CHEMICAL ENGINEERING
UNIVERSITY of WASHINGTON

Winter/Spring 2016

Catalyst

Innovation and Entrepreneurship Run Deep in ChemE

Fostering "knowledge and solutions for a changing world" is what unites us. Part of how we realize this goal is through innovation and entrepreneurship and by embedding a startup culture in the ChemE curriculum.

Team 6ixS at Health Innovation Challenge, carrying their message on their fitting crimson shirts

Offered as an alternative to traditional capstone process design, the year-long **ChemE 497 Entrepreneurial Design** course developed by **Prof. Dan Schwartz** prepares small groups of undergraduates for the startup world. Teams of seniors mentored by a graduate student work on technology developed by ChemE faculty with the goal of turning inventions into viable products or services. As part of the course requirements, innovation teams deliver a pitch in front of venture capitalists, investors and entrepreneurs during one of the business competitions organized by the UW Foster School of Business.

THIS YEAR, **YANBO QI**, a graduate student co-advised by Profs. Schwartz and Subramanian, teamed up with undergraduates Nannan Jiang, Niccolo Fortest, Samson Smith, Yutian Qian to improve the life of lithium-ion batteries per charge. The **Smart Charger Pro** team used predictive electrochemical models developed by the Subramanian group to dynamically control the charging process and developed a companion app that allows users to choose between normal, overnight, and fast charging modes.

ON THE HEALTH PLANE, **LE ZHEN**, a graduate student in Prof. Ratner's group is tackling the challenge of peripheral artery diseases. Synthetic vascular grafts have saved the lives of many patients experiencing arterial plaque build-up. However, they sometimes fail, and do so because the graft surface cannot mimic the ability of the real human vessel surface – called the endothelium – to prevent blood clot formation by blocking platelet deposition. Le's team **6ixS** (pronounced "success") with undergraduates Nicholas Zhen Hung, Isaac Lam, Jason Dang, Melissa Gile seeks to change the situation by engineering polymer microstructures and coatings that will promote endothelial cell growth at the graft surface, thus preventing failure.

Both projects caught the attention of the National Science Foundation Innovation Corps (I-Corps) program which supports select projects showing translational potential with broad applicability and impact. Yanbo plans to use NSF funding to send her team to an energy storage conference where they will talk to battery manufacturers and cell phone vendors in order to better understand the market and identify potential clients and collaborators. "The seniors in my team are smart, motivated and passionate about making an impact using what they learned in Chemical Engineering," says Yanbo. "And getting I-Corps funding means we can actually reach out to the real world to test our ideas." Smart Charger Pro pitched their idea at the recently held **Alaska Airlines Environmental Innovation Challenge (EIC)**.

6ixS was one of 18 teams that made the cut at the inaugural **Health Innovation Challenge**, a gathering of over 100 technologists, entrepreneurs, and investors from the Seattle area with interest in medicine and health. The team went on to win the "Judges Also Really Liked" award. "Having gone through such a realistic and challenging environment that they never experienced before, the undergrads in my team matured a lot," Le says. He

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IN THIS ISSUE

Message from the CHAIR

François Baneyx

For a Department Chair, nothing is more rewarding than reporting on the achievements of students and faculty. As you will read time and again in this edition of *Catalyst*, these achievements are many and far-reaching. In fact, I cannot resist the temptation of highlighting a few in this column.

Our students continue to amaze: senior Thao Nguyen was awarded the College of Engineering Dean's Medal, making her the fourth ChemE to earn this distinction in the past six years. Our undergraduates swept top honors at the 2016 Pacific Northwest AIChE Student Chapter Conference, winning the ChemE car competition, the ChemE Jeopardy competition and the Best Research Paper award. Even more remarkably, three ChemE students were selected to be part of the inaugural class of *Husky 100*, a group of 100 undergraduate and graduate students that embodies the best of UW.

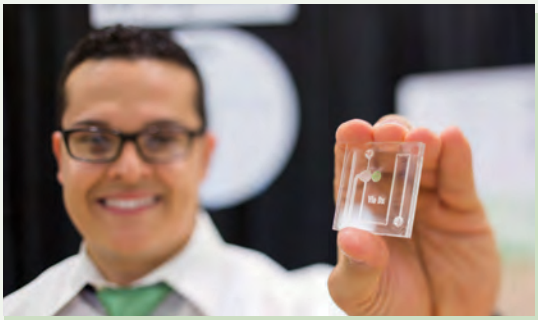
Our faculty continues to excel in education and research and the department continues to attract the best and the brightest. This year, we added Dr. Elizabeth Nance, the first Clare Boothe Luce Assistant Professor of Chemical Engineering to our ranks. Prof. Nance, a Burroughs Wellcome Fellow, was named a 2015 "30 under 30" in Science and Medicine by *Forbes* magazine and is already making waves in the field of nanomedicine. Prof. DeForest, who joined the department a scant two and a half years ago, won the 2016 UW Distinguished Teaching Award, becoming part of an elite cohort of master teachers that also includes Profs. Berg (1972) and Pfaendtner (2013). Prof. Schwartz won the 2015 Marsha L. Landolt Distinguished Mentor Award in recognition of his tireless dedication to educational activities and inclusion of Native American communities in our programs while Prof. Carothers was selected as one of 12 emerging scholars in all fields of academia by *Diverse* magazine. To top off this list of distinctions, Prof. Jiang's 2013 paper was picked as one of eight major hits in biomedical research published by *Nature Biotechnology* over the past 20 years and Profs. Jenekhe and Cao were named two of the World's Most Influential Scientific Minds by *Thomson Reuters*.

As you will read in our feature story, innovation was brewing in ChemE long before the term had become a buzzword. Several of our student entrepreneurial design teams have taken top honors at business competitions and the program has given birth to five startup companies that capitalize on the entrepreneurial spirit of our students and on our faculty's research to provide solutions that impact the real world.

I am humbled by the devotion and generosity of our alumni and donors. The Department received $3.89M in gifts and endowments in fiscal year 2015 – the highest in our history. These gifts allow us to provide scholarship and fellowship support to our students, recruit and retain world-class faculty, and invest in infrastructure renovation that are transforming the student experience. I am excited to share the fruits of your support in this issue. Thank you for your unwavering commitment. ■

Contact Chair Baneyx at chechair@uw.edu

Innovation & Entrepreneurship *(Continued from cover)*



Vie Diagnostics at Business Plan Competition

also plans to use NSF I-Corps funding to send his undergraduates to conferences and to interview potential customers for the vascular graft.

CHEME HAS A STRONG RECORD of success at the **UW Foster School of Business Competitions**. In May 2015, ChemE PhD candidates Charlie Corredor and Mark Borysiak along with Mechanical Engineering partner Babak Moghadam (advisor Prof. Jonathan Posner) won the **Grand Prize** and **Best Innovation Idea** (along with a $27,000 check) at the **Business Plan Competition**. Their start-up company, **Vie Diagnostics** (viedx.com), is developing a low cost test for sexually transmitted infections, which provides results in a matter of minutes. This inexpensive point-of-care diagnostic for STDs eliminates the need for lab-based testing. This means that patients can be tested and treated in a single clinical visit. Vie Diagnostics innovation received media attention on *GeekWire* and was featured on *KIRO7* News. "We're bringing point of care at the front lines where it's really needed," said co-founder Charlie Corredor in his interview with KIRO. Their long-term goal is to make the test available for at-home use.

Ion Informatics, a team led by Matt Murbach (advisor Prof. Dan Schwartz) and consisting of ChemE undergraduates Brendan Erickson, Daniel Gilbert, Arianna Whitten and business school students, won Honorable Mention and a $2500 check at the 2015 EIC. Ion Informatics is developing a proprietary technology that provides critical information to battery operators, and helps them optimize asset utilization to prolong battery useful life. This winter, **Ionic Windows**, a team advised by Prof. Lilo Pozzo and consisting of Dr. Greg Newbloom (Ph.D. '14), ChemE senior Anthony Moretti and MBA student Ian Hochstein, won **second place** and **Clean Energy Prize** at the EIC. Ionic Windows provides low-cost, high-performance membranes for emerging grid-scale energy storage technologies. Another ChemE team, **Battery Informatics** which aims at providing systems for optimal operation of lithium-ion batteries for electric grids and commercial buildings, was recognized with a **Judges Also Really Liked award** at the EIC. Excitingly, the team traveled to Washington D.C. with their advisor, Prof. Venkat Subramanian, to present the technology at the **Congressional Showcase** held during the March 2016 **Energy Innovation Summit**.

We are proud of our entrepreneurial design teams and of their potential for making a real world impact on energy, health and the environment. ■

- Shoko Saji

Alumni Support for ChemE Innovation & Entrepreneurship

Many of our alumni provide invaluable support and guidance for ChemE's innovation and entrepreneurship programs. One of these is **Mark Lawrence** (BS '94), a long-term supporter who served on the department's Advisory Board for 6 years and currently sits on the College of Engineering Visiting Committee. Mark established the **Lawrence Family Endowed Fund for Chemical Engineering** to recognize graduate students that have distinguished themselves in mentoring undergraduates enrolled in the Entrepreneurial Design program.

Mr. Mark Lawrence and Jessica Soto-Rodríguez

The 2015 recipient was **Jessica Soto-Rodríguez**, a Ph.D. student in the Baneyx lab who led a team of 4 undergraduates working on a technology for inexpensive, fast and green protein purification. "When her team delivered their final presentation on the technological and commercial path forward for the SiliCar9 technology, Jessica's mentoring influence shone through. Her students were able to clearly articulate key elements of the project in a comfortable, knowledgeable and concise manner," said Prof. Schwartz. Jessica had a chance to thank Mark in person and to show him around the lab. "Receiving this award is not only an honor for me, but also a motivation to continue impacting future generations," wrote Jessica in her letter to Mr. Lawrence. The award will support Jessica in her professional growth as an innovator and entrepreneur. ■

Startups spun out by UW ChemE faculty in the past 3 years

Pozzo Lab

PolyDrop (2013) makes conductive polymer additives for use in paints, coatings, composites and adhesives. The addition of conductive polymers enhances the conductivity of the material surface and enables the dissipation of electrostatic charges. Conductive surfaces are important in industries such as semiconductor chip manufacturing, aircraft design, flooring and electronic device enclosures. PolyDrop products are also used for the inhibition of corrosion damage of naval ships, oil pipes and bridges.

Ionic Windows (2016) produces membranes that are integral components of grid-scale energy storage infrastructure. Nanoporous glass membranes are fabricated for use in redox flow batteries at a cost that is more than 50 times lower than the currently used material. This reduction enables redox flow batteries with much lower energy-storage costs ($/kWh) that will contribute an accelerated adoption of clean energy sources.

Jiang Lab

Taproot Medical Technologies is developing a new class of highly biocompatible materials, and applying this technology to medical device development.

Schwartz & Subramanian Labs

Battery Informatics, Inc. (2016) is developing next-generation Battery Management Systems for cost-effective use of lithium-ion batteries in power grid and electric vehicle applications.

Baneyx Lab

Proteios (2015) is an emerging startup focused on providing researchers with affordable, easy-to-use and rapid kits to purify recombinant proteins. When commercialized, the kits will deliver the correct yield, purity and activity needed for downstream applications while utilizing environmentally friendly reagents.

2015 Distinguished Alumna in Industry, Mary Armstrong

Mary Armstrong

Ms. **Mary Armstrong** (BS '79) was recognized at the June 11, 2015 ChemE Graduation Ceremony with the **R. Wells Moulton Award for Distinguished Alumna in Industry**. Ms. Armstrong is retired Vice President of Environment, Health and Safety for The Boeing Company. Under her leadership, Boeing achieved workplace safety improvement and significant increase in energy and natural resource management. Armstrong joined the company in 1984 and served as President of Boeing Shared Service Group and VP/GM of several divisions. In 2011, *Financial Times* named Armstrong one the top 50 women in the wings of business leadership globally. In 2014, Boeing highlighted Armstrong as one of 13 women in an article entitled *Trailblazers: The Women of The Boeing Company*. Armstrong earned a Bachelor of Science degree from the University of Washington and a Master of Science from the University of Rochester, NY, both in Chemical Engineering.

In her address to the graduating class, Ms. Armstrong encouraged the digital generation to connect with people face-to-face. "Everyone likes to talk about what they do. Go to their turf and learn about it," she said. "Take the initiative. That's 'TTI' for you texters." She went on to tell a story about making the difficult (but in hindsight correct) decision to choose a position with Boeing in Montana over a company-sponsored fellowship opportunity that everyone was advising her to take. "Always have the courage to follow your heart."

Ms. Armstrong is a long-time supporter and strong advocate for the department. She has been a member of the UW Chemical Engineering External Advisory Board since 2011 and served as its Chair from 2013 to 2015. She has established the **Armstrong Scholarship in Chemical Engineering** to fund qualified undergraduates in need of financial assistance. We are proud to call Mary our alumna. ■

Ms. Mary Armstrong and Prof. & Chair François Baneyx

Chemical Engineering External Advisory Board Members

Paul Kenis (Chair), Department Head, Chemical & Biomelcular Engineering, University of Illinois, 2012~
Kathryn Soucy (Vice Chair), Patent Prosecution Professional, The Boeing Company, 2015~
Mary Armstrong, Retired Vice President of Environment, Health, and Safety, The Boeing Company, 2011~
Linda Broadbelt, Department Chair, Chemical & Biological Engineering, Northwestern University, 2015~
Mark Buehler, Sr. Process Engineer, Intel Corporation, 2013~
Camillo Cheng, Former President & Owner (retired), Golden Pheasant Foods, 2015~
Rich Dickinson, Department Chair, Chemical Engineering, University of Florida, 2015~
Karen Fleckner, President/CEO, Nu Element, Inc., 2013~
Rick Hyman, VP Business Development, NVDIA, 2016~
Hal Monbouquette, Professor of Chemical & Biomolecular Engineering, University of California Los Angeles, 2012~
Spencer Reeder, Sr. Project Developer for Climate, Vulcan, Inc., 2015~
Scott Roberts, Retired Vice President of Operational Excellence, Shell Chemicals, 2010~
Tom Temple, Former President & CEO (retired), U.S. Oil & Refining Co., 2014~
Andy Walker, Senior VP Manufacturing, Juno Therapeutics, 2016~

2015 Leadership Seminar Series

- **Richard Baillie** (BS '80)
  President, Baillie Advanced Materials
- **Jamie Hoffnauer Chakrabarty** (BS '85)
  Manager, Boeing Research & Technology
- **Michael Mastor** (BS '12)
  Associate Product Manager, Pyrotek USA.
- **Natalie Nairn** (BS '95)
  Director, Formulations, Blaze Bioscience
- **Amar Neogi** (MS '68, PhD '70)
  Director, Renewal Research, Weyerhaeuser, Retired
- **Richard Rapoza** (PhD '89)
  Divisional VP of R&D - Bioresorbables, Abbott Vascular
- **Michael Vrbanac** (PhD '89)
  Senior Counsel, Bracewell Law
- **Stephan Whitley** (BS '89)
  Senior Partner, Caravel Solutions

The Leadership Seminar Series, now in its ninth year, provides an interactive forum for undergraduate and graduate students to learn from industrial, academic and government leaders, covering a variety of topics in the chemical engineering profession including career planning, management, entrepreneurship, ethics, effective planning, interpersonal skills and strategic decisions. LSS explores the depth and breadth of a ChemE degree and careers.

Thank you to the alumni who took part in this year's LSS!

Class of 1966 50th Reunion - June 9, 2016

Calling all members from the **Chemical Engineering Class of 1966**! Join us for your 50th reunion held in conjunction with the 2016 Chemical Engineering Graduation ceremony. Come back to campus to reconnect with classmates, visit with faculty, and be formally honored during the Chemical Engineering Graduation on June 9. An official invitation with all of the details will be mailed soon. Please contact Kaitlin Colleary, Assistant Director of Advancement at kaitcoll@uw.edu or 206-685-6192 with any questions and to RSVP.

2015 Bruce A. Finlayson Lecture Features Klavs Jensen

Profs. Klavs Jensen (left) and Bruce A. Finlayson (right)

The **Finlayson Lecture**, named in honor of **Bruce A. Finlayson**, Rehnberg Professor Emeritus of Chemical Engineering, features distinguished chemical engineers who have demonstrated exceptional scholarship, teaching and service in their field.

The 2015 Finlayson Lecturer was **Klavs F. Jensen**, the Warren K. Lewis Professor and Head of the Department of Chemical Engineering at the Massachusetts Institute of Technology. Prof. Jensen's research focuses on understanding and controlling the interaction of reaction and transport processes in the realization and testing of functional micro- and nano-structured materials and devices for chemical, biological, optical, electronic and energy applications. He has authored over 530 articles, holds 39 patents and has been recognized by numerous awards including a NSF Presidential Young Investigator Award, a Camille and Henry Dreyfus Foundation Teacher-Scholar Grant, a Guggenheim Fellowship, and the Allan P. Colburn, Charles C.M. Stine, R.H. Wilhelm, and W.H. Walker Awards of the AIChE. He is a member of the National Academy of Engineering and American Academy of Arts and Science.

Prof. Jensen delivered two lectures: *Chemical and Biological Microsystems Provide Increased Insight and Performance* (research) and *Mico-Milli-Macro – The Importance of Scale* (public). ■

Student Honors and Achievements

Graduate Students

- Chinese Government Award for Outstanding Students Abroad: **Tao Bai**
- CoMSEF Conference Presentation Award: **Kayla Sprenger**
- NSF Graduate Research Fellowship: Winner - **Grant Williamson**, Honorable Mention - **Gabriella Tosado**
- SHPE Best Paper Award in Applied Physics/Electrical and Computer Engineering: **Jessica Soto-Rodriguez**
- UW ACES Graduate Student Symposium
  Poster 1st place
  Popular vote: **Matt Murbach**
  Industry vote: **James Clark and Trevor Braun**
  Talk 1st place: **Brian Swift**, 2nd place: **John Katahara**
  Faculty Lecture Award: **Beau Richardson**
  High Impact Paper Award: **Fang Sun**
  McCathy Teaching Award: **Caroline Tsao**
- UW CoMotion Graduate Innovator Award: **Beau Richardson**
- UW Graduate School fund for Excellence and Innovation (GSFEI) Travel Award: **Razieh Khalifehzadeh**
- UW Inaugural 2016 Class of Husky 100:
  Jessica Soto-Rodriguez, Laurel James

Team Ionic Windows won 2nd Place & Clean Energy Prize at Foster School of Business Environmental Innovation Challenge

College of Engineering Dean's Medal

Each year the College of Engineering recognizes two exceptional graduating seniors with the **Dean's Medal for Academic Excellence**. We congratulate ChemE senior **Thao Nguyen** (advisor Prof. John Berg) as this year's winner. **ChemE has produced 4 winners in the last 6 years** - a strong testimony to the quality of the program and that of our students.

2011: Melanie Drake
2012: Emily Hollenbeck
2014: Rainie Nelson
2016: Thao Nguyen

Undergraduate Students

- Pacific Northwest AIChE Student Chapter Conference
  Research Paper Competition
  1st place: **Jacob Hatzinger**, 3rd place: **Austin Habich**
  ChemE Car Competition 1st place:
  Team Dawg Sled - Victoria Hildreth, Heather Huang, Nannan Jiang, Yu Chen Liu , Parashara Shamaprasad, Samson Smith, Matthew Willette
  ChemE Jeopardy Competition 1st place:
  Bennett Battistoni, Wyatt Curtis, Payam Farahani, Thao Nguyen
- UW Chemical Engineering Bowen Design Award:
  Group Apollo - Ahmed Alamer, Derek DeGraff, Brian Gibbon, Katie Hickman
- UW College of Engineering 2016 Dean's Medal: **Thao Nguyen**
- UW Inaugural 2016 Class of Husky 100:
  Melissa Gile, Austin Wright-Pettibone

Graduate & Undergraduate Teams

- UW Foster School of Business Environmental Innovation Challenge:
  2nd place & Clean Energy Prize: **Ionic Windows - Greg Newbloom, Anthony Moretti**
  "Judges Also Really Liked" Award: **Battery Informatics - Manan Pathak, Matt Murbach**
- UW Foster School of Business Plan Competition: **Vie Diagnostics - Mark D. Borysiak, Charlie Corredor**
- UW Foster School of Business Health Innovation Challenge: "Judges Also Really Liked" Award:
  6ixS - Le Zhen, Nicholas Zhen Hung, Isaac Lam, Jason Dang, Melissa Gile

One Step Further: The Making of a Successful Internship

Time and again, internships have proven to be one of the best ways for our undergraduates to find their first job. The Chemical Engineering Academic Services team works with the College of Engineering Career Center to help students identify and secure internship opportunities that will give them a taste of a "real" job. Students also gain a competitive advantage over their peers when it's time to look for that first position. Indeed, many of our students have been hired by the very companies they interned for. We checked in with two recent graduates, **Sam Landsman** and **Jay Bennett**, and asked about their internship experience and how it led to their current jobs.

"A simple online application wasn't going to cut it," said recent graduate **Sam Landsman**, who interned at CH2M Hill and now works at the company's Connecticut office. Towards the end of his freshman year, Sam realized that he wanted to pursue a career in water engineering to design, upgrade and rehabilitate municipal water and wastewater treatment plants. CH2M Hill, an engineering consulting firm that designed and built the Cedar Water Treatment Plant which supplies Seattle's drinking water, became Sam's top choice.

"I could taste its success! Seattle's drinking water is world-class."

Sam had no problem finding open internships with the company, but how was he going to beat the competition? The answer: networking. He attended an on-campus event hosted by the American Water Resources Association in hopes of spotting someone from CH2M Hill.

"The best networking events are smaller and have a focus. I was interested in water, so I went to water networking events," Sam said.

He met a representative, introduced himself, and gave an elevator pitch explaining why he was specifically interested in CH2M Hill. "I had researched the company extensively and was able to speak intelligently about their projects." The next day, Sam followed up with a carefully crafted email ("which was essentially a cover letter"), attached a resume and asked if the representative could put in a good word on his behalf. "Only then, I submitted my online application. It worked!"

After an exciting summer of work at the Seattle site, Sam told his boss that he would love to continue working for the firm in a full-time capacity. The high praise for Sam's work ethic quickly spread to the East coast and a few months later, Sam received an offer from CH2M Hill's Hartford, Connecticut office, where he now works as a Project Engineer in the Water Business Group.

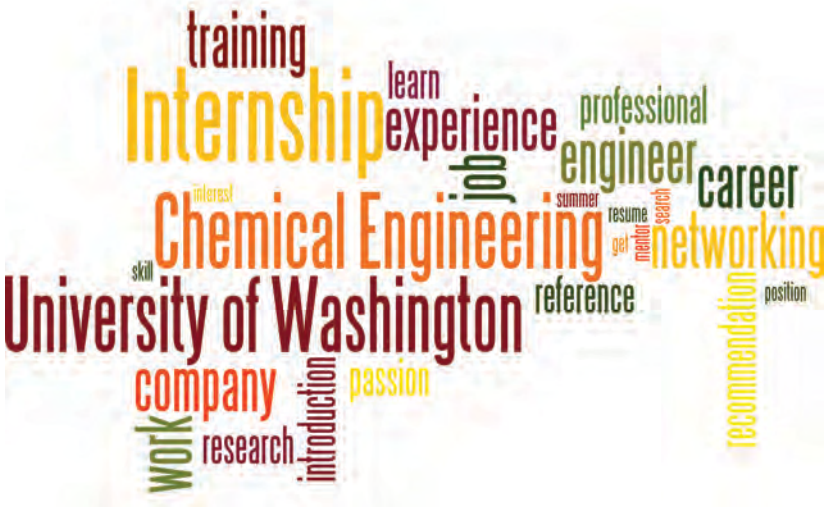
For **Jay Bennett**, it was all about persistence. "I didn't have research experience, not much work experiences other than mowing lawns, and I didn't have a 4.0 GPA like some of my classmates," Jay said reflecting on his freshman and sophomore years. "But, I did have the mindset that applying for a job and getting rejected wasn't a defeat. It's rather an opportunity to work on your interviewing skills and polish your sales pitch."

Jay applied to every refinery in the U.S. that had posted internships. He even contacted those that did not with different cover letters that he specifically tailored to each company, delivering a pitch about why he would be a great hire. Jay's persistence paid off. He was offered an internship at Phillips 66's Ferndale refinery in the spring and summer of 2014.

"I was working on projects that mattered and I felt I was making a difference." The company is now implementing cost-saving measures that Jay developed during his internship. Strong recommendations from his supervisors made a difference when Jay started his job search and led to a job offer from Phillips 66's WoodRiver Refinery outside of St. Louis. Jay is now a Process Engineer in charge of a vacuum distillation unit, a hydro-treating unit and some utilities. He spends his day analyzing the units for optimization and planning future projects.

Like many other UW ChemE interns, Sam and Jay knew what they wanted and they were willing to go one step further to secure their dream jobs.

If your company is interested in hiring UW ChemE undergrads as interns, please contact Dave Drischell, Academic Services Director, at rdd@uw.edu. ■



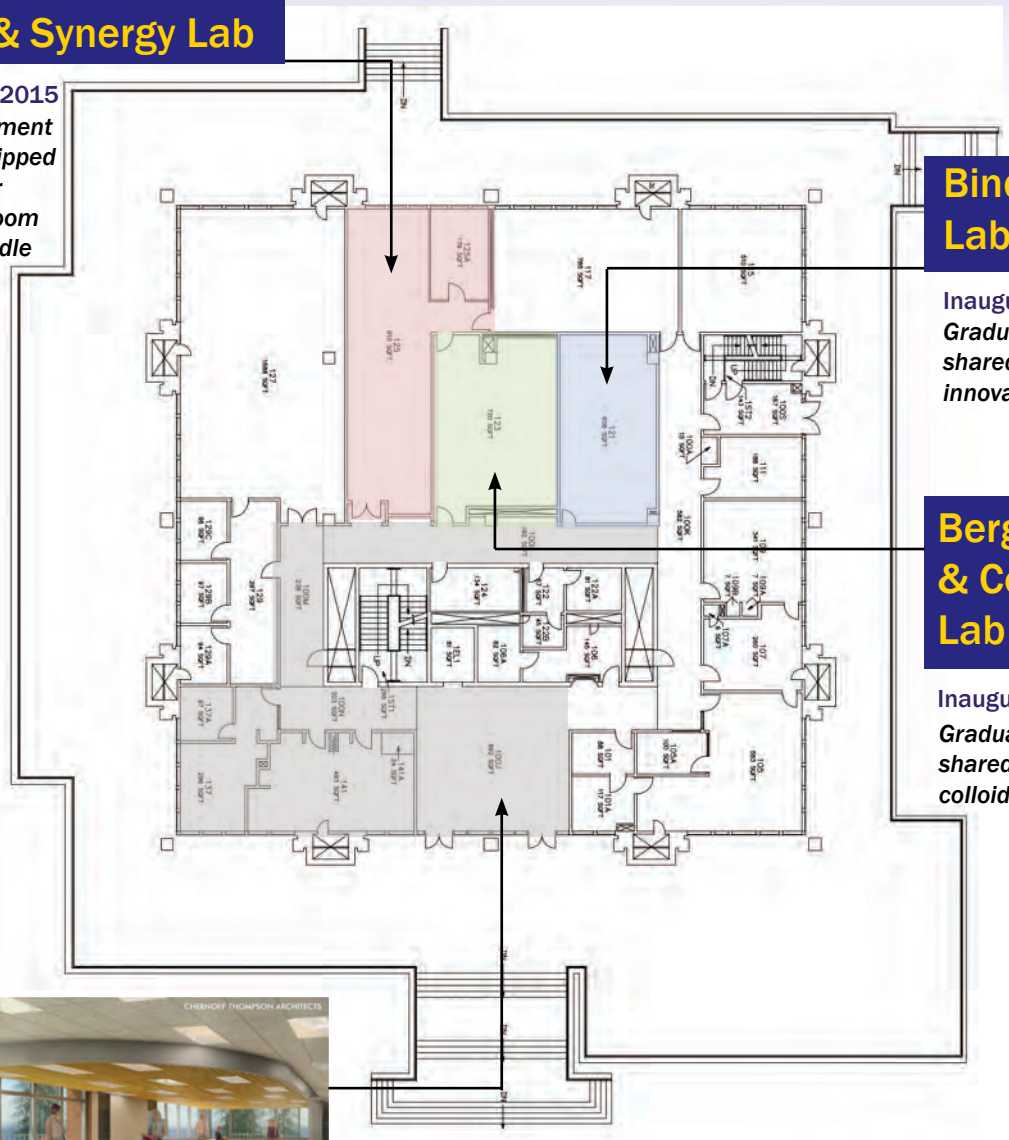
- Shoko Saji

BENSON HALL INNOVATION HUB

Undergraduate Computation & Synergy Lab

Inaugurated September 2015

Creative startup environment for undergraduates, equipped with individual computer stations, a conference room with a projector and huddle space for collaboration.



Bindra Innovation Lab

Inaugurated January 2015

Graduate and undergraduate shared use for polymer innovation and teaching.

Berg Interfacial & Colloid Science Lab

Inaugurated May 2015

Graduate and undergraduate shared use for surface and colloids innovation and teaching.

Lobby

Potential next project

Open design student lounge & reception area to the main office

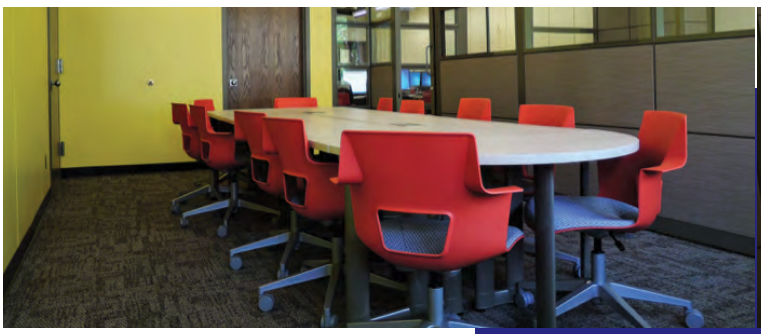
INNOVATION AT THE FOREFRONT OF BENSON RENOVATIONS

Home to the Department of Chemical Engineering since 1966, Benson Hall is being upgraded and renovated to incorporate innovation and shared people space. The *Jagjeet and Janice Bindra Innovation Lab* and the *John C. Berg Interfacial & Colloid Science Lab* are now vibrant teaching, prototyping and shared instrumentation spaces used by both undergraduate and graduate students. An entirely remodeled computation lab features the *Tom and Karin Temple Conference Room* and boasts collaborative huddle space for small group discussions. Benson Hall renovations are made possible by the generosity of our alumni and supporters.

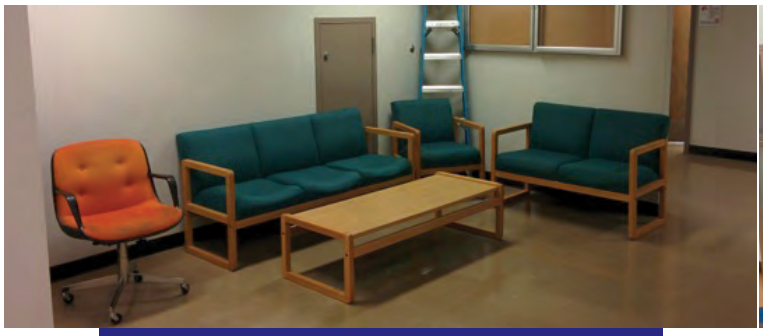
Computation Space

Bindra Innovation Lab

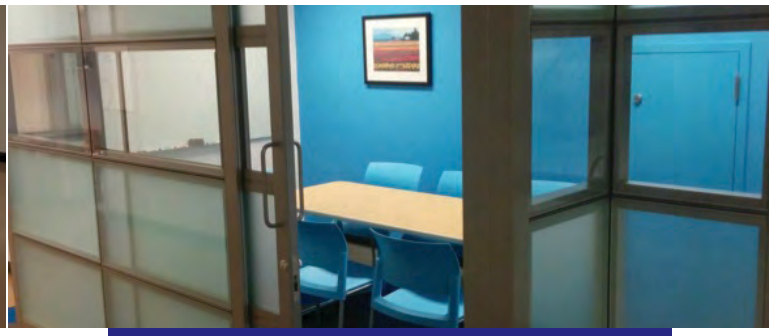
Berg Interfacial & Colloid Science Lab



Temple Conference Room



Interaction Space (Before)



Interaction Space (After)

In Their Own WORDS

VENKAT SUBRAMANIAN
WRF Associate Professor

VS: BETTER HIGH ENERGY and power batteries are critical for the future of clean energy grid and transportation technology.

We need a way to store energy from renewables like solar and wind, make it available for later when needed, and be able to dispatch energy in a blink. My lab facilitates two approaches towards next generation batteries – developing new materials or chemistries and developing next-generation battery management systems that maximize the efficiency and utility of a battery. Batteries are complex, nonlinear systems and we capture the associated physics and chemistry in software that continuously monitor and control the inner-workings of a battery. Ironically, many standard solvers spit out unrealistic imaginary numbers and fail to converge while solving battery models for certain conditions. Our group has developed perhaps the best possible algorithm for simulating the performance of batteries, and it is 100% fail-proof. We recently presented our work at the ARPA-E (Advanced Research Project Agency – Energy under the Department of Energy) Congressional Showcase in Washington D.C. The UW student start-up, Battery Informatics, for which I serve as Chief Scientific Advisor, is looking to commercialize the technology. I have a vision for physics-based control and optimization algorithms that will enable a paradigm shift for renewable grids. There is a push to move from top-down massive centralized grids to microgrids that are resilient to disturbances (like super storm Sandy). We can cut the battery footprint and capital cost significantly to affect this change. I'm pursuing this vision with PNNL and local utility partners.

VINCENT HOLMBERG
Assistant Professor

VH: ENGINEERING THE STRUCTURE and composition of materials at the nanoscale in order to tune their properties.

SS: In a nutshell, what is your research about?

If you can control structure and composition, then you can develop specialized materials designed for a specific type of device or technology. We are also interested in transformations that occur on the nanoscale, and study how the structure and composition of materials change in real time, and how those dynamics affect materials function.

Our main goal is to produce high-performance, engineered nanomaterials for energy conversion, energy storage, and medical applications. Unfortunately, most nanomaterials produced today (with a few exceptions) are only available in extremely small quantities – far too small to be useful in any real manufacturing process. My research group is focused on producing large quantities of high-quality, engineered nanomaterials so that they can actually make an impact in the technologies that we use every day. Right now we are studying nanowire growth, developing new types of battery materials, and engineering different plasmonic and photonic nanomaterials for medical applications. It's extremely exciting to realize that the materials you synthesize could lead to better, more efficient technologies, and that the discoveries that you make could fuel greater understanding and further progress in the field. All of this motivates what we do now – developing new materials for advanced technologies, at scale, to make an impact in the real world.

> "We're developing new materials for advanced technologies, at scale, to make an impact in the real world."

ELIZABETH NANCE
Luce Assistant Professor

EN: USING NANOTECHNOLOGY as a tool to understand transport limitations within the brain.

Specifically, I'm interested in how common aspects of diseases, like cell death, impact the ability of a therapeutic platform to treat patients. My focus is on pediatric diseases, but most findings could translate to adults.

13% of diseases in the world are brain related, with 700 billion dollars spent in the United States and no therapeutic cure. A lot of effort is spent on singular or linear perspective of a disease, often a single cell, single pathway, or single disease model. But all of those findings are not easily connected and don't scale to the variety of brain diseases seen in patients. We need a way to better connect all fields and do so at scale. We can do this by understanding the fundamentals of the disease using nanotechnology and engineer the nanomaterials to affect clinical outcomes for patients. My focus has been in autism, which is a challenging disease as the symptoms are variable and change over time. We believe that changes in the brain microenvironment, like fluid flow, cell spacing, and nanoparticle movements correlate with the disease state. We can measure these changes using a nanotechnology platform in a diseased brain and seeing how it behaves, or moves, in the brain. Correlating these aspects can help develop better therapeutics.

> "I'm interested in how common aspects of diseases, like cell death, impact the ability of a therapeutic platform to treat patients."

ChemE enjoyed an unprecedented growth with the hire of three highly sought-after faculty members in two short years. Professors Subramanian and Holmberg are fully integrated in the department, and Professor Nance has hit the ground running. I asked the same questions to all three in this parallel Q&A. Here are their answers, in their own words.

- Shoko Saji

SS: Why UW ChemE?

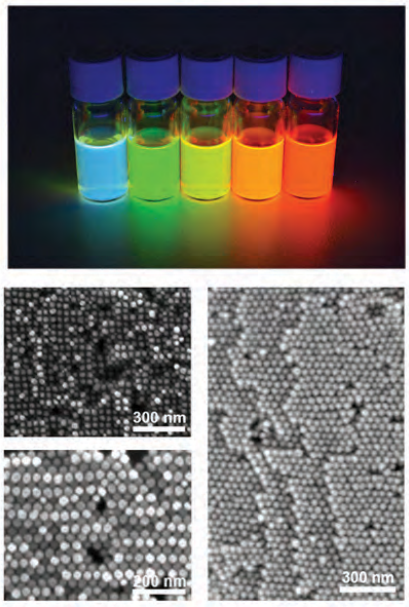
VS: UW CHEME IS WELL RESPECTED in the ChemE community and has national visibility. I visited here as a seminar speaker in 2008 and was impressed with the collegiality of the faculty. I also felt that I could play an active role in the strong electrochemical and energy cluster with Profs. Schwartz, Adler and Stuve. Our battery models and solvers are being used to enhance the value of nonlinear impedance methods developed in Prof. Schwartz's lab, and we are jointly funded by UW CoMotion to support technology translation to the marketplace.

The department also has had great pioneers like emeritus Prof. Larry Ricker with nonlinear model predictive control and Prof. Bruce Finlayson with his Orthogonal Collocation on Finite Element methods. My research builds on the congruence of these two approaches coupled with mathematical reformulation for control of batteries. I saw myself as being able to continue that great tradition. I am also a Clean Energy Institute (CEI) faculty and jointly appointed at the Pacific Northwest National Laboratory (PNNL) as a Chief Scientist. This provides me with great opportunities to collaborate and a direct path to test and validate my models for microgrids and grid scale applications. I am honored to be a part of the UW ChemE community.

Subramanian Research Group

VH: UW IS THE BEST RESEARCH UNIVERSITY in the Pacific Northwest! The UW has an incredible set of resources, both in terms of facilities and world-class expertise, not to mention the resources provided by the Clean Energy Institute (CEI), the Molecular Engineering and Sciences Institute (MolES), and the ability to access labs and infrastructure at Pacific Northwest National Laboratory (PNNL). We are collaborating with labs in and out of ChemE – those of Profs. Pozzo, Pauzauskie (MSE), Nance, DeForest, and Boechler (ME), as well as with Prof. Schwartz and our colleagues at PNNL.

My students and I have been working hard to get the lab up and running. I currently have two ChemE PhD students, one PhD student from MolES who was a ChemE undergrad, two MS students, and a couple of undergraduates. They are incredibly motivated, work very hard, and they are getting some fantastic results! We are happy to have our MolES lab completely finished and fully functional. It is in a great location, especially because of our frequent use of the Molecular Analysis Facility, which is housed in the MolES basement. We are also building up our lab infrastructure in Benson Hall, and we will be utilizing our Benson lab space much more, now that our MolES space is completely filled with equipment and experiments!



Holmberg Research Group

EN: UW CHEME PLACES A STRONG EMPHASIS on faculty being both outstanding scientists and educators, and it comes through in the reality of how we do things here. We have high expectations, but they are constructive and there is genuine support. It's also great to have both an engineering and medical school on the same campus for interdisciplinary collaborations with departments like Pediatrics. Also, UW treated me as an engineer and a faculty first, before my gender. Not all institutions understand that women faculty are not in need of special protection. This may come through in subtle nuances, but it was definitely a factor when selecting my next home. We have enough battles as academic chemical engineers and we shouldn't have to prove ourselves any more than our male colleagues. It's one of the reasons why I started the Women in Chemical Engineering at UW group, so we can educate and empower ChemE women and our supporters.

I threw myself into teaching in my first quarter because I wanted to start contributing and making a difference as soon as I could. I also wanted to get integrated into the fabric of the department and the student population right away. My lab is coming together: I now have seven very hard-working students in my group.

Nance Research Group

VENKAT SUBRAMANIAN: I NEVER AIM TO BE "the best" teacher… Rather, I try to be an effective teacher and help students learn from problem-solving approaches. I want them to take pen and paper concepts to practical applications. I often teach practical examples first then follow with theory.

When I taught Method of Engineering Analysis in the Fall, I brought in over 50 examples and had students solve problems they hadn't seen before, based on skills and tools they had learned in the course. That's how I learned as a student.

I also developed and taught a new course entitled Battery Systems Engineering. Differences in chemistry, mechanics, and thermal behavior make it challenging to develop a battery model that replicates what happens inside an operating battery. This course enables graduates and senior undergraduates from various backgrounds to move chemical engineering models from concepts to hardware integration and power electronics for transportation batteries and grid applications.

I try to lead by example. In my opinion, perseverance, hard work, depth and focus in an important topic can make a difference. I believe that, to some extent, I can help students outcompete the crowd in pursuit of their careers. For example, I can be very critical (sometimes to the point of being obnoxious!) in giving feedback on power point slides.

> "I have a vision for physics-based control and optimization algorithms that will enable a paradigm shift to a renewable grid."

VINCENT HOLMBERG: I'VE ALWAYS ENJOYED teaching. It's rewarding to watch the proverbial light bulb flip on and to see a student suddenly understand a new concept. Watching them put all the pieces together, making the connections, and learning how to become an engineer. I see it as my role to provide students with a set of tools, and then teach them how they can use those tools to tackle problems they haven't encountered yet. I also love it when students come rushing into my office, excited about a new piece of data or something they discovered in the lab, and I encourage them to run with it.

SS: How do you see your role as a teacher?

> "It's rewarding to watch the proverbial light bulb flip on and to see a student suddenly understand a new concept."

I've taught ChemE Process Design twice since I arrived, and last Fall, I introduced a new course called Quantum Mechanics for Chemical Engineers. The class is designed to cover the fundamentals of quantum mechanics in a way that is geared more towards engineers, pushing the course beyond the equations by emphasizing the applications of quantum mechanics in engineering. Quantum mechanics is a very fitting topic, given the nature of our research, and process design ties into what we do with the focus on producing materials at scale.

This Spring, I will be teaching a brand new graduate course called Nanomaterials Chemistry and Engineering. This course is even more closely related to my research and I'm excited to bring it to not only ChemE students, but also an interesting mix of MolES, Materials Science, Chemistry, and Environmental Sciences students.

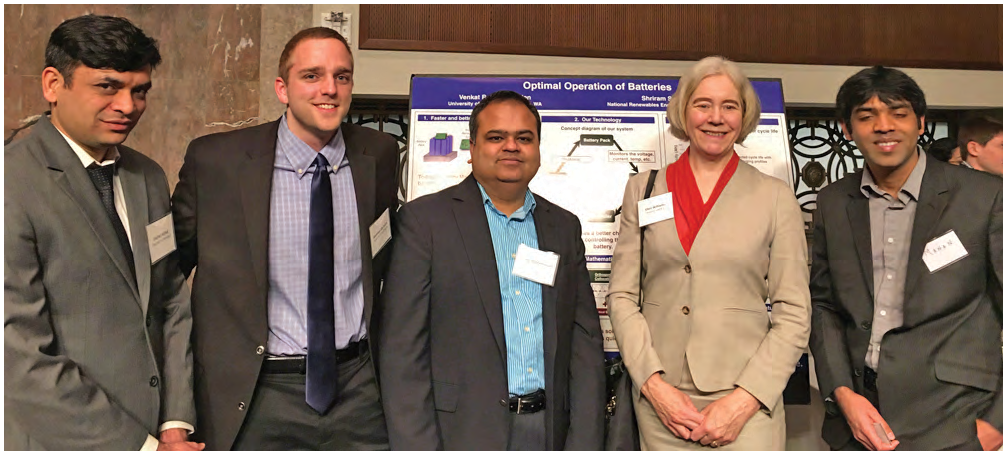
ELIZABETH NANCE: I SEE MYSELF AS the facilitator of students' understanding. There is more than one way of tackling a problem and helping students learn and understand the body of information that might be useful to them now or at some point in their lives. I like an interactive approach and I believe in students taking full accountability for their learning. I'm transparent about why I am teaching the way I am, even if it may be more difficult for them to grasp concepts sometimes. I have the opportunity to pay forward what I've received in my life, regardless of the subject matter. I enjoy being a mentor, learning about our students, and assisting in a way that is accessible. We have great students with highly diverse backgrounds and I enjoy connecting them to each other and also to other faculty. It's about helping them figure out the direction they want to go.

This Spring, I am teaching an elective class called Biological Transport Phenomena of Nanoscale Systems for Human Application focused on the physiology side of the transport of nanoscale materials. It's flipping the regular ChemE way of understanding materials, by putting the physiology perspective first. The course complements many ChemE and BioE electives but is a different approach so students can come at it from a different angle, while integrating a knowledge base from their own field. I want students to know that they can tackle interdisciplinary and nontraditional high-risk problems as chemical engineers.

SS: All of you are from out of state. What's unique about Seattle from an outsider's perspective?

VS: I GREW UP IN INDIA and spent some time in Columbia, South Carolina, Cookeville, Tennessee and St. Louis, Missouri before moving to Seattle. I love riding the bus on the floating bridge and seeing the snowy mountains.

The buzz of entrepreneurship and the start-up culture are everywhere and not limited to the technology sector. A good example is the Indian temples in Seattle. They keep growing and they can sustain the growth. It says something about the city that even nonprofits are like start-ups. Anything that's possible will happen in Seattle because of the entrepreneurship and the start-up culture.



Subramanian in Washington D.C. with members of Battery Informatics, Inc.

VH: THE REGION IS BEAUTIFUL, has big vibrant companies, plenty of opportunities, and a fantastic quality of life. I love living so near to the mountains and the ocean! I grew up in Montana, fairly close to Yellowstone National Park, spending lots of time in the outdoors.

When I was ten, my family moved to Minneapolis, where I spent my undergraduate years, followed by my PhD in Austin, Texas. Minneapolis is about as far from the ocean as you can get, and both Minnesota and Texas are very flat, so it's great to be back in a beautiful area surrounded by mountains, forest, and water, that just so happens to have the ocean nearby!

Holmberg with his students

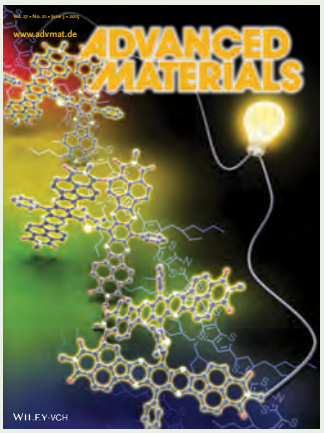
EN: SEATTLE IS OUTDOORSY with beautiful mountains, water, microclimates and geological variety. Weather doesn't bother me – it's freezing cold in the northeast! I'm from Charlotte, North Carolina and spent eight years in Maryland. I like Seattle's "tone" – it's a good mix of where I've lived previously – not too laid-back, but not too driven. There is a natural and inherent way of balancing being successful and enjoying life. ■

"I want students to know that they can tackle interdisciplinary and nontraditional high-risk problems as a chemical engineer."

Nance with her research group

Faculty Honors and Achievements

- **François Baneyx** was elected Fellow of the *American Academy of Microbiology* and Fellow of the *American Institute for Medical and Biological Engineering*. His research made the August cover of *Nano Letters* with an article on computational design of two-dimensional protein crystals.
- **David Beck** hosted a NSF sponsored Data Science Workshop for 100 graduate students from around the country. David was lead author of the May 2016 cover article of the *AIChE Journal* where he writes with Profs. Carothers, Pfaendtner and Subramanian on how data science is accelerating innovation and discovery in Chemical Engineering.
- **John Berg** was honored at the dedication ceremony celebrating the inauguration of the Berg Interfacial and Colloid Science Lab.
- **Guozhong Cao** was named one of the *World's Most Influential Scientific Minds* by Thomson Reuters.
- **James Carothers** was selected as the 2016 *Diverse Emerging Scholar in Higher Education* (12 in all fields of academia) and won the 2016 *College of Engineering Junior Faculty Award.*
- **Cole DeForest** received the 2015 *Jaconette L. Tietze Young Scientist Award* and won one of the 2016 *University of Washington Distinguished Teaching Awards*, the highest honor conferred to UW faculty in recognition of teaching excellence.
- **Samson Jenekhe** was elected Fellow of the *Royal Society of Chemistry* (RSC) and selected as Scientific Editor of the RSC new journal, *Molecular Systems Design & Engineering*. His research made the June cover of *Advanced Materials*. He was also named one of the *World's Most Influential Scientific Minds* by Thomson Reuters.
- **Shaoyi Jiang**'s 2013 paper on the use of zwitterionic hydrogels to eliminate the foreign body response to implants was named as one of eight *major hits* in the 20-year history of *Nature Biotechnology* biomedical research. He also hosted the *2nd International Conference on Bioinspired and Zwitterionic Materials* in Seattle.
- **Elizabeth Nance** won the *Forbes* magazine 2015 *"30 Under 30" in Science and Medicine*, named the *Clare Luce Boothe Assistant Professor of Chemical Engineering* and appointed Adjunct Assistant Professor in Radiology.
- **Jim Pfaendtner** was promoted to Associate Professor of Chemical Engineering and was selected as *Senior Teaching Fellow* for the UW Center for Teaching and Learning. His *Journal of Physical Chemistry* paper describing new *ab initio* approaches to investigate reaction dynamics and rates was featured as Editor's Choice by the *American Chemical Society*.
- **Jonathan Posner** was appointed as Joint Associate Professor of Chemical Engineering and Mechanical Engineering.
- **Lilo Pozzo**'s start-up company PolyDrop received a $750K NSF SBIR Phase II Award.
- **Buddy Ratner** delivered one of the *Langmuir Lectures* at the 2015 American Chemical Society National Meeting in Boston.
- **Dan Schwartz** received the 2015 *Marsha L. Landolt Distinguished Graduate Mentor Award* and won the Electrochemical Society (ECS) *Electrodeposition Research Award*.
- **Venkat Subramanian** was one of only six invited principal investigators to present his ARPA-E project at a *Congressional Showcase* held during the 2016 Energy Innovation Summit in Washington D.C.



Jenekhe's research on June 2015 cover of Adv. Materials

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For news, events, research highlights, student & faculty achievements and more, visit us at our newly designed website:

www.cheme.washington.edu

LinkedIn

Elizabeth Nance

Dr. **Elizabeth Nance** started in September 2015 as the first ***Clare Boothe Luce Assistant Professor of Chemical Engineering***. She is a recipient of the highly competitive *Burroughs Wellcome Career Award* and was recently named one of the 2015 *Forbes 30 under 30 in Science and Medicine* as one of the "most disruptive, game-changing and innovating young personalities in science."

Prof. Nance designs and engineers nanoparticles, both as biophysical probes and imaging biomarkers, to understand disease physiology and pathology in the central nervous system (CNS). She uses this knowledge to develop therapeutic nanoparticle platforms in clinically relevant models of pediatric and adult CNS diseases. She created the first nanoparticles that could both penetrate and move deep into the brain to improve imaging and treatment of ailments such as cancer, autism, stroke and cerebral palsy. Her background is highly interdisciplinary and lies at the interface of engineering, neurosciences and translational medicine. She collaborates with faculty in pediatrics, neurology, OB/Gyn, pediatrics, infectious disease and critical care. She has an adjunct appointment in the Department of Radiology.

Dr. Nance holds two nanomedicine patents and has over 13 publications in leading journals including *Science Translational Medicine, Journal of Controlled Release*, and *ACS Nano*. She earned her B.S. in Chemical Engineering from North Carolina State University and her Ph.D. in Chemical and Biomolecular Engineering from Johns Hopkins University. For two years prior to joining the UW faculty, she was a *Hartwell Foundation Postdoctoral Fellow* (10 granted in the U.S.) in the Department of Anesthesiology and Critical Care Medicine at Johns Hopkins.

"Prof. Nance takes a game changing approach to nanomedicine by putting the disease front and center and by learning about transport idiosyncrasies in the brain to design nanotherapies that work," says Matthaei Professor and Chair François Baneyx. "She is a top scholar who will deepen our ties with Bioengineering and the School of Medicine and who will help further enhance UW ChemE's reputation in translational and regenerative medicine."

"In the short time I've been here, the University of Washington and ChemE department already feels like home," says Dr. Nance. "I'm excited to grow my research program focused on disease-directed engineering, and take advantage of the breadth and depth of expertise and collaborations the UW has to offer."

Dr. Nance has hit the ground running and is already collaborating with neonatology, pediatrics and neurology on several NIH grant applications. ■

Inspire New Ideas - Support ChemE

Our dedicated students work hard to realize their future as chemical engineers and beyond. Private support for endowed scholarships, fellowships, professorships and chairs, along with flexible unrestricted gifts are essential to the success of our students and faculty. Planned gifts such as bequests, real estate and annuities offer flexible estate and charitable planning strategies while providing you with income and tax advantages. With your partnership, UW Chemical Engineering fosters knowledge and solutions for a changing world.

To learn more about supporting Chemical Engineering with a gift, please contact Jessie Muhm at jmuhm@uw.edu or 206.685.7748.

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Hire a Husky!

Is your organization interested in hiring UW ChemE students as interns or for career positions? Would you like to post a job opening, hold a company information session, or conduct interviews in Benson Hall? Our Academic Services team would love to hear from you!

Please contact Dave Drischell, Academic Services Director, at rdd@uw.edu.

2015 Distinguished Alumnus in Academia, Clayton Radke

2015 Distinguished Alumnus in Academia, Prof. Clayton Radke (BS '66), Professor of Chemical and Biomolecular Engineering at the University of California Berkeley with Department Chair François Baneyx.