Board of the Society for Biological Engineering (SBE) that promotes the engineering applications of biology to industry and medicine. He delivered this year's Academy Lecture at the Missouri Science and Technology University and was also honored with the selection as the First Biennial Ken Nobe Lecturer of UCLA. He continued to serve as editor-in-chief of the journal *Metabolic Engineering*, published by Elsevier, and on the Editorial Boards of seven other scientific journals. Besides numerous research presentations at professional societies meetings (AIChE, ACS, ASM), he also delivered plenary and invited lectures at the 13th European Congress of Biotechnology (Barcelona), the 15th Annual International Conference on Microbial Genomics, the XV Biochemical Eng. Conference (Quebec City), the International Conf. on Biorefineries (Beijing), the 2008 AAAS Meeting (Boston), the Joint Annual Meeting of VAAM/GBM Societies (Frankfurt), and a conference on Energy Crisis sponsored by the Italian Academy in Tuscany. During 2008 Professor Stephanopoulos was honored with the C. Thom Award of the Society for Industrial Microbiology and the Founders Award of the American Institute of Chemical Engineers.

Professor Michael S. Strano joined the chemical engineering department this past year and moved his laboratory in the spring of 2007 to the MIT campus. Over the past year, he has focused on rebuilding his program, teaching graduate and undergraduate courses in program 10, and adapting to life at the Institute. Highlights over the past year include winning the 2008 Outstanding Young Investigator Award from the Materials Research Society. He also received a 2008 ONR Young Investigator Award for his proposal on "Short Wavelength Optical Modulators for Undersea Communications via Franz-Keldysh Oscillations in Electronically Sorted Single Walled Carbon Nanotubes." He is also a 2008 Alfred P. Sloan fellow. He had the honor of delivering the Colburn Lecture at the University of Delaware this past semester.

Faculty Distinctions

Professor Jefferson W. Tester's research program focuses on clean chemical processing and renewable energy technologies with increasing emphasis on biomass conversion in hydrothermal media and advanced drilling technology using spallation and fusion methods. This past year, he continued co-chair responsibilities for the Energy Education Task Force as a part of MIT's Energy Initiative (*MITEI*). Professor Tester continued to serve as chair of the National Advisory Council of the US Department of Energy's National Renewable Energy Laboratory and as chair of the Governor's Advisory Committee of the Massachusetts Renewable Energy Trust. He also served on advisory boards for Los Alamos National Laboratory, Cornell University, American Council on Renewable Energy, and the Paul Scherrer Institute of the Swiss Federal Institute of Technology (ETH). Professor Tester chaired a MIT-led assessment of the potential of geothermal energy in the US which led to the release of major report, *The Future of Geothermal Energy*. In response to the findings and recommendations of that report, he provided testimony to the US Congress on three occasions and to the Australian Parliament. Professor Tester also gave invited lectures at Southern Methodist University, The National Resource Council, The Future of Science Conference in Venice, The Rome Festival of Science, University of Puerto Rico, Cornell University, Iowa State University, the World Energy Conference, and the Washington International Renewable Energy Conference.

Professor Bernhardt L. Trout set up major new projects with biopharmaceutical companies, including the new Novartis-MIT Center for Continuous Manufacturing, which began in Summer 2007. He has revamped and has been running the SMA CPE program (Chemical and Pharmaceutical Engineering). He is a member of the Committee on the Undergraduate Program, as well as multiple other Institute and Departmental Committees. He has been the invited or keynote speaker in various conferences on protein stabilization and pharmaceutical manufacturing.

Professor Daniel I.C. Wang was the Co-Chairman for the International Organizing Committee at the 13th International Biotechnology Symposium in Dalian, China. He was awarded the Honorary Professorship at East China University of Science and Technology, Shanghai, China. He delivered the Keynote Lecture at the Industrial Biotechnology International Conference, Naples, Italy. He participated and delivered an address at the NSF/China Workshop on Energy and Environment in Tianjin, China. He continued to hold the Distinguished Temasek Professorship at the National University Singapore. He participated in the MIT/Portugal Program and presented a two week course in Lisbon, Portugal. Lastly, the Journal of *Biotechnology and Bioengineering* honored him with its latest award, *Daniel I.C. Wang Award*, for the most outstanding publication for investigators under 35 years of age. ▫

Professor Klavs Jensen from page 1

The Department's research volume has increased to $33 million with many new research efforts, in particular in the MIT Energy Initiative (MITEI) and the new Novartis-MIT Center for Continuous Manufacturing. New efforts in energy include biofuels (**Kristala Prather, Greg Stephanopoulos**), fuel cells (**Paula Hammond**), solar cells (**Paula Hammond, Michael Strano**), and gas to liquids (**Bill Green, Klavs Jensen, Greg McRae**). **Bob Armstrong** continues at deputy director of the MITEI, expanding research opportunities for MIT faculty to address worldwide energy challenges. The MIT–Novartis Center, directed by **Bernhard Trout**, aims to transform conventional batch-based systems in the pharmaceuticals industry to continuous manufacturing processes. The research projects involve five faculty members from chemical engineering (**Paul Barton, Charlie Cooney, Alan Hatton, Klavs Jensen, and Bernhardt Trout**) along with colleagues from chemistry and mechanical engineering all working in close collaboration with their Novartis counterparts.

Biological research also continues to flourish in **Arup Chakraborty's** NIH-funded consortium on immune response along with other related intiatives. A new multidisciplinary program in microbiology involves several members from the Department. As mentioned above, the biofuels efforts in the Prather and Stephanopoulos laboratories are active contributors to the MIT Energy Initiative programs.

The Department continues to see many exciting research results. **Bob Cohen, Greg Rutledge**, and their team have designed the first simple process for manufacturing materials that strongly repel oils. The material, which can be applied as a flexible surface coating, could have applications in aviation, space travel and hazardous waste cleanup. The Hammond lab has developed a new thin-film coating that can deliver controlled drug doses to specific targets in the body following implantation, essentially serving as a "micro pharmacy." **Michael Strano** and his collaborators have built the most sensitive electronic detector yet for sensing toxic gases such as the nerve agent sarin. To build this super-sensitive detector, the team used an array of carbon nanotubes aligned across microelectrodes.

This summer, the department lost a great friend, colleague, mentor, and teacher, **Emeritus Professor Jack Howard**, after a year-long battle with brain cancer. Jack joined the department as a Ford Foundation Postdoctoral Fellow after receiving his doctoral degree from Pennsylvania State University in 1965, and remained a very active and highly regarded member of the Department as assistant, associate, and full professor until his retirement in 2002. Jack was a world-renowned expert on high temperature chemistry, especially mechanisms and kinetics of reactions in combustion, fuel processing, materials synthesis, and waste destruction. He made seminal contributions to many challenging research areas, including formation and oxidation polycyclic aromatic hydrocarbons, fullerenes and soot in flames as well as pyrolysis, gasification, and combustion of coal, biomass and solid waste. Jack's expertise with these important issues at the forefront of energy challenges facing the world will be deeply missed.

We will all miss Jack for his deep technical knowledge and his gentle, insightful advice to students and faculty alike. Jack and his family began this struggle with his brain tumor last summer. It has been a courageous battle with ups, downs, and at times some humor. Many of us followed his struggle through the Howard Family Blog. Jack had incredible support from his family, and was very blessed to have had them close by supporting him and one another. A memorial service was held at Park Street Church on July 16, 2008.

Our faculty members continue to distinguish themselves. To name just a few of the many awards, Bob Armstrong was elected to the National Academy of Engineering. Janós Beér was awarded the Hungarian Knight's Cross. Arup Chakraborty received IIT Kanpur Distinguished Alumnus Award and Bob Langer received the Max Planck Award, Prince of Asturias Award, and the Millennium Technology Prize. Kristala Prather was named one of Tech Review Top 35 Young Innovators. Greg Stephanopoulos received the Founders Award from the AIChE. Michael Strano had a banner year receiving the Unilever Award, the Materials Society Young Investigator Award, an Office of Naval Research Young Investigator Award, a Sloan Research Fellowship, and the AIChE Alan Colburn Award. Ken Smith's 70th birthday was recognized with a special issue of I&EC Research.

Our staff also makes us proud: **Steve Wetzel**, our stalwart Facilities Manager, deservedly won the School of Engineering Infinite Mile Award for Excellence. To quote the award's citation, Steve's job "covers everything from maintaining the Department's undergraduate teaching labs to… coordinating and overseeing major building renovations for new faculty hires. Steve is extremely knowledgeable about Building 66 and has been remarkably successful in keeping the Department's building operational despite its exceptionally high density of research activity and the corresponding burden on its 30-year old infrastructure." We are very lucky to have him.

Leading the discipline, keeping focused on delivering top quality education, performing pioneering research, renewing faculty, and improving space are continuing challenges on which we welcome your input. In particular, space continues to be a major challenge for the Department, as the building infrastructure continues to show its age. We are working with MIT central administration to formulate plans for upgrading the Department facilities. This will be a long term effort for which we would appreciate your support.

We hope you enjoy this issue of the newsletter. Please do write to us to let us know how you are doing and how we can continue to improve. Thank you for your support and best wishes for the coming year. ⊡

ChemE Connection

Happenings around the Department

Prof. Cohen and colleagues create oil repelling material

Professor Bob Cohen and his team have designed the first simple process for manufacturing materials that strongly repel oils. The material, which can be applied as a flexible surface coating, could have applications in aviation, space travel and hazardous waste cleanup. For example, the material could be used to help protect parts of airplanes or rockets that are vulnerable to damage from being soaked in fuel, such as rubber gaskets and o-rings. The team overcame oil's low surface-tension by creating microfibers that are a blend of a specially synthesized molecule called fluoroPOSS, which has an extremely low surface energy, and a common polymer. They can be readily deposited onto many types of surfaces, including metal, glass, plastic and even biological surfaces such as plant leaves, using a process known as electrospinning.

The researchers have also developed some dimensionless design parameters that can predict how stable the oleophobicity or oil-resistance between a particular liquid and a surface will be. These design equations are based on structural considerations, particularly the re-entrant nature (or concavity) of the surface roughness, and on three other factors: the liquid's surface tension, the spacing of the fibers, and the contact angle between the liquid and a flat surface.

Using these relationships, the researchers can design fiber mats that are optimized to repel different hydrocarbons. They have already created a non-woven fabric that can separate water and octane (jet fuel), which they believe could be useful for hazardous waste cleanup.

For more information, go to:
http://web.mit.edu/newsoffice/2007/surfaces-1206.html

Prof. Hammond's research group develops an implantable "micro pharmacy"

A new thin-film coating developed by Professor Paula Hammond can deliver controlled drug doses to specific targets in the body following implantation, essentially serving as a "micro pharmacy." The film could eventually be used to deliver drugs for cancer, epilepsy, diabetes, and other diseases. It is among the first drug-delivery coatings that can be remotely activated by applying a small electric field.

The film, which is typically about 150 nanometers (billionths of a meter) thick, can be implanted in specific parts of the body.

The films are made from alternating layers of two materials: a negatively charged pigment and a positively charged drug molecule, or a neutral drug wrapped in a positively charged molecule. The pigment, called Prussian Blue, sandwiches the drug molecules and holds them in place. (Part of the reason the researchers chose to work with Prussian Blue is that the FDA has already found it safe for use in humans.)

When an electrical potential is applied to the film, the Prussian Blue loses its negative charge, which causes the film to disintegrate, releasing the drugs. The amount of drug delivered and the timing of the dose can be precisely controlled by turning the voltage on and off. The electrical signal can be remotely administered (for example, by a physician) using radio signals or other techniques that have already been developed for other biomedical devices.

The films can carry discrete packets of drugs that can be released separately, which could be especially beneficial for chemotherapy. The research team is now working on loading the films with different cancer drugs. Eventually, devices could be designed that can automatically deliver drugs after sensing that they're needed. For example, they could release chemotherapy agents if a tumor starts to regrow, or deliver insulin if a diabetic patient has high blood sugar.

For more information, go to:
http://web.mit.edu/newsoffice/2008/drug-delivery-0211.html

At the AAAS Annual Meeting, Prof. Stephanopoulos discusses the future of biofuels

High oil prices, energy security considerations and fears about global warming have helped revive interest in renewable energy sources like biofuels, which burn cleanly and can be produced from plants.

Professor Gregory Stephanopoulos lead a discussion of the various ways scientists and energy policymakers are seeking to overcome limitations and make biofuels from renewable biomass feedstocks a significant part of the US energy supply. The symposium, "Biomass to Biofuels Conversion: Technical and Policy Perspectives," explored two aspects of biofuels: The first half covered biofuels policy and the second focused on technical issues in converting biomass to fuel.

Professor Stephanopoulos's own research involves bioengineering yeast. He and colleagues have developed a new way to engineer the genome of yeast to produce desirable traits--specifically, the ability to tolerate high levels of ethanol, which is normally toxic to yeast. The technique holds promise for the development of other traits that would make yeast more-efficient ethanol producers.

He also touched on other lines of biofuel research, including using plant materials to produce ethanol. To replace corn, scientists are turning to cellulose found in grasses and agricultural wastes.

"The technology to produce cellulosic ethanol is not there yet," Stephanopoulos said. However, he estimates that large-scale, economically feasible production of ethanol from cellulose could happen within 10 years.

For more information, go to:
http://web.mit.edu/newsoffice/2008/aaas-biofuels-0216.html

Langer Group Creates Gecko-Inspired Bandage

Led by Professor Bob Langer and his colleage Jeff Karp, a team of MIT ChemE researchers and colleagues have created a waterproof adhesive bandage inspired by gecko lizards that may soon join sutures and staples as a basic operating room tool for patching up surgical wounds or internal injuries. Drawing on some of the principles that make gecko feet unique, the surface of the bandage has the same kind of nanoscale hills and valleys that allow the lizards to cling to walls and ceilings. Layered over this landscape is a thin coating of glue that helps the bandage stick in wet environments, such as to heart, bladder or lung tissue.

And because the bandage is biodegradable, it dissolves over time and does not have to be removed. The work is described in the Feb. 11, 2008, online issue of the *Proceedings of the National Academy of Sciences*.

Other MIT authors of the paper are co-first authors Alborz Mahdavi, a former MIT lab technician now at the California Institute of Technology; Lino Ferreira, a former MIT postdoctoral fellow now at the University of Coimbra, Portugal; Jason W. Nichol and Edwin P. Chan, HST postdoctoral fellows; David J.D. Carter and Jeff Borenstein of Draper Laboratory; HST doctoral student Chris Bettinger; and MIT graduate students Siamrut Patanavanich, Loice Chignozha, Eli B. Joseph, Alex Galakatos and Seungpyo Hong, all from the Department of Chemical Engineering. Additional authors are from Massachusetts General Hospital and the University of Basel, Switzerland.

The work was funded by the National Institutes of Health, the Materials Research Science and Engineering Center (MRSEC) program of the National Science Foundation, and the MIT-Portugal program.

For more information, go to:
http://web.mit.edu/newsoffice/2008/adhesive-0218.html

ChemE Connection

Polymer electrolyte improves fuel cell performance

As reported in the May 2008 *Materials Today*, Professor Paula Hammond and her team have reported that the high ionic conductivity of novel polymer electrolyte thin films they've developed promises much for improved fuel cells, batteries, and dye-sensitized solar cells:

"Such electrochemical devices are dependent on electrolytes to facilitate charge transport between electrodes. But processing difficulties and safety concerns with liquid or gel electrolytes has tended to limit widespread use of these devices. In contrast, polymer electrolytes can provide mechanical strength and more flexibility in manufacture, but they must still offer fast ion conduction.

The team used the versatility of layer-by-layer (LBL) assembly to build thin films of two different polymers that when brought together offer both high conductivity and mechanical stability.

'We have generated an LBL-assembled solid-state thin film with ionic conductivity values over three orders of magnitude higher than the previous best performing multilayer films,' says Hammond. 'These new ionic conductors have proton conductivities close to those of much more expensive specialized polymers, making this technique a competitor for fuel cell and other solid-state electrolyte applications.'

The team found that by sulfonating a thermally and mechanically stable aromatic polyether and pairing it with a complementary functionalized polymer, they could achieve ionic conductivity values up to 35.3 mS cm–1. Furthermore, the assembled multilayer films show low methanol permeability. This makes the films of immediate interest in direct methanol fuel cells (DMFCs).

'Incorporating these LBL materials into a DMFC improves power output by over 50%,' Hammond says."

Prof. Michael Strano develops most sensitive detector for sarin, mustard gas and other nerve agents

Using carbon nanotubes, Professor Michael Strano and his team have built the most sensitive electronic detector yet for sensing deadly gases such as the nerve agent sarin. The technology, which could also detect mustard gas, ammonia and VX nerve agents, has potential to be used as a low-cost, low-energy device that could be carried in a pocket or deployed inside a building to monitor hazardous chemicals.

To build its super-sensitive detector, the team used an array of carbon nanotubes aligned across microelectrodes. Each tube consists of a single-layer lattice of carbon atoms, rolled into a long cylinder with a diameter about 1/50,000 of the width of a human hair, which acts as a molecular wire. The nanotube sensors require very little power--about 0.0003 watts. One sensor could run essentially forever on a regular battery.

When a particular gas molecule binds to the carbon nanotube, the tube's electrical conductivity changes. Each gas affects conductivity differently, so gases can be identified by measuring the conductivity change after binding. The researchers achieved new levels of sensitivity by coupling the nanotubes with a miniature gas-chromatography column etched onto a silicon chip smaller than a penny. The column rapidly separates different gases before feeding them into the nanotubes.

This is the first nanotube sensor that is passively reversible at this level of sensitivity. To achieve this, the team needed to decrease how strongly the nanotube sensor binds different gas molecules on its surface, allowing the sensor to detect a series of gas exposures in rapid succession.

Using a newly described chemistry outlined in a separate paper published in January in the *Journal of the American Chemical Society*, Strano and co-workers showed that this can be done by coating the nanotubes with amine-type molecules, which donate an extra pair of electrons to the nanotubes. The coating allows gas molecules to bind to nanotubes but detach a few milliseconds later, allowing another molecule from the column to move in. With a network of these reversible sensors, a gas could be tracked as it spreads through a large area.

For more information, go to:
http://web.mit.edu/newsoffice/2008/nanotube-0605.html

Congratulations to Facilities Manager Steve Wetzel in winning the School of Engineering's 2008 Infinite Mile Award

Mr. Stephen Wetzel, manager of facilities in the Chemical Engineering Department, was deservedly awarded the 2008 Infinite Mile Award for Excellence. Steve's job covers everything from maintaining the Department's undergraduate teaching labs to compliance with evolving environmental health and safety regulations (no small task in Chemical Engineering), to coordinating and overseeing major building renovations for new faculty hires. One nominee explained how Steve is extremely knowledgeable about Building 66 and has been remarkably successful in keeping the Department's "tired old building operational despite its exceptionally high density of research activity and the corresponding burden on its 30-year old infrastructure."

Steve's extensive knowledge, his creativity, good judgment, and common sense are amplified by his wonderful way with people, especially when it comes to complicated renovation projects. Steve provides advice on feasibility and scope to project planners, negotiates detailed plans and their revisions with faculty and student users, anticipates the impact of renovations on concurrent activities in order to minimize disruptions, and communicates personally with people in Facilities, IS&T, contractors, and others to ensure that everyone is in the loop.

Building 66 could not keep running without Steve's management and expertise, and the Department is thankful for his work through the years! ⊡

Ropewalk – A Cordage Engineer's Journey Through History

By Mark Martel

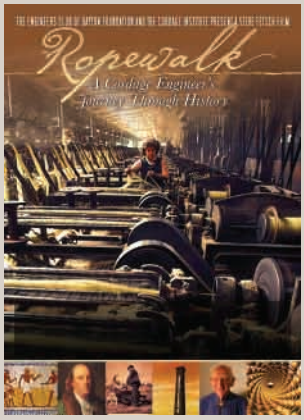
Bill Hagenbuch '40 is the focus of the new documentary "Ropewalk: A Cordage Engineer's Journey through History." Hagenbuch narrates the 60-minute-film about the past, present and future of cordage.

Hagenbuch spent his career making natural and synthetic rope at the Xenia, Ohio Hooven & Allison Company, one of the last natural fiber rope companies in America until its 2004 closing. Since his retirement in 1986, Hagenbuch has kept the local history alive with numerous community presentations. The "Ropewalk" film preserves that history through extensive archival footage, photographs, and narration.

The film contains strong relevance to today, showing how early globalization drove the need to innovate, while corporate consolidation sparked antitrust reform. Ropewalk ties together such unlikely topics as prehistoric tools, Ben Franklin, the Industrial Revolution, railroads, hemp agriculture, drug laws, WWII, globalization, plastics, carbon nanotubes, and space travel.

Ropewalk premiered in April, 2008 and has since reached cordage professionals, museum curators and rope enthusiasts across the United States and Europe, and from as far away as South Africa and Australia. It is directed by award-winning Ohio filmmaker Steve Fetsch, and features an original soundtrack by Ohio composer Bruce Dalzell.

The Engineers Club of Dayton Foundation, in cooperation with The Cordage Institute, sponsored the film as part of its educational mission for historic preservation and education in science and technology. A film trailer, photo gallery of the original Hooven & Allison Co and historical footage may be viewed at http://www.StoryOfRope.org. DVDs can be purchased at www.FilmBaby.com. ⊡



In Memoriam:
Professor Emeritus Jack Howard 1937-2008

On July 7, 2008, the Department lost a dear friend and colleague. Jack Howard, a professor emeritus in the Department, died after a battle with brain cancer. He was 70.

Howard received a BS in 1960 and an MS in 1961 from the University of Kentucky as well as a PhD in 1965 from Pennsylvania State University. After earning his doctorate, Howard came to MIT, where he held positions as assistant, associate, and full professor in the Department of Chemical Engineering and served as the department's executive officer from 1979 to 1981.

He was named the first holder of the Hoyt C. Hottel Chair of Chemical Engineering in 1995, appointed director for MIT's Center for Airborne Organics in 1996, and became a professor emeritus in 2002.

Howard was a world-renowned expert in the manufacture of nanostructured carbon materials. His research focused on high temperature chemistry, especially mechanisms and kinetics of reactions in combustion. He was the author or co-author of more than 200 scientific papers and holds 15 patents for his work.

In an interview with MIT *TechTalk*, Department Head Klavs Jensen noted how Howard had "made seminal contributions to many challenging research areas, including formation and oxidation polycyclic aromatic hydrocarbons, fullerenes and soot in flames as well as pyrolysis, gasification and combustion of coal, biomass, and solid waste. Jack's expertise with these important issues at the forefront of energy challenges facing the world will be deeply missed."

Howard received numerous awards during his career at MIT, including being named to the University of Kentucky's Engineering Hall of Distinction. He won the Bernard Lewis Gold Medal from the Combustion Institute in 1992 and the Henry H. Storch Award from the American Chemical Society in 1983.

He also held several posts in various professional societies, serving as co-chairman of the Energy Research Committee of the American Institute of Chemical Engineers from 1975-1980.

"We will all miss Jack for his deep technical knowledge and his gentle, firm advice to students and faculty alike," Jensen said.

He is survived by his wife, the former Carolyn Butler, of Winchester, Mass., and their two children, Courtenay and Jonathan. The family has maintained a blog about Professor Howard's battle at http://howardupdates.blogspot.com/

A Memorial Fund has been set up in Professor Howard's memory to support educational opportunities in the Department related to high temperature carbon chemistry. For more information or to give support, contact Melanie Miller at melmils@mit.edu or 617-253-6500. Please reference the Jack B. Howard Memorial Fund (2741586).

Lectureships and Events

In the Department of Chemical Engineering

Bayer Day: A Celebration of 25 Years of Collaboration between MIT and the Bayer Corporation

Friday, November 30, 2007

A Symposium of former and current Bayer Professors, with guest speakers from MIT Chemistry and the Bayer Corporation, celebrated 25 years of the Bayer Professorship in the Chemical Engineering Department, and the announcement of the latest Bayer Professor, Paula Hammond.

Speakers included Subra Suresh, Dean of the School of Engineering, and Attila Molnar, President of Bayer Corporation and Senior Bayer Executive for the USA. Former Bayer Professors Clark Colton, Gregory Stephanopoulos, Bob Cohen and Greg McRae also spoke on their research in conjunction with Bayer.

There was a lively poster session during lunch, where the Bayer executives judged over 20 research posters and met students. First place went to students Jordan J. Green and Daniel G. Anderson of Professor Bob Langer's lab, who presented "Enhanced Polymeric Nanoparticles for Gene Delivery." Second place went to Anish Tuteja, a post-doctoral associate of Professor Bob Cohen, and his poster on "Designing Superoleophobic Surfaces with FlouroPOSS." Professor Paula Hammond's student Kevin Krogman got third place with "Functionalized Multilayer Films for Protection against Acutely Toxic Compounds."

To see the full webcast of Bayer Day, go to:
http://web.mit.edu/cheme/news/bayerday.html

The Fall 2007 Hoyt C. Hottel Lecture in Chemical Engineering

"Frontiers of Surface Science: Transition from Studies of Crystal Surfaces in Vacuum to High Pressure and Liquid-based Bio-interfaces and Nanoparticles leads to New Science and Applications"
Gabor A. Somorjai
University Professor
University of California, Berkeley

On Friday, November 16, 2007, the MIT community played host to Berkeley University Professor Gabor A. Somorjai. Professor Somorjai gave the MIT audience a brief history of surface science "for those who are so misguided that [they] don't work in surfaces." He detailed discoveries and research from surface infrastructures in vacuums, to high pressure, applications, and nanotechnologies.

During his dynamic talk, Professor Somorjai stated that he believes "we are in a transition of molecular surface science to molecular surface biology."

For more information and to view the of Professor Somorjai's lecture, go to:
http://web.mit.edu/cheme/news/archives/07/hottel_2007.html

Gabor A. Somorjai was born in Budapest, Hungary, on May 4, 1935. He was a fourth year student of Chemical Engineering at the Technical University in Budapest in 1956 at the outbreak of the Hungarian Revolution. He left Hungary and immigrated to the United States, where he received his PhD degree in chemistry from the University of California, Berkeley in 1960. He became a U.S. citizen in 1962.

After graduation, he joined the IBM research staff in Yorktown Heights, New York, where he remained until 1964. At that time, he was appointed assistant professor of chemistry at the University of California, Berkeley. In 1967, he was named associate professor, and in 1972 promoted to professor. Concurrent with his faculty appointment, he is also a Faculty Senior Scientist in the Materials Sciences Division, and Director of the Surface Science and Catalysis Program at the Center for Advanced Materials, at the Lawrence Berkeley National Laboratory. He was appointed university professor by the UC Board of Regents in March 2002.

Professor Somorjai has educated more than 120 Ph.D. students and close to 200 postdoctoral fellows, about 100 of which hold faculty positions and many more are leaders in industry, He is the author of almost 1000 scientific papers in the fields of surface chemistry, heterogeneous catalysis, and solid state chemistry. He has written three textbooks, Principles of Surface Chemistry, Prentice Hall, 1972; Chemistry in Two Dimensions: Surfaces, Cornell University Press, 1981; and Introduction to Surface Chemistry and Catalysis, Wiley-Interscience, 1994; and a monograph, Adsorbed Monolayers on Solid Surfaces, Springer-Verlag, 1979.

Honors presented to Professor Somorjai include Fellowship of the American Association for the Advancement of Science (1982); membership of the American Academy of Arts and Sciences (1983) and the Hungarian Academy of Sciences (1990); the Henry Albert Palladium Medal (1986); the American Chemical Society's Peter Debye Award in Physical Chemistry (1989), Adamson Award in Surface Chemistry (1994) and Priestly Medal (2008); the Materials Research Society's Von Hippel Award (1997); American Physical Society's Langmuir Prize (2007) and the National Medal of Science (2002).

(Hottel Lecture cont.)

The **Hoyt C. Hottel Lectureship** was established in early 1985 to recognize Professor Hottel's contributions to the intellectual climate of the Chemical Engineering Department, to the encouragement of students over six decades, and to the foundation and direction of the Fuels Research Laboratory. The lectureship is intended to draw eminent scholars to MIT - preferably in the fields of combustion and energy technology - for short periods of residency in order to stimulate future generations of students. The inaugural Hottel Lecture was presented in April 1985 by Professor Hottel himself.

The Fall 2007 Frontiers in Biotechnology Lecture

"Improving Human Health through Translational Research"
Dr. Peter S. Kim
President
Merck Research Laboratories

On Friday, October 12, 2007, Dr. Peter Kim, returned to MIT to present the Frontiers in Biotechnology Lecture. After an introduction by Institute Professor Danny Wang, Dr. Kim, a former MIT biology professor, reminisced about his days at the Institute. "It's great to see old friends," he said, while sharing that one of his student evaluations stated he needed a haircut. "I've worked on it!" he noted.

Dr. Kim explained some of the work going on at Merck today and how it related to his engineering audience. He expounded on how to increase the probability of success in development, since "we're in a very low probability-of-success business." He then showed examples of Merck's chemistry and biotechnology work, as well as external research, licensing and acquisitions. He ended with a "pipeline update."

For more information and to view the of Dr. Kim's lecture, go to: **http://web.mit.edu/cheme/news/archives/07/frontiers_2007.html**

Peter S. Kim, PhD, is a structural biologist known for discovering how proteins cause membranes to fuse, a central feature of all life. He has designed novel compounds that stop membrane fusion by the AIDS virus, thereby preventing it from infecting cells.

Dr. Kim was appointed president of Merck & Co.'s Merck Research Laboratories (MRL) on January 1, 2003 and he is responsible for all of Merck's drug and vaccine discovery and development activities. Previously, Dr. Kim served as MRL's executive vice president of research and development, from February 1, 2001, to December 31, 2002.

Prior to joining Merck, Dr. Kim was a professor of biology at Massachusetts Institute of Technology (MIT). He was also a member of the Whitehead Institute and an investigator of the Howard Hughes Medical Institute. Dr. Kim also served as a member of the National Institutes of Health (NIH) Advisory Committee to develop an AIDS vaccine.

Dr. Kim received his undergraduate education at Cornell University, graduating with distinction in chemistry. He received his Ph.D. in biochemistry from Stanford University in 1985. While at Stanford, he was also a Medical Scientist Training Program Fellow.

His work has earned him numerous awards including the National Academy of Sciences Award in Molecular Biology, the Eli Lilly Award in Biological Chemistry, the Hans Neurath Award of the Protein Society, and the Samsung Foundation Ho-Am Prize in Basic Science.

Dr. Kim currently is a member of the Board of Directors of Fox Chase Cancer Center and the Whitehead Institute for Biomedical Research. He also serves as a member of the Council of the Institute of Medicine.

Dr. Kim was elected a member of the National Academy of Sciences in 1997, and was elected a member of the Institute of Medicine in 2000.

The **Frontiers in Biotechnology Lectureship** was established in 1999 through a generous donation from Dr. Noubar Afeyan to acknowledge the enabling technologies and developments that have sustained the growth of biotechnology and life sciences. Some of these include bioprocess engineering (upstream and downstream processes), bioanalytical developments, advanced and new instruments, novel delivery concepts, biomedical devices, rational drug design, computational methods, bioinformatics, and information technology. It is the intent of this Lectureship to recognize and honor achievements on the "frontiers of biotechnology" and the distinguished scientists and engineers responsible for them.

The 2007 Alan S. Michaels Distinguished Lectureship in Medical and Biological Engineering

"Medicine for the Millennium: How MIT Has Served as a Muse for Medtronic"
Dr. Stephen N. Oesterle
Senior Vice President for Medicine and Technology
Medtronic, Inc.

Dr. Stephen N. Oesterle presented the 2008 Alan S. Michaels Lecture on Friday, April 4, 2008. After an introduction by Institute Professor Bob Langer, Dr. Oesterle took a moment to mention Michaels Lecturers who had gone before him, especially Dr. Judah Folkman of the Surgical Research Laboratory of Children's Hospital, who passed away a few years ago.

Dr. Oesterle directed his lecture toward current students, explaining that their work they do now "can very directly have an impact on millions of patients lives." He described his current job as sorting technology for Medtronic, which is the world's larges technology company. Medtronic "spends about a billion and a half dollars" on research and development. He discussed a dozen MIT researchers, including chemical engineering professors Bob Langer and Doug Lauffenburger, who have influenced the work of Medtronic, much of which is implant technology for chronic degenerative diseases. Dr. Oesterle's highly entertaining lecture expounded on the present work of Medtronic and what he believes is the future for this research.

For more information and to view the webcast of Dr. Oesterle's lecture, go to:
http://web.mit.edu/cheme/news/michaels.html

Stephen N. Oesterle, M.D., joined Medtronic in 2002, after serving as Associate Professor of Medicine at the Harvard University Medical School and Director of Invasive Cardiology Services at Massachusetts General Hospital, Boston. In his position as Senior Vice President for Medicine and Technology, Oesterle provides executive leadership for Medtronic scientific research, formation of technological strategies and continued development of strong cooperative relationships with the world's medical communities.

A teacher and innovator in the field of cardiac catheterization, Oesterle developed and directed interventional cardiology programs at Good Samaritan Hospital, Los Angeles from 1986 to 1991; at Georgetown University in 1991 and 1992 and at Stanford University from 1992-98.

While at Stanford, Oesterle established the University Medical Center's first endovascular device laboratory. Subsequently, he founded a similar medical device development laboratory at Massachusetts General Hospital where he and his colleagues sought unique, minimally invasive methods for treating coronary disease, valvular disease, rhythm disturbances, and heart failure.

Oesterle was born March 3, 1951, in LaGrande, OR. He is a 1973 summa cum laude graduate of Harvard College and received his medical doctorate from Yale University in 1977. His internship and residency years were at Massachusetts General Hospital from 1977-80 and he served a fellowship in interventional cardiology at Stanford from 1981 to 1983.

The **Alan S. Michaels Distinguished Lectureship in Medical and Biological Engineering** was established in 1995 to stimulate the collaboration of the medical profession, life sciences industries, and chemical engineering researchers.

The most exciting and promising developments in medicine and the life sciences - those leading to improved therapies for the treatment or mitigation of intractable diseases, and strategies for prevention of debilitating or life-threatening genetic deficiencies - are largely emerging from discoveries in molecular biology and biochemistry, in concert with those in the sister-sciences of immunology, pharmacology, and genetics. These developments involve, in a very direct way, the basic tools that are the hallmark of the chemical engineer's profession: molecular thermodynamics, chemical reaction kinetics, homogeneous and the heterogeneous catalysis, fluid mechanics, and mass- and energy-transport processes. Few other engineering disciplines are as well qualified to deal with the microscopic and molecular phenomena affecting living systems.

The 2008 Warren K. Lewis Lecture

"Osmotic Propulsion:
The Osmotic Motor"
Professor John F. Brady
Professor of Chemical Engineering
California Institute of Technology

On Friday, May 9, 2008, Professor John Brady gave a lively presentation on his work with CalTech graduate student Ubaldo Cordova-Figueroa. Professor Brady, a former MIT chemical engineering professor, first discussed propulsion in nature – living and nonliving. He and his student studied nanomotors and creating autonomous motion to make a truly portable device. He calls the simplest way of propulsion osmotic propulsion.

Professor Brady compares his osmotic motor to a "pac-man" – it "eats the reactant and that will create a concentration gradient that will move him along through the fluid."

Professor Brady ended his lecture with a quote about Professor Lewis, written by Professor Hoyt Hottel: "Doc could stretch a small bit of factual knowledge about a problem farther than anyone he knew." This is what Professor Brady is trying to accomplish with his research.

For more information and to view the webcast of Professor Brady's lecture, go to:
http://web.mit.edu/cheme/news/lewis.html

John F. Brady is the Chevron Professor of Chemical Engineering and Professor of Mechanical Engineering at the California Institute of Technology. He received his BS in chemical engineering from the University of Pennsylvania in 1975 and spent the next year at Cambridge University as a Churchill Scholar. He received both an MS and PhD in chemical engineering from Stanford University, the latter in 1981. Following a postdoctoral year in Paris at the Ecole Superiéure de Physique et de Chimie Industrielles, he joined the Chemical Engineering department at MIT. Dr. Brady moved to Caltech in 1985, where he has remained ever since, serving as department chairman from 1993-1999.

Dr. Brady's research interests are in the mechanical and transport properties of two-phase materials, especially complex fluids such as biological liquids, colloid dispersions, suspensions, porous media, etc. His research takes a multilevel approach and combines elements of statistical and continuum mechanics to understand how macroscopic behavior emerges from microscale physics. He is particularly noted for the invention of the Stokesian Dynamics technique for simulating the behavior of particles dispersed in a viscous fluid under a wide range of conditions.

Dr. Brady has been recognized for his work by several awards, including a Presidential Young Investigator Award, a Camille and Henry Dreyfus Teacher-Scholar Award, the ASEE Curtis W. McGraw Research Award, the Corrsin and Batchelor lectureships in fluid mechanics, the Professional Progress Award of the American Institute of Chemical Engineers, and the Bingham Medal of the Society of Rheology. He has held positions as the Juliot-Curie Professor at ESPCI in Paris and the J.M. Burgers Professor at Twente University in the Netherlands. Dr. Brady was an associate editor of the Journal of Fluid Mechanics from 1990-2005 and is currently the editor of the Journal of Rheology. He is a fellow of the American Physical Society and a member of the National Academy of Engineering.

The **Warren K. Lewis Lectureship** was established in 1978 to recognize Professor Lewis's revolutionary impact on chemical engineering education. One of MIT's first students in chemical engineering, he made seminal impact to the discipline. By developing the concept of unit operations, first proposed by A. D. Little and William Walker, he revolutionized the design of chemical engineering processes and equipment. Throughout his career, Professor Lewis was mindful of the needs of industrial practice; accordingly, the Lewis lecture features speakers from industry and academia. ⊡

News from Alumni

In the Department of Chemical Engineering

William H. Hagenbuch (SB '40, MS '41), former president of one of the country's last natural-fiber rope-making companies, has written and narrated a one-hour documentary called "Ropewalk: A Cordage Engineer's Journey through History," released April 25, 2008.

In an interview with *Wire Rope News*, Hagenbuch explained, "The story of rope stretches back through every culture to the dawn of civilization. I dug back through some ancient history and went into the whole evolution of the cordage industry. I found that the Cro-Magnons 30,000 years ago were the first makers of rope. And now they're talking about this space elevator, going to places in space not using rockets, but traveling from Earth to satellites and even beyond, using advanced forms of rope."

Information about the film and the history of cordage can be found at **www.storyofrope.org**.

Hagenbuch at MIT in 1939.

Hagenbuch with daughter Kate Hagenbuch, executive producer of "Ropewalk" at the Movie World Premiere, April 25, 2008, Engineers Club of Dayton, Ohio. (Photo: Dick Palmer)

William T. van Ravenswaay '44 and his wife Carmen recently celebrated their 52nd wedding anniversary. Their two sons and families live in Houston and visit often. The younger has given them two granddaughters.

David S. Hacker (MS '50) is currently lecturing on energy options, in a series of seven lectures to community and other local agencies.

Marc Aelion (BS '51, MS '52, CHE '54) retired a few years ago from full-time work, but is continuing part-time activity related mostly to valuation of companies.

Clifford Coffey (MS '53) retired in 1992 from ExxonMobil Chemical. He now volunteers with a cancer support group at Jupiter Medical Center. He is married with 14 grandchildren from four children.

Allan Hoffman (SB '53, SM '55, ScD '57) received the 2007 Founders' Award of the Controlled Release Society. With Dr. Buddy Ratner, Allan has co-edited the *Textbook of Biomaterials Science*, which has been adopted worldwide by every major college or university that teaches related courses and is a member of the National Academy of Engineering.

Shintaro Furusaki (SM '64) retired in March 2008 from Sojo University in Kumamoto, Japan. This was his third retirement after the University of Tokyo in 1998 and Kyushu University in 2001. He is still doing research on bioreactors for plant cell culture at Kanto-Gakuin University in Yokohama, Japan.

David Camp (MS '74, PhD '79) is currently the president and CEO of Key Technology, a company that develops and markets products that serve the food safety and security industries (www.key.net). Its business is global, with divisions in the Netherlands, Mexico, China, Singapore, as well as North America. He and wife Ellen live in Walla Walla, WA, "the home of tremendous Washington wines, and it is truly a great place to live."

Parvez H. Wadia (SM '70, ScD '75) has been appointed to the University of Charleston's board of trustees. Wadia is chief technical officer of the Mid-Atlantic Technology, Research and Innovation Center, based in Charleston, WV.

Eve Higginbotham (SB '75, SM '75) has been elected to the Harvard Board of Overseers by the Harvard Alumni Association. A 1979 graduate of Harvard Medical School, Higginbotham is dean and senior vice president for academic affairs at the Morehouse School of Medicine. A member of the Institute of Medicine, she is an ophthalmologist with expertise in the treatment of glaucoma.

News From Alumni

Douglas Gilbert '78, has joined Pearl Cohen Zedek Latzer (www.pczlaw.com) as a resident partner. He is an intellectual property law litigation specialist who has litigated patent matters for chemical, pharmaceutical, consumer product, medical device and computer industry clients. A former chairman of the Subcommittee on Litigation Practice and Procedure of the New York Intellectual Property Law Association and member of the ITC committee of the Intellectual Property Owners Association, Gilbert was formerly a partner at Fish & Neave, and Ropes & Gray. He received his Juris Doctor degree from the New York University School of Law.

Peter Balbus '82, founder and managing director of Pragmaxis LLC, was a featured innovation expert on American Airlines, Northwest Airlines and Delta Airlines in-flight audio programs from August to December 2008. The program, an interview conducted by SkyRadio host Dennis Michael, features Balbus explaining the proprietary concept of "Ownable Distinction - the Antidote to Commodization", and how companies of all types and sizes can use the strategy to rapidly achieve and sustain high-margin competitive positioning.

Steven R. Izatt (SM '84), president and CEO of IBC Advanced Technologies, Inc. (IBC), American Fork, Utah, is the recipient of the 2008 International Precious Metals Institute (IPMI) Jun-ichiro Tanaka Distinguished Achievement Award. Presented annually by IPMI, the award, sponsored by Tanaka Kikinzoku Kogyo K.K., is the IPMI's highest award and recognizes an individual for his or her significant contributions to the advancement of the precious metals industry – technical, economic or managerial.

Izatt has innovated developing, testing, and commercializing new highly selective separation products to meet commercial needs for the production and use of precious metals of high purity. IBC develops and markets highly selective and environmentally friendly products based on the concepts of molecular recognition technology (MRT). MRT has been adopted by a number of precious metal refineries around the globe. Areas in which MRT separations technologies are involved include: refining of platinum group metals and gold, environmentally friendly recovery of precious metals from low grade resources such as spent catalysts, efficient and sensitive detection and analysis of precious metals, and purification of Pd-103 for brachytherapy.

Akin Akinc (PhD '03), along with ***David Nguyen '02*** and ***Jason Fuller (PhD '08)***, has developed safe and effective methods to perform RNA interference, a therapy that holds great promise for treating a variety of diseases including cancer and hepatitis.

Scientists see RNA interference (RNAi) as a way to turn off specific disease-causing genes. Despite this potential, researchers studying the technique have been stymied by one major problem: how to deliver RNAi agents to target tissues.

These alumni and their team have developed a library of new molecules that successfully delivered RNA interference agents in several animals, including mice, rats and cynomolgus monkeys. The team hopes to test the delivery materials in human clinical trials within the next few years.

Jeremy Johnson (PhD '06), and ***R. Michael Raab (PhD '06)***, through their company Agrivida, plan to bring to market by 2012 cellulose-based ethanol. In May 2008, Agrivida partnered with Codon Devices, founded by MIT ChemE alumnus ***Brian Baynes (PhD '05)***, to utilize its BioLOGICTM Engineering Platform to develop enzymes optimized for Agrivida's proprietary biofuel production technology. The collaboration's objective is to develop and express optimized enzymes in plants that enable a controllable degradation process that will be used to produce renewable fuels and chemicals.

"We believe this is the first time that a protein has been regulated using a distinct thermally activated protein element," stated Baynes, "This work highlights the strength and creativity of these scientific teams."

Raab concurs: "This accomplishment is accelerating our research as we continue our development of plant traits and technology for the production of biofuels. The development of an effective protein switch has broad implications for the use of optimized proteins across a number plant species, as well as a variety of industries, including bioenergy."

Maciek R. Antoniewicz (PhD '06), University of Delaware assistant professor of chemical engineering, was recently honored by the DuPont Co. as one of 17 young professors from universities in the United States, China, Spain, and India with the annual DuPont Young Professor Grant for original research. This innovative grant program is designed to provide start-up assistance to promising young and untenured research faculty working in areas aligned with DuPont's strategic business growth.

Antoniewicz will receive a grant of $25,000 per year for three years. The grant may be used to obtain matching funds through the National Science Foundation or other organizations. His research interests include metabolic engineering and systems biology and engineering microbial cells for production of biofuels and biochemicals.

"Maciek is a talented scientist whom we were fortunate to have on staff at the DuPont Experimental Station last year before he accepted his current assignment at the University of Delaware," said Uma Chowdhry (DMSE PhD '76), DuPont senior vice president and chief science and technology officer. "We will continue to be interested in his research as he pursues sustainable biofuels technologies."

Christopher Loose (PhD '07) was named one of *Technology Review's* "35 Top Innovators Under 35." TechReview states "As a graduate student at MIT, Christopher Loose created a design tool to optimize formulations of naturally occurring antibiotics called antimicrobial peptides (AMPs), and developed a way to use them in medical devices. Found in bacteria, human sweat, and plants, these short proteins puncture bacteria like balloons. The mechanism is nonspecific, so microbes have trouble developing resistance to the peptides.

AMPs are too expensive for routine oral or intravenous use. So Loose incorporated optimized peptides into coatings for medical devices, which are effective with a small amount of peptide. When bacteria approach a hip implant or catheter coated with the peptides, they 'see a bed of nails,' says Loose. The coating doesn't release the drugs the way typical antibacterial coatings do, so its activity is potentially permanent. Loose founded SteriCoat [now known as Semprus BioSciences] to commercialize the technology and is currently its chief technology officer; the company is testing coated intravenous lines in animals and hopes to bring them to market in 2011."

Loose was also awarded the Hertz Foundation Doctoral Thesis Prize for 2006-2007.

Jeffrey A. Easley '08 received the Epstein Award in recognition of distinguished service and musical contribution to the MIT Symphony Orchestra. In addition, Easley, who plays the bassoon, was awarded a Ragnar and Margaret Naess Award in recognition of exceptional talent and commitment to private performance study as an Emerson Fellow and an additional Ragnar and Margaret Naess Award in recognition of exceptional talent and demonstrated excellence in public performance as an Exceptional Emerson Wind Student.

In Memoriam

Meyer Shnitzler '33
1912-2007

Mr. Shnitzler died in his Brookline home on Oct. 18, 2007. Shnitzler was 95. His health had declined since a bout of pneumonia during the summer of 2007.

During his 34 years working at Gillette, Shnitzler used his MIT background to help perfect blade technology, allowing for smoother shave. He held or shared more than two dozen patents, from adjustable safety razors to an aerosol dispenser.

A former Gillette colleague explained Mr. Shnitzler's work in a Boston Globe interview:

"He was involved in the invention of the silicone coating on Super Blue Blades," said Joe Boyce of Braintree. "Prior to that, there had never been any kind of organic coating on blade edges. The organic coating made the shave much more comfortable because the razor blade edge would cut through the whiskers without pulling them up from the hair follicle. So you got a smoother shave than anyone had ever gotten."

Along with his expertise with razor blades, Boyce said, Shnitzler had a hand in the development of Right Guard deodorant.

"There was a vice president at Gillette, who will remain nameless, who had a terrible problem with body odor," Boyce said. "He could not find anything to overcome or mask it. So he told Meyer about it, and Meyer had been working on some chemicals that he thought might be suitable for an underarm deodorant. And it worked for this guy."

(Mr. Meyer Shnitzler cont.)

Shnitzler was born in Boston, MA, and grew up as one of three sons of Polish immigrants. His mother ran an apartment building and Shnitzler developed his engineering skills when he was enlisted to help with repairs. He graduated from English High School and studied chemical engineering at MIT, from which he graduated in 1933. Soon he began working at Gillette, where he stayed until retiring in 1967. After retirement, he did consulting work for Gillette for another 10 years, and also helped tutor students at Brookline High School in English and chemistry.

Shnitzler leaves a son, Richard, of Philadelphia; a daughter, Linda Young, of Mashpee, Mass.; a brother, Robert, of Canton, Mass.; his companion, Selma Goldberg, of Marblehead, Mass.; two granddaughters; a great-grandson; and a great-granddaughter.

Frederick J. Kolb, Jr. (SB '38, SM '39, ScD '47)
1917-2008

Mr. Kolb, Jr. passed away May 10, 2008, three days after his 91st birthday. Kolb worked for 45 years at Eastman Kodak, in the Manufacturing Experiments Division, contributing many advances to motion picture film technology. After retirement, he continued as a consultant to Kodak for another 15 years, totaling 60 years of service.

At Kodak, Kolb became recognized as a giant in his field, and published widely on many topics such as air cooling of film during projection, the measurement of screen brightness, magnetic striping, liquid gate for projection, splicing of polyester base film, the wear of magnetic heads against striped film, print film lubrication and Particle Transfer Roller (PTR) cleaning of film. For seven years, he was the lead scientist in the introduction of magnetic tape by Kodak, spending much time at Kodak Pathé in Paris. He worked on projection concerns in the conversion of film from cellulose nitrate to cellulose triacetate base and with the introduction of polyester base.

In addition to his Kodak activities, Kolb was a Life Fellow of the Society of Motion Picture and Television Engineers, (SMPTE). He was a major contributor to SMPTE Standards Committees, the Audio Engineering Society (AES) and Cinematography.

Kolb received the SMPTE Journal Award in 1950 for his paper "Air cooling of motion picture film for higher screen illumination"; the Samuel L. Warner Medal Award in 1988 for his contributions to the development of magnetic striping of film; and the Technicolor / Herbert T. Kalmus Gold Medal Award in 1995 for his outstanding contributions in the development of color films, processing, techniques or equipment.

In 1990, Kolb received a Technical Oscar Achievement Award from the Academy of Motion Picture Art & Sciences for the development of a 35mm projection test film. The projection test film allowed better understanding of how changes in projection lenses could improve the quality of film viewing.

At MIT, he was president of his class, and remained active with the alumni organizations, many years as '38 alumni class president. He interviewed many students interested in attending MIT. Kolb received several Distinguished Service Alumni Award from MIT, and was director of the MIT Club of Rochester for many years.

Dr. Kolb was active in the Summerville Presbyterian Church, serving in many leadership roles in the church, including deacon and elder, and leader of the long range planning team in the 70's that implemented the new sanctuary design. He was active in both the Kodak and Rochester Genealogy Societies. He led an active life, even bicycling through the Loire valley in France with an Elderhostel group when he was 80 years old. He also attended courses in Burgundy at the Academy of Wines.

Dr. Kolb is survived by his daughters Carolyn, Katharine and Merribeth, daughter-in-law Kathie, seven grandchildren and four great-grandchildren. His wife Polly (Priscilla) died in 1987, and son Jay (Fred Kolb III) passed in 2001.

His father, Frederick Kolb Sr. (deceased), was comptroller of Rochester Institute of Technology from the 1920s until 1958, when he passed away.

G. Richard Worrell (SB '48, SM '49)
1927-2008

Dr. Worrell, 81, a retired chemical engineer for the Atlantic Refining Co., later Arco Chemical Co., in Philadelphia, died of pneumonia Sunday, June 29, 2008.

Worrell's 39-year career was spent with the company, where he developed 17 patents in petroleum engineering. His last was for a flame arrestor, a device that stopped fire from traveling through a pipeline.

He taught petroleum engineering for several years at the University of Pennsylvania and at Drexel University. He was a frequent contributor to scholarly journals and magazines.

Mr. Worrell showed early proficiency in math and science when he was growing up in Waltham, Mass. He was admitted to MIT at age 16, said his wife, Maryanna Lenham Worrell. He had attended two years of college classes when he decided to postpone his chemical engineering studies to serve in World War II. He was 18.

Worrell, who joined the Navy, was stationed in Washington, where he taught radar and radio repair to the troops. He returned to MIT when the war was over, and completed his bachelor's and master's degrees in chemical engineering.

He moved to the Philadelphia area to join Atlantic in 1949. Worrell earned a doctorate in chemical engineering from the University of Pennsylvania while working for Arco. He traveled extensively for the company, and lived in Germany and Finland for several years. He worked at the company's local divisions in Glenolden, Philadelphia and Newtown Square.

Worrell retired in the late 1980s and could often be found on the golf course. He was a founding member of the Unitarian Universalist Church of Delaware County and served as the congregation's first president.

In addition to his wife, Mr. Worrell is survived by sons Ross and Keith; daughter Amy; three stepchildren, and two step-grandchildren.

Harvey L. Fein (SM '61, ScD '63)
1936-2008 (Summarized from Matt Schudel of the Washington Post)

Dr. Fein, 72, a retired chemical engineer and senior official with local Washington D.C. technology and energy companies, died June 4, 2008 at Virginia Hospital Center after surgery for cancer. He lived in Alexandria.

Fein graduated from Cornell University in 1959 and received master's and doctorate degrees in chemical engineering from MIT in 1961 and 1963. He began his career in 1963 with the Atlantic Research Corp. in Alexandria, VA, where he was a project manager and head of the thermodynamics section. In 1975, he joined TRW Energy Systems Group in McLean, where he directed the preliminary design and application studies of coal gasification and liquefaction projects. From 1981 to 1986, Fein was senior project officer with the U.S. Synthetic Fuels Corp. in Washington, managing the assessment of commercial fuels projects valued as high as $2.5 billion.

He was a member of the American Institute of Chemical Engineers, the American Chemical Society and the American Institute of Aeronautics and Astronautics. He was also a member of the Tau Beta Pi, Phi Lambda Upsilon and Sigma Xi honorary societies.

Fein considered his greatest achievement his lifelong battle with muscular dystrophy, which was diagnosed when he was in his early 20s. Survivors include his wife of 34 years, Pamela Fein of Alexandria; two children, Alison Rachel Young of Franklin, Tenn., and Andrew Jason Fein of Atlanta; and a sister, Lenore Beth Fein of Alexandria. ⊡

Alumni Donors

This honor roll is a special salute to those who have given over $100 to the MIT Chemical Engineering Department for the period July 1, 2007, through June 30, 2008.
Thank you to everyone who has supported us throughout the year!

Every effort has been made to ensure the accuracy of this list.
Please direct corrections to: ***Melanie Miller, Editor***
Email: ***melmils@mit.edu*** – Phone: ***617-253-6500*** – Fax: ***617-258-8992***

Noubar B. Afeyan '87
Edward S. Ahn '97
Sameer K. Ajmera '02
Collin H. Alexander '39
Paschalis Alexandridis '90
George Alexopoulos '92
Guillermo A. Ameer '99
Paul R. Ammann '57
Bharthwaj Anantharaman '02
John E. Anderson '50
Steven J. Anderson '78
James Annenberg La Vea
Donald B. Anthony '74
Alfred J. Antos III '82
Minas R. Apelian '88
Henry R. Appelbaum '80
Gerald M. Appelstein '80
Fred J. Armellini '87
Vassiliki Athanassiou '96
Efstathios S. Avgoustiniatos '90
Ricardo Avila Araujo '72
Lionel V. Baldwin '55
Eric T. Banks '84
Robert E. Baron '81
Michael D. Barrera '90
Mark P. Bartilucci '85
Thomas M. Bartos '85
Osman A. Basaran '78
William C. Beck Jr. '62
William F. Beck '64
Henry A. Becker '61
William C. Behrmann '60
Alexis T. Bell '64
Henrietta B. Bente '68
Paul F. Bente III '68
Richard I. Bergman '55
Leonard Berkowitz '58
David A. Berry '00
Krishin H. Bhavnani '51
Wayne W. Bidstrup '88
Richard E. Bockrath '82
Robert E. Bohman '77
Richard L. Bolin '50
Andreas S. Bommarius '82
Edward D. Boston '49
Gregory D. Botsaris '59
Van T. Boughton Jr. '49
Alain L. Bourhis '89
Walker H. Bowman '51
James C. Bray '72
P L T. Brian '56
Henry T. Brown '56
Rodney F. Brown '78
Evan Buck '61
Julian J. Bussgang '51
Jeffery W. Butterbaugh '90
Pat C. Campbell '81
Thomas D. Canby '52
John Carrier '95
William H. Ceckler '61
Leonard B. Chandler '36
Chiechun J. Chang '83
Michael C. Chen '73
Nai Y. Chen '59
Zee-Puu Chen '77
Jarvis T. Cheung '92
Shyur-Jen Chien '82
Herman S. Chiu '43
Chai Y. Choo '60
Howard W. Chou '76
Shiao-Ming Chu '89
Matthew B. Chun '99
Jack J. Cinque '53
Jason A. Cline '97
Henry D. Cochran Jr. '73
Jerry A. Cogan Jr. '58
Jerald A. Cole '82
Grace E. Colon '95
Clark K. Colton '69
Peter A. Colvin '03
James H. Comfort '88
John P. Congalidis '81
Edward T. Cook '40
Stuart L. Cooper '63
Jennifer E. Corbin '81
Gordon S. Craig '89
Joseph J. Cramer '68
Matthew S. Croughan '88
Nigel W. Curlet '76
Rebecca L. Dabora '89
Thonet C. Dauphine' '35
Robert W. Davis '50
David L. De Bruin '77
Richard P. De Filippi '59
Eleanor M. De Groot '90
Jean B. De Hemptinne '90
Kathleen A. Dennison '86
Andre C. Deprez '55
Keith E. Dionne '90
William W. Doerr '79
Wieske S. Dolan '94
Charles M. Donohue '61
Christopher J. Dowd Jr. '93
Barrett S. Duff '50
Louis J. Durlofsky '86
Christopher Egolf '66
Ronald S. Eisinger '70
Daniel L. Ellig '81
Ramon L. Espino '68
Nancy A. Etani '55
Michael Falco '59
Robert H. Fariss '51
Roger D. Farr '79
Alan S. Feitelberg '90
Joao P. Ferreira '93
John A. Feyk '50
Hunter H. Ficke '77
Edwin L. Field '50
Robert E. Fisher '66
Stephen K. Fok '80
William K. Fraizer '80
Constantinos S. Frangoulis '66
Richard W. Freedman '76
Manfred Gans '51
Frank T. Gentile '88
Donald M. Glass '79

John J. Glover ’49
Cobb S. Goff ’70
Kent E. Goklen ’86
James A. Goldstein ’89
Anil Gopala ’96
Neal F. Gordon ’89
George D. Gould ’47
Rene Goutte ’61
David C. Gray ’89
Frank R. Graziano ’77
Charles O. Grigsby ’89
Donald A. Grindstaff ’69
Philip M. Gross ’63
John H. Grover ’48
Philip M. Grover ’57
Ramin Haghgooie ’03
Mohammadreza Hajaligol ’81
Robert T. Hanlon ’85
James W. Hanson ’52
Nicholas J. Haritatos ’52
Peter Harriott ’52
Brian M. Harrison ’97
Robert L. Hatch ’47
Gary R. Hattery ’78
Robert W. Hausslein ’58
Robert D. Hawthorn ’54
Robert W. Heinze ’68
Joseph J. Helble Jr. ’87
Richard K. Helling ’86
Kelly L. Hellmuth ’00
Mary Jane J. Hellyar ’82
Charles B. Henderson ’52
Donald L. Hendrickson ’50
Mary S. Hense ’42
David C. Herak ’89
Arthur E. Higinbotham ’60
Charles G. Hill Jr. ’59
Thomas J. Hirasuna ’76
Wilburn H. Hoffman ’46
Henry R. Holgate II ’89
Laura S. Holgate ’90
Glenn T. Hong ’81
Allen F. Horn ’84
Jane F. Hortelano ’94
Patrick A. Houghton ’88
Robert T. Hucks Jr. ’51
George A. Huff Jr. ’82
Edwin P. Hunger ’54
Jean B. Hunter ’76
Gilbert L. Huppert ’89
Daehee Hwang ’03
Brian Hynes ’95
Hiroshi Iino II ’67
James J. Isenberg ’75
Shingo Ishikawa ’79
Ahmed E. Ismail ’05
Hesley F. Jackson ’73
Norman A. Jacobs ’59
Thomas A. Jadwin ’69
Hugh R. James ’74
Earp F. Jennings Jr. ’39
Douglas L. Johnson ’53
Harry E. Johnson ’83
Nikola M. Juhasz ’92
Beth H. Junker ’89
Robert J. Kallal ’49
Mauritz J. Kallerud ’62
Elsa Kam-Lum ’74
Ravindra S. Kane ’95
Henry S. Kao ’67
Kim Y. Kao ’83
Orhan I. Karsligil ’00
I. M. Kasser ’60
James R. Katzer ’70
William J. Kausch Jr. ’78
James B. Keeler ’81
George M. Keller ’48
Cary J. King III ’58
Robert C. King Jr. ’88
Terry S. King ’79
William C. King ’48
Linda D. Kiss ’87
Hans A. Klemm ’75
Douglas F. Kline ’93
Robert W. Koucky ’56
David W. Kress Jr. ’67
Charles L. Kroll ’49
Val J. Krukonis ’64
Douglas H. Kuller ’84
Catherine B. Labelle ’96
James Lago ’47
Chiu-Kin S. Lai ’86
Frederick W. Lam ’89
Paul R. Larson ’54
Michael E. Laska ’97
James S. Law ’72
Andrew W. Lee ’76
Chun-Hyuk Lee ’94
David S. Lee ’94
George Lee ’52
Helen H. Lee ’02
Jorge R. Leis ’86
Joseph E. Leitgeb ’57
Robert B. Lennox ’83
Donald & Mabel Leslie-Wainwright
James C. Leung ’75
Roy N. Levitch ’66
Peter F. Levy ’79
William R. Licht ’87
Bruce D. Lilly ’93
Larry J. Lilly ’65
Nelson P. Lin ’91
Ben J. Lipps ’63
George O. Lof ’40
John M. Longoria ’86
Christopher R. Loose ’07
Richard A. Loring ’62
Bertrand C. Louvet ’62
Richard N. Lovett ’43
Martiel A. Luther ’82
Dushyant Manmohan ’08
Michael P. Manning ’76
Geoffrey Margolis ’69
Kishore V. Mariwala ’59
Gregory S. Markiewicz ’82
Joseph B. Marx ’37
Edward A. Mason ’50
David K. Matsumoto ’88
David J. Mawer ’62
Robert H. Mayer ’69
John P. McKay ’40
Gareth H. McKinley ’91
Julian T. McKinnon Jr. ’89
Lee P. McMaster ’69
James D. McMillan ’90
Marco A. Mena ’99
Harold S. Mickley ’46
Wayne E. Miller ’44
Clare L. Milton ’40
Leon Mir ’61
Wang-Tsee T. Mo ’88
Michael Modell ’60
Geoffrey D. Moeser ’00
William C. Mohr ’84
Brian V. Mokler ’60
Charles W. Monroe ’55
Timothy L. Montgomery ’74
Albert L. Moore ’58
Arthur W. Moore ’59
Joe F. Moore ’52
Antonio Morales-Pena ’95
Eric M. Morrel ’87
James D. Mottley ’61
Joan T. Muellerleile ’85
Lorenz A. Muller ’87
Michael Mutsakis ’72
Robert S. Nahas ’56
Radha Nayak ’93
Elba A. Nazario ’95
George W. Neuner ’66
Andrew S. Ng ’73
Shih-Tung Ngiam ’91
James J. Noble ’68
Peter D. Noymer ’92
David C. O’Brien ’53
Darren D. Obrigkeit ’97
John P. O’Connell ’61
Augustus N. Ogunbameru ’71
Sven A. Olund ’51
Ravinder K. Oswal ’80
Shukong Ou ’76
Tuomas A. Paloposki ’88
Donald W. Peaceman ’51
Frank G. Pearce ’46
Jorge A. Pefaure ’76
Rolph A. Person ’52
David F. Petherbridge ’67
Kavas N. Petigara ’72
Dimitrios P. Petridis ’91
Pemakorn Pitukmanorom ’02
Dirk A. Plummer ’52
Allen Pollack ’96
Paul M. Premo ’65
Cordelia M. Price ’78
John J. Prior ’97
William F. Pritchard Jr. ’78
James M. Prusko ’86
Waqar R. Qureshi ’90
William P. Raiford ’89
Dilip Rajagopalan ’91
Julie A. Rakestraw ’90
Scott L. Rakestraw ’90
Carlos A. Ramirez ’79
Alonso R. Ramos Vaca ’78
Elta M. Chian Ratliff ’94
Carl W. Rausch ’74
William A. Reed ’43
Toby R. Reitzen-Sachen ’78
Timothy J. Resch ’95
Hyman Resnick ’49
Harold A. Ricards Jr. ’41
James W. Rice ’57
Robert L. Richards Jr. ’51
Bradford D. Ricketson ’97

Alumni Donors

Auguste E. Rimpel Jr. ’60
Irven H. Rinard ’57
Kimberly E. Ritrievi ’85
Sandra J. Roadcap ’81
John H. Roberts ’56
Joseph E. Rogers ’73
Edwin G. Roos ’44
Thatcher W. Root ’79
Stephen H. Rose ’71
Ronald E. Rosensweig ’56
Murray W. Rosenthal ’53
Keith E. Rumbel ’43
Morley E. Russell ’53
Leonard W. Russum ’47
Gregory C. Rutledge ’90
Philip A. Ruziska ’62
Lisa M. Ryan ’81
Albert Sacco Jr. ’77
Hiroshi H. Saito ’91
Jeffrey B. Sakaguchi ’82
Todd R. Salamon ’96
Vishak Sankaran ’90
John T. Santini Jr. ’99
Martin J. Schad ’83
Rhonda J. Schaefer ’83
Fred H. Schlesinger ’83
John P. Schmidt ’63
Dean A. Schneider ’69
George R. Schneider ’56
Robert J. Schrader ’43
Eric G. Schwarz ’53
Chris E. Schwier ’84
Arthur D. Schwope ’72
Steven F. Sciamanna ’81
Menelaos E. Scouloudis ’97
George R. Seiler ’57
Lawrence R. Sewell ’72
Rajendra Y. Shah ’74
Deborah S. Sharpe ’76
Lifen Shen ’97
Yen Shen ’42
Lynn Shi ’00
John W. Shield ’89
Ashley K. Shih ’91
Adam L. Shrier ’60
Robert E. Siegfried ’47
Charles A. Siletti ’89
Marvin I. Singer ’63
Cynthia Smith ’08
Frank G. Smith III ’81
Robert A. Snedeker ’50
George A. Sofer ’50
Yihhong L. Song ’78
Kevin A. Sparks ’91
Stephen H. Spiegelberg ’93
Herbert L. Spivack ’49
Arthur L. Squyres ’53
Arnold F. Stancell ’62
John E. Stauffer ’57
Reed C. Steinmetz ’87
A G. Sterling Jr. ’48
Leonard I. Stiel ’59
Roger Stillwater
Thibaud S. Stoll ’90
Bayard T. Storey ’55
David E. Swanberg ’40
Oded Tavory ’51
Catherine E. Teague Sigal ’81
Jefferson W. Tester ’71
Michael P. Thien ’88
Edward F. Thode ’42
Keith M. Thompson ’64
Jean Tilly ’83
Sonja L. Tong ’01
Rowena J. Torres-Ordonez ’86
Olev Trass ’58
George A. Truskey ’85
W. H. Tucker ’46
Howard T. Tupper ’52
William D. Van Vorst ’43
Patrick J. Vayn ’69
Nancy P. Vespoli ’79
Chitra Viswanathan ’95
Friedrich K. Von Gottberg ’92
Eva C. Wan ’81
Stephen S. Wan ’82
Beatrice Wang ’99
Robert A. Ware ’84
Douglass J. Warner ’59
Robert P. Webb ’51
Alfred E. Wechsler ’55
James C. Wei ’54
Martin A. Welt ’57
Ralph L. Wentworth ’48
Gary L. White ’77
Lawson E. Whitesides Jr. ’71
Carl V. Wikstrom ’90
Richard J. Wilcox ’85
John A. Wilkens ’77
Lucile S. Wilkens ’77
Curtis C. Williams III ’50
Brian G. Willis ’99
R. N. Wimpress ’39
James F. Wishart ’79
Graham A. Woerner ’76
Byron B. Woertz ’39
Eric W. Wong ’81
Patrick S. Wong ’62
Pang T. Woo ’51
Benjamin H. Wood Jr. ’62
Walter F. Worth ’68
Wesley Wright Jr. ’57
Winifred T. Wu ’81
Jirong Xiao ’90
Vijay M. Yabannavar ’88
Hiroshi Yagi ’79
Kurt S. Yanagimachi ’00
Bruce S. Yarmoska ’79
Michael J. Yaszemski ’95
Reginald S. Yeung ’59
Kai W. Young ’58
Lily H. Youtt ’97
Rama A. Zakaria ’97
Michael Zeltkevic ’99
Jorge Zemella Frea ’63
Yizu Zhu ’92
Allyn J. Ziegenhagen ’59
Samuel Znaimer ’81
Irwin S. Zonis ’52
Andrew L. Zydney ’85

Research Highlights

In the Department of Chemical Engineering

Encoded Hydrogel Particles for High-Throughput Molecular Diagnostics

Patrick S. Doyle

Detection of nucleic acids and proteins is a fundamental tool that lies at the heart of a broad range of applications from clinical diagnostics to pathogen detection in biodefense to genetic engineering in agriculture. Such biomolecule analysis is most efficiently accomplished via multiplexing – detecting many targets simultaneously in a single sample. Nucleic acids (DNA and RNA) are particularly attractive targets as they can be conveniently amplified and labeled for detection while they provide a high degree of specificity, thus minimizing "false-positive" results.

There are two broad classes of commercially available technologies commonly used for multliplexed analysis. Microarrays (DNA chips) are ideal for high-density applications that demand the detection of 10,000(+) nucleic acid targets in a single sample while bead-based systems are required for *high-throughput* analysis of thousands of samples per day, but provide only a modest density of ~100 targets per sample. As the field of molecular diagnostics progresses, it is becoming clear that there exist several arenas that require *medium-density* (100 – 3000 targets), *high-throughput* screening. These include *in vitro* cancer diagnostics, drug discovery, and neonatal screening. Unfortunately, the multiplexing tools available today cannot efficiently accommodate these applications.

To this end, Professor Doyle's group is developing a technology that can meet the emerging demands in molecular diagnostics, providing higher performance at a lower cost. The process consists of three parts: synthesis of barcoded particles, incubation with a sample, and particle scanning in a flow-through microfluidic device (*Science 2007*). This is shown schematically in Figure 1.

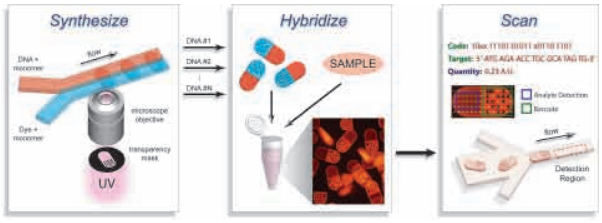


Figure 1: Schematic of multiplexed analysis using barcoded hydrogel particles. Particles are synthesized with an encoding region and probe-loaded region using continuous flow lithography, mixed and incubated with a sample, and then scanned in a flow-through device.

Particles are created using microfluidic-based synthesis techniques developed by the Doyle group called Continuous Flow Lithography (CFL, *Nature Materials 2006*) and Stop Flow Lithography (SFL, *Lab-on-a-Chip 2007*). These processes allow for the creation of geometrically complex microparticles (triangles, rods, or any 2-D extruded shape) by coupling microfluidics and photolithography. Additionally, the method allows for the polymerization across laminar co-flowing streams of UV-curable monomers, providing a means to synthesize multifunctional particles.

The barcoded particles are designed to have two functionalities – one fluorescent, graphically encoded region that identifies the probe attached to the particle and one probe-loaded region. More regions can be created by simply co-flowing multiple streams. Control regions (where no binding should occur) can also be built into each particle. In one design, the particles bear a 20-bit code through the use of unpolymerized holes in the wafer-shaped structure, thus offering the possibility of over 10^6 unique codes. The method of particle synthesis is unique from all others in that particle synthesis, encoding, and biomolecule functionalization are combined into a *single step*.

The particle materials and multifunctional design are also quite unique. Particles are composed of a porous, hydrogel that provides the ideal environment for nucleic acid hybridization, allowing the system to be extremely sensitive and highly specific for the designated targets. Furthermore, the ability to physically separate the code region from the probe region on a particle allows the use of fluorophores with similar spectral characteristics for encoding and target detection, and so requires only one illumination and detection source (i.e. is a single color approach). This will allow for more compact and economical scanners.

After hybridization of fluorescently-labeled targets, the particles are flowed through a microfluidic device, where they are aligned using flow-focusing, and scanned with a detector. Overall, the technology is inexpensive and extremely versatile. The approach has been applied to both DNA and RNA detection and validated for applications in drug discovery and *in vitro* cancer diagnostics. With help from MIT's Deshpande Center, Professor Doyle and a recent graduate from his group are hoping to push the technology toward commercialization.

The Doyle Lab's approach to particle synthesis has implication far beyond diagnostics. Already, flow lithography has been used to synthesize mesoscopic surfactants (*Langmuir 2007*), photonic structures (*Angewandte Chem. Int. Ed. 2007*), and cell-loaded particles for tissue engineering (*Lab-on-a-Chip 2008*). With enormous potential that is still largely untapped, the approach will continue to be an intense area of research in Professor Doyle's group.

Near Infrared Optical Modulation of Carbon Nanotubes for Biomedical Sensors

Michael S. Strano

The Strano laboratory continues its focus on the chemistry of low dimensional systems and, specifically, transduction mechanisms for nano-sensors. In recent work, they have demonstrated a new class of sensors for life science and biomedical applications based upon single walled carbon nanotubes (SWNT.) These carbon based molecular cylinders have tunable, near infrared fluorescent emission in a region of the electromagnetic spectrum through which biological materials, such as tissue and blood, exhibit minimal autofluorescent background and enhanced optical transparency[1]. Their lack of photobleaching makes them ideally suited for long term monitoring[2]. To date, the Strano laboratory has developed chemical interfaces and transduction mechanisms for the specific detection of glucose[3], divalent metal cations[4] and DNA hybridization[5] even through blood and other highly scattering media. Recent work [6] has focused on the optical responses of carbon nanotubes to osmotic pressure gradients in a hydrogel-based, tissue implantable construct (Figure 2). The effort thus far is able to validate and expand upon existing theories of lattice strain and optical modulation for 1D quantum confined systems. The Strano laboratory hopes to study and further refine such systems for use as real time glucose sensor devices that are optically queried.

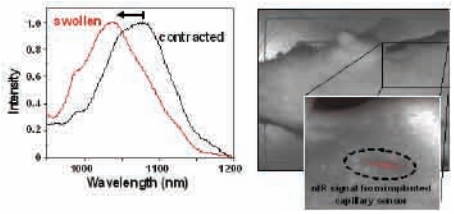


Figure 2: A SWNT-Hydrogel sensor shows shifts in SWNT fluorescence in response to the swelling state of the hydrogel (left). A SWNT fluoresce sensor implanted beneath the skin of a rat can easily be imaged through the tissue (right).

Nanoscale sensing elements have other advantages, such as the potential for single molecule analyte detection in physically or biologically constrained environments. The Strano laboratory has recently demonstrated that a pair of carbon nanotubes can provide four nearly orthogonal optical modes for signal transduction that can be used to identify distinct classes of genotoxic analytes (Figure 3). The system can uniquely fingerprint, for example, chemotherapeutic drugs and reactive oxygen species (ROS) which are spectroscopically differentiated into four distinct classes. The team also recently demonstrated single-molecule sensitivity of hydrogen peroxide, one of the most common genotoxins and an important signalling molecule. The sensors have been tested in real time within live mammalian cells, demonstrating the first multiplexed optical detection from a nanoscale biosensor and the first label-free tool to optically discriminate between genotoxins.

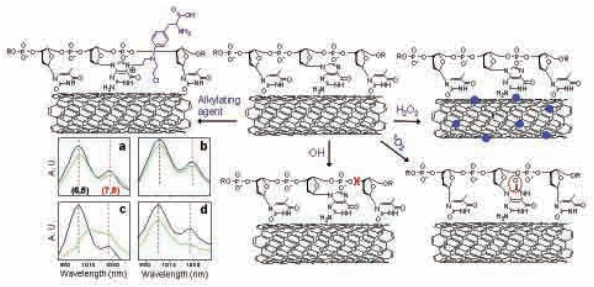


Figure 3: Four genotoxic chemistries elicit distinct optical responses from a pair of two DNA wrapped carbon nanotubes. a) alkylation, b) hydrogen peroxide physisorption, c) singlet oxygen, d) hydroxyl radical.

1. Wray S, Cope M, Delpy DT, Wyatt JS, Reynolds EOR. Characterization of the near-Infrared Absorption-Spectra of Cytochrome-Aa3 and Hemoglobin for the Non-Invasive Monitoring of Cerebral Oxygenation. Biochimica Et Biophysica Acta 1988 Mar 30;933(1):184-192.
2. Graff, RA; Swanson, JP; Barone, PW; Baik, S; Heller, DA et al. Achieving individual-nanotube dispersion at high loading in single-walled carbon nanotube composites. Advanced Materials 2005, 17, 980.
3. Barone, PW; Baik, S; Heller, DA; Strano, MS Near-infrared optical sensors based on single-walled carbon nanotubes. Nature Materials 2005, 4, 86.
4. Heller DA, Jeng ES, Yeung TK, Martinez BM, Moll AE, Gastala JB, et al. Optical detection of DNA conformational polymorphism on single-walled carbon nanotubes. Science 2006 JAN 27;311(5760):508-511.
5. Jeng ES, Moll AE, Roy AC, Gastala JB, Strano MS. Detection of DNA hybridization using the near-infrared band-gap fluorescence of single-walled carbon nanotubes. Nano Letters 2006 Mar;6(3):371-375.
6. Barone, PW; Zhang, J; Ortiz, R; Strano, MS 2008 in preparation.

GSC-X 2007-2008 News

By Ben CP Lin, Jon DeRocher and Jordi Mata-Fink

Greetings from the 2007-2008 incarnation of the GSC-X! We've spent a whirlwind year organizing events, dispensing food and drinks, and generally lubricating the social atmosphere of our generous department. Having been promised that writing this article will be our final task before we are released to the sweet embrace of our respective theses, it is with great delirium that we rush to recount the year in passing.

We began with our annual ChemE-BioE summer picnic featuring delicious Redbones BBQ and an ice cream truck as well as sand volleyball, face painting, a bounce castle, and of course, the traditional dunk tank. Amazingly, Steve Wetzel managed to see out his entire dunk tank shift unscathed, although Professors Jensen and Green were not so lucky.

The Fall breeze brought us a new crop of star-crossed first years – it was thoughtful of the department to recruit the entertainment for our TGs. We welcomed them with the final ChemE outdoor picnic held on the lawn at Main and Ames (which has now become a construction site). As always, each month was marked by a succession of TGs to keep the spirits up. Of course, there is no better way to say "Hang in there, we're so proud of you!" to our first year students than to force them to bob for apples during Halloween. The semester reached a climax with our show-stopping Thanksgiving and Christmas TGs, with wonderfully catered meals and fancy hors d'oeuvres. The first years managed to set a new standard for creativity and production quality during the Christmas skits with their clever spoofs of popular television shows (search for "MIT ChemE Skits" on YouTube if you have some spare time).

The spring semester was packed with even better food and an ever increasing variety of drinks as the department feasted on six TGs. The GSC-X played host to three consecutive recruiting TGs and the graduate students were on their best and most charming behavior – another record admissions yield is imminent!

Nth year graduate students ham it up during the annual holiday skits.

The ChemE intramural sports teams had another successful year in competition, to match Boston's blossoming professional teams. We won the championship in indoor soccer and summer softball, and were semifinalists in unihoc, outdoor soccer, and football. There was strong participation among the first year class despite the overwhelming courseload, and the old veterans were as active as ever. The graduate students look forward to bringing more glory to the department in 2008-09.

As we scurry back to our fume hoods and pray for some useful data, we leave the GSC-X in the very capable hands of our brand new crop of Nth years. Have a great year!

Your (former) GSC-X, version 2007-2008 ⊡

CHEME HAS A NEW WEBSITE!

After many months hard work, the MIT Department of Chemical Engineering is proud to premier its new online presence! The new ***web.mit.edu/cheme*** includes student and alumni profiles, a searchable calendar of news and seminars, even photo galleries of student events around the department.

Along with its more user-friendly format, a prominent new feature of the site is a dedicated "Alumni" section, ***web.mit.edu/cheme/alumni***, which includes links to current and archived news about your fellow alumni.

This "Alumni" tab is designed to be a link between our department and alumni; we welcome your feedback on what you'd like to see on this page.

We look forward to hearing from you!

Melanie Miller, Editor
Department of Chemical Engineering

Chemical Engineering Alumni News is an annual publication of MIT's Department of Chemical Engineering.

psb 08-06-0407

Massachusetts Institute of Technology
Department of Chemical Engineering
77 Massachusetts Avenue, Room 66-350
Cambridge, MA 02139-4307 USA

ADDRESS SERVICE REQUESTED