MIT CHEMICAL ENGINEERING ALUMNI NEWS

XCurrents

Alumni, friends and colleagues gather to remember Professor Emeritus Adel F. Sarofim during May 11 Symposium (Page 18)

Letter from *Department Head Klavs F. Jensen*

Welcome to the Fall 2012 edition of the Alumni Newsletter. The students and faculty have returned to campus after a beautiful New England summer and engaged in a new semester of learning, teaching, and research.

On the cover of this fall's newsletter is an image of the bench scale demonstration plant from the Novartis-MIT Center for Continuous Manufacturing in connection with a visit by the Novartis CEO, Joe Jimenez. The Center, whose custom laboratory is housed in Building 66, combines the industrial expertise of Novartis with MIT's expertise in scientific and technological innovation. The Center is working to develop new technologies that could replace the conventional batch-based approach in the pharmaceuticals industry with continuous manufacturing processes from start to finish. This spring, the Center demonstrated the first truly continuous production of pharmaceuticals from starting reagents to final tablets under automated control. The Center completed its first five year period, and I'm pleased to report that Novartis has committed $45 million to another five year period. Bernhardt Trout has skillfully led the formation of the Center with faculty colleagues from chemical engineering, chemistry, and mechanical engineering. You can find more about the center on page 14.

HIGHLIGHTS

find the latest news online:

web.mit.edu/cheme/

MITChemEng MITChemE

Massachusetts Institute of Technology

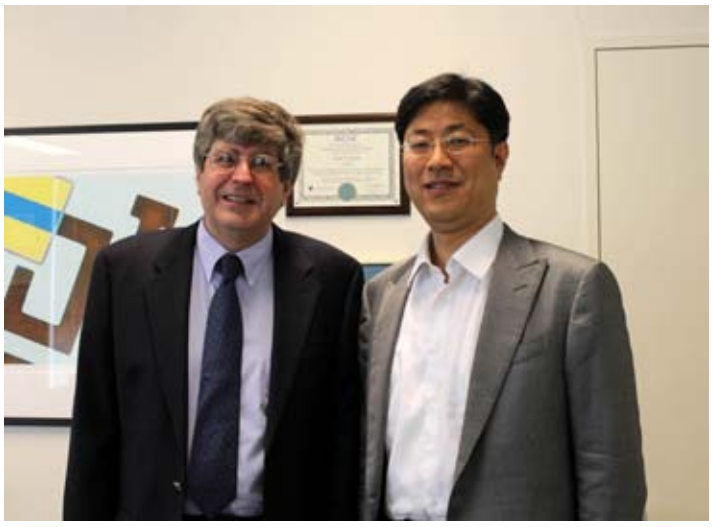
Letter from the Department Head continued

In general, sponsored research volume in the department has increased once again to a total of $54 million over the past year. The high level of interdisciplinary work and collaboration across fields continues to provide a strong basis for innovation in the department, as well as a root for the development of new investigative tools and computational approaches.

In July, Professor Bill Deen retired and stepped down from his role as the department's graduate officer - a role that we are fortunate Professor Pat Doyle has accepted. Luckily for us, Bill will still be around the department, returning part-time to teach 10.50. Bill served for over a decade as graduate officer, and set the standard through his thoughtfulness, affability and care for each and every student that walked through his always-open door. Bill's skill as a teacher and mentor was recently recognized through his earning of the MIT's 2012 Bose Award for Excellence in Teaching and AIChE's 2012 Warren K. Lewis award. More on Bill's career and legacy can be found on page 5.

On Friday, May 11, 2012, former colleagues and students gathered to remember our dear colleague, friend, teacher and chemical engineering giant, Adel Sarofim, who passed away in December 2011. The symposium was a very special tribute, including wonderful reminiscences from former students and collaborators who spoke with great feeling and insight about their work with this remarkable man. Photos and a summary of the event are on page 18. As you may also know, the Adel F. Sarofim (1962) Fund was established in 2001 to honor Adel when he retired from MIT. Through its endowment, the fund provides an ongoing source of much-needed support for graduate students in the Department of Chemical Engineering. As the need for such support is far greater than the resources currently available, we welcome gifts at all levels to help increase the endowment and pay tribute to the memory of a great educator. To help reach the funding goal, we have been given a generous $100,000 challenge grant by alumna Kimberly Ritrievi, (ScD, SM 1985) and her partner Darryn Tilden. They have pledged to match gifts of any value between now and December 31, 2012, as well as pledges of $10,000 or more paid over the next five years (through June 30, 2017), dollar for dollar, thus doubling the values. We are very thankful to Kim and Darryn for this generous tribute. More information on how to give can also be found on page 18.

On November 30th, 2012, we will host the 26th annual Hoyt C. Hottel Lecture. This year's lecturer will be Dr. Eric Toone, principal deputy director of the US Department of Energy's Advanced Research Projects Agency – Energy (ARPA-E). Dr. Toone is responsible for oversight of all of ARPA-E including direct oversight of its electrofuels program. He is also a professor of biochemistry at Duke University. We look forward to hearing his thoughts and expertise on today's energy climate. More can be found on page 17 of this newsletter, and as always, the most current information on the Hottel Lecture is at http://web.mit.edu/cheme/news/hottel.html.



Alumnus Chun-Hyuk Lee (PhD '94)visits with Department Head Klavs Jensen on the occasion of the Adel Sarofim Symposium on May 11, 2012. For more information on the symposium or how you can support the Adel F. Sarofim Fellowship, go to page 18.

Bill [Deen] served for over a decade as graduate officer, and set the standard through his thoughtfulness, affability and care for each and every student that walked through his always-open door.

Our faculty continues to garner awards and distinctions for their research and efforts to further the field of chemical engineering (more on this on page 10). Also I'm happy to report that several members of our staff earned recognition this spring for their dedication and competence in keeping the Chemical Engineering Department running. Jim Hardsog, our tireless IT manager, and the Administrative Services Organization's team of Phoebe Spence Biagiotti, Ximena Forero-Irizarry, David Kubiak, Richard Lay, Renee LeBlanc, and Christine Rodriguez received the 2012 School of Engineering's Infinite Mile Award. They and all our staff's dedication and diligent work are critical to the success of our students and faculty. They truly deserve this recognition. Please find more about these and other awards on page 9.

Space continues to be a major challenge for the department, but we are receiving help from the Institute. Early in the spring four faculty members, Pat Doyle, Bill Green, Kristala Prather and

Greg Rutledge, will move to newly renovated space in E17/18 bringing the total number of faculty in the E17/18/19 cluster to seven. The move will allow much needed decompression of laboratory space in Building 66. The Institute has performed a thorough evaluation of space, called MIT 2030, (http://web.mit.edu/mit2030/). In this evaluation Building 66 is identified as a top priority both programmatically and in terms of renovation. Facilities has done an extensive study of the building and identified many of the issues you probably recall, such as problems with heating and cooling, and leaks through the ceiling and basement. An architectural firm has made a plan for the building that addresses the infrastructure issues and importantly makes a safer environment for our students by separating their office areas from lab areas. The price tag and schedule are not known yet, but this is a good first step to ensuring that we can retain our leadership in the profession.

The Institute has performed a thorough evaluation of space, called MIT 2030: http://web.mit.edu/mit2030/ In this evaluation Building 66 is identified as a top priority both programmatically and in terms of renovation.

We are also in the midst of planning the 125th anniversary of Chemical Engineering at MIT; the first American chemical engineering degree was born here in 1888, and since then we have been at the forefront of the field. We are planning a symposium for the fall of 2013, focusing on the future of chemical engineering. We will let you know the details as they solidify. You can always find the latest on this event and other happenings in the department on our website: web.mit.edu/cheme/.

The generous external support to the Practice School and our doctoral program by you, our alumni, is an essential asset in our effort to attract the very best students. We are truly indebted to you for your ongoing commitment and support. 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 allow them to focus on the core subjects of chemical engineering and explore the breadth of research opportunities before choosing a thesis topic.

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 fall.

On the cover: Course X graduate student Patrick Heider explains to the CEO of Novartis the current work of the Novartis-MIT Center for Continuous Manufacturing. For more information, go to page 14.

Klavs F. Jensen
Department Head
MIT Chemical Engineering Department

Practice School News

Greetings from the MIT Practice School!

I am pleased once again to be able to tell you the latest developments in the Practice School program and the stations we are running. During the Spring of 2012, the David H. Koch School of Chemical Engineering Practice continued its legacy of promoting Course X students' engineering problem solving and project management skills. After 95 years, the Practice School is still the only academic program of its kind. What started in 1916 as five stations in the Northeast has burgeoned out to four continents and numerous new industries and technologies as the field of chemical engineering has evolved.

The centennial of the Practice School will be in 2016, and we're already working on plans to commemorate this milestone. More information on the event will come with the next edition of XCurrents. We look forward to celebrating with our students, supporters and alumni, who have all been integral to making it the robust and unique program it is today.

Spring 2012 Stations

General Mills (GMI), Minneapolis MN
Directed by Bob Hanlon

Comprised of a healthy blend of theory and experiment, the students' projects for this session had them applying such basic chemical engineering concepts as crystallization, kinetics, and process optimization, to the improvement of the manufacturing and quality control of some of GMI's signature products, such as Cheerios® and Fiber One® Bars. An added benefit to all involved was the visit by Professor Allan Myerson, a leader in crystallization research. Professor Myerson arrived at MIT in 2010 from IIT Chicago and readily agreed to this opportunity to learn what the Practice School program is all about. His presentation on crystallization to both company and students was very well attended and received, especially by those involved in the application of such technology to food processing.

One of the themes of this station concerned understanding value. The students entering the program today have stronger communication skills than yesterday. Hence, less teaching time is needed for the technical aspects of written reports and oral presentations, which has freed up more time for higher level concepts, such as understanding value. This to me is one of the most important skills any engineer can have.

When the deep understanding that arises from such efforts becomes the springboard for the students' work, good things happen. We saw this to one extent or another in each of the projects when the results 'jolted' the company's thinking, as one GMI consultant shared with me. While we typically seek hard results when assessing the value of our projects, we also seek those intangible results wherein the students' work shifts the company's view on a certain project and so impacts its future direction long after the students are gone.

Novartis Pharmaceutical Corp., Basel, Switzerland
Directed by Claude Lupis

It is always a pleasure to return to the Basel station where Walter Bisson and his team organize so efficiently all details of our projects, accommodations, work permits, etc. This year, we had seven students attending the station. Three projects were selected; they extended over the two sessions of four weeks and

The Novartis Basel group takes some time off to sightsee in the old town.

at three different sites (Wehr in Germany, and Schweizerhalle and Stein in Switzerland), although some of the laboratory experiments had to be conducted at a fourth site, the Novartis campus in Basel. At the end of the first session, the compositions of the teams were changed and the students worked on a different project than on the first session. Thanks to the wonderful Basel transportation system, the multiplicity of sites did not present much of a commuting problem and instead gave the students a chance to experience the different cultures of the different sites.

The projects addressed problems of process performance and optimization, reallocation of equipment, product stability, and elimination of various defects and impurities. Once again, the results seemed to yield a "win-win" situation.

"Fasnacht," Basel's renowned ancient three-day carnival always represents a highlight of the students' stay. It starts on a Monday at 4am, and this year that Monday corresponded to the first day of the second session. Having that day off provided the students with an extended weekend, which in their busy schedule was much appreciated. Basel is at the border of three countries (Switzerland, France and Germany) and the area offers endless touristic opportunities. The students particularly enjoyed the tours of Colmar and Strasbourg, in Alsace, France.

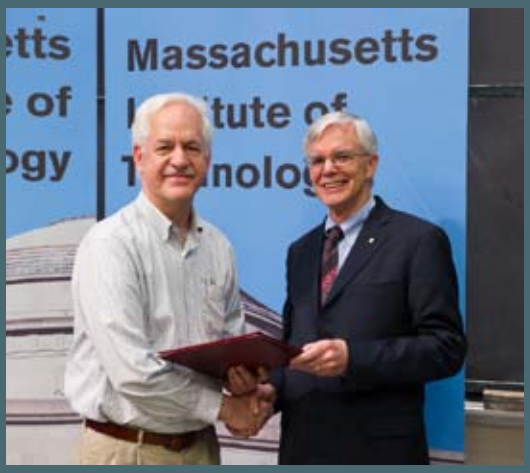
I look forward to sharing more Practice School work and adventures with you in the next newsletter!

Best regards,

T. Alan Hatton
Director

Professor Bill Deen Retires

After over three decades as MIT faculty, Professor William M. Deen has stepped down from teaching to become an emeritus professor. Fortunately for the students and the department, he will be returning part time to teach 10.50. For a decade, Bill served as a wise, firm, and caring graduate officer to the Course X graduate community. During that time, he chaired innovations in our graduate curriculum, oversaw improvements in the department's qualifying procedures, and acted as an exceptional mentor to the graduate body. In the spring of 2012, Bill received the Bose Award for Excellence in Teaching. This award was established in 1989 by the School of Engineering to recognize outstanding contributions to education by members of its faculty. Bill is the first Chemical Engineering faculty member to receive this award.



Bill receives the Institute's Bose Award for Excellence in Teaching, May 9, 2012.

During the 2012 AIChE Meeting, Bill will receive the Warren K. Lewis Award for Chemical Engineering Education, which recognizes distinguished and continuing contributions to chemical engineering education.

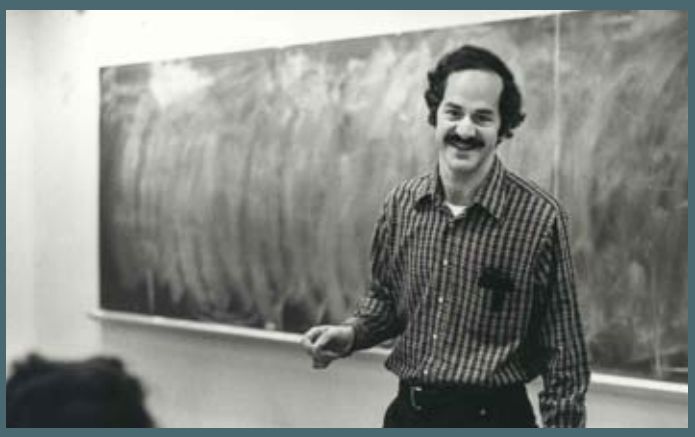
These awards recognize what our department and students have known for years: Bill genuinely cares for each student's education and well-being.

Bill talks with new incoming graduate students in 2005.

Throughout his career, Bill worked to advance chemical engineering education. In 1998, he wrote the seminal chemical engineering textbook, *Analysis of Transport Phenomena*, which is still in use today.

In 1988, Professor Robert C. Reid wrote of Bill and his work, "Bill is well-known to our Graduate Students who have bested 10.50. This subject in transport phenomena reflects Bill's major interest, and his principal research lies in applications to biomedical engineering – and in particular to the complex behavior of the kidney. Bill says he finds the kidney to be a fascinating, intricate organ with numerous unsolved mass-transfer problems. Some 25% of the arterial flow from the heart is directed to the kidneys. There, the blood is filtered and a significant fraction of the water, salts, glucose, amino acids, urea and other materials are removed as the glomerular filtrate. Following this step, the kidney must then selectively reabsorb most of these same materials and leave a concentrated solution of water, salts, urea and other wastes which then forms the body urine. This filtration-reabsorption process is complex and clearly non-steady state as the body tries to cope with variable water levels (e.g. too much beer) yet still maintain appropriate concentrations of ions, sugar, amino acids, etc. in the blood. The kidney presents many challenges to those who wish to model it in a mathematical sense and to understand the basic principles underlying its operation."

The Chemical Engineering Department is immensely grateful to Bill for his contributions to the department, our students and the field of chemical engineering. We will miss his thoughtful and wise counsel as well as his witty yet calming demeanor.



On May 14, 2012, The department hosted its annual Award Ceremony and traditional dessert reception. Presided by Department Head Klavs F. Jensen, the ceremony recognized undergraduates, graduate students, staff and faculty for their achievements and contributions to the department during the school year.

A variety of organizations, as well as individuals, outside the department and MIT donated prizes and scholarships to students in chemical engineering. The awards are below.

Course X Awards Day 2012

Merck Technology Fellowship Award
Jared Forman ’13

Merck Manufacturing Diversity Fellowship Award
Tejas Navaratna ’14

Robert T. Haslam Cup
Awarded to a student who shows outstanding professional promise in Chemical Engineering
Mengfei Yang ‘12

Roger de Friez Hunneman Prize
Recognizes outstanding scholarship in class and research
Shawn Pan ‘12

Gates Cambridge Scholarship
Joshua Cohen ‘12
Allison Hinckley ’12

Phi Beta Kappa
Yunxin Joy Jiao’12

Genentech Scholar Award
Michelle Dion ’13

Amgen Scholar
Nikita Consul ’13

MIT Federal Credit Union “People Helping People Award”
Corinne Carland ’13

Wing S. Fong Memorial Prize
Awarded to a chemical engineering senior of Chinese descent with the highest cumulative GPA, in honor of the memory of Wing S. Fong, his hard work, and dedication to his adopted home, university, and country.
Yuewei Lucy Ji ‘12
Yunxin Joy Jiao ‘12

C. Michael Mohr Outstanding Faculty Award
Recognizes excellence in teaching in undergraduate subjects
Narendra Maheshri, Assistant Professor of Chemical Engineering

Edward W. Merrill Outstanding Teaching Assistant Award
Cary Opel (G)

Outstanding Graduate Teaching Assistant Award
Karthik Shekhar (G)

Graduate Student Council Outstanding Faculty Award
Arup Chakraborty, Robert T. Haslam Professor of Chemical Engineering
William Deen, Carbon P. Dubbs Professor

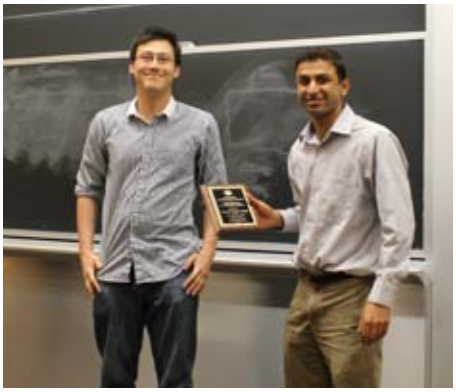
Fall 2011 Best Student Seminar
Karthik Shekhar (G)

Spring 2012 Best Student Seminar
Mitchell Wang (G)

Chemical Engineering Outstanding Employee Award
Gwen Wilcox, Administrative Assistant

Chemical Engineering Individual Accomplishment Award
Gracie Dorneus, Administrative Assistant
Rachel Howden (G)

Rock Award
Given to a deserving student for showing leadership on the athletic field
Stephen Morton (G)








Departmental Special Service Awards

Course X Undergraduate Chapter of AIChE
Mary Boyd ’12
Timothy Chang ’12
Paige Finkelstein ‘14
Allison Hinckley ’12
Saloni Jain ’12
Mark Kalinich ’13
Lauren Kazmierski ‘12
Charlotte Kirk ‘14
Molly Kozminsky ’12
Michelle Lu ’12
Kelechi Nwosu ’12

Graduate Student Council for Course X (GSCX)
Irene Brockman (G)
Noemie-Manuelle Dorval Courchesne (G)
Connie Gao (G)
Justin Kleingartner (G)
Aditya Kunjapur (G)
Mark Molaro (G)
Stephen Morton (G)
Sven Schlumpberger (G)
Carl Schoellhammer (G)
Stefanie Schulze (G)
Ksenia Timachova (G)
Zachary Ulissi (G)

Congratulations Class of 2012!

Course X's most recent alumni class was feted at this year's Commencement Reception, Friday, June 8th, 2012. Graduates, families, faculty, friends and alumni mingled at the Chemical Engineering Tent on the McDermott Circle.















Course X Staff Members Receive School of Engineering's Infinite Mile Award

The MIT School of Engineering hosted its 12th annual Infinite Mile Awards ceremony on Wednesday, April 11th, 2012, to recognize and reward members of the school's administrative, support, service and sponsored research staff. Nominations are made by department heads and laboratory directors, and awards are presented to individuals and teams whose work is of the highest quality — who stand out because of their level of commitment, energy and enthusiasm.

This year, the Infinite Mile Awards for Team Excellence went to Administrative Services Organization's Research Management Team members Phoebe Spence Biagiotti, Ximena Forero-Irizarry, David Kubiak, Richard Lay, Renee LeBlanc, and Christine Rodriguez. Chemical Engineering system administrator Jim Hardsog won the Infinite Mile for Individual Excellence.

(l to r) Richard Lay, Renee LeBlanc, Jim Hardsog, Phoebe Biagiotti, Ximena Forero-Irizarry and David Kubiak.

The ASO team handles the highly complex multi investigator and multi institutional proposals for the Department of Materials Science and Engineering, the Chemical Engineering Department and the Center for Biomedical Engineering. They provide advice for pre and post award management, deliver account summaries tailored to the needs of the faculty, as well as take care of all the post award efforts of reconciling expenses, monitoring accounts, balancing close-outs, and alerting the faculty to potential financial problems.

Award nominees for the ASO team stated, "The teamwork and the team spirit among these six individuals are unmatchable. They are willing to help each other (and other members of the ASO), by lending a hand whenever someone needs extra help, willingly covering each other for vacations and long term leaves. The team's "work hard, play harder" mentality is contagious and the effect on the other ASO members and that of the departments they serve is tremendously positive. Dave is ASO's "social chair" who organizes off-hours, out-of-the-office social activities for the team, Phoebe is the official cake baker for the ASO's quarterly birthday celebrations, and Renee and Phoebe are co-captains for the two get-fit teams that ASO organized with some ChemE and DMSE staff members and affiliates. The team members not only get along with each other but they work well with the other staff members and all of the ASO customers. They cohesively create a very collegial, courteous and energetic atmosphere that alleviates an otherwise very stressful working environment."

Jim assists with the teaching effort, administrative needs, faculty, staff, and students for the whole department, made up of 35 faculty, and approximately 45 staff, 80 postdocs, 240 graduate students, and 220 undergraduates. Jim's service to MIT and the department was best summarized by Department Head, Klavs Jensen: "Jim goes the extra mile to help everyone – faculty, staff, students, and he does it thoroughly, never seeming frazzled and with a cheerful comment." ◊

Executive Officer Bill Green congratulates Jim Hardsog on his well-deserved award.

Faculty News

Michael Strano and Martin Bazant Promoted to Full Professor

Two MIT Chemical Engineering professors have been promoted to full professorship.

Professor Bazant is broadly interested in engineering physics and applied mathematics. His research focuses on transport phenomena with applications in energy storage, water purification, and lab-on-a-chip technology.

Bazant's faculty career at MIT began in the Department of Mathematics, where he led the Nonlinear Electrokinetics Group, Dry Fluids Laboratory, and Applied Mathematics Computational Laboratory, developed a class on Random Walks and Diffusion (18.366), and continues hold a joint appointment. In 2008, he joined the Department of Chemical Engineering in order to focus more on applied research and to start an experimental laboratory. His laboratory is currently developing new "membraneless" water deionization and flow battery systems and investigating various electrochemical and microfluidic transport phenomena, closely coupled to their mathematical modeling.

Professor Strano's research focuses on biomolecule/nanoparticle interactions and the surface chemistry of low dimensional systems, nano-electronics, nanoparticle separations, and applications of vibrational spectroscopy to nanotechnology. He is the recipient of numerous awards for his work, most recently including: the 2008 Young Investigator Award from the M.R.S., the Colburn award from the AIChE; and in 2009 was named one of Popular Science's Brilliant 10 for advances and new platforms for the biomedical detection of cancer.

George Stephanopoulos Elected to AAAS

"Election to the [AAAS] is both an honor for extraordinary accomplishment and a call to serve," Academy President Leslie C. Berlowitz said in a statement. "We look forward to drawing on the knowledge and expertise of these distinguished men and women to advance solutions to the pressing policy challenges of the day." The current membership of AAAS includes more than 250 Nobel laureates and more than 60 Pulitzer Prize winners.

Patrick Doyle Named Soft Matter Lecturer

The editors of the Soft Matter Journal have selected Professor Doyle as the 2012 Soft Matter Lecturer. The recipient of this honor is an early career researcher who has made signficant contributions to the field of soft matter. This annual Lectureship was established by the journal in 2009 to recognize a researcher in the earlier stages of his or her scientific career who has made a significant contribution to the field.

Daniel Anderson Named Goldblith Associate Professor

Professor Daniel Anderson has been selected to hold the Samuel A. Goldblith Career Development Professorship for a three-year term commencing July 1, 2012. Professor Goldblith was a distinguished member of the MIT community for many years as an accomplished scientist in the field of food science and as an adroit administrator. The Chair was established by gifts from Professor Goldblith's friends and is a wonderful expression of gratitude for his dedication to the Institute.

Professor Goldblith was a survivor of the Bataan Death March who became a professor of food science and technology at MIT, a leader in the field of food preservation and a tireless advocate of business and educational cooperation between the US and Japan. He passed away in December of 2001.

Christopher Love Wins Dreyfus Teaching Award

Professor J. Christopher Love has been awarded a Camille Dreyfus Teacher-Scholar Award based on his work in the application of interfacial chemistry, microfabrication, and process design to engineer integrated approaches to single-cell analysis. The Camille Dreyfus Teacher-Scholar Awards Program supports the research and teaching careers of talented young faculty in the chemical sciences. Based on institutional nominations, the program provides discretionary funding to faculty at an early stage in their careers. Criteria for selection include an independent body of scholarship attained within the first five years of their appointment as independent researchers, and a demonstrated commitment to education, signaling the promise of continuing outstanding contributions to both research and teaching.

Robert Langer Receives Perkin Medal

The Perkin Medal is an award given annually by the American section of the Society of Chemical Industry to a scientist residing in America for an "innovation in applied chemistry resulting in outstanding commercial development." It is considered the highest honor given in the US industrial chemical industry.

Klavs Jensen Wins IUPAC-ThalesNano Prize

The International Union of Pure and Applied Chemistry (IUPAC) and ThalesNano announced at the 2nd International Conference of the Flow Chemistry Society in Munich that the International Flow Chemistry Prize was awarded to Professor Klavs Jensen. The prize was awarded in recognition of his extensive activities and publications, which have made an outstanding contribution to the field of flow chemistry both in academia and industry.

During his acceptance speech, Jensen said, "Dr. Ferenc Darvas, thank you for this tremendous honor and for your leadership of the Flow Chemistry field. Also thank you to Prof. Droescher for supervising this special IUPAC prize. I would also like to thank my many colleagues in the flow chemistry and microreactor communities, my colleagues at MIT (Prof. Bawendi, Buchwald, and Jamison), and importantly, my students and postdocs. I have learned a lot from everyone!"

ThalesNano is a world-leading provider of continuous process chemistry instruments in the rapidly developing market of laboratory and process scale flow reactors.

Professor Emeritus János Beér Wins ASME's Worcester Reed Warner Medal

ASME (the American Society of Mechanical Engineers) awards the Worcester Reed Warner Medal to an individual for outstanding contribution to the permanent literature of engineering.

Contributions may be single papers, treatises or books, or a series of papers. They should be progressive ideas relating to engineering, scientific and industrial research associated with mechanical engineering; the design and operation of mechanical and associated equipment; industrial engineering or management, organization, operation, and the concomitants of each; or other subjects closely associated with those mentioned.

Five Professors Earn AIChE Awards

Professor George Stephanopoulos was named the recipient of AIChE's 2012 Founders Award. The AIChE Founders Award recognizes outstanding contributions in the chemical engineering field. The award is presented 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 should have a long and distinguished record of service to the profession, including both technical and professional activities.

Professor Karen Gleason earned the Excellence in Process Development Research Award. This award recognizes individuals who have made significant technical contributions to the advancement of process development within research, teaching, or regulatory activities. Emphasis is placed on accomplishments and advances made within the last ten years although the award can also be given to someone for an outstanding career.

Professor Michael Strano garnered the Nanoscale Science and Engineering Forum Award, which recognizes outstanding contributions to the advancement of nanoscale science and engineering in the field of chemical engineering through scholarship, education or service.

Professor Greg Stephanopoulos was also elected a Fellow of AIChE. To gain this honor, a senior member of AIChE must have been practicing chemical engineering for more than 25 years and has demonstrated significant accomplishments in, and contributions to the profession.

Professor Bill Deen received the Warren K. Lewis Award for Chemical Engineering Education, which recognizes distinguished and continuing contributions to chemical engineering education. ◊

Research Highlights

For more information, go to *web.mit.edu/cheme/news/*

All-carbon solar cell harnesses infrared light

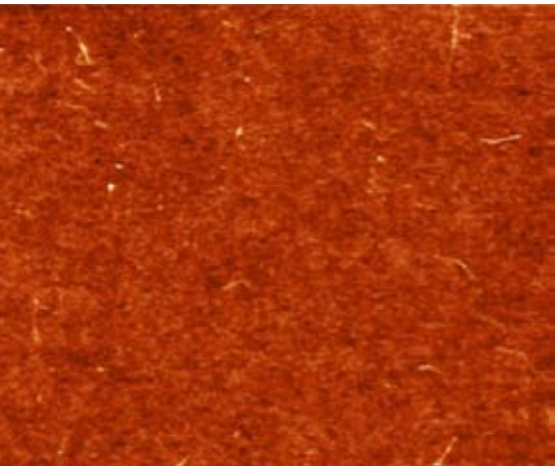
New type of photovoltaic device harnesses heat radiation that most solar cells ignore.

Article by David L. Chandler, courtesy of the MIT News Office.

About 40 percent of the solar energy reaching Earth's surface lies in the near-infrared region of the spectrum — energy that conventional silicon-based solar cells are unable to harness. But a new kind of all-carbon solar cell developed by MIT researchers could tap into that unused energy, opening up the possibility of combination solar cells — incorporating both traditional silicon-based cells and the new all-carbon cells — that could make use of almost the entire range of sunlight's energy.

"It's a fundamentally new kind of photovoltaic cell," says Michael Strano, professor of chemical engineering at MIT and senior author of a paper describing the new device that is being published this month in the journal Advanced Materials.

The new cell is made of two exotic forms of carbon: carbon nanotubes and C60, otherwise known as buckyballs. "This is the first all-carbon photovoltaic cell," Strano says — a feat made possible by new developments in the large-scale production of purified carbon nanotubes. "It has only been within the last few years or so that it has been possible to hand someone a vial of just one type of carbon nanotube," he says. In order for the new solar cells to work, the nanotubes have to be very pure, and of a uniform type: single-walled, and all of just one of nanotubes' two possible symmetrical configurations.



(at left) An atomic-force microscope image of a layer of single-walled carbon nanotubes deposited on a silicon surface, as the first step in manufacturing the new type of solar cell developed by an MIT team. Individual nanotubes can be seen in the image. Image: Rishabh Jain et al

Other groups have made photovoltaic (PV) cells using carbon nanotubes, but only by using a layer of polymer to hold the nanotubes in position and collect the electrons knocked loose when they absorb sunlight. But that combination adds extra steps to the production process, and requires extra coatings to prevent degradation with exposure to air. The new all-carbon PV cell appears to be stable in air, Strano says.

The carbon-based cell is most effective at capturing sunlight in the near-infrared region. Because the material is transparent to visible light, such cells could be overlaid on conventional solar cells, creating a tandem device that could harness most of the energy of sunlight. The carbon cells will need refining, Strano and his colleagues say: So far, the early proof-of-concept devices have an energy-conversion efficiency of only about 0.1 percent.

But while the system requires further research and fine-tuning, "we are very much on the path to making very high efficiency near-infrared solar cells," says Rishabh Jain, a graduate student who was lead author of the paper.

Because the new system uses layers of nanoscale materials, producing the cells would require relatively small amounts of highly purified carbon, and the resulting cells would be very lightweight, the team says. "One of the really nice things about carbon nanotubes is that their light absorption is very high, so you don't need a lot of material to absorb a lot of light," Jain says.

Typically, when a new solar-cell material is studied, there are large inefficiencies, which researchers gradually find ways to reduce. In this case, postdoc and co-author Kevin Tvrdy says, some of these sources of inefficiency have already been identified and addressed: For instance, scientists already know that heterogeneous mixtures of carbon nanotubes are much less efficient than homogeneous formulations, and material that contains a mix of single-walled and multiwalled nanotubes are so much less efficient that sometimes they don't work at all, he says.

"It's pretty clear to us the kinds of things that need to happen to increase the efficiency," Jain says. One area the MIT researchers are now exploring is more precise control over the exact shape and thickness of the layers of material they produce, he says.

The team hopes that other researchers will join the search for ways to improve their system, Jain says. "It's very much a model system," he says, "and other groups will help to increase the efficiency."

The work also involved MIT graduate students Rachel Howden, Steven Shimizu and Andrew Hilmer; postdoc Thomas McNicholas; and professor of chemical engineering Karen Gleason. It was supported by the Italian company Eni through the MIT Energy Initiative, as well as the National Science Foundation and the Department of Defense through graduate fellowships to Jain and Howden, respectively. ◊

Delivering RNA with tiny sponge-like spheres

New RNA interference method holds promise for treating cancer, other diseases.

Article by Anne Trafton, courtesy of the MIT News Office.

For the past decade, scientists have been pursuing cancer treatments based on RNA interference — a phenomenon that offers a way to shut off malfunctioning genes with short snippets of RNA. However, one huge challenge remains: finding a way to efficiently deliver the RNA.

Most of the time, short interfering RNA (siRNA) — the type used for RNA interference — is quickly broken down inside the body by enzymes that defend against infection by RNA viruses.

"It's been a real struggle to try to design a delivery system that allows us to administer siRNA, especially if you want to target it to a specific part of the body," says Paula Hammond, the David H. Koch Professor in Engineering at MIT.

Hammond and her colleagues have now come up with a novel delivery vehicle in which RNA is packed into microspheres so dense that they withstand degradation until they reach their destinations. The new system, described Feb. 26 in the journal Nature Materials, knocks down expression of specific genes as effectively as existing delivery methods, but with a much smaller dose of particles.

Such particles could offer a new way to treat not only cancer, but also any other chronic disease caused by a "misbehaving gene," says Hammond, who is also a member of MIT's David H. Koch Institute for Integrative Cancer Research. "RNA interference holds a huge amount of promise for a number of disorders, one of which is cancer, but also neurological disorders and immune disorders," she says.

Lead author of the paper is Jong Bum Lee, a former postdoc in Hammond's lab. Postdoc Jinkee Hong, Daniel Bonner PhD '12 and Zhiyong Poon PhD '11 are also authors of the paper.

RNA interference is a naturally occurring process, discovered in 1998, that allows cells to fine-tune their genetic expression. Genetic information is normally carried from DNA in the nucleus to ribosomes, cellular structures where proteins are made. siRNA binds to the messenger RNA that carries this genetic information, destroying instructions before they reach the ribosome.

Scientists are working on many ways to artificially replicate this process to target specific genes, including packaging siRNA into nanoparticles made of lipids or inorganic materials such as gold. Though many of those have shown some success, one drawback is that it's difficult to load large amounts of siRNA onto those carriers, because the short strands do not pack tightly.

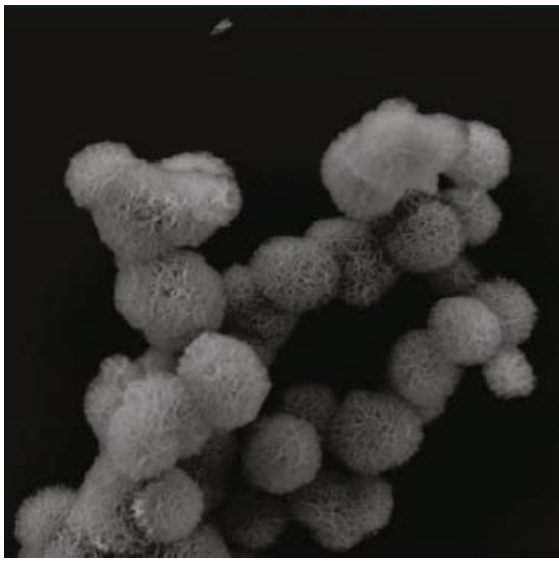
To overcome this, Hammond's team decided to package the RNA as one long strand that would fold into a tiny, compact sphere. The researchers used an RNA synthesis method known as rolling circle transcription to produce extremely long strands of RNA made up of a repeating sequence of 21 nucleotides. Those segments are separated by a shorter stretch that is recognized by the enzyme Dicer, which chops RNA wherever it encounters that sequence.

As the RNA strand is synthesized, it folds into sheets that then self-assemble into a very dense, sponge-like sphere. Up to half a million copies of the same RNA sequence can be packed into a sphere with a diameter of just two microns. Once the spheres form, the researchers wrap them in a layer of positively charged polymer, which induces the spheres to pack even more tightly (down to a 200-nanometer diameter) and also helps them to enter cells.

After the spheres enter a cell, the Dicer enzyme chops the RNA at specific locations, releasing the 21-nucleotide siRNA sequences.

In the Nature Materials paper, the researchers tested their spheres by programming them to deliver RNA sequences that shut off a gene that causes tumor cells to glow in mice. They found that they could achieve the same level of gene knockdown as conventional nanoparticle delivery, but with about one-thousandth as many particles.

In future studies, the researchers plan to design microspheres coated with polymers that specifically target tumor cells or other diseased cells. They are also working on spheres that carry DNA, for potential use in gene therapy. ◊



A cluster of microsponges made of long strands of folded RNA, as seen by scanning electron microscopy Image: Hammond laboratory

Research Highlights

For more information, go to *web.mit.edu/cheme/news/*

Continuous drug manufacturing offers speed, lower costs

New system developed by MIT researchers could help transform the pharmaceutical industry.

Article by Anne Trafton, courtesy of the MIT News Office.

Traditional drug manufacturing is a time-consuming process. Active pharmaceutical ingredients are synthesized in a chemical manufacturing plant and then shipped to another site, where they are converted into giant batches of pills. Including transport time between manufacturing plants, each batch can take weeks or months to produce.

Five years ago, MIT and pharmaceutical company Novartis launched a research effort to transform those procedures. Instead of manufacturing drugs using this conventional batch-based system, they envision a continuous manufacturing process, all done in one location, which would cut down on time and cost.

Such a system would allow greater flexibility in supply and could reduce the environmental impact of manufacturing. Continuous manufacturing could also improve quality-assurance testing, says Bernhardt Trout, director of the Novartis-MIT Center for Continuous Manufacturing.

Tablets produced by a prototype drug-manufacturing system built at MIT. Image: Dominick Reuter

"We see the future of pharmaceutical manufacturing as continuous," says Trout, who is also a professor of chemical engineering at MIT. "That includes continuous flow together with a systems approach, integration and advanced control."

Trout and other MIT researchers have now developed and demonstrated a prototype continuous-manufacturing system — the first that can transform raw materials into tablets in a nonstop process. The research team described the new prototype at last October's annual meeting of the American Institute of Chemical Engineers.

Going with the flow

The original grant supporting the MIT-Novartis Center for Continuous Manufacturing was $40 million over the first five years, with the possibility of renewal for another five years. Researchers at the center, which includes about a dozen MIT faculty members, have been working on different components of the prototype, including reactions between drug precursors, purification, crystallization, tablet formation and monitoring of the overall process.

To demonstrate the system, the researchers built a prototype that produces tablets of a specific drug manufactured by Novartis. However, the system is designed so that components can be swapped in and out to create different drugs.

Key to the continuous system is the development of chemical reactions that can take place as the reactants flow through tubes, as opposed to the huge vats in which most pharmaceutical reactions now take place. Traditional "batch processing" is limited by the difficulty of cooling large vats, but the flow system allows reactions that produce a great deal of heat to be run safely.

For drugs that require multiple steps, new ingredients can be added to the flow at specific points. Also integrated into the system are points where the drug solution is purified. Once the final active product is achieved, it is crystallized into a solid. Any necessary inert ingredients — such as preservatives or flavorings — are added, and the drug is then molded into the traditional tablet shape.

In the new prototype, all of these steps take place within an enclosure 24 feet long, 8 feet wide and 8 feet tall in an MIT chemical engineering lab. In addition to Trout, MIT faculty members involved in the project include Klavs Jensen, Stephen Buchwald, Tim Jamison, Gregory Rutledge, Allan Myerson, Paul Barton and Richard Braatz.

Several of those researchers — Jensen, Jamison and Myerson — are now also working on an even smaller, tabletop version of the technology, funded by DARPA.

Many benefits

With continuous-flow manufacturing, drug companies could manufacture drugs in small plants scattered around the globe, offering greater supply flexibility. Eliminating the need to transport drug components during the manufacturing process would also cut costs significantly: Estimates for the total cost savings of switching to continuous manufacturing range from 15 to 50 percent.

"We see the future of pharmaceutical manufacturing as continuous. That includes continuous flow together with a systems approach, integration and advanced control."

- Bernhardt Trout, professor of chemical engineering and director of the Novartis-MIT Center for Continuous Manufacturing

Another advantage is improved quality control, according to the center's researchers. "Once you go to continuous, you begin to have continuous monitoring, so it's much easier to control the quality," says Jensen, the Warren K. Lewis Professor and head of the Department of Chemical Engineering, who developed much of the flow chemistry for the prototype system.

Continuous manufacturing also allows chemists to explore new ways to make drugs, by using reactions that would require too much heat or dangerous chemicals if performed in a huge vat. "We can use a lot of chemistry in continuous that we couldn't use in batch," Trout says.

Novartis recently renewed its grant to MIT for a second five-year term, during which the MIT research teams will work on new ways to form tablets, recycle catalysts and design more complex multistep syntheses, among other projects.

In the meantime, Novartis is setting up a pilot plant at its headquarters in Basel, Switzerland, to create a larger-scale version of the flow technology developed at MIT. It will likely take another four years to begin commercial rollout, and another five to 10 years to convert all of Novartis' production facilities, says Tom Van Laar, head of global technical operations for Novartis. He expects that many other pharmaceutical companies will head in the same direction.

"It's kind of like what happened with the first iPad. When it became successful, everybody else started making tablet computers," Van Laar says. "I think the benefits are so huge, companies are almost going to have to try to do it." ◊

Researchers at the Novartis-MIT Center for Continuous Manufacturing built this drug-manufacturing prototype in an MIT chemical engineering lab. The system, which consists of six connected units, can transform raw ingredients into finished drug tablets. Image: Dominick Reuter

Other Fall 2012 Course X Research News

- Robert Langer's targeted nanoparticles show success in clinical cancer trials
- Martin Bazant and colleagues uncover a reason why the hottest new material for rechargeable batteries, lithium iron phosphate, works so well
- Daniel Anderson and Robert Langer develop nanoparticles that could manufacture cancer drugs at tumor sites
- Robert Langer and his team design nanoparticles that deliver high doses of antibiotics directly to bacteria
- The energy-related work of Kristala Prather and Karen Gleason are highlighted in the most recent edition of MIT's SPECTRUM magazine

For more information on these stories and other Departmental news, go to web.mit.edu/cheme/news/

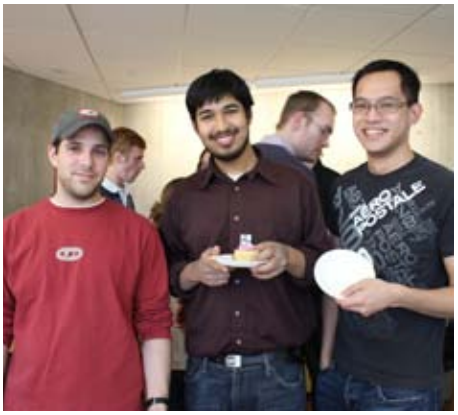
Chemical Engineering wins Laboratory Safety Award

MIT's Environment, Health and Safety Management System (EHS-MS) is the cornerstone by which the Institute sets policies and maintains compliance with federal, state and local environmental, health and safety regulations. Each year, the Provost recognizes departments, labs and centers (DLCs) which have achieved a noteworthy level of performance in meeting the requirements of the EHS-MS and thus have demonstrated a level of environmental, health and safety excellence.

To be eligible for an EHS-MS award, a DLC must perform and, importantly, document biannual EHS inspections within a specified time period. The DLC must also complete an annual update of key written documents in a timely manner, while ensuring that at least 90% of personnel indicated by the EHS Management System to need EHS training have successfully completed and maintained core EHS training. The DLCs must meet and sustain all stated criteria during the evaluation period to be considered as having met the requirements of the EHS Management System. The top performers are then selected for the awards.

This year the EHS Award of Excellence for a large DLC went to Chemical Engineering. Chemical Engineering takes the safety of its students, staff and faculty very seriously, and we are proud to have been recognized for our efforts. Special thanks goes to the student safety coordinators in each lab, as well as Steve Wetzel, Facilities Manager and Bill Dalzell, our Safety Officer.

On February 13, 2012, the Department hosted a reception to celebrate the honor. Graduate student Rachel Howden, winner of the 2011 Holiday Baking Contest grand prize, created a periodic table of cupcakes and several delicious and beautiful homemade cakes representing several lab safety motifs, as well as an edible version of Building 66, complete with sugar-glass windows and color-coordinated floors.



Miles C. Barr (PhD '12) receives Lemelson-MIT Student Prize

Miles C. Barr received on March 7, 2012, the prestigious $30,000 Lemelson-MIT Student Prize for his innovative solar technologies and creativity. Barr's most recent inventive breakthrough — a pioneering approach to fabricating solar cells on a variety of everyday surfaces — could lead to widespread adoption of solar power. Barr's approach, which enables solar cells to be printed directly on common materials such as paper and textiles, could reduce the cost of solar energy by eliminating the need for specialized installation.

Miles Barr, winner of the 2012 $30,000 Lemelson-MIT Student Prize. Image: Lemelson-MIT Program

"There is a huge opportunity to harvest energy from the light that hits every surface around us," Barr said. "If we can take that energy and convert it into electricity without compromising the aesthetics of everyday surfaces that is extremely powerful." Developed with the support of the eni-MIT Solar Frontiers Center and professors Karen Gleason and Vladimir Bulović, Barr's lightweight and bendable solar technology opens untapped venues for commercial applications, including wall paper, window shades and clothing. The portability of the technology will allow for inexpensive power generation, which Barr not only hopes will increase adoption in the United States, but help those in the developing world as well.

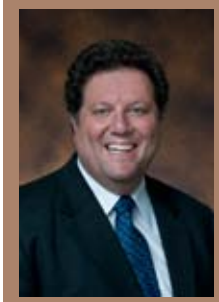
Barr was an imaginative risk taker from an early age. Refusing to be constrained by the limits of any one interest area, he immersed himself in a variety of subject matters completing majors in chemical engineering, mathematics and music as an undergraduate student at Vanderbilt University. Barr's passion for diverse influences remains at the core of his approach to invention today.

To read the full press release about the 2012 $30,000 Lemelson-MIT Student Prize winner, visit: *http://web.mit.edu/invent/n-pressreleases/n-press-12SP.html.*

Upcoming Fall 2012 Lectureship

During the 2012 fall semester, the Chemical Engineering Department will host several academic and industry leaders during our seminar series (schedule on the back cover). A fall highlight will be the annual Hoyt C. Hottel Lecture, noted below.

Webcasts for all Chemical Engineering major lectures can be accessed at *web.mit.edu/cheme/news/webcast.html.*



2012 Hoyt C. Hottel Lecture
Friday, November 30, 3pm in 32-123

"Emerging Technologies and the Future of Energy Production"

Eric Toone, Principal Deputy Director of the Advanced Research Projects Agency – Energy

Dr. Eric Toone is the Principal Deputy Director of the Advanced Research Projects Agency – Energy (ARPA-E), responsible for oversight of all of ARPA-E's programs. In addition to his role at ARPA-E, Toone is currently the Anne T. and Robert M. Bass Professor of Chemistry and Professor of Biochemistry at Duke University.

Toone is a scientific founder of two venture-backed companies: Aerie Pharmaceuticals, a research-based ophthalmology company, and Vindica Pharmaceuticals, a nitric oxide delivery company. He has served as a permanent member of the Bioorganic and Natural Products Study Section at the National Institutes of Health, and is currently a member of the NSERC Organic & Inorganic Review panel (Canada).

Dr. Toone studied chemistry as an undergraduate at the University of Guelph, graduating in 1983. That same year he moved to the University of Toronto to begin graduate studies with Professor J. Bryan Jones. Toone graduated from the University of Toronto in 1988 and moved to Harvard University to continue his studies with Professor George Whitesides.

Adel F. Sarofim Memorial Symposium

On Friday, May 11, 2012, former colleagues and students gathered to remember a dear friend, teacher and chemical engineering giant, Adel Sarofim, who passed away in December 2011. The symposium was a very special tribute, including wonderful reminiscences from former students and collaborators who spoke with great feeling and insight about their work with this remarkable man.

Photos and a webcast of the event are now online at: *http://web.mit.edu/cheme/news/2012/sarofim-symp.html*

The Adel F. Sarofim (1962) Fund was established in 2001 to honor Adel when he retired from MIT. Through its endowment, the fund provides an ongoing source of much-needed support for graduate students in the Department of Chemical Engineering. As the need for such support is far greater than the resources currently available, we welcome gifts at all levels to help increase the endowment and pay tribute to the memory of a great educator.

To help reach the funding goal, the Department has been given a generous $100,000 challenge grant by Visiting Committee member and alumna Kimberly Ritrievi, (ScD, SM 1985) and her partner Darryn Tilden. They have pledged to match gifts of any value between now and December 31, 2012, as well as pledges of $10,000 or more paid over the next five years (through June 30, 2017), dollar for dollar, thus doubling the values.

If you would like to make a gift or pledge to the Sarofim Fund, please use the following link to MIT's giving website for the Adel F. Sarofim (1962) Fund: *https://giving.mit.edu/givenow/ConfirmGift.dyn?desig=3309040*. The site also has information on the mechanics of giving. Checks should be payable to MIT, and note that your gift is in memory of Adel Sarofim, for the Adel F. Sarofim (1962) Fund #3309040. Please mail checks to: Bonny Kellermann, Office of Memorial Gifts, 600 Memorial Drive Room W98-5th Floor, Cambridge MA 02139. Questions about gifts may be directed to Bonny at 617-253-9722 or bonnyk@mit.edu.

James Donovan ’89

Alumnus Highlight

Jim Donovan has been unanimously elected to the Foundation for the National Institutes of Health (FNIH) Board of Directors. He began his term May 16, 2012. Donovan has worked in investment banking, investment management and corporate strategy for nearly two decades. He also shares his expertise in the classrooms of the University of Virginia where he serves as an adjunct professor.

“I deeply respect the role the FNIH plays in supporting the NIH’s commitment to improving health, and am honored by this appointment,” says Donovan. “I’ve been an advocate of cancer research in particular for many years, and I’m excited to help support efforts in its treatment and prevention. I hope my background, experience and knowledge will serve the FNIH well as it continues to build strong partnerships to advance the NIH mission.”

“I nominated Jim because of his experience in the medical field and his extensive financial background,” says Paul M. Montrone, PhD, FNIH board treasurer. “His work as a trustee of The Dana-Farber Cancer Institute will bring an added dimension to the FNIH board of directors.”

Among the board members’ responsibilities are helping guide the FNIH’s mission and purpose; ensuring effective organizational planning; ensuring adequate resources and managing them effectively; reviewing, monitoring, and strengthening FNIH’s programs and services; and enhancing FNIH’s public standing.

Donovan earned his BS in chemical engineering from MIT and an MBA from MIT Sloan School in 1989. He earned his JD from Harvard Law School in 1993. He serves on the Corporation Development Committee (CDC) for MIT, the Athletic Committee for MIT, is a Friend of MIT Crew and a former MIT Crew Varsity Oarsman. In addition, Donovan established an MIT Scholarship Fund in 2000 to assist incoming students from financially disadvantaged backgrounds.

Donovan serves on the Board of Trustees of the Dana-Farber Cancer Institute (DFCI), is a member of The Lank Center for Genitourinary Oncology, and established the Christy and Jim Donovan Fund for Prostate Cancer Research at DFCI in 2008 in honor of his late friend, who died of cancer. Jim also co-hosts an annual breakfast fundraiser for the Institute; his gifts provide critical support to Mission Possible: The Dana Farber Campaign to Conquer Cancer.

Donovan lives with his wife Christy, his two daughters, two sons and his mother in Virginia. An avid runner, he participates in road races to raise money for cancer prevention and treatment. Donovan has been featured in a number of publications for his achievements and contributions, including Fortune Magazine and Harvard Alumni Magazine. Donovan is an adjunct professor at the University of Virginia. He teaches classes on corporate strategy and leadership.

Brother-Sister Alumni Bakers Win Small

Course X alumni Timothy McIntosh ’08 and Winnette McIntosh Ambrose ’98 used their chemical engineering know-how to win the $10k prize in a March 2012 episode of Food Network’s Cupcake Wars. *Here they are pictured in their Washington DC bakery, The Sweet Lobby. For more info, go to www.sweetlobby.com. Image: Carla Sims*

Course X Alumnus Returns to Campus to Make Students Laugh

Dr. Pete Ludovice (PhD '89) returned to MIT's campus on July 10, 2012 to share with current MIT students his wit and wisdom through his stand-up powerpoint presentation, "Feel the Power of the Dork Side." After regaling the packed audience with humorous anecdotes from his life, Pete got a chance to meet with former students who are now at MIT, as well as some of his own former classmates.

After a PhD from MIT and postdoctoral studies at IBM, NASA and the Eidgenössische Technische Hochschule-Zürich, Pete is not only a nerd but he learned certain invaluable things like how to pronounce Eidgenössische Technische Hochschule-Zürich. After a brief stint in industry he is now an associate professor in the School of Chemical & Biomolecular Engineering at the Georgia Institute of Technology. where he is trying to prove that engineers can be funny and not funny-looking. Pete lectures internationally on the use of humor in technical communication and education and carries out research on the use of improvisational humor in improving creativity in engineering design. He currently directs a Living Learning Community at Georgia Tech entitled "Humor and Innovation" that examines the use of humor in technical communication, education and innovation. Pete also co-hosts *Inside the Black Box*, a weekly program on science and technology everay Sun. from noon to 1pm on WREK 91.1FM in Atlanta. "Science, only funnier," is the motto of Pete and his co-host, fellow Georgia Tech professor and comedian, Bill Hunt, as they add a little humor to discussions of science and technology relevant to our everyday lives.

ChemE Undergrads Represent at AIChE Regional Conference

During March 16 and 17, 2012, the undergraduate student chapter of AIChE attended the 2012 Northeast Student Regional Conference at the University of New Haven. Tim Chang, president of the Course X student chapter, reported Course X undergraduates won all three prizes at the undergraduate research paper competition:

1st Place: Carmen Chan
2nd Place: Nahyun Cho
3rd Place: Michelle Teplensky

Congratulations to all the student AIChE chapters on a successful meeting! ◊

John Ehrenfeld ’53, PhD ’57

Alumnus Highlight

The aspirations of John Ehrenfeld’s 2009 book are summed up by his e-mail signature: “Sustainability is the possibility that human and other life will flourish on the planet forever.”

In that book, *Sustainability by Design: A Subversive Strategy for Transforming Our Consumer Culture*, Ehrenfeld argues that reducing the unsustainable aspects of modern society through steps such as cutting pollution is not enough—people need new ways to live that focus more on *being* and less on *having*.

After earning his MIT degrees in chemical engineering, Ehrenfeld progressed through engineering and management posts in public and private organizations, such as Arthur D. Little, as well as teaching appointments worldwide.

“I thought technology was going to save the world,” he says. “Over time, I began to realize that it took more than good technology ideas to create the world I wanted. I fell into environmental work.”

In 1967, he founded Walden Research Corporation in Wilmington, Massachusetts. “My research company was hired to help prepare the first set of air pollution regulations for the brand-new EPA,” he says. “Since then, I have continued my work on the social and regulatory side of things.” After a Carter administration appointment heading the New England River Basins Commission, Ehrenfeld returned to MIT in 1986 as a lecturer and the director of the MIT Program on Technology, Business, and Environment.

“We chose to look at organizational behavior, not just the technical side,” he says. “My students and I took one question to heart: Why doesn’t business do what they say they are going to do for the environment? We found there were huge differences in how corporations were employing new environmental tools—and it largely had to do with organizational barriers and power structures.”

After retiring from MIT in 2000, he served as executive director of the International Society for Industrial Ecology until 2009 and continues his work there as a journal editor. He also writes a blog, Sustainability by Design. He and Andy Hoffman, SM ‘91, PhD ‘95, are working on a book sparked by Ehrenfeld’s keynote at the 2011 MIT Sustainability Summit, where he discussed the evolution of sustainability as an academic field. His honors include a lifetime achievement award from the World Resources Institute.

Ehrenfeld and his wife, Ruth, live in Lexington, Massachusetts. They enjoy time with their nine grandchildren and take courses at the Harvard Institute for Learning in Retirement. “Lifelong learning is good for your health,” he says.

This article, by Nancy Duvergne Smith, first appeared in the September/October issue of Technology Review.

ChemE the Next Generation

Course X alumni Brian Mickus (PhD ’05) and Christopher Loose (PhD ’07) show off Sloan and Nathan, the next generation of MIT ChemEs and budding followers of the teachings of Professors Emeriti Bill Deen and Jeff Tester, respectively.

Course X Undergrad Makes a Four-Week Commitment and a Long-Lasting Impact

Even though MIT was on semester break during the month of January, some students still made a point of spending time in the classroom.

Over Independent Activities Period (IAP) in 2012, 11 MIT students served in schools around the country as part of the fifth annual *Four Weeks for America* Challenge. Through *Four Weeks for America*, which is offered by the MIT Public Service Center and *Teach For America*, students have the opportunity to work under the guidance of a *Teach For America* host teacher to develop projects that will have a long-term effect on the participating schools. Such projects often include curriculum development, data analysis or classroom management strategies. The success of the program at MIT has led *Teach For America* to create similar models at other universities, including at Harvard University and Johns Hopkins University.

This year, the MIT students implemented projects as close as Boston and as far away as San Jose, Calif. For some, *Four Weeks for America* served as an outlet to transform a passion for science into an impact in the classroom.

Nikita Consul, a junior in chemical engineering, was excited to be matched with Webster Middle School in Oklahoma City because the teacher wanted to start a science fair for her students.

Consul took the time to work directly with the middle school students in their own preparations. Though the students' ideas often took explosive turns toward erupting volcano models, bottle rockets and the like, she always strove to point them to the underlying science — be it the principles of plate tectonics or the physics of flight.

"The science fair was a good way to establish a role for myself in the eyes of the students," Consul says. "The students viewed me as a science expert and always asked a lot of questions."

Though the fair won't actually happen until April, Consul has been working on guidelines for the school to assist with logistics and development of student projects. Her four-week experience has officially ended, but she is still working with the school on documentation so the fair can be replicated every year.

After graduation, Consul plans on pursuing a career in medicine and academia. Even though medical school is likely to be a different experience than the middle school classroom, her experience with education through *Four Weeks for America* only reaffirmed her plans.

"I was able to realize my fondness for using my knowledge to convey information that is useful to another person," Consul says. "I enjoyed bringing a smile to the students' faces as they realized that their idea for a science project could actually translate into scientific terminology and the steps of the scientific method. This past month was the turning point in my MIT career in which I solidified my desire to study medicine and become a professor of medical school."

This article is an excerpt of the original by Kevin Leonardi of the MIT Public Service Center. The Four Weeks for America Challenge is an annual program administered by the MIT Public Service Center in conjunction with Teach for America. For more information, contact program administrator Linden McEntire at mcentire@mit.edu.

Blast from the Past

In the Spring 2012 edition, fellow alumni found friends and faculty in the posted photos:

(to the left) Amrit Jalan (SM ’11) was the first to recognize professors Bill Deen and Preetinder Virk in this post-holiday skits photo.

(to the right) an anonymous contributor believes the ultimate frisbee player on the far right is Ted Nunn (SM ’82).

Incredibly, Pete Ludovice (PhD ’89) (featured on page 20) found himself in the Spring 2012 newsletter, along with friend and alumnus Jim Johnston (PhD ’91) (at right). They are the trumpet player and keyboardist, respectively, in the holiday skit band to the left.

Debi P. Mukherjee (SM ’65, ChE ’67, PhD ’69) shared an image from his time at the Practice School. He writes:

As I was looking the 2011 fall news from the Chem E dept where there was a picture of practice school attendees in 1965, I tried to find if I had a picture of our group attending the Chem E practice school. I found in one my old files a copy of the picture of our group attending the practice school station in American Cyanamid Co. in Bound Brook NJ. Our station directors were Dr. Mike Modell in Bound Brook and Dr. Jon Valvert in Esso (now EXXON) in Linden NJ.

I hope this may of interest to some of our alums.

Here for Nine Weeks

Six in M.I.T. Class

Six students are in the current class of the M.I.T. Practice School here at the plant. The engineers, who will be here for nine weeks of study, arrived February 8.

The group consists of Kenneth Sinclair of Ontario, Canada; Merle Ditz, Fryburg, Pa.; Avelino Rodriguez of Orense, Spain; Debi Mukherjee of West Bangel, India; Richard Goode of Wellesley, Mass.; and Hernan Barreto of Lima, Peru.

This is the third class of the school year in the joint effort of the Massachusetts Institute of Technology and the Bound Brook plant. After their stay here, the students spend an additional nine weeks at the Bayway Refinery Station of Esso Standard Oil Company. They are working toward their M.S. degrees in chemical engineering.

STUDENTS are (seated, l. to r.) Kenneth Sinclair, Merle Ditz, Avelino Rodriguez; (standing) Debi Mukherjee, Richard Goode, and Hernan Barreto.

CYANAMID FEBRUARY 26, 1965

Do you have a photo you’d like to share? Email chemealum@mit.edu.

Alumni News

We want to hear from alumni like you! Please send us your news and photos.
Please direct news to: ***Melanie Miller, Editor***
Email: ***chemealum@mit.edu***, Phone: ***617-253-6500***, Fax: ***617-258-8992***

Robert Johnston '45 SM '46 and his wife live in Bristol Glen, a Methodist retirement home in Newton, NJ. He has written a series of essays on spiritual topics, based on his experiences in life, for the Bristol Glen Newsletter.

Charles J. LaBlonde (SM '65) (Colonel USAF Retired) has completed publication of the fifth volume in his award winning series that documents the World War II postal history of Switzerland. His latest work, entitled "Post D-Day Swiss Mail To/From Great Britain and the Americas," examines and explains the postal turmoil that ensued as the Allies liberated Europe. LaBlonde has been elected a Fellow of the Royal Philatelic Society London in recognition of his extensive research in this area.

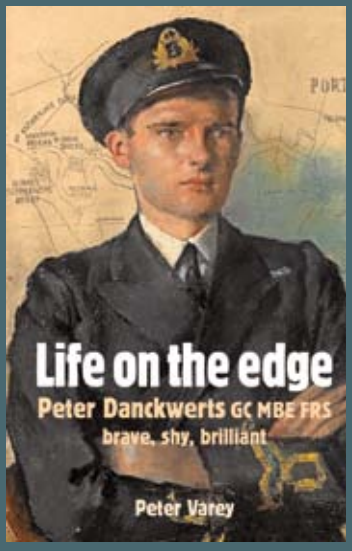
Yaw D. Yeboah '75 SM '75 PhD '79 has been named the new dean of the Florida A&M University (FAMU) and Florida State University (FSU) College of Engineering.

FAMU Provost and Vice President for Academic Affairs Cynthia Hughes Harris stated, "I am confident that with Dr. Yeboah's level of experience, research expertise and professionalism, he will ensure that the college remains one of the top producers of baccalaureate minority engineers in the nation. We are very fortunate to have him join our team of academic leaders."

Yeboah will be the fifth leader of the jointly operated engineering college, which enrolls approximately 2,250 undergraduate and 300 graduate students annually.

In 2008, Yeboah received the Black Achiever in Chemical Engineering Award for extraordinary contributions to chemical engineering and the engineering profession from the American Institute of Chemical Engineers.

In 1975, Yeboah was the first Massachusetts Institute of Technology student to ever earn four degrees in four years bachelor's degrees in management, chemistry and chemical engineering, and a master's degree in chemical engineering practice. He earned a doctorate in chemical engineering in 1979, also from MIT.



A book has been written about the life of alumnus Peter Danckwerts (SM '48): *Life on the Edge: Peter Danckwerts GC MBE FRS - Brave, Shy, Brilliant.*

Danckwerts received the George Cross in 1940 for the "great gallantry and undaunted devotion to duty" he showed in defusing landmines dropped by the Luftwaffe in London.

You can find more information on Danckwerts or the new book on his life at *www.amazon.com.*

Robert Hone '79 is the founder and CEO of Red Hill Studios, an educational software and health game developer. Red Hill Studios is planning to develop health games addressing issues such as cerebral palsy and stroke rehabilitation. In educational games, they are looking to develop a series to excite kids about science.

David Levy (PhD '92) who invented the atmospheric Spatial Atomic Layer Deposition process (SALD), has joined Natcore Technology Inc. as Director of Research & Technology. Levy brings 20 years of industrial R&D experience with vapor/vacuum coating, nanoparticle synthesis and dispersions, liquid coating, circuits and electronic devices to Natcore, a company that uses its liquid phase deposition (LPD) technology to grow antireflective coatings on silicon wafers for the purpose of creating solar cells.

While working with air-free synthesis of nanoparticles, Levy also gained familiarity with quantum dot systems. The ability to create a three dimensional matrix of quantum dots is a critical step toward the formation of a fully functioning tandem cell, a principal goal of Natcore scientists. These cells could achieve twice the power output of today's most efficient solar cells.

The Wall Street Journal named **Hendi Susanto (MS '98)** as one of the top-3-ranked analysts in 2011 for the semiconductors sector in its annual Best on the Street Analysts Survey. ◊

In Memoriam

Clyde Kempton Smith (SM '35)

Clyde passed away on August 6, 2012, having achieved the milestone of celebrating his 100th birthday in May of this year with all of his family. Clyde was born in St Louis, Missouri, and graduated from Stanford University in 1933. He graduated with a masters degree in chemical engineering from MIT in 1935 and spent most of his working career with Bechtel Corporation in San Francisco. He was married to Margaret Jeanne (Molsberry) from 1944 until her death in 2010. He was a 60 year resident of San Mateo, CA, and a member and active congregant of The First Presbyterian Church of San Mateo. After retiring from Bechtel in 1977, he was active as a docent at the California Academy of Sciences for many years. Clyde is survived by his two sons, Kempton and Philip, six grandchildren, and six great grandchildren.

Howard S. Turner (PhD '36)

Howard Turner, former President and Chief Executive Officer of Turner Construction Company, died on April 25th, 2012 at the age of 100.

Howard was the nephew of Henry Turner, who founded Turner Construction Company in 1902, and the son of J. Archer Turner, Jr. who was President of Turner Construction Company from 1941 to 1946. Howard graduated Phi Beta Kappa from Swarthmore College in 1933. He completed a doctorate in organic chemistry and chemical engineering in 1936 from the Massachusetts Institute of Technology.

Upon graduation, Howard joined the DuPont Corporation as a research chemist where he worked on novel uses of a new synthetic material – nylon – for such things as parachutes and food packaging. He then joined Pittsburgh Consolidation Coal Company in 1946 to lead their new research and development division. In 1954, Howard joined Jones & Laughlin Steel Company as the Vice President of research and development.

Howard joined Turner's Board of Directors in 1952. In 1965, he was selected to serve as President of Turner Construction Company. He served as President and Chief Executive Officer from 1968 to 1971. Howard served as Chairman of the Board from 1971 to 1978. From 1978 to 1982, Howard served as Chairman of the Executive Committee.

Under his leadership, the company grew from seven offices in the United States to operations in 20 cities; the company's community affairs program was formalized and the Turner School of Construction Management for minorities and women was established; and the company's international division was launched with operations in four countries. The company's sales grew from $591 million in 1965 to $1.7 billion by 1978.

On the occasion of Howard's retirement from Turner, he said, "To lead this company, itself a leader among builders, has been an honor and an exciting opportunity for which I am most grateful. Turner has always been known for its depth of talent, regularly fed from the best of each year's college graduates. The company's growth will, as in the past, be based on the character and high standards of the Turner staff, its commitment to serve its clients and the satisfaction all Turner people feel in making a contribution to building lasting monuments of our civilization."

In Memoriam

Lewis Woodruff Hull ’38

Lewis Woodruff Hull of Southampton passed away peacefully on Sunday, Feb. 26, 2012. He was 95.

Born Oct. 16, 1916, he was the second son of Robert Alonzo and Clara Woodruff Hull. He grew up in Waverly, Pa., attended local schools, then Phillips Exeter Academy, Class of 1934, and graduated from MIT, Class of 1938, with a degree in Chemical Engineering.

He married Margaret Burns Carson of Germantown, Pa. in June of 1947. At the time, he was working for F. J. Stokes Machine Company. He started Hull Corporation in 1952, which he operated until 2002. The company produced equipment used to freeze-dry pharmaceutical products and a separate division pioneered the plastic encapsulation of electronic components. At one time the company had operations in Hatboro, and Lehighton Pa., as well as Scotland and Japan. He was involved with HullVac Pump Corporation from 2002 until his death.

He co-founded the Philadelphia Glider Council in 1941 and soaring remained one of his favorite hobbies. He was also an avid skier well into his 80s.

Lew was involved with numerous professional, civic and charitable organizations, including the Pennsylvania Free Enterprise, Bucks County Conservancy, Churchville Nature Center, YMCA, Goodwill Industries, Rotary, Audubon Society, Franklin Institute, North and Southampton Reformed Church, Plastics Pioneers, American Vacuum Society and Soaring Society of America.

Lewis enjoyed being a world traveler, having visited dozens of countries for pleasure and business. He and his brothers explored uncharted areas on Baffin Island, Canada in 1961. He celebrated the positive in every person he met, and enjoyed every opportunity, in his polite and caring way.

Lewis is survived by his four children, Arthur and his wife, Mary, Martha Halvonik and her husband, Terry, Stephen and his wife, Maria, and Rebecca; his grandchildren, Matthew and his wife, Tracey, and their son, Nicholas, Timothy and his wife, Amanda, and their children, Tallulah and Samuel; and his step-grandchildren, Daniel Wenner and Rachel Wenner. Lewis is also survived by his sister, Barbara Richardson and was preceded in death by his brothers, Robert and John.

William Harbine Hagenbuch ’40 SM ’41

Age 93 of Beavercreek, died Thursday, May 24, 2012 at home. Bill Hagenbuch was born October 19, 1918 in Muncie Indiana. At six he was bedridden for months with osteomyelitis. He occupied his mind to compensate, learning chess and playing with building toys. Perhaps then he developed his social skills, ability to delegate, positive attitude and eagerness to explore. After a mid-year promotion in high school, Bill was transferred to the Blue Ridge School for Boys in Hendersonville, North Carolina, graduating at 16. After a year at Miami University, which he enjoyed “too thoroughly” he transferred to MIT and made the Dean’s list. At MIT he earned a BS in 1940 and a Masters in 1941 in chemical engineering. He was active in student government, ROTC and Sigma Nu.

He first worked at Hercules Powder in Delaware, earning his pilot’s license on his lunch hours. In WWII he took radar training at Harvard and MIT, had a stint at flight training and then worked in radar countermeasures at Wright Field, near the family farm in Beavercreek. Bill’s rare mix of technical smarts and diplomacy played out across his lifetime.

In 1944 he was sent to England with the U.S. 8th Army Air Corps where he witnessed the London bombing and liberation of Paris. While there he met American Wellesley student Grace Horner working in a civilian radar lab. After the war they married, moved to the family farm and Bill joined the family ropemaking business in Xenia. Over 40 years he rose to chief engineer and CEO of the Hooven & Allison Company, where he modernized operations to make synthetic rope. The Cordage Institute twice honored him as an industry pioneer.

The Hagenbuchs adopted daughters Susan, Bonnie, Christine and Kate. Bill and Grace also hosted ten exchange students and developed far-reaching friendships. Bill volunteered with the Art Institute and Cincinnati Zoo Safari Club; was president of the Greene County Red Cross; was a long-time member of Xenia Rotary; and was president and 16-year member of the Beavercreek School Board. In 1947 he joined the Engineers Club of Dayton and remained a lifelong member, earning the 2005 Deeds-Kettering Award for his ambassadorship, contributions, and endless curiosity. Bill continued to live to the fullest after retirement in 1986.

In 1988 he co-founded the Beaver Creek Wetlands Association to protect the local wetlands corridor. He served as its first president and donated two properties, the Zimmerman Prairie and Hagenbuch Reserve.

He read widely in history and science and was an accomplished photographer with a catalog of over 30,000 slides. His favorite photo

of a giraffe at sunset was published on the cover of the Cincinnati Enquirer in 1965. Travels with Grace and others took them to Europe, Central and South America, Africa, Australia, Indonesia and much of the U.S.

After Grace died in 2003, Bill continued to "see and be seen" with the help of his four daughters and many friends. Bill was a great storyteller, and in 2008 he narrated and starred in the documentary film Ropewalk: A Cordage Engineer's Journey through History.

Bill was preceded in death by his wife of 56 years, Grace Horner Hagenbuch. He is survived by four daughters, Susan Martin Davidson of Los Angeles, Bonnie Martin Gordon of Portland, Oregon, Christine Martin of Beavercreek, and Kate Hagenbuch of Oakwood; and grandchildren Pamela Gordon Waldman and Jack Gordon.

Peter Cukor '66

Peter M. Cukor, Age 67, passed away on February 18th in Berkeley, CA. Peter was, for almost 40 years, the adored husband of Andrea and unequaled father of Christopher (Nina) and Alexander. And he was the enthusiastic grandfather of 10-month-old Max. Peter was born on June 2, 1944 and raised in Wilton, CT by his late parents Jane and Clarence Cukor. He graduated from Wilton High School in 1962 and went on to earn his BS in Chemical Engineering from MIT, class of '66. While at MIT Peter was President of Phi Mu Delta Fraternity and elected to the Honor Societies Tau Beta Pi and Phi Lambda Upsilon. After graduating from MIT he went to UC Berkeley where he earned his PhD in Chemical Engineering and followed that with a Post-Doctoral Fellowship at the Harvard University School of Engineering and Applied Sciences. While at Harvard he caught the eye of George C. Lodge who invited him to teach an MBA course on manufacturing policy in the energy industries.

After he and Andrea married in 1972, Berkeley beckoned once again when Peter received an offer to join Teknekron Inc. as a consultant. He stayed at Teknekron for almost 20 years before starting his own companies, Peter M. Cukor & Associates and Cukor Solutions Group. Peter was a unique man with an unusually broad range of interests, skills and knowledge. He could recite extensively in Latin from Aesop to Cicero, and was equally well versed in the works of Dr. Seuss and Lewis Carroll, able to recite Thidwick The Big-Hearted Moose, the Jabberwocky and many more from memory. He loved physical exercise - cycling, swimming, hiking - and worked out daily for almost 35 years, most recently with Olympians as coaches. He also loved grammar, puns, red wines, single malts, the stock market, rock music of the 60's and 70's, and most of all his friends and family, whom he hugged strongly and warmly as often as possible. He had a brilliant mind that he never showed off for vanity but would happily use to help or entertain others. He embraced life with unmatched enthusiasm and optimism, seeing every day as a new challenge that he took on with a smile. Peter is also survived by his brother Michael (Debi), sisters Marcia Northon, Tricia Cukor-Avila (Salvador), sister-in-law Joan Priore (Vincent), nieces Diana Van Etten (Keith) and Alison Kripke (Jeff) and nephews Scott Rydell and Nicholas Avila. He will be missed by his grand nieces and nephews Caroline and Holly Van Etten, and Jonathan and Joshua Kripke.

Michael Szady (SM '92 PhD '95)

Michael J. Szady died Wednesday, May 16th, 2012, surrounded by his family, after succumbing to a rapidly escalating bout with colo-rectal cancer. He was 43.

Mike died as he lived, giving every breath he had to pushing forward to make his mark. He attended Princeton University and MIT, where he received his doctorate in Chemical Engineering in 1995. He derived more joy than anyone can imagine from the friendships he grew while building his fledgling bio fuels business he so obviously loved.

Mike enjoyed playing sports as well as spectating on the weekends at his daughter's many athletic events. He loved the camaraderie and competition of the HW Basketball League, and he remarkably played just a couple of months ago. He was blessed with tremendous confidence in himself and those who survive him.

His legacy will live on in his daughters Cecily (12) and Sophia (10), his wife Ivana of Hamilton, MA. He was also survived by his Father and Mother, David and Peg Szady of N. Falmouth, and two brothers, Kevin Szady and his wife Barbara, of Bristow, VA, and Brian Szady and his wife Lisa of San Francisco, CA, his in-laws: Walter and Dolores Clayton of Hamilton and his loving sister-in-laws: Christiane Hopkins of Hamilton, Dacia Rubel of Wenham, Giglia Harlamert of Hamilton and Rachel Clayton of Somerville, MA. ◊

Thank You for Your Support!

This honor roll is a special salute to those who have given over $100 to the MIT Chemical Engineering Department for the period of July 1, 2011, through June 30, 2012.

Thank you to everyone who has supported us throughout the year!

Every effort has been made to ensure the accuracy of this list.
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Michael Zeltkevic SM '99
Lei Zhang SM '95, PhD '98
Yizu Zhu PhD '92
Samuel Znaimer SM '81
Andrew L. Zydney PhD '85

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Fall 2012 Chemical Engineering Dept. Seminar Schedule

All Seminars are Fridays at 3pm in 66-110, unless otherwise noted.

Friday, October 5
Self-assembly of nanoparticles and artificial viruses
Nicholas A. Kotov, Chemical Engineering, University of Michigan

Friday, October 19
Directed assembly of block copolymers on lithographically-defined chemically nanopatterned substrates
Paul F. Nealey, University of Wisconsin-Madison

Friday, November 9
Life's little mysteries: molecular-level modeling of living systems
Andrew J. Spakowitz, Chemical Engineering, Stanford University

Friday, November 16
Title TBD
Rolf Findeisen, Electrical Engineering & Information Technology
Otto-von-Guericke-Universität Magdeburg

Friday, November 30
HOYT C. HOTTEL LECTURE
Dr. Eric Toone, Principal Deputy Director
Advanced Research Projects Agency – Energy (ARPA-E),
US Department of Energy

Friday, December 7
Microfluidic technologies for high-throughput high-content developmental biology and neurogenetics
Hang Lu, Georgia Institute of Technology

The MIT Chemical Engineering Department cordially invites you to attend the

MIT Chemical Engineering Reception
2012 Annual AIChE Meeting
To recognize

Professor William M. Deen
Winner of the Warren K. Lewis Award

Professor Karen K. Gleason
Winner of the Process Development Research Award

Professor George Stephanopoulos
Winner of the Founders Award

Professor Michael S. Strano
Winner of the NSEF Forum Award

Monday, October 29th, 2012
7:00 – 9:00 p.m.

Room 319/320
David L. Lawrence Convention Center
1000 Ft. Duquesne Boulevard
Pittsburgh, Pennsylvania