

The Catalyst

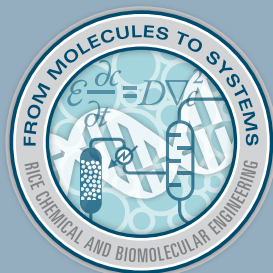


Chemical and Biomolecular Engineering

Fall 2011

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Message from the Chair

Dear alumni and friends,

Welcome to a new edition of our newsletter. It is our sincere hope that this newsletter will catalyze a close and productive interaction between our department and you - its alumni and friends.

With the help of our newsletter, we'll keep you informed of our progress and solicit your participation in our efforts to maintain our leadership positions in research and education.

We invite you to begin that participation by contacting the department via e-mail or by writing to us. Our contact information is on page 7 of this newsletter.

Tell us about yourself, announce recent awards or achievements, ask our faculty members about their research, give us your opinion about our educational programs and let us know how you might want to involve yourself in our efforts to grow.

I also urge you to participate in the networking events organized by our alumni and students.

And, stay tuned as we prepare to celebrate our 100th anniversary next year. We're planning an array of exciting events for alumni, friends and current students.

Kyriacos Zygorakis

A.J. Hartsook Professor and Chair

CHBE Launches Centennial Council

The words "no upper limit" have fueled a commitment to excellence, an uncommon drive toward innovation and almost 100 years of remarkable achievement. Now, this same ambition will propel the university through a second century of original thought and tangible contributions to the world.

In an effort to continue this same level of excellence, the ChBE Department and the Office of Resource Development created The Centennial Council. The council has approached select alumni asking them to share their expertise with regard to developing and expanding the department's academic programs and faculty, engaging the community members in departmental activities,

and increasing the visibility and reputation of the department in their respective regions. The Centennial Council members include: Dr. Victor Edwards '62, Dr. Michael Gibson '73, Robert Herlin '77, Phillip Layton '85, Dr. David Dankworth '86, and Albert Grobmyer '87.

Building on a foundation of extraordinary vision, the Centennial Council has championed the Centennial Campaign's efforts to rededicate Rice to the pursuit of three fundamental objectives: transforming extraordinary students into extraordinary leaders, facing challenges and generating solutions, and learning and leading locally and globally.

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CHBE Goals for Research and Teaching Excellence

With the help of its two alumni advisory groups, the Centennial Council and the Alumni Advisory Committee, our department formulated a strategic plan to guide the future growth of its educational and research programs. Our efforts over the next few years will focus on the following action items:

- Create new faculty lines in the areas of energy, materials and health.
- Retain existing faculty and attract new ones with current-use funding.
- Bring many more visiting faculty, guest speakers and postdoctoral fellows to our department.
- Establish graduate student fellowships (endowments or current-use funds) to enhance and expand the pool of prospective students.
- Support undergraduate teaching initiatives in energy and sustainability or undergraduate student participation in research (endowments or current-use funds).
- Strengthen our outreach efforts to provide Rice students and our community with a better understanding about the role that chemical and biomolecular engineers can play in solving the major energy and health challenges of our society.

Meet the new Dean of Engineering

Edwin L. “Ned” Thomas



Edwin L. “Ned” Thomas, the chair of MIT’s Department of Materials Science and Engineering, became dean of Rice University’s George R. Brown School of Engineering on July 1, 2011.

Both a materials scientist and a mechanical engineer, Thomas had spent the past 22 years on the MIT faculty. His research in polymeric materials is well-known and respected worldwide. Thomas said colleagues have asked why he’s leaving the top-ranked materials science department.

“At Rice, there’s a chance to move the university forward. It’s in my DNA to try to lead and make things better, and this is a great opportunity to do that,” he said.

“I think I can take the School of Engineering in a new direction, and I’m eager to give it a shot.”

In addition to his role as dean, Thomas will be the William and Stephanie Sick Chair and a professor

in both the Department of Mechanical Engineering and Materials Science and the Department of Chemical and Biomolecular Engineering.

Thomas succeeded Sidney Burrus, who served as interim dean of engineering since Sept. 1, 2010.

“I am truly delighted at the appointment of Professor Ned Thomas as Dean of Engineering at Rice,” Burrus said. “His experience, stature and vision are attributes that will enable him to make a significant contribution to both the George R. Brown School and the greater Rice community. I look forward to a smooth transition and an exciting future.”

Burrus also served as Rice’s dean of engineering from 1998 to 2005 and will remain on the faculty as the Maxfield and Oshman Professor Emeritus of Electrical and Computer Engineering.

CHBE Launches Centennial Council continued from page 1

To achieve the objectives, our department has chosen to focus on four key areas: (i) Create new faculty lines in the areas of energy, materials and health; (ii) Establish graduate student fellowships to expand the pool of prospective students.; (iii) Support undergraduate teaching initiatives in energy and sustainability; and (iv) Strengthen our outreach efforts to provide Rice students and our

community with a better understanding about the role Chemical and Biomolecular Engineering can play in solving the major energy and health challenges of our society.

If you would like more information about the Centennial Campaign, please contact Angela L. Young, CFRE, Executive Director of Development at angelay@rice.edu.

Faculty Highlights

Recent CHBE Faculty Hires

Deepak Nagrath joined Rice in August 2009 as assistant professor, after serving as research associate in the Department of Surgery at Massachusetts General Hospital and Harvard Medical School.

Nagrath's research interests lie in the application of systems biology approaches to human diseases such as metabolic syndrome, cancer, and diabetes. Using transcriptional and metabolic design principles, he analyzes healthy and diseased biological states, seeking potential treatments based on metabolic supplementation and embryonic stem cells. His methodology is based on fundamental engineering principles such as multi-objective optimality and non-equilibrium thermodynamics for analyzing complex disease states.

Nagrath earned a PhD in chemical engineering in 2003 and an MS in applied mathematics from the Rensselaer Polytechnic Institute. He received a bachelor's degree in chemical engineering from the Indian Institute of Technology in Roorkee, India.

Rafael Verduzco joined Rice as an assistant professor in a position endowed by the Louis and Peaches Owen Foundation. Verduzco's research focuses on nanotechnology and polymeric materials. One current area of focus is the development of polymeric solar cells, which requires an understanding of material properties and behavior from the molecular level up to macroscopic sizes. This work relies heavily on polymer synthesis, neutron and x-ray scattering, and surface characterization tools.

Verduzco is from Sugar Land and attended Rice, receiving a BS degree in chemical engineering in 2001. He earned a master's degree in 2003 and his PhD in chemical engineering in 2007 from the California Institute of Technology. Most recently, Verduzco was a postdoctoral scholar in the Center for Nanophase Materials Sciences at the Oak Ridge National Laboratory in Tennessee, where he studied bent-core liquid crystals, water-soluble dendrimers for drug delivery, and conjugated polymeric materials for organic electronics.

ChemE '99 Graduate Joins Rice BIOE

Amina Ann Qutub, who received a BS in chemical engineering from Rice in 1999, joined Rice as an assistant professor in bioengineering in 2009. She earned a PhD in bioengineering from the University of California, Berkeley in 2004 and was a postdoctoral fellow at the School of Medicine at Johns Hopkins University before coming back to Rice.

Amina's research interests are in computational modeling of molecular and cellular responses to hypoxia with applications in cerebrovascular biology, the engineering of specialized blood vessels, and the design and computational testing of hypoxic response-targeted therapies.

Qutub, who is from Hoffman Estates, Illinois, spent a year as vice president for administration and director of corporate partnerships for the Foundation for International Medical Relief of Children in Washington D.C. She also founded B3io, Inc. in Berkeley, to provide tissue and membrane simulation tools for the pharmaceutical industry.

Deepak Nagrath



Rafael Verduzco



Amina Ann Qutub



OUR ENERGY VISION

“There are no quick answers to the energy problems facing today's world,” Walter Chapman, the W.W. Akers Professor of Chemical Engineering said during his testimony to a committee of the US House of Representatives in 2008. “Innovative research is providing many new opportunities in conventional and unconventional fossil fuels, as well as renewable energy technologies. But, good public policy must be based on a sound scientific and economic foundation.”

Our department aims at becoming one of the premier departments in the world for energy research that can lead us to a sustainable, affordable and secure energy future. We recognize that fossil fuels will continue for many years to play an important role in meeting the energy demands of the global economy. At the same time, however, we will need to invent and develop technologies that will drive the transition to a carbon-neutral and sustainable energy future.

For this reason, our strategic plan has targeted the following areas of energy research for future growth.

Increasing fuel availability while mitigating the effect of carbon emissions

In order to meet the challenge of increased consumption and reliance on imports, the US energy industry is working hard to boost production from declining oil fields and to develop new “unconventional” resources (like oil sands, oil shale, shale gas and methane hydrates) for liquid and gas fuels. Our department already has a leadership position in this area with a world-class group that is led by Hirasaki and includes well-recognized experts like Miller and Chapman and rising younger faculty like Biswal and Verduzco.

However, improved recovery methods and the development of unconventional sources are only part of the solution. In a carbon-constrained world, processes that do not adequately mitigate greenhouse gases such as carbon dioxide will likely

meet with new regulations and public resistance.

This necessitates the development of new methods to capture and sequester the CO₂ produced during the combustion of fossil fuels in order to minimize the impact on global warming and climate change. Hirasaki and Wong are already working on a novel CO₂ capture process, while Zygourakis has formed an inter-disciplinary group with faculty from Earth Sciences and other departments to study the properties of biochars produced from biomass pyrolysis and propose sustainable processes for large-scale carbon sequestration through biochar soil amendment.

“Energy is the single most important challenge facing humanity today”

Richard E. Smalley

1996 Nobel Prize in Chemistry

Harnessing the Power of The Sun

Using as leverage our outstanding materials group (Pasquali, Wong, Biswal, Verduzco, Chapman, Robert) and its close interactions with a broad spectrum of research groups from Rice and other institutions, we will expand our efforts in nanotechnology to develop new materials for solar cells, novel wires for electric power distribution or organic materials such as conjugated block copolymers. Such materials offer the promise of inexpensive, easily processable systems that could help us meet the grand challenge of capturing and transmitting solar electricity to meet a large fraction of our future energy needs.

Biomass to Chemicals and Fuels

Our primary goal here will be to strengthen and expand our department's expertise (Gonzales) in biotechnological applications for biomass conversion to chemicals and fuels. While we recognize

the scalability problems of first and second generation biofuels (corn ethanol, biodiesel, cellulosic ethanol), we believe that biomass can become the major source of chemical feedstocks for the productions of polymeric materials and specialty chemicals. Biomass can also be used for distributed production of biofuels that can meet local, specialized applications. There are tremendous opportunities for growth in these areas across the entire university, as well as for productive collaborations with other faculty members from CHBE (Segatori, Zygourakis) and other departments (potential joint hires).

Energy Education

The same vision will also guide our educational mission. We are revising and enriching our curricula in order to instill in our students an understanding of the environmental, economic and socio-political consequences of energy choices.

We have already started taking steps in this direction with the introduction of a new course (CHBE 281: Engineering Solutions for Sustainable Communities) and the enrichment of core courses with modules on energy and sustainability.



The familiar relief sculpture on the front of Abercrombie is called *Energy* and was nicknamed “Uncle Jube” by the artist, William McVey (Rice 1927).

CHBE NEWS AND EVENTS

Chapman and Cox Win Brown Teaching Awards

Walter Chapman and Ken Cox received George R. Brown Awards for Superior Teaching at the 2011 Commencement. These awards honor top Rice professors as determined by the votes of alumni who graduated two and five years ago.

Wong Wins GSA Teaching/Mentoring Award

Mike Wong was this year's co-winner of the Graduate Student Association's Faculty Teaching/Mentoring Award. The award is presented annually to faculty members who demonstrate outstanding service to graduate student education.

Hightower Receives SWCS Award for Excellence in Applied Catalysis

Joe Hightower received the SWCS Award for Excellence in Applied Catalysis. This is the first time our Southwest Catalysis Society (which Joe helped co-found over 40 years ago) is offering this annual award. The announcement was made at the SWCS meeting held on April 15, 2011.

Joe Hightower, Jack Lunsford (former student of Tom Leland, and professor emeritus of Chemistry at TAMU), and Jim Richardson (Rice PhD, professor of Chemical Engineering at UH) shared the SWCS Award. All three were recognized for original contributions to catalysis as they relate to commercial processes in the petrochemical industries.

2011 School of Engineering Design Showcase Winners

Nearly 60 teams of senior engineering students participated in the 2011 Brown School of Engineering Showcase Design competition sponsored by the Oshman Engineering Design Kitchen.

Team CHBE Group 2 (Spencer Reynolds, Mohammed Al Makhaita, Alberto Eyzaguirre, Varun Juloori, and David Maher) won \$500 for Best Sustainability or Environmental Design Project for their process "Bamboo to Lactic Acid".

Graduate News

The CHBE Graduate Student Association (ChBE-GSA) is the governing body of graduate students enrolled in the Masters and PhD programs. Its main goal is to improve the overall graduate experience by organizing academic and networking events.

Last academic year, the ChBE-GSA helped organize the recruitment weekend for prospective students, conducted the thesis proposal orientation and mock qualifying exams, and helped the alumni advisory board to host the spring 2011 alumni networking mixer. In addition, the ChBE-GSA invited our distinguished alums Drs. Kirk Raney and Charlie Meyer from Shell to share their industry-related experience through departmental seminars. Mr. Bill Ramey from Novak Druce enlightened the graduate students on the inventions side of research and technology with a seminar on intellectual property and patents.

The ChBE GSA's academic calendar also includes several recreational and social events to provide faculty and graduate students, much needed breaks from their rigorous schedules.

Post-qualifier BBQs, ice cream and tea socials, the annual Christmas holiday dinner and departmental outings were among the notable events organized in 2010-11. Watching the soccer world-cup final at Brian O'Neils Pub was a new and unique experience offered last year.

For more information on upcoming and past events and a list of ChBE-GSA officers, please visit the website: <http://www.ruf.rice.edu/~chbegsa/>

Graduate Student Awards

- Sumedh Warudkar and Sayantan Chatterjee, 2011 GSA Robert Lowry Patten Award for Distinguished Service to Graduate Students.
- Robert Li (1st place) and Sayantan Chatterjee (2nd place), SPE Gulf Coast Student Paper Contest.
- Sayantan Chatterjee, 1st place, SPE Gulf Coast Emerging Engineers Conference Poster Contest.
- Fan Wang, 2010 Kobayashi Fellowship for Best PhD Thesis Proposal.
- Kung-Po Chao and Sravani Gullapalli, 2011 Fellowship, Shell Center for Sustainability.
- Venetia Rigou, 2011 Graduate Scholarship, Hellenic Professional Society of Texas.

Undergraduate News

The Department held its annual undergraduate banquet on April 25, 2011 and honored several seniors and juniors for their scholastic achievements and contributions to the department.

Jim Wang won the Ann and Joe Hightower Superior Award in Chemical Engineering. This award recognizes a graduating student for outstanding academic scholarship and service to the chemical engineering department.

The senior design team of Naoki Nitta, Nora Xu, Stuart Luyckx, Jill Swindells and Lathan Henderson was recognized for winning this year's W.W. Akers Senior Design Competition with a process to produce acetone-butanol-ethanol (ABE) from rice residue.

Several other seniors and juniors were also recognized for winning T.W. Moore and McCardell scholarships.

Members of the student chapter of AIChE are preparing to attend the 2011 National AIChE conference that will be held this year in Minneapolis, MN. For the first time, our chapter has submitted an entry to the Chem-E car competition, where student teams compete with chemically powered vehicles they have designed and build themselves. We all hope they make it to the finals!

2011 Ph.D. Degrees

Christopher Emborsky
Nikta Fakhri
Yu-Lun Fang
Shyam Kadali
Dichuan Li
Robert Li
Kai-Wei Liu
Arjun Prakash
Michael Rauschhuber
Zheng Yang

2011 M.S. Degrees

Tzu-Yu Liu
John Park
Ruiqiang Sun

2011 M.Ch.E. Degrees

Timothy Drayna
David Jahnke
Aubrey Sansing

Meet our Faculty: Lisa Biswal

Engineering Soft Matter

"I've been fascinated with how Mother Nature builds; she's actually the greatest engineer of all time."



Discovering Chemical Engineering

Sibani Lisa Biswal, Ph.D. was introduced to the joys and challenges of her future career by her father, an engineer in the semiconductor industry, who showed her the satisfaction that comes from using engineering principles to solve problems.

"I've always been interested in materials and why they behave as they do," Biswal said. "Also, I've been fascinated with how Mother Nature builds; she's actually the greatest engineer of all time."

While pursuing her undergraduate degree at the California Institute of Technology, Biswal discovered Chemical Engineering. Intrigued by the variety of problems that could be tackled in the field, she also appreciated the range of professions it included. After earning a master's degree and Ph.D. from Stanford, Lisa discovered a passion for teaching during post-doctorate work at the University of California-Berkeley.

"Before that experience, I wasn't sure if I'd go into industry or academia," she said. "But I found that I loved teaching and influencing other young minds. I also knew that through academia I could do cutting-edge research."

Biswal's decision was influenced by another family member—this time her Ph.D. "faculty family" advisor. "My advisor's advisor was one of the first female chemical engineers in the country," she said.

Biswal says she chose Rice because of its similarities to her undergraduate alma mater. "Both schools are small, attract very bright students, do outstanding research and encourage professors and students to get to know one another," she said.

"Colloidal Origami" to Large-Capacity Batteries

In 2009, Biswal won the prestigious National Science Foundation CAREER Award to pursue research into the development of new colloidal microstructures. Colloids are mixtures with properties between those of a solution and finely suspended fluids. Biswal works with paramagnetic colloids – particles containing random traces of iron oxide – that organize into linear chains under the influence of an external magnetic field. She is researching methods for linking colloids, using proteins, DNA or other molecules, so they remain in chains even when a magnetic field is removed.

"What I'm interested in are systems that self-assemble. We want to properly design objects so that

when combined, these objects will arrange themselves together automatically," says Biswal. "The idea is to create flexible structures that can bend but stay together. Fantastic new structures with different functions can be created with these particles."

Such particles, which she calls "colloidal origami," could have applications in medicine for clinical diagnostics, among other potential uses in analyzing chemical and biological substances.

Biswal is also involved in the Lockheed Martin Advanced Nanotechnology Center of Excellence at Rice (LANCER) along with colleague, Mike Wong, to enhance the inherent ability of silicon to absorb lithium ions in the use of large-capacity batteries. Silicon has the highest theoretical storage capacity for lithium; much more than the currently used graphite. Nanopores are created on silicon wafers that allow lithium to adhere in larger volumes and without compromising the wafer itself to potential cracking due to cyclical expansion and contraction. The team is in the process of developing a method for industrial manufacturing. The researchers are confident that cheap, plentiful silicon combined with ease of manufacture could help push their idea into the mainstream.



CHBE Faculty

Sibani Lisa Biswal, Assistant Professor; Ph.D. Stanford, 2004.

Interactions of colloidal particles with solid and liquid media, interfacial behavior of biomolecules.

Walter G. Chapman, W. W. Akers Professor; Ph.D. Cornell, 1988.

Thermodynamics, statistical mechanics, polymer solutions, surface-fluid interactions, molecular simulations, gas hydrates, waxes and asphaltenes.

Kenneth R. Cox, Professor in the Practice; Ph.D. Illinois, 1979. Product and process design, phase equilibria for advanced separations design.

Ramon Gonzalez, Associate Professor (joint appointment in Bioengineering); Ph.D. University of Chile, 2001. Metabolic engineering, functional genomics, systems biology, microbial fermentations, chemicals and fuels from renewables.

George J. Hirasaki, A. J. Hartsook Professor; Ph.D. Rice, 1967. Foams and emulsions, aquifer remediation, NMR-measured transport properties of fluids and rocks, enhanced oil recovery, gas hydrates and carbon capture.

Clarence A. Miller, Research Professor; Ph.D. Minnesota, 1969. Interfacial phenomena, surfactants, foam, emulsions, aquifer remediation.

Deepak Nagrath, Assistant Professor; Ph.D. Rensselaer Polytechnic Institute, 2003. Nutritional systems biology, stem

cells, cellular repair, metabolic and transcriptional networks, multi-objective optimality and thermodynamic analysis of network biology.

Matteo Pasquali, Professor (joint appointment in Chemistry); Ph.D. Minnesota, 1999. Micro- and nano-structured liquids, carbon nanotubes, free surface flows, computational modeling of processing flows.

Marc A. Robert, Professor; Ph.D. Swiss Federal Institute of Technology, Lausanne, 1980. Thermodynamics, interfacial phenomena, thin films, random media.

Laura Segatori, T.N. Law Assistant Professor (joint appointments in Bioengineering and Biochemistry and Cell Biology); Ph.D. University of Texas at Austin, 2005. Molecular engineering of protein folding catalysts and chaperones.

Rafael Verduzco, Louis Owen Assistant Professor; Ph.D. California Institute of Technology, 2007. Polymer design and synthesis, organic electronics, liquid crystals, and polymer self-assembly.

Michael S. Wong, Professor (joint appointment in Chemistry); Ph.D. MIT, 2000. Catalysis, quantum dots, hollow microspheres, materials chemistry, green chemistry, nanotechnology.

Kyriacos Zygorakis, A. J. Hartsook Professor and Department Chair (joint appointment in Bioengineering); Ph.D. Minnesota, 1981. Cellular and tissue engineering, chemical reaction engineering, biochar for soil amendment, energy and sustainability.

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New Professional Excellence Award

The Alumni Advisory Committee has established a new faculty award to honor the Rice chemical engineering professor who has most impacted your career.

For more details and to submit your nomination, please go to:

www.rice.edu/chbe/faculty_award.



Plan to attend the Fall Networking Dinner!

Join current and former students and faculty at a casual networking dinner organized by the CHBE Alumni Committee, the CHBE Graduate Student Association and the Rice Chemical and Biomolecular Engineering Department.

Wednesday, October 12, 2011
Grand Hall, Rice Memorial Center
6 to 9 p.m.

For more information, e-mail us at
chbe@rice.edu or call (713) 348-4902

Department History

Our First Graduates

1912: On September 23, 1912, Rice Institute opens the doors to its first class of students. A bachelor's in chemical engineering is among the degrees offered.

The first Rice catalog (published in 1915) states that "...courses will be offered in chemical, civil, electrical and mechanical engineering. A complete course in any one of these branches will extend over five years. A student who has successfully completed the first four years of a course will be awarded a bachelor's degree, and after successfully completing

the remaining year of his course he will be awarded an engineering degree..."

1916: There are 3 chemical engineering graduates among the 36 members of the Rice Class of 1916. James Lee Bramlette (San Angelo, Texas), William Marion Standish (Houston, Texas), and Herbert Wray Wilber (Kingsville, Texas) receive their bachelor's degrees in chemical engineering from President Lovett.

1917: Bramlette, Standish and Wilber receive their master's degrees in chemical engineering.

For a multi-media journey through 100 years of Rice University go to
<http://timeline.centennial.rice.edu/>

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