COLUMBIA UNIVERSITY
CHEMICAL ENGINEERING NEWSLETTER

SPRING 2015

Left: Photo taken of Graduating students at Departmental Commencement Dinner May 8, 2015 at Lincoln Center

CONGRATULATIONS TO THE CHEMICAL ENGINEERING CLASS OF 2015!

Every year, the Chemical Engineering Department is delighted to recognize three talented undergraduate students for their achievements and accomplishments during their time at Columbia.

The Robert Edward Reiss Prize: The Prize is presented to the student who shows the greatest promise of success in applying the discipline of chemical engineering to the improvement of biological products and medical devices. This year's prize is awarded to Asher Krell. Asher is joining the MD/PhD program at the University of Alabama School of Medicine.

The Carl C. Gryte Undergraduate Award: The Gryte Award is given to the student who shows the greatest promise for service to Chemical Engineering. This year's award goes to Emma Yee. Emma is joining MIT in the Fall as a PhD student. Emma also won the prestigious NSF Graduate Research Fellowship.

The Charles F. Bonilla Medal: The Bonilla Medal is awarded to a graduating senior who has demonstrated outstanding academic merit. The 2015 Bonilla Medal is awarded to Bianca Sganga. She is joining Goldman Sachs after graduation; specifically, she'll be working in their Restructuring team, which is part of the Leveraged Finance Investment Banking Division.

INSIDE THIS ISSUE…

COLUMBIA UNIVERSITY

Dear Alumni and Friends,

What a positive year we have had!! Our graduating BS class (60) is the largest in recent memory, we have the largest MS class entering in the Fall (~70), and our PhD students have won 6 prestigious (NSF/DOE) fellowships over the last two years. Keeping up with these large numbers has been a challenge – but one that that is greatly helped by the new faculty we have added. Dan Esposito (PhD Delaware, post-doc at NIST) started in July '14. Dan works in the area of catalysis and his post-doc activities have taken him into the solar photovoltaics area. Robert G. Bozic (Lieutenant Colonel, U.S. Army, Retired) was hired last Fall to run our MS program. We have also added Michael Burke (MechE Asst Prof) as an adjunct professor in our department. With these additions, our faculty size will go to 14. These numbers must be contrasted with faculty size across the top 20 departments in the country. If we exclude Stanford and CalTech, the smallest department in the top 20 has a faculty of 18. Competing with these schools means that we have to grow our faculty by at least 4 – a target that is written into our strategic plan, and one that we hope to achieve in the near to mid term.

None of this would have been possible without the work of a top notch, dedicated group of faculty, staff, students and post-docs. One particular person I want to highlight is Michael Hill, a lecturer in discipline in our department. Michael has been a loyal member of our faculty, and it will be a pity to see him retire and go to Florida at the end of this academic year.

Over time, I will be reaching out to you with the goal of involving you more with the Department, with the overall aim of raising the stature of the Department further. As part of this you will be invited to our department's annual reception at the AIChE meeting in November -please do attend. While we will be reaching out to you, this is an open invitation to each and every one of you – please call, email or stop by anytime you are in the vicinity. We value your input and support, and would continue to develop our department that you are so proud of.

Best regards,

Sanat Kumar

Dr. Robert G. Bozic, (Ph.D., Columbia 2008) Lieutenant Colonel U.S. Army (Retired) joined the Department of Chemical Engineering faculty in the Fall 2014 semester and is having an immediate impact in the Department. Robert is now the director of the MS in Chemical Engineering Program. Before his retirement from the Army in September 2014, Robert most recently served as an Associate Professor at the U.S. Military Academy, West Point, New York, where he was the Deputy Director of Chemical Engineering and helped create an ABET accredited program.

Robert also assisted in teaching the CHEN E4500 Principles in Process Design course in the Fall 2014 semester and he taught his new elective, CHEN E4501 Chemical Engineering Process Safety in the Spring 2015 semester. This new course is an addition to current department curriculum offerings and is based on the 2010 Safety in Chemical Engineering Education (SAChE) recommendations to ABET. This new process safety course is developed around the American Institute of Chemical Engineers (AIChE) SAChE certification program, and includes case studies of major chemical accidents, a computer aided design component using ASPEN software, and a special operator training educational component. The course covers, but is not limited to, Process Hazard Analysis (PHA), risk assessment, what-if analysis, inherently safer design, Layer of Protection Analysis (LOPA), and process safety management. The course places students into safety teams that are given safety oriented exercises that they will likely see in industry. Robert has also teamed up with industry to get the students exposed to what students will see in the area of operator training.

Within the department, Robert has directed the MS program which includes the "Scientist to Engineer" (S2E) program. He has further developed an increasingly popular program, adding a personal touch to his service to MS in chemical engineering students from the orientation, to the MS in Chemical Engineering Banquet held at the Columbia Club here in New York. Robert has also been charged with recruiting for the MS in Chemical Engineering program in which we have seen 30% increase in applications, with a 75% increase in domestic applicants.

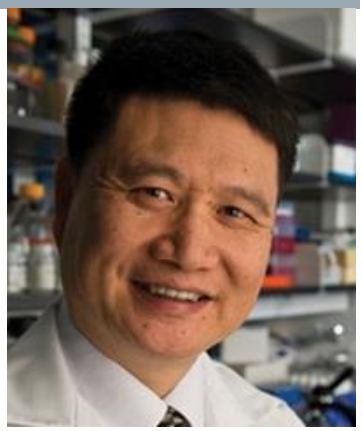
"No One Can Engineer Like a Columbian."
-Robert Bozic

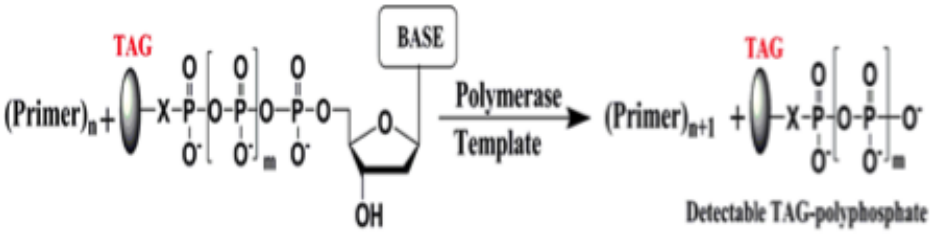
"We are extremely grateful for the generous support from the NIH, which has enabled us to make rapid progress in the development of the NanoSBS technology, the outstanding contributions from all the members of our research consortium, and the world-class expertise in technology transfer from our colleagues at Columbia Technology Ventures. We are looking forward to working closely with our colleagues at Roche to develop a leading platform for precision medicine."

- Dr. Jingyue Ju

SINGLE MOLECULE ELECTRONIC DNA SEQUENCING

Professor Jingyue Ju





Single molecule electronic DNA sequencing, a new technology developed at the laboratory of Jingyue Ju, Samuel Ruben-Peter G. Viele Professor of Engineering and Director of Center for Genome Technology and Biomolecular Engineering at the Department of Chemical Engineering, along with his collaborators, holds the key to reducing the cost of DNA sequencing, which will allow deciphering an individual's genome to become a routine part of medical research and health care, a new paradigm of precision medicine.

The Ju laboratory has been collaborating with Genia Technologies, Inc., researchers at Harvard University and the National Institute of Standards Technology (NIST) supported by a grant from the National Human Genome Research Institute of the National Institutes of Health (NIH), to develop a nanopore-based sequencing by synthesis (NanoSBS) system using polymer-tagged nucleotides that will accelerate the use of DNA sequencing for wide application in clinical diagnosis and healthcare. This collaboration has focused on the research and development of a single molecule electronic NanoSBS platform combining Genia's complementary metal-oxide semiconductor (CMOS) integrated circuit and the NanoTag sequencing chemistry that was developed in a collaboration between the laboratories of Ju at Columbia and John Kasianowicz at NIST, along with the novel protein constructs from George Church's laboratory at Harvard Medical School.

Genia has licensed the NanoSBS technology and the resulting single molecule electronic DNA sequencer is expected to be faster, more accurate and cost-effective than current commercially available technologies in decoding the human genome. In June of 2014, Roche, a leader in research-focused healthcare with combined strengths in pharmaceuticals and diagnostics, acquired Genia for $125 million in upfront payment, plus up to $225 million in milestone payments.

We are delighted to congratulate Professor Jingguang Chen, Thayer Lindsley Prof of Chemical Engineering, for receiving the 2015 George A. Olah Award in Hydrocarbon or Petroleum Chemistry. The award was presented during the 249th National Meeting of the American Chemical Society (ACS) in Denver, Colorado. Professor Chen was recognized with this prestigious award for his "experimental and theoretical investigations that have led to fundamental understanding and discovery of novel catalytic materials for hydrocarbon transformation reactions." The George Olah Award was first established in 1948 to recognize, encourage, and stimulate outstanding research achievements in hydrocarbon or petroleum chemistry. The award has existed under the current title since 1997 and is named after George Olah, the 1994 recipient of the Nobel Prize in Chemistry.

Professor Chen has been a faculty member at Columbia University since 2012, and holds a joint appointment as a Senior Chemist at Brookhaven National Laboratory where he is the co-founder and principle investigator of the Synchrotron Catalysis Consortium at the National Synchrontron Light Source. Before coming to Columbia University, Prof. Chen was the Claire D. LeClaire Professor of Chemical Engineering at the University of Delaware and previously worked for eight years at the Exxon Research and Engineering Company.

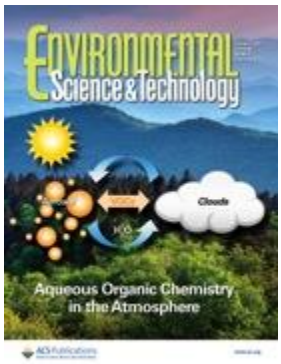
During his career, Prof. Chen has published over 280 publications and has been granted 20 patents relating to catalytic science and technology. He has advised over 50 Ph.D. and postdoctoral students during his time in academia, and his research on the development of novel catalytic technologies has had significant impact on many technologies, including hydrocarbon transformations, fuel cells, biomass conversion, renewable H2 production, and more. Of particular significance is Prof. Chen's combined use of experimental and theoretical tools for the development of low-cost, earth-abundant catalytic materials with minimal or no precious metals. Catalysts are essential materials for many energy and chemical conversion processes, and are especially important for many clean energy technologies.

Please join us in congratulating Professor Chen on this prestigious award!

PROFESSOR FAYE MCNEILL

We are delighted to announce that Prof. V. Faye McNeill received her tenure in 2014. She made history by becoming the first woman faculty member granted tenure in our department's 109 year history! The McNeill Lab has been in the forefront in developing innovative approaches for modeling aqueous aerosol processes in the atmosphere. The group first introduced the first detailed process-level numerical model of aqueous aerosol chemistry, GAMMA (Gas-Aerosol Model for Mechanism Analysis) in 2012. Prof. McNeill and Dr. Joseph Woo recently developed a reduced version of GAMMA, called simpleGAMMA, which captures the overall behavior of the detailed model faithfully but has very few tracers, so it is suitable for coupling to large-scale 3D atmospheric chemistry or climate models, or analyzing field data with limited inputs. The power of GAMMA and simpleGAMMA is that together they bridge the scales between the detailed molecular-level information obtained from laboratory measurements and large-scale models. The models, especially simpleGAMMA, are in demand within the community, particularly among field scientists seeking detailed analysis their data, and among those running 3D models with no or incomplete representations of aqueous aerosol chemistry.

Prof. McNeill was recently invited to write a feature article on aqueous atmospheric chemistry for *Environmental Science & Technology*. She also designed the cover art to go with the theme of the feature article. The cartoon depicts the interactions of clouds, aerosols, volatile organic compounds, and water vapor that lead to haze formation in the Southeast USA, including the Smoky Mountains. These processes have important implications for air quality policy since they combine both biogenic and anthropogenic emissions to create particulate matter – and therefore are only partially "controllable". More details can be found in: Aqueous Organic Chemistry in the Atmosphere: Sources and Chemical Processing of Organic Aerosols (Feature), V.F. McNeill, Environ. Sci. Technol. (2015) 49 (3) 1237-1244.



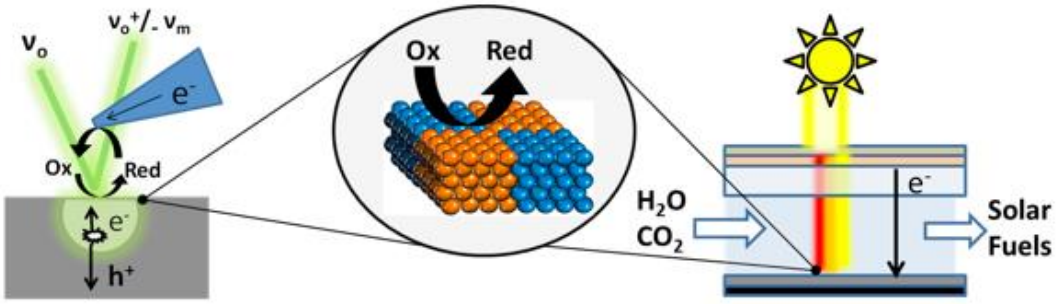
PROFESSOR VENKAT VENKATASUBRAMANIAN

Professor Venkat Venkatasubramanian will deliver a keynote lecture at the 12th Process Systems Engineering (PSE) and 25th European Symposium on Computer Aided Process Engineering (ESCAPE) in Copenhagen, Denmark, in May 2015. This will be Venkat's 25th Keynote/Plenary lecture in his career.

Prof. Venkatasubramanian, along with Dr. Kevin Joback, taught CHENE 4510 Process and Product Design II in Spring 2015 in collaboration with engineers and scientists from Johnson & Johnson, led by Dr. Euen Gunn, shown in the photo standing next to Venkat among the ChE senior students who took the class. With Dr. Gunn's guidance the students worked on two projects that focused on designing personal healthcare products – one involved Aveeno, a J&J product, and the other, a treatment for removing blackheads on skin. The students learned the physics, chemistry, engineering, safety and economic principles that are involved in the design of healthcare products. This experience is different from designing flow sheets for petrochemical plants, which they learnt in Fall 2014. J&J awarded $100 cash prize to each student from the top two teams for both projects; contributing a total of $1800 in prize money. J&J also organized a site visit to their Skillman, NJ, facility, which the students found exciting and informative of career options in the personal care industry. Our most sincere thanks to Dr. Gunn and the J&J team! We plan to continue this relationship with J&J, and hope to develop similar ones with other companies in the area.

Prof. Esposito has now been with the department for almost one year, having taught the graduate-level kinetics and reactor design course in the Fall semester while being given the Spring semester off from teaching to focus on research. During this past semester the Esposito group grew by 7 members, with the addition of Glen O'Neil (postdoc), Jack Davis (Ph.D. student), Tian Wang (MS student), Xinxin Li (MS student), Ji Qi (MS student), Duncan Lomax (UG student), and Akul Arora (UG student, to start in the Fall). With new equipment to be installed soon and almost everyone sticking around for the summer, the group is looking forward to ramping up its efforts to full speed.

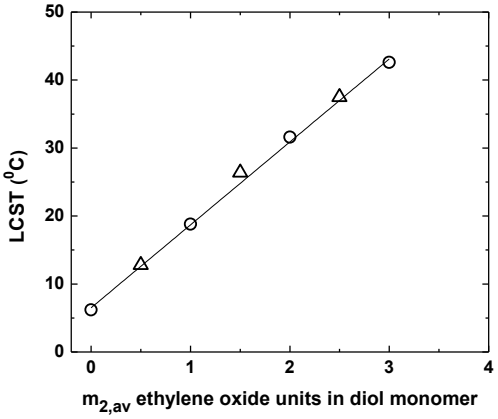
The group's research efforts are broadly based around the topics of electrochemical and solar energy conversion, with a particular focus on the development of materials, electrodes, and reactors for photoelectrochemical (PEC) production of fuels. Using PEC technology, low energy reactants (such as H_2O or CO_2) are converted into high energy "solar fuels" (such as H_2 or CH_3OH) using sunlight as the only energy input. If the performance and cost of such technology can be improved to appropriate levels, solar fuels could become invaluable for overcoming energy storage challenges associated with intermittent renewable resources while serving as a versatile energy feedstock for transportation, the chemical industry, the electrical grid, and more. A more detailed description about research in this area and group publications can be found on the group website:
https://danesposito.wordpress.com/research/



In other news, **The Esposito Research Group Blog** was brought on line this past semester. The group uses this blog to post short write-ups and links to recent technological developments in all areas related to energy. If you are interested in energy-related technology and current events, you can subscribe to the blog to receive email notifications for new posts by entering your email into the left hand panel of the blog homepage just below the photograph of Low Library.

Koberstein Group Discovers New Stimuli Responsive Polymer that is Water-Soluble and pH-Degradable

Jeff Koberstein and postdoctoral associate Sanjoy Samanta, have discovered an exciting new family of water-soluble polymers that are the first temperature-responsive polymers to be intrinsically biodegradable, hydrolyzing in acidic environments. Several patents have been filed on the invention and a manuscript on the new materials is being submitted to Nature materials for publication. The work is funded by a new grant provided by the National Science Foundation Polymers Program within the Division of Materials Research. Funding is also being sought for commercial application of the technology. The new polyacetal materials exhibit lower critical solution temperature (LCST) behavior, that is, they fall out of solution upon heating. The polyacetals are made by simple reactions between amphiphilic diols and divinyl ethers. Each diol monomer (1) comprises n_1 hydrophobic methylene units and n_2 hydrophilic ethylene oxide units, while each divinyl ether monomer (2) comprises m_1 methylene units and m_2 ethylene oxide units. The hydrophilic/hydrophobic balance can therefore be controlled precisely by adjusting these four composition variables. What is remarkable about the new materials is their extraordinary temperature response shown in the figure below. The LCST temperature is linearly dependent on three of the four composition/structural variables, which allows the temperature to be predicted and controlled over a broad temperature regime (ca. 8-80°C) by adjusting the molecular structure of the polymer. Applications of the polymer are anticipated in a wide variety of fields including pesticide delivery in agriculture, controlled temperature release of cleaning agents, the preparation of clothing with temperature adaptive permeability and drug delivery for cancer treatment. In the latter application, we take advantage of the fact that the temperature of tumors is several degrees higher than physiological temperature and that the tumor microenvironment is acidic. A polymer is designed to be soluble at physiological temperature but to fall out of solution when it enters a tumor. If the polymer is designed to carry an anticancer drug, it then effectively concentrates and localizes the drug within a tumor. Once delivered to the tumor, the polymer degrades in the acidic environment to release the drug. The Koberstein group is working with a team of interventional endoscopists at the Columbia medical center to inject the drug laden polymers into pancreatic tumors and thereby provide a new treatment for a disease with a dismal prognosis. Ms. Rebecca Balaj, a 3rd year Chemical Engineering undergraduate is assisting with synthesis of the new polymers.



The 2014 Kim Award for Faculty Involvement was awarded to Professor Michael Hill at the 2014 SEAS Class Day. The Kim Award, established in 2000 by Edward and Carole Kim, was created to honor a faculty member who is not only an excellent teacher but who also shows a special, personal commitment to students.

Nominations for the Kim Award are made by undergraduate and graduate students. Selection criteria include how the faculty member "goes the extra mile" for students, effectively guides students in professional development and demonstrates a caring attitude toward students by engaging with them.

To Columbia ChemE students, past and present:

As many of you know, I am leaving Columbia after this semester. As someone who spent an entire career in industry, I had the rare opportunity to develop a second career as an instructor at Columbia. This has been an experience I will never forget. Without a doubt, the best part has been the personal interaction I have enjoyed with so many of you students, not just about academic questions, but also life and career issues. It has been a delight to know I have influenced so many of you in such a positive way, and I deeply appreciate the opportunity to have known you.

-Michael Hill

Student Quotes & Thanks

"Best professor in the Department Hands-down! I learned more from his teachings and lessons because he breaks the material down and gives you a detailed analysis and the 'why' behind it all that definitely made me understand the material. Thank you for this!"
– Ms. Michelle Ynsinare, Chemical Engineering '15

"Thank you for being a great mentor. It was truly a pleasure to have you as a lecturer and work with you in your lab. Best wishes for wherever life takes you next!"
– Roshan Ramkeesoon, Chemical Engineering '15

WHERE ARE THEY GOING?

Emma Yee
MIT
PhD Candidate

Akachi Ukwu
Procter & Gamble
Process Engineer

Kopano Ramsey
Johnson & Johnson
Associate Analyst

Varun Jotwani
Barclays Capital
Analyst

Alcoa

Lamont-Doherty
Earth observatory

Genentech

Michael Ong
Amec Foster
Wheeler
Process Engineer

Roshan Ramkeesoon
University of
California, Santa

Yani Zhang
DuPont
Chemical Engineer

Veronica Li
Dow Corning
Process Engineer

Yale
University

Martin Rosenbaum
Columbia University
Biomedical Engineering
MS

Booz Allen
Hamilton

Radhe Patel
New York City
Urban Fellowship
Political Science
Fellow

Con Edison

Laura Boning Zhu
Kostelanetz & Fink
Law Firm

Peri Shapiro
PepsiCo
Research &
Development
Engineer

University of
Southern
California

Asher Krell
University of Alabama
School of Medicine
MD/PhD Candidate

The department is working to increase the number of employment opportunities available to our students. If your organization has full-time and internship opportunities please reach out to Itanza Lawrence, The Career Placement Officer for the department, at isl2111@columbia.edu.

CHEMICAL ENGINEERING GRADUATE ORGANIZATION

President – Christopher Hawxhurst

Vice President – Kolade Adebowale

Social Chair – Kristen Garcia

Academic Chair – Brian Tackett

Treasurer – Jack Davis

Internal Outreach Chair – Kevin Knehr

External Outreach Chair – Christianna Lininger

Masters Representatives – Martin Cerny & Weiran Sun

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

President - Annie Tan

Vice President - Yani Zhang

Secretary - James Zhang

Treasurer - Ebun Andrew

Mentorship Chair - Michael Ong

ChemE Car Captain - Steven Lathrop

Chemists' Club Rep - Abdulrahman Khoshaim

Webmaster - Veronica Li

Activities Coordinator - Linh Lai

Summer BBQ | August 8, 2014

We had our annual welcome back BBQ in Avery Plaza. Faculty, current and incoming students gathered together to meet, greet, and ring in the new academic year!

The Gaden Memorial Lecture | October 28, 2014

The department held its 8th Gaden Lecture, named after the late Elmer L. Gaden Jr, who is widely known as the "Father of Biochemical Engineering". The Gaden Memorial Lecture is an annual event examining the changing interface between chemical engineering, cognate sciences, and society.

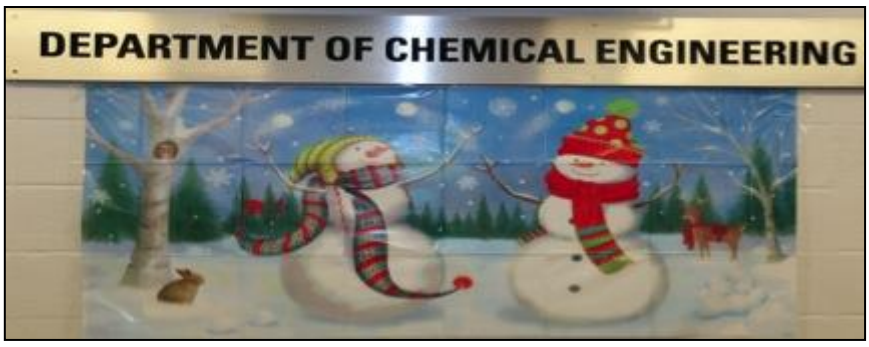
Our speaker was Nicholas A. Peppas, Cockrell Family Regents Chair in Engineering #6, Family Chair for Department Leadership #1, Professor of Chemical Engineering, Biomedical Engineering and Pharmacy, Chairman of the Department of Biomedical Engineering at the University of Texas at Austin.

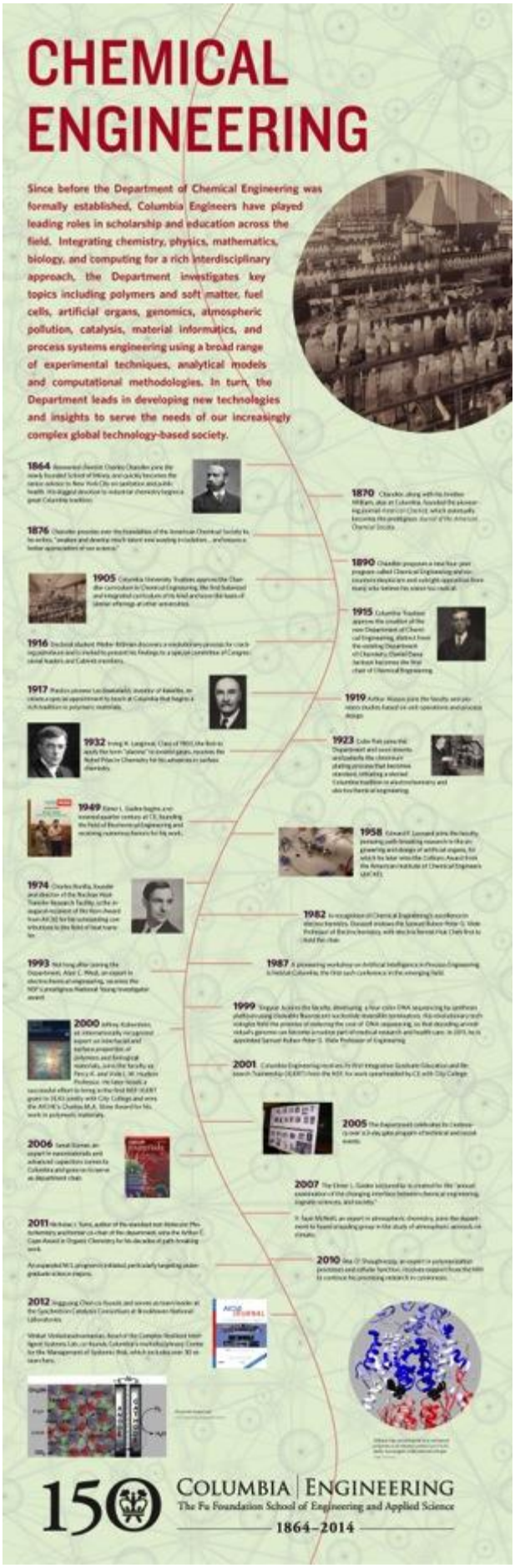
MS Graduation Dinner | December 4, 2014

We celebrated our MS Engineering Banquet at the Columbia Club in downtown Manhattan. Faculty and students gathered to celebrate the MS class of 2014.

Annual Winter Celebration | December 10, 2014

The department ended the year on a high note and celebrated the holidays with friends, faculty, staff, and some holiday cheer!!





As you may know, Columbia SEAS celebrated the 150th anniversary of its founding (1864-2014) with a series of exciting events throughout 2014. One of these events was our departmental celebration, on November 14th, 2014, well attended by many alumni and friends. It featured a short overview of our history, delivered by Prof. Ed Leonard, followed by the Department's future plans by Prof. Sanat Kumar. Prof. Venkat Venkatasubramanian presented departmental highlights (such as the poster seen on the left), the Gala, and the Symposium. This was followed by an open session where alumni and students and faculty mingled to discuss ongoing research and other matters. The departmental celebration concluded with a catered sit down luncheon in the Carleton Lounge. More than 150 people participated in the event.

In the afternoon, there was a SEAS-wide Symposium held at the Roone Arledge Auditorium attended by over 1100 alumni, students, colleagues and friends. Professors Ju, Venkatasubramanian and West made short presentations highlighting the contributions of pioneering Columbia Chemical Engineers Elmer Gaden and Colin Fink as well as the future of Precision Medicine. Below is a photo of Prof. West (Left) delivering his lecture on Prof. Colin Fink.

The festivities culminated in a Grand Gala function held on the evening of November 15, 2014 at the Cathedral for St. John the Divine, beneath a magnificent art installation that combines engineering ingenuity with artistic creativity. Chinese contemporary artist Xu Bing's Phoenix, massive sculptures of two birds—made of discarded materials from construction sites—are suspended in the nave, offering a stunning setting to the evening's celebration.

Over 800 alumni and friends attended the Gala, the largest event ever in Columbia's history, only exceeded by the commencement ceremonies. And here is the special ChE feature -- approximately 130 were ChE alumni and guests! We were ~15% of the show. We punched way above our weight! Shown below are some photos from the Gala. One of which shows a group of elegantly dressed chemical engineering professors and alumni.

You can learn more about the 150 year history of SEAS in this wonderful video:

https://www.youtube.com/watch?v=ZMTQARmH6TI

Best Wishes to Teresa Colaizzo

After 15 years of dedication and hard work as Department Administrator, Teresa Colaizzo is leaving ChE to pursue other interests. Our Department is very grateful for her yeoman service over the years and wishes her well in her new endeavors. We all wish her much success and happiness. She will be missed!!!!!!!!

- Chemical Engineering Department

Special Thanks To Our Fall 2014 & Spring 2015 Speakers…

Alex Bell
Arindam Bose
Tom Edgar
Benny Freeman
Dongeun Huh
Santanu Kundu
Sheeley Minteer
James Rawlings
Phil Savage
David Sholl
Jason Surratt
Michael Tsapatsis
Ian Wheeldon

Congratulations to the following alumni:

Joseph Woo, PhD Lafayette College, Visiting Assistant Professor in the Department of Chemical & Biomolecular Engineering

Yanir Maidenberg, PhD Manhattan College, Visiting Associate Professor

Damla Eroglu, PhD Middle East Technical University

Congratulations to the following students:

Ellie Buenning, NSF award winner

Connor Bilchak, NSF honorable mention

Sarah Belinger, Honorable Goldwater Scholarship