Spring/Summer 2022
Massachusetts Institute of Technology
Course X News
cheme.mit.edu

MIT Chemical Engineering Alumni News

X Currents

A step toward "living biotherapeutics"

The Furst Lab has created a coating for microbes that could make it easier to deploy the organisms to treat gastrointestinal disease.

Professor Heather Kulik explores the sprawling universe of possible chemical combinations.

Massachusetts Institute of Technology

MIT Chemical Engineering Alumni News

XCurrents

About ChemE

Education
To offer academic programs that prepare students to master physical, chemical, and biological processes, engineering design, and synthesis skills; creatively shape and solve complex problems, such as translating molecular information into new products and processes; and exercise leadership in industry, academia, and government in terms of technological, economic, and social issues.

Research
To provide a vibrant interdisciplinary research program that attracts the best young people; creatively shapes engineering science and design through interfaces with chemistry, biology, and materials science; and contributes to solving the technological needs of the global economy and human society.

Social responsibility
To promote active and vigorous leadership by our people in shaping the scientific and technological context of debates around social, political, economic, and environmental issues facing the country and the world.

Table of Contents

We want to hear from you!

E-mail: chemealum@mit.edu
facebook.com/mitchemeng
twitter.com/mitcheme
Instagram.com/mit_cheme

MIT Chemical Engineering
77 Massachusetts Avenue
Building 66, Room 350
Cambridge, MA 02139

Newsletter Staff

Melanie Miller Kaufman
Editor

Puritan Press, Inc.
Printing

Ink Design, Inc.
Design

Many thanks to those who contributed, including Web Chappell, Gretchen Ertl, Felice Frankel, Lillie Paquette, and members of the MIT News Office.
Acknowledgments

From the Department Head

It is a pleasure to share with you the current issue of XCurrents. Spring is coming, and along with it, hopeful signs of a waning pandemic. We have resumed in-person lectures and events, and the Infinite Corridor is bustling again with student activity and traffic. The campus is coming back alive, and I hope we get to see a few of our friends and alumni soon as we find opportunities to invite you back to MIT.

Our first in-person lecture since the pandemic started was a fabulous Hottel Lecture given by Nobel Laureate Francis Arnold. It was great to get to visit in person, and hear her discuss her work creating new-to-nature enzymes that can increase the scope of molecules and materials that can be built using synthetic biology. Joe DeSimone was our Michaels Lecturer, speaking on his work with continuous liquid interface production (CLIP), and I'm happy to announce that our Lewis Lecturer in May will be Noubar Afeyan PhD '87, discussing "Emergent Discovery – From Scientific Leaps to Breakthrough Medicines." We hope you will be able to make it to campus for this event as mandates are lifted and warm weather comes to Boston!

This fall we were able to honor Institute Professor Daniel IC Wang '59 SM '61 with a two day memorial symposium. It was so great to see so many alumni and colleagues collect to remember this incredible individual. I was able to spend some time with his wife Vicki, and remember not only his academic accomplishments, but how special he was to his students and his family. He will always be missed, but all one has to do is take a quick stroll around Kendall Square, with its proliferation of biotech residents, to see the ongoing influence of his work.

Unfortunately, on that day in November when we were celebrating the extensive legacy of one professor, we lost way too soon a young member of our faculty, James Swan. Jim started his MIT career in 2013, and despite being with us such a short time, left an incredibly lasting impact. He was brilliant and authentic, and so thoughtful in his desire to create the best learning environment and experience for his students. He had recently earned tenure and been recognized for his innovative modeling work. Jim won the department's graduate teaching award three years in a row, and to honor him, our faculty recently voted to name that teaching award after him.

I know that many of our alumni may not be familiar with Jim, since he was a recent hire. I urge you to read this issue's piece about him and his work, as he embodied so much of the spirit of what we are trying to do as educators and mentors. He was known for ending his meetings and messages with an encouraging "Excelsior!" a Latin phrase meaning "ever upward." As we continue our commitment to our community and our research, we will strive to live up to the standards that Jim exemplified.

There are so many examples in these pages of the incredible work happening in the department. I cannot express enough how proud I am of our students, faculty and staff, as they have navigated the challenges of the pandemic these past two years. Their resiliency and ability to adapt to an ever changing physical environment (how do you socially distance while working in a lab?) and shifting mandates (you have to test twice a week, now once a week) has been remarkable, and I am honored and delighted to see the positive attitudes and creative solutions that have helped keep all of us going.

I would love to hear your thoughts on our current happenings around the department and hope to see you on campus. Please enjoy this edition of XCurrents and I sincerely thank you for your continued support and friendship.

Excelsior!

Paula T. Hammond
Department Head

Jim Swan in 2017, winning one of his department graduate teaching awards.

Greetings from the MIT Practice School

The pandemic of the past two years created unique challenges for the Practice School, but challenges are what we are about! Our directors, students, and host companies worked together to find new ways of engaging and solving problems, and I'm proud to share some of them below.

As originally designed in 1916, MIT's School of Chemical Engineering Practice embraced the learn-by-practice model to teach graduate students professional project skills by having them conduct four one-month projects at two different host company locations under the supervision of on-site MIT faculty. While very successful, this model sometimes led to a conflict between skill learning and project completion, with the urgency of the latter shutting down the less-urgent former. Given this, and in the spirit of continuous improvement, the current Practice School station directors brought together their years of industrial experience to create a whole new course, 10.801, to teach critical project skills, e.g., project management, project economics, problem solving, safety, and conflict resolution, to the students prior to their station experience. The directors successfully launched 10.801 in January 2021 for thirteen students and delivered the course again in January 2022 for forty students; both sessions were done using Zoom due to Covid. The students responded very favorably to the course and offered thoughtful and actionable feedback, the most important of which was: less lecture, more interaction. In response, the directors will continue to evolve 10.801 in this direction for the planned January 2023 course.

After the spring and summer 2021 stations being exclusively remote, our students were once again able to work in person with their industrial hosts. Some highlights:

During spring 2021, the students worked with Corning and AstraZeneca (AZ), two seasoned host companies who were great partners in optimizing the remote experience. At Corning, the team tackled several projects, including the design of tougher optical fiber secondary coating through a priori prediction of coating properties using machine learning models, designed improvement to Single-Use Technology (SUT) components in the biopharma industry, and three core areas crucial for the scale-up of a bioreactor. Corning also graciously offered a future visit to the Sullivan Park facility, allow the students to see the facility and finally meet their project sponsors face to face.

The remote environment allowed work on projects balanced between AZ's Cambridge, England and Gaithersburg, Maryland, sites; in fact, two of our students worked from Canada. The projects were Computational Fluid Dynamics (CFD) modelling of reactor parameters and development of new analytical methods (including spectroscopy) through the use of AI algorithms to detect unknown correlations in biological processes were our main objectives. Good progress was made on all projects and we were invited back for spring 2022 – in person this time!

During the summer of 2021, virtual stations were Merck and Sclumberger. Once again, remote work was an advantage: the students addressed real-world projects originating from many different sites, most stateside (Rahway, Kenilworth, and West Point) but one project included a plant in Oss, Netherlands. Many projects involved data mining and AI to improve process outcomes, however, we also had one project targeting reduction of a site's carbon footprint and one project regarding development of an apparatus. Similar to 2020, the MIT Practice School partnered with Schlumberger New Energy on three exciting projects central to the new division's mission. The students successfully completed projects in the optimization of materials to produce lithium-ion batteries, analysis and optimization of carbon capture options, and the analysis and optimization of renewable energy options to produce green ammonia.

In fall of 2021, our students visited St. Gobain, Via Separations and Schlumberger. At St. Gobain, all six projects were highly visible platforms within the corporation. Each project required major experimental (and/or data mining) and modeling efforts, which provided results well received by the sponsors and the general R&D audiences that attended the presentations. Via, a newcomer to the Practice School program is an entrepreneurial venture in its infancy. We were able to work on site with company leadership on a project exploring new applications for their proprietary membrane technology while a Via applications team managed a pilot test of the membrane. The students successfully identified some options as well as limitations for the new application. For the second half of the fall, the students continued work from the previous Schlumberger station.

Take care. I hope everyone has a safe and healthy summer!

T. A. Hatton
Director
David H. Koch School of Chemical Engineering Practice

Practice School students attend the Holiday Pops in Boston during their fall 2021 assignment.

Professor Paula Hammond named to White House science council

MIT Chemical Engineering Department Head serves on the President's Council of Advisors on Science and Technology.

Anne Trafton, MIT News Office

Paula Hammond, an MIT Institute Professor and head of MIT's Department of Chemical Engineering, has been chosen to serve on the President's Council of Advisors on Science and Technology (PCAST), the White House announced today.

The council advises the president on matters involving science, technology, education, and innovation policy. It also provides the White House with scientific and technical information that is needed to inform public policy relating to the U.S. economy, U.S. workers, and national security.

"For me, this is an exciting opportunity," Hammond says. "I have always been interested in considering how science can solve important problems in our community, in our country, and globally. It's very meaningful for me to have a chance to have an advisory role at that level."

"Paula is an extraordinary engineer, teacher, and colleague, and President Biden's decision to appoint her to the council is an excellent one," says Maria Zuber, MIT's vice president for research and co-chair of PCAST. "I think about the work ahead of us — not just to restore science and technology to their proper place in policymaking, but also to make sure that they lead to real improvements in the lives of everyone in our country — and I can't think of anyone better suited to the challenge than Paula."

Hammond, whose research as a chemical engineer touches on the fields of both medicine and energy, said she hopes to help address critical issues such as equal access to health care and efforts to mitigate climate change.

"I'm very excited about the opportunities presented at the interface of engineering and health, and in particular, how we might be able to expand the benefits that we gain from our work to a broader set of communities, so that we're able to address some of the disparities we see in health, which have been so obvious during the pandemic," says Hammond, who is also a member of MIT's Koch Institute for Integrative Cancer Research. "How we might be able to use everything from computational modeling and data science to technological innovation to equalize access to health is one area that I care a lot about."

Hammond's research focuses on developing novel polymers and nanomaterials for a variety of applications in drug delivery, noninvasive imaging, solar cells, and battery technology. Using techniques for building polymers with highly controlled architectures, she has designed drug-delivering nanoparticles that can home in on tumors, as well as polymer films that dramatically improve the efficiency of methanol fuel cells.

As an MIT faculty member and mentor to graduate students, Hammond has worked to increase opportunities for underrepresented minorities in science and engineering fields. That is a goal she also hopes to pursue in her new role.

"There's a lot of work to be done when we look at the low numbers of students of color who are actually going on to science and engineering fields," she says. "When I think about my work related to increasing diversity in those areas, part of the reason I do it is because that's where we gain excellence, and where we gain solutions and the foresight to work on the right problems. I also think that it's important for there to be broad access to the power that science brings." X

In Memoriam:

James Swan 1982-2021

James Swan, who joined the MIT faculty in 2013, was recently tenured and studied the structure and dynamics of soft matter.

Anne Trafton, MIT News Office

James Swan, an associate professor of chemical engineering at MIT, died Nov. 5, 2021, following a medical event. He was 39.

Swan, who joined the MIT faculty in 2013, had recently earned tenure and held the Class of '22 Career Development Chair. His research focused on how microstructured materials, particularly nanoparticles, can be manipulated for the benefit of society. His lab also studied the structure and dynamics of soft matter, which includes gels, colloids, and many biological materials.

Department Head Paula Hammond describes Swan as an outstanding scholar and beloved colleague, teacher, and mentor.

"Jim was both brilliant and kind, a thoughtful and generous mentor and teacher," Hammond says. "His scientific accomplishments were truly groundbreaking and opened the world to new levels of understanding complex material systems; however, his biggest and largest gifts to us were his scholarship, his sense of integrity and humanity, and the guidance, wisdom, strength, and confidence that he provided to his students and postdocs."

MIT President L. Rafael Reif informed the MIT community of Swan's passing, stating, "Our hearts break for his family, friends and students and his colleagues at MIT and across the discipline as they endure this untimely loss. For faculty inside and outside the department, he was beloved for his intellectual generosity, personal wisdom and kindness."

Swan's research focused on computation of Brownian dynamics — the random motion of particles suspended in a material such as a gas or liquid — including hydrodynamic interactions that can greatly influence molecular and particle behavior in flow.

"He generated new computational approaches that have completely revolutionized the way in which we understand and address these very important materials systems in flow," Hammond says.

In recent work, Swan had developed a new framework to help guide the design of new materials that belong to a class known as "particulate gels." Many everyday items such as paint, yogurt, and toothpaste belong to this class of material, in which small pieces of one kind of substance are suspended within another.

Based on laboratory experiments and computational simulations, Swan and his colleagues developed mathematical models that can predict the macroscopic mechanical and flow properties, such as elasticity and settling, that result from the networks of particles that form within these gels.

He also developed models that could be used to optimize the flow properties of therapeutic antibodies as they are injected, which could help make such treatments more effective.

Swan as Santa and his son Henry as his elf during a ChemE Holiday Party.

Swan with Zsigmond Varga PhD '18, the first student to graduate from his research group.

The Swan Research Lab group costume for Halloween 2021.

A native of Arizona, Swan received his bachelor's degree in chemical engineering from the University of Arizona in 2004. He then went to Caltech, where he earned a master's degree in 2007 and a PhD in 2010, both in chemical engineering.

After finishing his doctorate, Swan worked in the laboratory of Eric Furst in the Department of Chemical and Biomolecular Engineering at the University of Delaware, where he directed experimental investigations of nanoparticle self-assembly that were performed by astronauts on the International Space Station.

At MIT, he taught Introduction to Chemical Engineering for several years to second-term, first-year undergraduates; he was also the instructor for the department's core required graduate course in numerical methods. For three years in a row, he won the MIT Chemical Engineering Graduate Teaching Award, an honor voted on by students.

"The training of students was one of Jim's greatest joys," says Patrick Doyle, the Robert T. Haslam Professor of Chemical Engineering at MIT. "Among his research group, Jim was known for his intellectual depth and creative approaches to solving complex problems. Above all, he was known as a caring mentor and wonderful listener. Jim was keen to spend hours scribbling ideas on the whiteboard with his students and also carve out time to talk about life."

This semester, Swan was co-teaching a course on heat transfer, mass transfer, and fluid mechanics with Martin Bazant, the E.G. Roos Professor of Chemical Engineering.

"Jim was a beloved and effective teacher, a gifted and inspirational researcher, and a compassionate advisor and friend. He was taken too soon and will be sorely missed. Our hearts go out to his family," Bazant says.

In 2016, Swan received a National Science Foundation CAREER Award and an American Chemical Society Petroleum Research Fund Doctoral New Investigator Award. He was also awarded the Postdoctoral Scholar Poster Prize at the 82nd Annual Meeting of the Society of Rheology in 2010.

Outside of his work, Swan enjoyed cooking, fishing, paddleboarding, and doing science experiments with his son, Henry, says his wife, Laura Swan.

In addition to his wife and son, Swan is survived by his parents, Gregory Swan and Jeanine Blanchard; his stepmother, Paulette Swan; his stepfather, Tim Blanchard; a sister, Heather Evanoff; parents-in-law, Thomas and Betsy McPhee; sisters-in-law Diana McPhee and Lisa Grinell; brother-in-law Andrew McPhee; and many aunts, uncles, and cousins. X

▶ **This is a condensed version of the original article. For the full version, go to news.mit.edu**

Faculty Highlights

Connor Coley wins two awards, joins the Schwarzman College of Computing

Connor Coley has won the Bayer Foundation's Early Excellence in Science Award for Chemistry. He is recognized for "his pioneering work in applying machine learning to virtual screening, prediction, and automated synthesis of novel small organic molecules with therapeutical potential."

Through its awards, the foundation recognizes the outstanding contributions of world leading experts and highlights outstanding young scientists with the potential to transform their fields. This recognition is designed to not only reward their past achievements but to bring the inspiring discoveries and unique skills of these brilliant people to a diverse audience of scientists, innovators and society.

Coley also won a National Science Foundation Early Career Development (CAREER) Award. These awards are among the NSF's most prestigious awards in support of the early career-development activities of teacher-scholars who most effectively integrate research and education in their work.

Coley has also accepted a shared position between MIT Chemical Engineering and the Artificial Intelligence and Decision Making (AI+D) Faculty of the Department of Electrical Engineering and Computer Science (EECS). This new shared position is within the MIT Schwarzman College of Computing, where he will collaborate with other MIT faculty working at the forefront of computing research and at the nexus of computing and other disciplines.

Ariel Furst named a finalist for MIT Future Founders Prize Competition

Ariel Furst has been named to the MIT faculty cohort that will participate in the first MIT Future Founders Prize Competition, announced by the MIT Future Founders Initiative and supported by Northpond Ventures. The Future Founders Initiative was established in 2020 to promote female entrepreneurship in biotech. The competition is structured as a learning cohort in which participants are supported in commercializing their existing inventions with instruction in market assessments, fundraising, and business capitalization, as well as other programming.

At the end of the program, the cohort members will pitch their ideas to a selection committee composed of MIT faculty, biotech founders, and venture capitalists. The grand prize winner will receive $250,000 in discretionary funds, and two runners-up will receive $100,000.

Paula Hammond elected to NAI, joins the board of The Engine

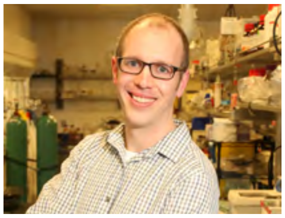
Paula Hammond has been named as a fellow of the National Academy of Inventors (NAI). According to the NAI, election as a fellow is the "highest professional distinction accorded to academic inventors who have demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development, and the welfare of society."

The Engine, the venture firm spun out of MIT that invests in early-stage Tough Tech companies solving the world's most urgent problems, announced the appointment of Paula Hammond to its Board of Directors. She brings to The Engine entrepreneurial experience and a deep background in macromolecular design and synthesis, targeted drug delivery for cancer, nanoscale assembly of synthetic biomaterials, electrostatic and directed materials assembly.

Robert Langer wins BBVA Frontiers of Knowledge Award

The BBVA Foundation's 14th Frontiers of Knowledge Award in Biology and Biomedicine has gone to Katalin Karikó, Robert Langer and Drew Weissman "for their contributions to messenger RNA (mRNA) therapeutics and delivery technology that enable our own cells to produce proteins for disease protection and treatment," remarked the committee in its citation. Karikó and Weissman, a biochemist and immunologist respectively, and Langer, a chemical engineer, are the authors of critical breakthroughs in the chain of scientific findings that have made messenger RNA therapies a reality, with a technology that gets the body's own cells to produce the molecules needed to fight off disease.

The first contribution came from Langer; his was the first paper, published in Nature in the 1970s, which showed that it was possible to take nucleic acid molecules – such as RNA, standing for ribonucleic acid – and encapsulate them in nanoparticles for release into the body. This insight, says the committee, enabled "packaging of macromolecule therapeutics including mRNA and delivering them into cells, allowing the cellular translation machinery to synthesize the protein/antigen." Karikó and Weissman added their part of the equation, by "developing mRNA modification methods to prevent the immune system from recognizing and destroying the mRNA," in the words of the award citation.



Zach Smith promoted to associate professor

Zach Smith has been approved for promotion to associate professor, effective July 1, 2022. Smith's research focuses on the rational design, synthesis, and characterization of polymers and porous materials for applications in energy-efficient separations, energy storage, and catalysis. He joined the Department of Chemical Engineering as an assistant professor in January 2017. Smith earned his bachelor's degree in chemical engineering from Pennsylvania State's Schreyer Honors College, and completed his PhD in chemical engineering at the University of Texas at Austin, where he worked under the guidance of Benny Freeman and Don Paul. While at UT Austin, Smith developed structure/property relationships for gas diffusion and sorption in polymer membranes.

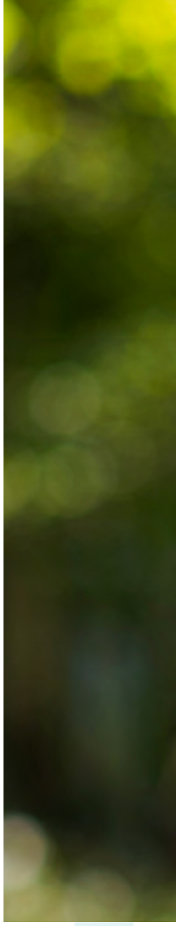
Greg Stephanopoulos receives J-WAFS Solutions Grant

The Abdul Latif Jameel Water and Food Systems Lab (J-WAFS) recently announced the 2021 J-WAFS Solutions grant recipients. The J-WAFS Solutions program aims to propel MIT water- and food-related research toward commercialization.

Stephanopoulos's project, "Converting dairy industry waste into food and feed ingredients," tackles the "hidden dark side" of one of the trendiest foods in the last decade, Greek yogurt: acid whey. This low-pH, liquid by-product of yogurt production has been a growing problem for producers, as untreated disposal of the whey can pose environmental risks due to its high organic content and acidic odor.

With an estimated 3 million tons of acid whey generated in the United States each year, MIT researchers saw an opportunity to turn waste into a valuable resource for our food systems. Led by Stephanopoulos, and Anthony J. Sinskey ScD '67, professor of microbiology, the researchers are utilizing metabolic engineering to turn acid whey into carotenoids, the yellow and orange organic pigments found naturally in carrots, autumn leaves, and salmon. The team is hoping that these carotenoids can be utilized as food supplements or feed additives to make the most of what otherwise would have been wasted. X

An explorer in the sprawling universe of possible chemical combinations



Heather Kulik embraces computer models as “the only way to make a dent” in the vast number of potential materials that could solve important problems.

Michlaae Jarvis, MIT News correspondent

The direct conversion of methane gas to liquid methanol at the site where it is extracted from the Earth holds enormous potential for addressing a number of significant environmental problems. Developing a catalyst for that conversion has been a critical focus for Associate Professor Heather Kulik and the lab she directs at MIT.

As important as that research is, however, it is just one example of the innumerable possibilities of Kulik’s work. Ultimately, her focus is far broader, the scope of her exploration infinitely more vast.

“All of our research is dedicated toward the same practical goal,” she says. “Namely, we aim to be able to predict and understand using computational tools why catalysts or materials behave the way they do so that we can overcome limitations in present understanding or existing materials.”

Simply put, Kulik wants to apply novel simulation and machine-learning technologies she and her lab have developed to rapidly investigate the sprawling world of possible chemical combinations. In the process, the team is mapping out how chemical structures relate to chemical properties, in order to create new materials tailored to particular applications.

“Once you realize the sheer scale of how many materials we could or should be studying to solve outstanding problems, you realize the only way to make a dent is to do things at a larger and faster scale that has ever been done before,” Kulik says. “Thanks to both machine-learning models and heterogeneous computing that has accelerated first-principles modeling, we are now able to start asking and answering questions that we could never have addressed before.”

Majoring in chemical engineering at the Cooper Union, Kulik says she wanted to occupy her mind, do something useful, and “make an okay living.” Chemical engineering was one of the highest-paying professions for undergraduates, she says.

The first thing she remembers hearing about graduate school was from a teaching assistant in her undergraduate physics class, who explained that being in academia meant “not having a real job until you’re at least 30” and working long hours.

“I thought that sounded like a terrible idea!” Kulik says.

Luckily, some of her classroom experiences at the Cooper union, as well as encouragement from her quantum mechanics professor, Robert Topper, led her toward research.

“While I wanted to be useful, I kept being drawn to these fundamental questions of how knowing where the atoms and electrons were located explained the world around us,” she says. “Ultimately, I obtained my PhD in computational materials science to become a scientist who works with electrons every day for that reason. Since what I do hardly ever feels like a chore, I now have a greater appreciation for the fact that this path allowed me to ‘not have a real job.’”

Kulik credits MIT professor of chemistry and biology Cathy Drennan, whom Kulik collaborated with during graduate school, with "helping me see past the short-term barriers that come up in academia" and "showing me what a career in science could look like." She also mentions Nicola Marzari, her PhD advisor, then an associate professor in the MIT's Department of Materials Science and Engineering, and her postdoc advisor at Stanford University, Todd Martinez, "who gave me a glimpse of what an independent career might look like."

Kulik works hard to pass on her ethics and her ideas about work-life balance to students in her lab, and she teaches them to rely on each other, referring to the group as a "tight-knit community all with the same goals." Twice a month, she holds meetings at which she encourages students to share how they have come up with solutions when working through research problems. "We can each see and learn from different problem-solving strategies others in the group have tried and help each other out along the way."

She also encourages a light atmosphere. The lab's web page says its members "embrace very #random (but probably fairly uncool) jokes in our Slack channels. We are computational researchers after all!"

"We like to keep it lighthearted," Kulik says.

Nonetheless, Kulik and her lab have achieved major breakthroughs, including changing the approach to computational chemistry to make the way multiscale simulations are set up more systematic, while exponentially accelerating the process of materials discovery. Over the years, the lab has developed and honed an open-source code called molSimplify, which researchers can use to build and simulate new compounds. Combined with machine-learning models, the automated method enabled by the software has led to "structure-property maps" that explain why materials behave as they do, in a more comprehensive manner than was ever before possible.

For her efforts, Kulik has won grants from the MIT Energy Initiative, a Burroughs Wellcome Fund Career Award at the Scientific Interface, the American Chemical Society OpenEye Outstanding Junior Faculty Award, an Office of Naval Research Young Investigator Award, a DARPA Young Faculty Award and Director's Fellowship, the AAAS Marion Milligan Mason Award, the Physical Chemistry B Lectureship, and a CAREER award from the National Science Foundation, among others. This year, she was named a Sloan Research Fellow and was granted tenure. X

This is a condensed version of the original article. For the full version, go to cheme.mit.edu.

Research Highlights

Size matters in particle treatments of traumatic injuries

Traumatic injuries are the leading cause of death in the U.S. among people 45 and under, and such injuries account for more than 3 million deaths per year worldwide. To reduce the death toll of such injuries, many researchers are working on injectable nanoparticles that can home in on the site of an internal injury and attract cells that help to stop the bleeding until the patient can reach a hospital for further treatment.

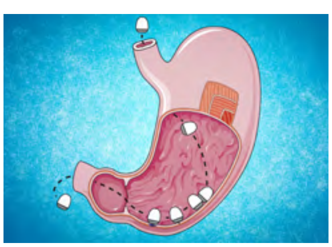
While some of these particles have shown promise in animal studies, none have been tested in human patients yet. One reason for that is a lack of information regarding the mechanism of action and potential safety of such particles. To shed more light on those factors, The Hammond and Olsen labs have now performed the first systematic study of how different-sized polymer nanoparticles circulate in the body and interact with platelets, the cells that promote blood clotting.

A new analysis offers guidance on the size of nanoparticles that could be most effective at stopping internal bleeding.

Making RNA vaccines easier to swallow

Like most vaccines, RNA vaccines have to be injected, which can be an obstacle for people who fear needles. Now, the Langer Lab, in conjuction with Mechanical Engineering's Traverso Lab, has developed a way to deliver RNA in a capsule that can be swallowed, which they hope could help make people more receptive to them.

In addition to making vaccines easier to tolerate, this approach could also be used to deliver other kinds of therapeutic RNA or DNA directly to the digestive tract, which could make it easier to treat gastrointestinal disorders such as ulcers.

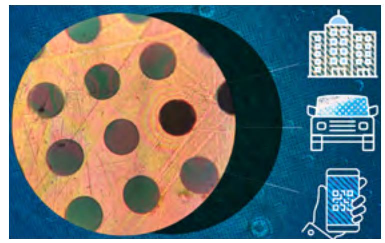


MIT researchers have designed an ingestible capsule that, after being swallowed, can attach itself to the lining of the stomach and inject RNA.

New lightweight material is stronger than steel

Using a novel polymerization process, The Strano Lab has created a new material that is stronger than steel and as light as plastic, and can be easily manufactured in large quantities.

The new material is a two-dimensional polymer that self-assembles into sheets, unlike all other polymers, which form one-dimensional, spaghetti-like chains. Until now, scientists had believed it was impossible to induce polymers to form 2D sheets. Such a material could be used as a lightweight, durable coating for car parts or cell phones, or as a building material for bridges or other structures.

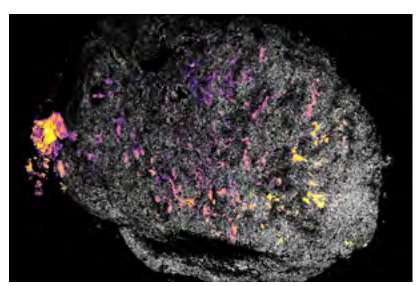


The new material is a two-dimensional polymer that self-assembles into sheets and could be used as a lightweight, durable coating for car parts or cell phones, or as a building material for bridges or other structures.

Method for delivering immune system-stimulating drugs may enhance cancer immunotherapy

Stimulating the body's immune system to attack tumors is a promising way to treat cancer. Scientists are working on two complementary strategies to achieve that: taking off the brakes that tumors put on the immune system; and "stepping on the gas," or delivering molecules that jumpstart immune cells.

However, when jumpstarting the immune system, researchers have to be careful not to overstimulate it, which can cause severe and potentially fatal side effects. The Wittrup Lab, working with the Irvine Lab at the Koch Institute, has now developed a new way to deliver a stimulatory molecule called IL-12 directly to tumors, avoiding the toxic effects that can occur when immunostimulatory drugs are given throughout the body. In a study of mice, this new treatment eliminated many tumors when delivered along with an FDA-approved drug that takes the brakes off the immune system.

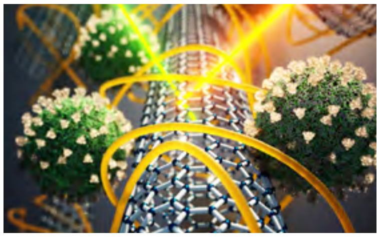


This image depicts a tumor right after treatment with alum-bound IL12. The pink dye shows IL-12, and the yellow shows alum.

Carbon nanotube-based sensor can detect SARS-CoV-2 proteins

Using specialized carbon nanotubes, MIT engineers have designed a novel sensor that can detect SARS-CoV-2 without any antibodies, giving a result within minutes. Their new sensor is based on technology that can quickly generate rapid and accurate diagnostics, not just for Covid-19 but for future pandemics, the researchers say.

The diagnostic is based on carbon nanotube sensor technology that Strano's lab has previously developed. Once the researchers began working on a Covid-19 sensor, it took them just 10 days to identify a modified carbon nanotube capable of selectively detecting the viral proteins they were looking for, and then test it and incorporate it into a working prototype. This approach also eliminates the need for antibodies or other reagents that are time-consuming to generate, purify, and make widely available.



Using specialized carbon nanotubes, MIT engineers have designed a novel sensor that can detect SARS-CoV-2 without any antibody, giving a result within minutes.

Ten-minute test detects Covid-19 immunity

The Sikes Lab has worked with the Antimicrobial Resistance (AMR) interdisciplinary research group at Singapore-MIT Alliance for Research and Technology (SMART) and the Nanyang Technological University, Singapore (NTU Singapore) to successfully develop a rapid point-of-care test for the detection of SARS-CoV-2 neutralizing antibodies (NAbs). This simple test, only requiring a drop of blood from a fingertip, can be performed within 10 minutes without the need for a laboratory or specially trained personnel. Currently, no similar NAb tests are commercially available within Singapore or elsewhere.

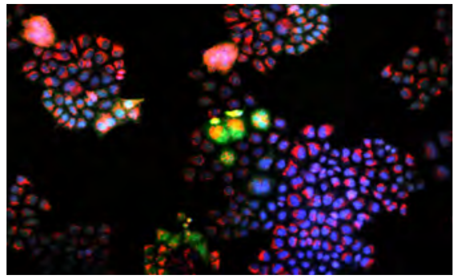
To evaluate herd immunity and the effectiveness of vaccine immunization programs, it is essential to screen populations for the presence of SARS-CoV-2 NAbs on a faster and larger scale. As part of a body's natural immune response, NAbs are generated by either exposure to the virus or a vaccine. For effective prevention of viral infections, NAbs must be generated in sufficient quantities. The number of NAbs present in individuals indicate if they possess protective immunity to the virus and their probability of experiencing severe outcomes should they be infected. NAb testing can determine whether vaccinated individuals should be considered for booster shots for additional protection against the virus.

A new screening method targets hydrogen peroxide in the search for new cancer therapeutics

MIT chemical engineers have developed a way of swiftly screening compounds to determine their therapeutic potential for certain kinds of cancers. With a genetically engineered sensor and high-throughput technology, their method probes for changes in cellular concentrations of hydrogen peroxide (H2O2), a specialized molecule known as an oxidant.

"The regulatory pathways of some tumors depend on elevated levels of H2O2," says Hadley Sikes, the Esther and Harold E. Edgerton Career Development Professor in the Department of Chemical Engineering. "But further increases in concentrations of this oxidant can lead to programmed cell death." In the researchers' screens of 600 small-molecule compounds, they were able to identify those that selectively boosted H2O2.

The MIT screen is the first to zero in on a single oxidant. This enabled the team to characterize the cellular responses to potential drugs and to demonstrate that some of these compounds activated H2O2-mediated toxicity in susceptible cancer cell lines.



Fluorescence microscopy image of a tumor sample where elevated levels of hydrogen peroxide have been discovered.

A new method for removing lead from drinking water

The Bazant Lab has developed a new approach to removing lead or other heavy-metal contaminants from water, in a process that they say is far more energy-efficient than any other currently used system, though there are others under development that come close. Ultimately, it might be used to treat lead-contaminated water supplies at the home level, or to treat contaminated water from some chemical or industrial processes.

The new system is the latest in a series of applications based on initial findings six years ago by members of the same research team, initially developed for desalination of seawater or brackish water, and later adapted for removing radioactive compounds from the cooling water of nuclear power plants. The new version is the first such method that might be applicable for treating household water supplies, as well as industrial uses. X

Engineers have designed a relatively low-cost, energy-efficient approach to treating water contaminated with heavy metals.

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

A step toward "living biotherapeutics"

The Furst Lab created a coating for microbes that could make it easier to deploy the organisms to treat gastrointestinal disease.

Anne Trafton, MIT News Office

The human gut is home to thousands of species of bacteria, and some of those bacteria have the potential to treat a variety of gastrointestinal diseases. Some species may help to combat colon cancer, while others could help treat or prevent infections such as C. difficile.

One of the obstacles to developing these "living biotherapeutics" is that many of the species that could be beneficial are harmed by oxygen, making it difficult to manufacture, store, and deliver them. MIT chemical engineers have now shown that they can protect those bacteria with a coating that helps them to survive the manufacturing process.

In a study appearing today in the Journal of the American Chemical Society, the researchers showed they could use the coating on a strain of E. coli as well as another species that may aid in digestion of plant starches. The coating could be applied to many other species as well, they say.

"We believe this coating could be used to protect pretty much any microbe of interest," says Ariel Furst, the Raymond and Helen St. Laurent Career Development Professor of Chemical Engineering and the senior author of the new study. "We think there are microbes out there that can help with a variety of diseases, and that we can protect them for manufacture and production."

Chemical engineers have created a coating for microbes that could make it easier to deploy them to treat gastrointestinal disease. Credit: Felice Frankel

MIT postdoc Gang Fan is the lead author of the study. Pris Wasuwanich, an MIT undergraduate, and Mariela Rodriguez-Otero, a former MIT Materials Research Laboratory Summer Scholar, are also authors of the paper.

Protective coating

Most of the microbes that live in the human gut are anaerobic, and they have varying degrees of sensitivity to oxygen. Some can tolerate a little bit of oxygen, while for others, oxygen is deadly.

This makes it difficult to test their potential as treatments for human disease, because bacteria need to be freeze-dried and formulated as capsules in order to be used therapeutically. In this study, Furst and her colleagues decided to try protecting anaerobic bacteria by coating them with a material made from metal ions and organic compounds called polyphenols.

When polyphenols and metal ions are put into a solution, they form a two-dimensional, grid-like sheet. For this study, the researchers used iron, which is safe for human consumption, and three polyphenols that are all classified as GRAS (generally regarded as safe) by the Food and Drug Administration: gallic acid, tannic acid, and epigallocatechin, all of which are found in tea and other plant products.

If bacteria are also added to the solution, the material self-assembles into a coating on individual bacterial cells. This coating protects bacteria during the freeze-drying and manufacturing process. The researchers showed that the coated cells were healthy and able to perform normal cellular activities, although their growth was temporarily inhibited.

When exposed to an acidic environment, such as that of the stomach, the coating breaks down and releases the bacteria.

Deploying bacteria

One of the strains that the researchers used to test the coating is Bacteroides thetaiotaomicron. This species, which has enzymes specialized to digest carbohydrates, appears to be more abundant in the gut microbiome of healthy people. However, it has been difficult to study how these bacteria might promote health if given as biotherapeutics, because they are very sensitive to oxygen.

Bacteria with this type of protective coating could also be useful for agricultural applications such as helping to make crops more stress-tolerant. Another possible application for the coating is to use it to protect microbes that are used as vaccines. The BCG vaccine, which consists of the bovine version of the microbe that causes tuberculosis, is difficult to produce and must be stored at low temperatures. Coating it with a protective layer could eliminate the need for cold storage and make distribution easier, Furst says.

"If we can remove the need for cold storage and transport, we think it would make a lot of therapeutics more widely available," she says.

The research was funded by the MIT-Deshpande Center, the Undergraduate Research Opportunities Program at MIT, and the MIT Materials Research Laboratory MRSEC Program of the National Science Foundation. **X**

▶ **This is a condensed version of the original article. For the full version, go to cheme.mit.edu.**

Energizing communities in Africa

MIT senior Ayomikun Ayodeji seeks to expand access to reliable, affordable energy in his home country of Nigeria, and beyond.

Alli Armijo, MIT News correspondent

Growing up in Lagos, Nigeria, Ayomikun Ayodeji enjoyed the noisy hustle and bustle of his neighborhood. The cacophony included everything from vendors hawking water sachets and mini sausages, to commuters shouting for the next bus.

Another common sound was the cry of “Up NEPA!” — an acronym for the Nigerian Electrical Power Authority — which Ayodeji would chant in unison with other neighborhood children when power had been restored after an outage. He remembers these moments fondly because, despite the difficulties of the frequent outages, the call also meant that people finally did have long-awaited electricity in their homes.

“I grew up without reliable electricity, so power is something I’ve always been interested in,” says Ayodeji, who is now a senior studying chemical engineering. He hopes to use the knowledge he has gained during his time at MIT to expand energy access in his home country and elsewhere in Africa.

Before coming to MIT, Ayodeji spent two years in Italy at United World College, where he embarked on chemistry projects, specifically focusing on dye-sensitized solar cells. He then transferred to the Institute, seeking a more technical grounding. He hoped that the knowledge gained in and out of the classroom would equip him with the tools to help combat the energy crisis in Lagos.

“The questions that remained in the back of my mind were: How can I give back to the community I came from? How can I use the resources around me to help others?” he says.

This community-oriented mindset led Ayodeji to team up with a group of friends and brainstorm ideas for how they could help communities close to them. They eventually partnered with the Northeast Children’s Trust (NECT), an organization that helps children affected by the extremist group Boko Haram. Ayodeji and his friends looked at how to expand NECT’s educational program, and decided to build an offline, portable classroom server with a repository of books, animations, and activities for students at the primary and secondary education levels. The project was sponsored by Davis Projects for Peace and MIT’s PKG Center.

Because of travel restrictions, Ayodeji was the only member of his team able to fly to Nigeria in the summer of 2019 to facilitate installing the servers. He says he wished his team could have been there, but he appreciated the opportunity to speak with the children directly, inspired by their excitement to learn and grow. The experience reaffirmed Ayodeji’s desire to pursue social impact projects, especially in Nigeria.

“We knew we hadn’t just taken a step in providing the kids with a well-rounded education, but we also supported the center, NECT, in raising the next generation of future leaders that would guide that region to a sustainable, peaceful future,” he says.

Ayodeji has also sought out energy-related opportunities on campus, pursuing an undergraduate research program (UROP) in the Buonassisi Lab in his sophomore year. He was tasked with testing perovskite solar cells, which have the potential to reach high efficiencies at low production costs. He characterized the cells using X-ray diffraction, studying their stability and degradation pathways. While Ayodeji enjoyed his first experience doing hands-on energy research, he found he was more curious about how energy technologies were implemented to reach various communities. “I wanted to see how things were being done in the industry,” he says.

In the summer after his sophomore year, Ayodeji interned with Pioneer Natural Resources, an independent oil and gas company in Texas. Ayodeji worked as part of the completions projects team to assess the impact of design changes on cluster efficiency, that is, how evenly fluid is distributed along the wellbore. By using fiberoptic and photographic data to analyze perforation erosion, he discovered ways to lower costs while maintaining environmental stability during completions. The experience taught Ayodeji about the corporate side of the energy industry and enabled him to observe how approaches to alternative energy sources differ across countries, especially in the U.S. and Nigeria.

“Some developing economies don’t have the capacity to pour resources into expanding renewable energy infrastructure at the rate that most developed economies do. While it is important to think sustainably for the long run, it is also important for us to understand that a clean energy transition is not something that can be done overnight,” he says.

Ayodeji also employs his community-oriented mindset on campus. He is currently the vice president of the African Students’ Association (ASA), where he formerly chaired the African Learning Circle, a weekly discussion panel spotlighting key development and innovation events taking place on the African continent. He is also involved with student outreach, both within the ASA and as an international orientation student coordinator for the International Students Office.

As a member of Cru, a Christian community on campus, Ayodeji helps lead a bible study and says the group supports him as he navigates college life. “It is a wonderful community of people I explore faith with and truly lean on when things get tough,” he says.

After graduating, Ayodeji plans to start work at Boston Consulting Group, where he interned last summer. He expects he’ll have opportunities to engage with private equity issues and tackle energy-related cases while learning more about where the industry is headed.

His long-term goal is to help expand renewable energy access and production across the African continent.

“A key element of what the world needs to develop and grow is access to reliable energy. I hope to keep expanding my problem-solving toolkit so that, one day, it can be useful in electrifying communities back home,” he says. **X**

Toasting a founding father of biochemical engineering

A November symposium pays tribute to Daniel I.C. Wang, who catalyzed the biotech industry

During a memorial symposium celebrating his professional accomplishments, mentorship, and legacy, Daniel I.C. Wang ’59, SM ’61 sometimes appeared larger than life. But amidst the flood of moving reminiscences, humorous anecdotes, and research stories about this former MIT institute professor, considered a founding father of the field of biochemical engineering, a complex, multifaceted human being sprang into vivid focus.

The two-day live event on November 4th and 5th, 2021,featured speakers from different eras of Wang’s life—from his graduate mentor, 94-year-old Arthur E. Humphrey, dean emeritus of engineering & applied sciences at the University of Pennsylvania, to recent students and colleagues.

“We all got a different part of Dan,” said Mike Thien ScD ’88, vice president of Merck. To Sherry Gu PhD ’97, senior vice president of WuXi Biologics, he was like “a Chinese grandpa or a teddybear.” He was “a straight shooter, who didn’t leave you even after you left MIT,” said John Aunins PhD ’89 a senior advisor at Seres Therapeutics.

He could be “tough and critical, someone who loved a good sparring partner,” said Kristala Jones Prather ’94, Arthur D. Little Professor of Chemical Engineering. “Danny expected all of us to excel,” said Araba Lamousé-Smith PhD ’00, vice president of supply chain & CMC management at MacroGenics, Inc.

To student and colleague Charles Cooney PhD ’70, professor emeritus in the Department of Chemical Engineering, Wang created a community with a “dynamic impact in academia and industry that continues to flourish.”

Prolific innovator

Wang died at 84 on August 29, 2020, after serving on the MIT faculty for 55 years. His research helped spawn the hybrid discipline of biochemical engineering, which is concerned with the production of proteins through genetically engineered microbes and human cells.

The innovative technologies Wang pioneered in fermentation, bioprocess monitoring, enzyme technology, mammalian cell

culture, and protein purification, among other areas, “set the stage for our modern biotechnology industry and for many of the advanced pharmaceuticals saving lives today,” said Paula Hammond, Institute Professor in Engineering and the Head of the Department of Chemical Engineering, during introductory remarks at the symposium on November 4th. “Danny had an uncanny ability to see the big picture of where the field was going.”

He co-authored hundreds of research papers, wrote books, licensed numerous patents, catalyzed careers and launched companies. But the heart of Wang’s remarkable enterprise was the community he was continuously building—a network of talented students and collaborators from around the world, on whom he had a profound impact, as speaker after speaker attested. Among this group are leaders of growing renown in the field he started.

Essential mentor

“Danny was one of the first people I spoke with when I was starting what became Moderna in 2010,” said Noubar Afeyan PhD ’87, founder and president of Flagship Pioneering, a life sciences venture capital firm. Afeyan worried that the idea behind Moderna might be troubling to Wang. “The premise involved obviating the need for fermentation and purification in the way we knew it,” said Afeyan. “I’d spent my life making and purifying proteins, and optimizing RNA would do away with that.” But rather than being troubled by the prospect of erasure of decades of his innovations, Afeyan said, “Danny was intrigued, telling me that this is what people said about DNA at the beginning of his work.”

Researchers at Moderna spent a decade learning to “code through software to make any protein we want” and to “tame molecules for delivery into human cells in a way that doesn’t allow an immune response,” said Afeyan. If Wang were just starting out today, he would eagerly embrace such methods, Afeyan asserted, because he always found value in leaping into unfamiliar territory.

“We must go after the important problems, and they are not sitting next to things we know how to do,” said Afeyan. “From working on mammalian proteins to mRNA, that’s not adjacent, and the exciting things happen outside.”

At Moderna, the willingness to pursue this vision over many years, solving a series of unprecedented biochemical challenges, has led to “a brave new frontier, a pioneering platform for a new class of medicines,” said Afeyan—the kind of work Wang’s “descendants are doing to try to propel his legacy.” he said.

Vaccine rush order

The company’s venturesome mindset paid off in an astonishing way in 2020. The D.I.C Wang Lecture on the Frontiers of Biotechnology, held annually since 2014, was delivered by Melissa Moore PhD ’89, Moderna’s chief scientific officer for platform research. In her talk, she described the company’s sprint to create a vaccine for SARS-CoV-2.

"From idea to GMP (good manufacturing practice-approved) drug product took less than two months," said Moore. This astonishingly quick product development came courtesy of the years Moderna had already spent designing an mRNA-based platform for a personalized cancer vaccine. "We had learned how to go from a tumor sample to personalized vaccine in 45 days, and this enabled us to see what kind of protein we needed for Sars-CoV-2."

The mRNA vaccine blueprint for Covid-19 took researchers one hour, she said, and from there it was 44 days to National Institutes of Health approval, and nine more months to sticks in arms.

The flexibility of this platform means researchers can readily adapt it as the Covid virus mutates. "We've been tracking the variants in real time, and we're making sure we're ready to go," said Moore. The company's mRNA technology is also being refined for personalized cancer vaccines, and a wide array of afflictions, from cystic fibrosis to cytomegalovirus, a deadly disease of newborns and people with immune disorders.

From candy to medical revolutions

The rise of many biotech inhabitants of a crowded Kendall Square can be traced directly back to Danny Wang, said Phillip Sharp, Nobel laureate, and Institute Professor of Biology at the Koch Institute for Integrative Cancer Research. During the energy crisis of the 1970s, Wang led a project converting corn stalks to ethanol, and this was the kind of work Sharp and other scientists wanted to pursue in their new company, Biogen. "Danny was an integral part of this, leading the company's production and manufacturing processes," he recalled.

His leadership in forming the Biotech Processing Engineering Center in 1985 represented "the first real integration between biological science and engineering at MIT," Sharp said, a convergence that has only become stronger and more central to the Institute's goals. Wang "stimulated the whole biotech industry by his engagement, training of others, and founding of an industry at a time it was in an embryonic state."

Because of Wang, said Sharp, a moribund corner of Cambridge known for the Necco candy factory became a biotechnology R&D and manufacturing engine powering economic growth on the I-95 corridor, and beyond. "Danny changed the history of life science and health care in the world. He was a great friend, and I loved his Chinese food and his can-do attitude," he said.

Wang's legacy

"I'm looking at the world through the lens Dan taught me to look through," said Charles Cooney, Wang's first graduate student. Displaying Wang's academic family tree, with its 1453 members, Cooney and others described some lessons Wang's students invariably picked up from him: the proper use of chopsticks, and more seriously, "stick-to-itiveness," the

importance of multidisciplinary collaborations, and of staying true to your values. “The goal is not building a plant, doing an experiment or establishing proof of concept, the goal is delivery science to society, in a sustainable way,” said Cooney.

The bearers of Wang’s legacy have taken these lessons to heart. Reshma Shetty PhD ’08 and president and co-founder of Ginkgo Bioworks, Inc, felt a “call to arms when the pandemic hit.” Her company used a cell programming platform to develop largescale Covid testing for K-12 classrooms. Bernat Olle SM ’05, MBA ’07, PhD ’07, the CEO and co-founder of Vedanta Biosciences has created a pill containing a unique cocktail of beneficial bacteria that has the potential to help patients suffering from gastrointestinal diseases and antibiotic-resistant pathogens. Luis Alvarez SM ’99, PhD ’09, founder of Theradaptive, returned from Iraq determined to help victims of war trauma. With new biologics, he is engineering implants for missing bone based on genetically engineered tissue repair.

The symposium was also an opportunity to celebrate a new branch in the Wang academic family tree. The Departments of Chemical Engineering and Biological Engineering jointly announced a major gift from Victoria Wang. This gift will provide further support to the Wang Professorship in Biological Engineering, and will also endow the Daniel I.C. Wang Fellowship Fund and the Daniel I.C. Wang Faculty Research Innovation Fund. The Wang Fellowship will support a cohort of students in both Chemical Engineering and Biological Engineering working on research in bio-manufacturing, with preference given to young women working in this discipline. The Wang Faculty Research Innovation Fund will support mid-career faculty in both departments, providing them with seed grants to pursue high-risk, high-reward new research that has the potential to shape both the discipline and the future of their careers. Paula Hammond shared that, “These new funds will be a fitting tribute to the twin poles of Danny’s legacy: he was a generational talent who broke boundaries and set the course for a discipline, and he was fiercely committed to nurturing the next generation of scholars. Thanks to this gift from the Wang Family, we are honored to be able to carry on this work in Danny’s name.”

In the symposium hall, images of Wang were projected onto large screens. He beamed down as members of his extended family rose to recall his lobster meals and Karaoke get-togethers; his “naps” during research lectures that invariably ended with sharp questions for the presenter; his benevolent bullying around thesis topics, and nonnegotiable career advice; his insistence on “family first,” including championing working mothers in the department. It wasn’t hard to imagine he was taking pleasure presiding over a gathering with the people whose company he most cherished. **X**

Alumni Highlights

Sanat Kumar SM '84 ScD '87 has won the 2022 Polymer Physics Prize from the American Chemical Society. Kumar, Columbia University's Bykhovsky Professor of Chemical Engineering, was awarded the 2022 Polymer Physics Prize "for fundamental experimental, simulatory, and theoretical contributions to understanding structure, assembly, and dynamics in polymer nanocomposites and thin films."

Kumar and his group create, analyze, and model new classes of polymer-based materials, with a focus on hybrid materials with inorganic fillers and polymer upcycling. His group's goal is to advance the science of energy conversion and storage, such as membranes for gas separation and for the selective transport of ions as relevant to batteries, and to mimic biology to guide the assembly of nanoparticles into desired structures.

Landmark Bio has appointed **Gregg Nyberg PhD '98** as chief technology officer. Nyberg brings more than 20 years' biopharmaceutical industry experience to his new role at Landmark Bio. Most recently, he was associate vice president at Merck, where he led the company's biologics process development and clinical manufacturing organizations. He also spent nearly 15 years in positions of increasing responsibility at Amgen including key leadership roles in process development and cell sciences and technology.

Troy Gayeski '98 has been named chief market strategist and managing director for FS Investments. Gayeski's responsibilities will include communicating with external stakeholders around the firm's product platform and market views, commercializing the firm's existing fund lineup and exploring potential new product offerings. Gayeski most recently served as partner, co-chief investment officer and senior portfolio manager at SkyBridge Capital. At SkyBridge, he oversaw all the firm's investment activities, managed the firm's discretionary fund of hedge fund portfolios and served as a member of the Portfolio Allocation and Real Estate Investment Committees. Prior to joining SkyBridge in 2010, he performed similar duties in the Hedge Fund Management Group at Citigroup Alternative Investments, Bank of America and Yankee Advisers.

Guillermo Antonio Ameer ScD '99 has been elected to the National Academy of Medicine. Ameer, the Daniel Hale Williams Professor of Biomedical Engineering and Surgery at the Northwestern University Feinberg School of Medicine, is also the director of the Center for Advanced Regenerative Engineering. He is cited by the NAM "for pioneering contributions to regenerative engineering and medicine through the development, dissemination, and translation of citrate-based biomaterials, a new class of biodegradable polymers that enabled the commercialization of innovative medical devices approved by the U.S. Food and Drug Administration for use in a variety of surgical procedures."

Maria Robinson '09 has been tapped to be President Biden's Assistant Secretary in the Office of Electricity at the Department of Energy. Her confirmation hearing was in February 2022. Robinson is serving her second term in the Massachusetts House of Representatives where she was elected as the first Korean-American legislator in 2018. Prior to her election, she led Advanced Energy Economy's Wholesale Markets Program, including engagement at FERC and the regional transmission organizations. Previously, she focused on regulatory issues relating to energy and air, leading policy efforts in over two dozen states across the country.

Aditya Kunjapur PhD '15 has won AIChE's 2021 Langer Prize for Innovation and Entrepreneurial Excellence. The Langer prize awards an unrestricted grant of up to $100,000 to enable creative researchers and engineering entrepreneurs in their early careers to pursue potentially game-changing innovations with transformative societal impact. In his laboratory at the University of Delaware, Kunjapur and his research group are designing innovative biomolecular technologies to address a variety of societal needs. The Langer Prize will support Kunjapur's work to boost the efficacy of live vaccines by engineering cells to produce an immunogenic amino acid.

Rathi Srinivas PhD '15's Droplette has been named one of Popular Science's 2021 "Best of What's New" in personal care. The magazine explains, "The Star Trek-esque device turns pods of treatments like collagen and retinol into a super-fine mist to help skin absorb the ingredients more quickly. Droplets 100 times smaller than the width of a human hair get that good stuff into a deeper layer of skin than a cream or serum could. With funding and support from the Walter Reed hospital, the National Institutes of Health, and NASA, the company's ultimate aim is to use the tech to deliver drugs without needles. Research is currently underway to treat alopecia, battlefield wounds, and a painful condition called Epidermolysis Bullosa."

Joe F. Moore Sr. ’52
1929-2021

Joe Farnham Moore Sr. passed away on Friday, the 20th of August 2021, at the family home in Piney Point Village.

After graduating from MIT, he joined the Humble Oil and Refining Company. In 1956, in partnership with fellow alumnus and fraternity brother, John S. Bonner, they founded Bonner and Moore Associates, one of the world’s first computer consulting companies. They continued to build the company they had created for 43 years until the company was sold when Joe retired.

Joe remained active in the affairs of MIT throughout his life, serving in various roles and positions, including president of the MIT National Alumni Association and 11 years as a trustee. Additionally, he served on and lead several academic committees, including the Humanities Committee, where he assiduously promoted the expansion of humanities courses at MIT, as he believed that a well-rounded education made for a better engineer.

In 2018, he followed in the footsteps of his Chickasaw Indian great – grandfather, Colbert Ashalatubby Burris when he was honored by the Chickasaw Nation being inducted into the Chickasaw Hall of Fame in Oklahoma.

Joe is preceded in death by Glenna, his beloved wife of 71 years. He is survived by his daughter, Ellen Moore Miller and her husband Rod, his son, Joe Moore Jr. and his wife Therese, his son, Randall Moore, and his wife, Charisse, his son Michael Moore, and his daughter, Jane Moore Kampschmidt, and her husband, Bernie. He is also survived by 13 grandchildren and spouses, and 12 great – grandchildren.

You can find Dr. Moore’s full obituary at dignitymemorial.com.

Michael Kesler ’51 SM ’54 SM ’55
1924-2021

Dr. Michael Kesler died August 23, 2021 from advanced Parkinsons disease at the age of 97, surrounded by family at his home in East Brunswick, NJ. Born in Dubno, Poland (now Ukraine), Michael and his sister Luba fled their family home to escape the Nazis. They wandered through 3,000 miles to Uzbekistan. During four years, they suffered yet persevered in their quest to survive.

After the war, Michael spent a year in a displaced person’s camp in Germany, and was awarded a scholarship from the B’nai B’rith Association to Colby College in Maine. He transferred to MIT, where he earned three degrees: a bachelor’s and master’s in chemical engineering, and a second master’s in biology. Later, he was awarded a PhD in Chemical Engineering from NYU.

In his career as a chemical engineer in the petroleum industry, he was employed by M.W. Kellogg, where he created one of the first chemical engineering simulation programs, The Flexible Flowsheet. He then worked for Exxon, then Mobil Oil. While at Mobil, he created a well-known set of mathematical tools called the Lee-Kesler Correlations, with his colleague B.I. Lee.

When Dr. Kesler retired in the 2000s, due to blindness caused by glaucoma, he embarked on a new career as a nonfiction writer. He authored four books, beginning with editing his late wife’s account of surviving the Holocaust and finding a new life in America, as a Harvard-educated pediatrician. He followed that with a memoir of his World War II experiences and a self-help book for when cancer strikes a family. His latest volume, *The Remnant*, published in April 2021 by Vallentine Mitchell (UK), concerns the remnant of Polish Jewry who survived the War by fleeing to the Soviet Union.

Dr. Kesler leaves behind his wife, Dr. Barbara S. Reed of East Brunswick, NJ. He is also survived by his four children with his late wife, Dr. Regina Kesler: Mark (of Durham, NC), May Kesler Breslow (of Chevy Chase, MD), David (of San Francisco, CA) and Theodore (of White Plains, NY), as well as two stepchildren: Michael Reed (of Mountain View, CA) and Rabbi Esther Reed (of Highland Park, NJ). He was Zaydee/Poppy to eleven grandchildren: Aaron Kesler, Regina Breslow, Joe and Maia Kesler, Korina and Daniel Kesler, Megan and Hannah Reed, and Isaac, Sammy, and Jonah Reed-Schwartz.

You can find Dr. Kesler’s full obituary at legacy.com. **X**

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

Massachusetts Institute of Technology
Chemical Engineering Department
77 Massachusetts Avenue, Room 66-369
Cambridge, MA 02139-4307 USA

web.mit.edu/cheme

Address service requested

NON-PROFIT ORG.
U.S. POSTAGE
PAID
PERMIT # 54016
CAMBRIDGE MA

Keep in touch! Our events are back in person and we hope to see you soon! Save the dates:

Friday, May 6, 2022

Warren K. Lewis Lectureship
Emergent Discovery – From Scientific Leaps to Breakthrough Medicines

Noubar Afeyan, Founder and CEO, Flagship Pioneering

Thursday, May 26, 2022

Time and location on MIT campus TBD
MIT Commencement Alumni Reception

Follow us:
facebook.com/mitchemeng
twitter.com/mitcheme
instagram.com/mit_cheme

For more information on these and other Department events, go to cheme.mit.edu.