Artie McFerrin Department of
CHEMICAL ENGINEERING
TEXAS A&M UNIVERSITY

ANNUAL REPORT
& Research Portfolio

2014

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LETTER FROM DEPARTMENT HEAD

Dear Reader,

If 2013 was a budding year for the department, 2014 was a prelude to an exceptional harvest. Overnight, the department has continued to flourish as an educational ecosystem growing and thriving. In 2014, we hired nine new faculty members from institutions around the country and overseas. The 25 by 25 Initiative of the College of Engineering was implemented and our response came in the form of a custom road map for a state-of-the-art presence in the science and practice of chemical engineering. We presented $311,000 in scholarships to 245 undergraduate students in 2014 and proudly added eight new experiments to our unit operations laboratory. Last year, we also received $1.1 million in gifts to the department.

We aim to help solve the grand challenges facing energy, medicine, water and the environment, among others. The faculty and staff within our department are determined to use all available resources to advance proficiency in our curricula and research portfolios. We are the leading force in the nation with respect to educating engineers for the 21st century.

Truly,

M. N. Karim

NEW FACULTY | NEW SCIENCE

In 2014, the department welcomed nine new faculty members.

Dr. Christodoulos Floudas
Professor
Director, Texas A&M Energy Institute
Erle Nye '59 Chair Professor for Engineering Excellence

Dr. Stratos Pistikopoulos
Professor
Associate Director, Texas A&M Energy Institute
TEES Distinguished Research Professor

Dr. Yossef Elabd
Professor

Dr. Costas Kravaris
Professor

Dr. Micah Green
Associate Professor

Dr. M. M. Faruque Hasan
Assistant Professor

Dr. Chad Mashuga
Assistant Professor

Dr. Phanourios Tamamis
Assistant Professor

Dr. Christin Wilson
Lecturer

CRAIG C. BROWN Outstanding Senior Engineer Award Winners

The most prestigious honor bestowed upon a graduating senior in the Dwight Look College of Engineering was awarded to five undergraduate students—three of whom were from the Artie McFerrin Department of Chemical Engineering. Recipients of the Craig C. Brown Outstanding Senior Engineer Award were: Laura Bolling of Sugar Land, Texas; Lauren Lauher of El Paso, Texas; and David Quiroz of Houston. The award is based on scholastic achievement, leadership and character. This year's recipients each received a $5,000 educational grant and cast medallion. Their names were also added to the program's recognition plaque.

(Opposite): A photo of the unit operations laboratory in the Zachry Building.

Fact Sheet

Located in the 205,000 square-foot, exemplary Jack E. Brown Engineering Building, the department provides its students and faculty members access to the latest resources, including 88 research and teaching facilities, six general classrooms, 13 conference rooms, four computer laboratories and a 600 sq. feet computer cluster room.

Areas of Study:

- Biomedical | Biomolecular
- Complex Fluids
- Computational Chemical Engineering
- Environmental | Sustainability
- Materials
- Microelectronics
- Microfluidics
- Modeling | Simulation
- Nanotechnology
- Process Safety
- Process Systems Engineering
- Reaction Engineering
- Thermodynamics

Faculty

- 17 Professors
- 5 Associate Professors
- 7 Assistant Professors
- 7 Lecturers/Senior Lecturers
- 5 Chair Holders
- 7 Endowed Professorships
- 2 Regents Professors
- 2 Endowed Faculty Fellowships

Research

Direct Research Expenditures (FY '14): $6.71 million
Research Awards (FY '14): $10.4 million
Refereed Journal Publications (CY '14): 242
Patents (CY '14): 7

Rankings

Undergraduate: 11th (Public) | 16th (Overall)
Graduate: 16th (Public) | 26th (Overall)
U.S News & World Report

Enrollment Statistics

	Undergraduate		Graduate	
	Fall '13	Fall '14	Fall '13	Fall '14
University	52,449	47,567	9,893	10,602
College of Engineering	9,253	10,556	3,075	3,391
Chemical Engineering	713	*519	144	185

Department Demographics

	Undergraduate		Graduate	
	Fall '13	Fall '14	Fall '13	Fall '14
Minority	36%	31%	12%	7%
International	9%	4%	67%	67%
Women	36%	34%	28%	30%
Men	64%	66%	72%	70%

Entering SAT Scores Fall 2014 (AVG)

	Math	Verbal	Total
University	610	579	1189
College of Engineering	666	614	1280
Chemical Engineering	720	641	1361

Entering GRE Scores Fall 2014 (AVG)

	Quantitative	Verbal
University	158	153
College of Engineering	163	153
Chemical Engineering	164 (Ph.D.) 163 (Master's)	153 (Ph.D.) 152 (Master's)

Degrees Awarded

	2012	2013	2014
B.S.	144	147	133
M.S.	5	2	8
M.E.	1	2	4
Ph.D.	20	21	12

**Freshmen are admitted into the program in the spring term.*

PROFESSORS

PERLA B. BALBUENA

GPSA Professor
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Dr. Balbuena's research is based on the prediction of physical and chemical properties of materials using first principles atomic-level simulations. She has contributed to an improved understanding of interfacial reaction phenomena, which is useful for the design of power sources such as lithium-ion batteries and fuel cells and for the development of new materials for catalytic processes. Her interests include reactions on nanoclusters and surfaces and at interfaces; applications to catalysis, electrochemistry and corrosion; prediction of thermodynamic and transport properties; and first-principles materials design. Balbuena is an AAAS fellow and a TEES Senior Fellow.

RESEARCH

"Optical Property, Charge Carrier Relaxation and Charge Transfer," **National Science Foundation,** 6/2014-6/2017 (Co-PI).

"Addressing Internal Shuttle Effect: Electrolyte Design and Cathode Morphology Evolution in Li-S Batteries," **Department of Energy/Office of Energy Efficiency & Renewable Energy,** 10/2014-7/2015 (PI).

"SEI Layer Formation and Control on Carbon-Based Electrodes of Li-ion Batteries," **Honda RD Americas, Inc.,** 10/2013-9/2014 (PI).

"Modeling Catalyzed Growth of Single-Walled Carbon Nanotubes," **Department of Energy/ Basic Energy Sciences,** 9/2006-8/2015 (PI).

"First Principles Modeling of SEI Formation on Bare and Surface /Additive Modified Silicon Anode," **Lawrence Berkeley Laboratory (DOE),** 4/2013-4/2017 (PI).

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Burgos, J. C.; **Balbuena, P. B.** Engineering Preferential Adsorption of Single-Walled Carbon Nanotubes on Functionalized ST-Cut Surfaces of Quartz. *ACS Appl. Mater. Interfaces* **2014,** *6* (15), 12665-12673.

Burgos, J. C.; Jones, E.; **Balbuena, P. B.** Dynamics of Topological Defects in Single-Walled Carbon Nanotubes during Catalytic Growth. *J. Phys. Chem. C* **2014,** *118* (9), 4808-4817.

Gomez-Ballesteros, J. L.; Callejas-Tovar, A.; Coelho, L. A. F.; **Balbuena, P. B.** Molecular Dynamics Studies of Graphite Exfoliation Using Supercritical CO_2. *Design and Applications of Nanomaterials for Sensors* **2014,** *16,* 171-183.

González-Huerta, R. G.; Ramos-Sánchez, G.; **Balbuena, P. B.** Oxygen Evolution in Co-Doped RuO_2 and IrO_2: Experimental and Theoretical Insights to Diminish Electrolysis Overpotential. *J. Power Sources* **2014,** *268,* 69-76.

Javier, A.; Li, D.; Cruz, J.; Binamira-Soriaga, E.; **Balbuena, P. B.**; Soriaga, M. P. C-H Activation/Metalation at Electrode Surfaces: 2, 3-Dimethyl-1, 4-Dihydroxybenzene on Pd(pc) and Pd(111) Studied by TLE, HREELS and DFT. *Dalton Trans.* **2014,** *43* (39), 14798-14805.

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Ma, Y.; **Balbuena, P. B.** DFT Study of Reduction Mechanisms of Ethylene Carbonate and Fluoroethylene Carbonate on Li+-Adsorbed Si Clusters. *J. Electrochem. Soc.* **2014,** *161* (8), E3097-E3109.

Martinez de la Hoz, J. M.; **Balbuena, P. B.** Reduction Mechanisms of Additives on Si Anodes of Li-Ion Batteries. *Phys. Chem. Chem. Phys.* **2014,** *16* (32), 17091-17098.

Mera, H. A.; Gomez-Ballesteros, J. L.; **Balbuena, P. B.** Structure and Dynamics of Carbon Dioxide, Nitrogen, Water, and Their Mixtures in Metal Organic Frameworks. *J. Chem. Eng. Data* **2014,** *59* (10), 2973-2981.

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Ramos-Sanchez, G.; Godínez-Salomón, F.; Solorza-Feria, O.; **Balbuena, P. B.** Activity and durability of PEFCs Alloy Core-Shell Catalysts: Role of Surface Oxidation. *Adv. Sci. Tech.* **2014,** *93,* 31-40.

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DRAGOMIR B. BUKUR

Joe M. Nesbit Professor
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Dr. Bukur's research includes areas of chemical reaction engineering, applied catalysis and catalyst synthesis; GTL and CTL technology, and mathematical modeling. Bukur is the vice-chairman of the Natural Gas Conversion Board and also serves on its international scientific advisory board. He is a Senior TEES Fellow and an AIChE fellow.

RESEARCH

"Intensifying Methane Reforming by Combining Carbonate and Chemical Looping," **Qatar National Research Fund,** 11/2012-11/2015 (PI).

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Antzara, A.; Heracleous, E.; **Bukur, D. B.**; Lemonidou, A. A. Thermodynamic Analysis of Hydrogen Production via Chemical Looping Steam Methane Reforming Coupled with in Situ CO2 Capture. *Energy Procedia.* **2014,** *63,* 6576-6589.

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Dr. El-Halwagi's research includes process synthesis, simulation, design, operation, integration and optimization. He focuses on the development of sustainable practices, eco-industrial systems, hydrocarbon processing, and systematic methodology strategies that enable chemical engineers to achieve productivity enhancement, yield improvement, debottlenecking and energy conservation. His research also addresses industrial pollution prevention and the design of integrated biorefineries. El-Halwagi is an AIChE fellow.

RESEARCH

"A Life-Cycle Integrated Approach to the Incorporation of Safety in the Design, Operation, and Optimization of Supply Chains in Qatar," **Qatar National Research Fund,** 01/2014-01/2017 (PI).

"A Systems Approach to the Development of Sustainable Water Strategies for Qatar," **Qatar National Research Fund,** 7/2012-7/2015 (PI).

"An Integrated Approach to the Simultaneous Design and Operation of Industrial Facilities for Abnormal Situation Management," **Qatar University,** 2/2013-2/2016 (PI).

PROFESSORS

"Design of Synthetic Fuels and Value Added Chemicals Derived from Natural Gas Via Combined Experimental and Process Integration Methodology," **Qatar National Research Fund,** 12/2012-12/2015 (PI).

"Development of Computer-Aided Modules for Sustainable Manufacturing," **Computer-Aids in Chemical Engineering (CACHE Corp.),** 5/2014-4/2015 (PI).

"Potentials for the Shale Gas Monetization: Lessons Learned from the Qatari Experience with Natural Gas," **National Science Foundation,** 10/2013-9/2014 (PI).

"Sustainable Manufacturing Advances in Research and Technology (SMART) Coordination Network," **National Science Foundation,** 1/2012-12/2016 (Co-PI).

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Bishnu, S. K.; Linke, P.; Alnouri, S. Y.; **El-Halwagi, M. M.** Multiperiod Planning of Optimal Industrial City Direct Water Reuse Networks. *Ind. Eng. Chem. Res.* **2014,** *53* (21), 8844-8865.

Bocanegra-Martínez, A.; Ponce-Ortega, J. M.; Nápoles-Rivera, F.; Serna-González, M.; Castro-Montoya, A. J.; **El-Halwagi, M. M.** Optimal Design of Rainwater Collecting Systems for Domestic Use into a Residential Development. *Resour., Conserv. Recycl.* **2014,** *84,* 44-56.

Cerón, I. X.; Ng, R. T. L.; **El-Halwagi, M. M.**; Cardona, C. A. Process Synthesis for Antioxidant Polyphenolic Compounds Production from Matisia Cordata Bonpl. *(Zapote) Pulp. J. Food Eng.* **2014,** *134,* 5-15.

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Elsayed, N. A.; Barrufet, M. A.; **El-Halwagi, M. M.** Integration of Thermal Membrane Distillation Networks with Processing Facilities. *Ind. Eng. Chem. Res.* **2014,** *53* (13), 5284-5298.

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Gutiérrez-Arriaga, C. G.; Abdelhady, F.; Bamufleh, H. S.; Serna-González, M.; **El-Halwagi, M. M.**; Ponce-Ortega, J. M. Industrial Waste Heat Recovery and Cogeneration Involving Organic Rankine Cycles. *Clean Technol. Environ. Policy* **2014,** DOI: 10.1007/s10098-014-0833-5, 1-13.

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Julián-Durán, L. M.; Ortiz-Espinoza, A. P.; **El-Halwagi, M. M.**; Jiménez-Gutiérrez, A. Techno-Economic Assessment and Environmental Impact of Shale Gas Alternatives to Methanol. *ACS Sustainable Chem. Eng.* **2014,** *2* (10), 2338–2344.

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Lira-Barragán, L. F.; Ponce-Ortega, J. M.; Serna-González, M.; **El-Halwagi, M. M.** Optimal Design of Process Energy Systems Integrating Sustainable Considerations. *Energy* **2014,** *76*, 139-160.

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PROFESSORS

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Dr. Elabd's research includes the synthesis of new polymers for clean energy and water. Energy applications include fuel cells, batteries and capacitors; water applications include electrochemical water purification. The transport and thermodynamics of ions and small molecules in polymers guide his synthetic design principles. Elabd is interested in answering complex questions regarding multicomponent transport, diffusion and sorption of water, ion transport and transport-morphology relationships in polymers using both an experimental and modeling approach.

RESEARCH

"Center for Sustainable Corrosion Protection," **DOD-Army Research Laboratory,** 9/2014-8/2015 (PI).

"Collaborative Research: Development of Anti-Fouling Electrochemical Membranes for Water Treatment," **National Science Foundation,** 9/2014-7/2015 (PI).

"Highly Conductive Anion Exchange Block Copolymers," **DOD-Army Research Office,** 9/2014-2/2015 (PI).

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PROFESSORS

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Dr. Floudas' research interests are in chemical process systems engineering and lie at the interface of chemical engineering, applied mathematics, operations research, computer science and molecular biology. He addresses fundamental problems in process synthesis and design, interaction of design and control, process operations, discrete continuous nonlinear optimization, deterministic global optimization, computational chemistry, structural biology and bioinformatics. His research relies heavily on mathematical modeling at the microscopic, mesoscopic and macroscopic level, rigorous optimization theory, algorithms and large-scale computations on high performance clusters of workstations. In 2014, he received an honorary doctorate from Abo Akademi University for his research in process systems engineering. For his work in computer science, Floudas was named a Highly Cited Researcher with Thomson Reuters, a compilation that includes more than 3,000 influential names across 21 areas of research. In 2014, he was also elected as Corresponding Member of the Academy of Athens. He is a member of the National Academy of Engineering, a TIAS Faculty Fellow and Eminent Scholar, an AIChE fellow and a SIAM fellow.

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Dr. Glover's research includes asphalt materials' rheological properties, asphalt oxidation kinetics, and the development of thermal and oxygen transport models for the oxidation of asphalt binders in pavements. Additionally, he collaborates with researchers in the Zachry Department of Civil Engineering and the Texas A&M Transportation Institute on the effects of binder oxidation on pavement performance, with age-related fatigue cracking being an important example.

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KENNETH R. HALL

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Dr. Hall's research includes precision measurement of the thermophysical properties of fluids and their mixtures as well as the development of molecular-thermodynamic models and correlations. He evaluates thermodynamic properties for a variety of fluids and their mixtures to yield further insight into process and product design in chemical and related industries.

REFEREED JOURNAL PUBLICATION

Tibaduiza, A. D. P.; Cristancho, D. E.; Ortiz-Vega, D.; Mantilla, I. D.; Gomez-Osorio, M. A.; Browne, R. A.; Holste, J. C.; **Hall, K. R.** Calculation of Energies and Entropies from Isochoric and Isothermal Experimental Data. *J. Chem. Eng. Data* **2014,** *59* (4), 999–1005.

PROFESSORS

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Dr. Holste's research includes measurement and correlation of thermodynamic properties of fluids at high pressures.

REFEREED JOURNAL PUBLICATION

Tibaduiza, A. D. P.; Cristancho, D. E.; Ortiz-Vega, D.; Mantilla, I. D.; Gomez-Osorio, M. A.; Browne, R. A.; Holste, J. C.; Hall, K. R. Calculation of Energies and Entropies from Isochoric and Isothermal Experimental Data. *J. Chem. Eng. Data* **2014,** *59* (4), 999–1005.

MARK T. HOLTZAPPLE

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Dr. Holtzapple's research includes bio-based fuels and chemicals, food and feed processing, water desalination, air conditioning, high-efficiency engines, jet engines and vertical-life aircraft. He has developed a wide variety of technologies, including conversion of alcohol fuels from biodegradeable wastes and protein sugar recovery from energy cane. He has developed the StarRotor engine, which is three times more efficient than the conventional internal combustion machine. Holtzapple led an undergraduate research team to place first in the 2014 Odebrecht Award for Sustainable Development.

RESEARCH

"Detonation Shock and Countercurrent Digestion of Lignocellulosic Plant Wastes," **Mars, Inc.,** 7/2014-3/2015 (PI).

"Earth Energy Renewables Testing Agreement," **EE-Terrabon Biofuels, LLC,** 4/2013-4/2014 (PI).

"Liquid Biofuels: Creating Economic Incentives for Improved Sanitation," **Bill and Melinda Gates Foundation,** 11/2011-4/2014 (PI).

"Novel Mechanical Pretreatment for Lignocellulosic Feedstocks," **DOE-Golden Field Office,** 9/2011-3/2014 (PI).

"Task Order No. 4: Phase 2 – Galveston," **Cameron International Corporation,** 8/2014-7/2015 (PI).

"Swades Chaudhuri to Learn to Operate and Test a Pilot Unit," **Cameron International Corporation,** 2/2013-7/2015 (PI).

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Cope, J. L.; Hammett, A. J.; Kolomiets, E. A.; Forrest, A. K.; Golub, K. W.; Hollister, E. B.; Holtzapple, M. T.; Wilkinson, H. H. Evaluating the Performance of Carboxylate Platform Fermentations Across Diverse Inocula Originating as Sediments from Extreme Environments. *Bioresour. Technol.* **2014,** *155*, 388-394.

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Holtzapple, M. T.; Rabroker, G. A. Gerotor Apparatus for a Quasi-Isothermal Brayton Cycle Engine. **U.S. Patent 8,821,138,** September 2, 2014.

Holtzapple, M. T.; Rabroker, G. A. ; Ross, M. K.; Atmur, S. D.; Noyes, G. P. Gerotor Apparatus for a Quasi-Isothermal Brayton Cycle Engine. **U.S. Patent 8,905,735,** December 9, 2014.

PROFESSORS

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Dr. Jayaraman's research includes molecular systems biotechnology, specifically the use of integrated experimental and modeling approaches for investigating problems in human health and medicine. Current research projects include systems biology of cytokine signaling in inflammatory diseases, inter-kingdom signaling interactions between bacteria and human cells in GI tract infections, and the development of microfluidic model systems for combinatorial drug screening and vascular tissue engineering.

RESEARCH

"CAREER: Inter-Kingdom Signaling as a Paradigm for Molecular Systems Biology," **National Science Foundation,** 6/2009-5/2014 (PI).

"Collaborative Research: Identification of Immunomodulatory Microbiota Metabolites," **National Science Foundation,** 7/2013-6/2016 (PI).

"Computational Metabolomics of Gut Microbiota Metabolites," **Tufts University,** 2/2014-12/2014 (PI).

"Microbiota-Derived Metabolites in Mucosal Homeostasis," **Texas A&M University Health Science Center,** 9/2012-8/2015 (PI).

"Rapid Fabrication of Bio-Inspired Microvascular Networks," **National Science Foundation,** 9/2011-8/2015 (PI).

"Rewiring Cellular Metabolism to Control Biofilm Formation and Virulence by Turning Cell Regulators," **Pennsylvania State University,** 1/2012-7/2014 (PI).

"Structural Basis of Signaling Between Bacterial Chemoreceptors and Flagella," **University of Texas Health Science Center at Houston,** 9/2014-8/2015 (Co-PI).

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PROFESSORS

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Dr. Karim has been the department head of chemical engineering at Texas A&M University since Sept. 1, 2012. His research includes developing technologies and exploring fundamental issues related to second and third-generation renewable biofuels production. In addition, he is creating novel dual-modal cellulosic monolith membranes for flu virus separation, purification and cell-culture-based vaccine production. Karim also focuses on the development of algorithms for the detection of leaks in natural gas pipelines through methodologies, which include modeling, simulation and use of particle filters and nonlinear observers. Additionally, his group researches fault detection methods for chemical and biological processes. Karim is a fellow of AIChE.

RESEARCH

"EAGER: Peptide Affinity Membranes for Binding Influenza Viruses: H1N1 and H5N1," **National Science Foundation,** 2012 - 2014 (PI).

"Design of a Packed-bed, Continuous-flow Fermentation Process Tailored for Cellulosic Ethanol Production," Sub-contract from **Texas Tech University, National Science Foundation,** 2012 - 2014 (PI).

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Dr. Kravaris' research focuses on nonlinear process control, state estimation and dynamic model reduction. The aim is the development of systematic methodologies to be able to construct effective control and monitoring algorithms for nonlinear processes. Theoretical issues are approached with invariant manifold and Lyapunov function methods. Applications currently focus on environmental and energy systems, including anaerobic digestion and activated sludge processes.

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Bournazou, M. N. C.; Junne, S.; Neubauer, P.; Barz, T.; Arellano-Garcia, H.; Kravaris, C. An Approach to Mechanistic Event Recognition Applied on Monitoring Organic Matter Depletion in SBRs. *AIChE J.* **2014,** *60* (10), 3460-3472.

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Dr. Kuo's research includes nano- and microelectronics, with emphasis on semiconductor and optoelectronic materials, processes and devices; thin films and plasma technology are also studied. In his Thin Film Nano and Microelectronics Research Laboratory, Kuo develops new materials, novel processes and advanced devices with the ultimate goal of creating high-performance, highly reliable, manufacturable devices for present and future applications. Current projects include use of the following: TFTs, ULSIC, LEDs, solar cells and biosensors. Kuo received the 2014 Innovation Award from Texas A&M System Technology Commercialization. In 2014, he maintained acclaim in *ECS Transactions* for a most-cited solid state paper. He is a fellow of both IEEE and the Electrochemical Society.

PROFESSORS

RESEARCH

"A Novel Fabrication Process Polysilicon Thin Film Solar Cells," **National Science Foundation,** 5/2010-4/2014 (PI).

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Director, Mary Kay O'Connor Process Safety Center
Regents Professor
T. Michael O'Connor Chair I
Ph.D., University of Oklahoma
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Dr. Mannan's research interests include aerosol research, inherently safer design, quantitative risk assessment, reactive chemicals, modeling of silane releases, LNG safety and flammability of materials. Mannan has served as a consultant to numerous entities in both the academic and private sectors. He also has testified before the U.S. Congress on multiple occasions, lending his expertise on matters of national security as it relates to chemical safety and infrastructure. In 2014, Mannan was named distinguished visiting professor at the Research Institute of Safety Engineering and was appointed guest professor at Tianjin University. He is a fellow of AIChE.

RESEARCH

"A Life Cycle Approach to the Incorporation of Safety in Design, Operation, and Optimization of Supply Chains in Qatar," **Qatar University,** 1/2014-1/2017 (PI).

"Collaborative Research: Study of Flammability, Mechanism and Heat/Mass Transfer Associated with Burning of Flame Retardant Polymer Nanocomposites," **National Science Foundation,** 9/2013-8/2016 (PI).

"Deflagration/Detonation Hazard Analysis for ADN Synthesis Unit Based on Two-Phase Flow Pattern Recognition," **Ascend Performance Materials,** 6/2014-5/2018 (PI).

"Development of an Index System for Inherently Safer Process Design," **China Petrochemical International Company Limited,** 10/2014-9/2016 (PI).

"EAGER: Correlation of Explosibility and Dispersion Characteristics of Combustible Engineered Nanomaterials," **National Science Foundation,** 8/2013-7/2015 (PI).

"Evaluation of Small Quantities of Class 3 and Class 9 Hazmat Materials in Transportation," **National Academy of Sciences,** 7/2014-11/2015 (PI).

"Experimental and Theoretical Studies on Bund Overtopping in Case of Catastrophic LNG Tank Failure," **National Grid,** 6/2014-5/2018 (PI).

"Industry Practices with Codes, PHA Conduction & PHA Revalidation," **Project Enhancement Corporation,** 6/2014-5/2018 (PI).

Multiple awards, **State of Alaska,** 6/2013-6/2014 (PI).

"Operation and Maintenance of the Ocean Energy Safety Institute (OESI)," **Department of the Interior,** 11/2013-11/2018 (PI).

"Process Safety Management Program Review," **Formosa Plastics Corporation,** 6/2014-5/2018 (PI).

"QA – Source Term Modeling of LNG Vapor Formation by Experimental Investigation and CFD Simulation," **Qatar National Research Fund,** 11/2013-11/2016 (Co-PI).

"Risk Screening on H2S Radius of Exposure," **Occidental Oil and Gas Corporation,** 2/2014-5/2014 (PI).

PROFESSORS

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Basha, O.; Olewski, T.; Véchot, L.; Castier, M.; **Mannan, M. S.** Modeling of Pool Spreading of LNG on Land. *J. Loss Prev. Process Ind.* **2014,** *30*, 307-314.

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Kim, B. K.; Mentzer, R. A.; **Mannan, M. S.** Numerical Study on Physical Mechanisms of Forced Dispersion for an Effective LNG Spill Mitigation. *Ind. Eng. Chem. Res.* **2014,** *53* (22), 9488-9498.

Lira-Flores, J. D.; Vásquez-Román, R.; López-Molina, A.; **Mannan, M. S.** A MINLP Approach for Layout Designs Based on the Domino Hazard Index. *J. Loss Prev. Process Ind.* **2014,** *30*, 219-227.

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Dr. Pistikopoulos' research interests lie in the field of process and multiscale systems engineering, with particular emphasis on the developments of (i) model-based optimization theory, computational tools for multi-parametric programming and explicit model predictive control; and (ii) an integrated framework for design, control and scheduling of complex multiscale networks, with applications in sustainable energy systems, smart manufacturing and personalized health engineering. In December 2014, he delivered the 21st Professor Roger W. H. Sargent Lecture at London's Imperial College. The same year, he received an honorary doctorate from University Politehnica of Bucharest, Romania. He is a fellow of the Royal Academy of Engineering (U.K.).

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Chang, H.; Krieger, A.; Astolfi, A.; **Pistikopoulos, E. N.** Robust Multi-Parametric Model Predictive Control for LPV Systems with Application to Anesthesia. *J. Process Control* **2014,** *24* (10), 1538-1547.

PROFESSORS

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Krieger, A.; Panoskaltsis, N.; Mantalaris, A.; Georgiadis, M. C.; **Pistikopoulos, E. N.** Modeling and Analysis of Individualized Pharmacokinetics and Pharmacodynamics for Volatile Anesthesia. *IEEE Trans. Biomed. Eng.* **2014,** *61* (1), 25-34.

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Wittmann-Hohlbein, M.; **Pistikopoulos, E. N.** Approximate Solution of mp-MILP Problems Using Piecewise Affine Relaxation of Bilinear Terms. *Comput. Chem. Eng.* **2014,** *61*, 136-155.

Zhao, Y.; Marzinek, J. K.; Bond, P. J.; Chen, L.; Li, Q.; Mantalaris, A.; **Pistikopoulos, E. N.**; … Lian, G. A Study on Fe^{2+-} α-Helical-Rich Keratin Complex Formation Using Isothermal Titration Calorimetry and Molecular Dynamics Simulation. *Journal of Pharmaceutical Sciences* **2014,** *103* (4), 1224-1232.

JORGE M. SEMINARIO

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Dr. Seminario's research covers several aspects of nanotechnology, such as the analysis design and simulation of systems and materials of nanometer dimensions, especially those needed for development and systems for energy, nanosensors and nanoelectronics. Among his goals is the design of smaller, cleaner, more efficient and faster devices for clean energy production as well as for detection of chemical, biological and nuclear agents. He has developed new scenarios for nanodevice architectures using a multiscale and multidisciplinary approach that progresses from the atomistic nature of their components to the final product, guided by first principles calculations.

RESEARCH

"Near and Far-Field Interfaces to DNA-Guided Nanostructures from RF to Lightwave: Exploiting the Spectrum," **University of California-Irvine,** 11/2010-10/2014 (PI).

PROFESSORS

"First Principles Modeling of SEI Formation on Bare and Surface/Additive Modified Silicon Anode," **Lawrence Berkeley Laboratory,** 4/2013-4/2017 (Co-PI).

"Development of Graphene Sensor," **Argonne National Laboratory,** 6/2014-5/2018 (PI).

REFEREED JOURNAL PUBLICATIONS

Aguilera-Segura, S. M.; Seminario, J. M. Ab Initio Analysis of Silicon Nano-Clusters. *J. Phys. Chem. C* **2014,** *118* (2), 1397-1406.

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Salazar-Salinas, K.; Baldera-Aguayo, P. A.; Encomendero-Risco, J. J.; Orihuela, M.; Sheen, P.; Seminario, J. M.; Zimic, M. Metal-Ion Effects on the Polarization of Metal-Bound Water and Infrared Vibrational Modes of the Coordinated Metal Center of Mycobacterium tuberculosis Pyrazinamidase via Quantum Mechanical Calculations. *J. Phys. Chem. B* **2014,** *118* (34), 10065-10075.

VICTOR M. UGAZ

Charles D. Holland '53 Professor
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Associate Department Head
Chair, Texas A&M Professional Program in Biotechnology (PPiB)
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Dr. Ugaz's research focuses broadly on harnessing the unique characteristics of transport and flow at the microscale, with specific interests in microfluidic flows (both single-phase and nanoparticle suspensions), microchip gel electrophoresis, PCR thermocycling in novel convective flow devices, and construction of 3D vascular flow networks for biomedical applications.

RESEARCH

"FFATA: Noise-Synchronized Electrophoretic Manipulation in Nanoporous Hydrogels," **National Science Foundation,** 8/2012-7/2015 (PI).

"Microvesicle Isolation from Mycobacterium Tuberculosis Infected Macrophage Using Multi-Stage Microfluidic Channel," **National Institutes of Health,** 6/2014-5/2016 (Co-PI).

"Rapid Fabrication of Bio-Inspired Microvascular Networks," **National Science Foundation**, 9/2011-8/2015 (PI).

REFEREED JOURNAL PUBLICATIONS

Meng, F.; King, M. D.; Hassan, Y. A.; Ugaz, V. M. Localized Fluorescent Complexation Enables Rapid Monitoring of Airborne Nanoparticles. *Environ. Sci.: Nano.* **2014,** *1*, 358-366.

Shi, N.; Ugaz, V. M. An Entropic Force Microscope Enables Nano-Scale Conformational Probing of Biomolecules. *Small* **2014,** *10* (13), 2553-2557.

Shi, N.; Ugaz, V. M. Entropic Stochastic Resonance Enables Trapping Under Periodic Confinement: A Brownian-Dynamics Study. *Phys. Rev. E: Stat., Nonlinear, Soft Matter Phys.* **2014,** *89* (1), 012138.

Shi, N.; Ugaz, V. M. Noise-Enhanced Gel Electrophoresis. *Electrophoresis* **2014,** *35* (12-13), 1758-1765.

ASSOCIATE PROFESSORS

ZHENGDONG CHENG

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Dr. Cheng studies complex fluids and active soft matter. His research focuses on the self-organization of intelligent colloids and anisotropic particles, the fabrication of photonic crystals and integrated photonic circuits, solar hydrogen production via water splitting and the application of microfluids to bio-encapsulation. The techniques developed will be applicable to the modeling of phase transitions and liquid crystal materials; the engineering of nanocomposites and semiconductors of light; solar energy and a wide range of therapeutic treatments.

RESEARCH

"Nanoplate Surfactants for Enhanced Oil Recovery," **Chevron U.S.A, Wintershall (BASF) and GONG Energy via ITF-oil-consortium of UK,** 11/2011-8/2014 (PI).

"Liquid Crystals of Nanoplates," **NASA,** 9/2013-8/2018 (PI).

"Phase Transitions in Colloidal Suspensions of Disks," **National Science Foundation,** 7/2010-7/2014 (PI).

"Yuly Fernanda Lopez Contract," **Universidad Industrial de Santander,** 2/2013-12/2014 (PI).

"Microemulsion Fracture Fluids," **CNPC USA Corporation,** 6/2014-5/2018 (PI).

REFEREED JOURNAL PUBLICATIONS

Castellanos, D.; Lewandowski, A.; Diaz, A.; Mejia, A. F.; Carreto, V.; Mashuga, C.; Rangwala, A. S.; Cheng, Z.; Mannan, M. S. Influence of Particle Size and Crystalline Level on the Efficiency of Dust Explosion Inhibitors. *Ind. Eng. Chem. Res.* **2014,** *53* (28), 11527-11537.

Chen, Y.; Huang, Z.; Zhang, H.; Chen, Y.; Cheng, Z.; Zhong, Y.; Ye, Y.; Lei, X. Synthesis of the Graphene/Nickel Oxide Composite and its Electrochemical Performance for Supercapacitors. *Int. J. Hydrogen Energy* **2014,** *39* (28), 16171-16178.

Li, H.; Wang, X.; Chen, Y.; Cheng, Z. Temperature-Dependent Isotropic-To-Nematic Transition of Charged Nanoplates. *Phys. Rev. E: Stat., Nonlinear, Soft Matter Phys.* **2014,** *90* (2), 020504.

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Li, Y.; Wu, P.; Zhang, H.; Luo, Z.; Wang, Y.; Cheng, Z.; He, L. The Instability of Monodisperse Bubbles Passing Through a Confined Geometry. *Appl. Phys. Lett.* **2014,** *105* (20), 201605.

Liu, Z.; Chen, Y.; Mo, S.; Cheng, Z.; Li, H. Stability of TiO_2 Nanoparticles in Deionized Water with ZrP Nanoplatelets. *J. Nanosci. Nanotechnol.* **2014,** *15* (4), 3271-3275.

Ramos-Sanchez, G.; Albornoz, M.; Yu, Y-H.; Cheng, Z.; Vasiraju, V.; Vaddiraju, S.; El Mellouhi, F.; Balbuena, P. B. Organic Molecule-Functionalized Zn_3P_2 Nanowires for Photochemical H_2 Production: DFT and Experimental Analyses. *Int. J. of Hydrogen Energy* **2014,** *39* (35), 19887-19898.

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PATENT

Link, D. R.; Weitz, D. A.; Cristobal-Azkarate, G.; Cheng, Z.; Ahn, K. Electronic Control of Fluidic Species. **U.S. Patent 8765485,** July 1, 2014.

MICAH J. GREEN

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Dr. Green's research focuses on understanding the processing and engineering of nanomaterials in the liquid phase for use in multifunctional composites and films. Areas of interest include polymer-nanomaterial interfacial studies, microstructure-rheology coupling, nanomaterial morphology evolution and scalable nanomaterial manufacturing. His group aims to lead in bringing a chemical engineering perspective to bear on the field of nanomaterials processing.

RESEARCH

"CAREER: Structure Property Processing Relations for Aggregation Resistant Graphene," **National Science Foundation,** 8/2014-2/2018 (PI).

"Collaborative Research: Understanding Cholesteric Pitch in Nanocylinder Films," **National Science Foundation,** 9/2014-8/2017 (PI).

"2014 DuPont Young Professor Grant," **DuPont Corporation,** 9/2014-8/2017 (PI).


VIDEO

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ASSOCIATE PROFESSORS

(Continued from pg. 19)

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Bari, R.; Tamas, G.; Irin, F.; Aquino, A. J. A.; **Green, M. J.**; Quitevis, E. L. Direct Exfoliation of Graphene in Ionic Liquids with Aromatic Groups. *Colloids Surf. A* **2014,** *463*, 63-69.

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Satapathi, S.; Gill, H. S.; Das, S.; Li, L.; Samuelson, L.; **Green, M. J.**; Kumar, J. Performance Enhancement of Dye-Sensitized Solar Cells by Incorporating Graphene Sheets of Various Sizes. *Appl. Surf. Sci.* **2014,** *314*, 638-641.

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Dr. Jeong's research includes the development of novel methodologies to design, modify, deposit and microfabricate nanostructured materials and to build them into hierarchical structures and complex forms for wide ranges of applications including separation membranes, selective catalysts and adsorbents. Jeong's research group develops several innovative and commercially viable strategies to prepare ultra-thin nanoporous framework membranes with unprecedentedly high olefin/paraffin separation performances. In collaboration with Dr. Dong-Hee Son, Jeong's team is developing highly efficient semiconductor nanocrystal/graphene composites for photocatalytic hydrogen production.

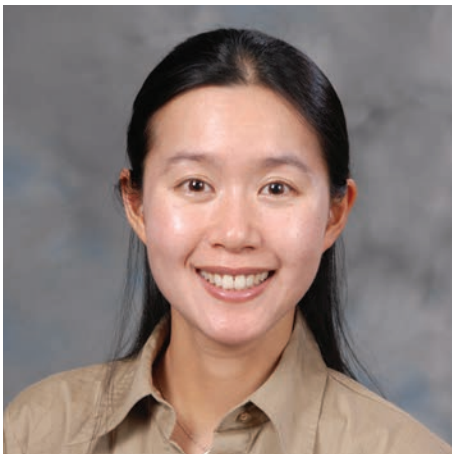
RESEARCH

"Doped-Nanocrystal/Graphene Hybrid Structure for Noble Metal-Free Photocatalytic Hydrogen Production," **National Science Foundation,** 8/2013-7/2016 (Co-PI).

"FFATA: An Innovative, Unorthodox, and General Strategy for the Synthesis of Zeolitic-Imidazolate Framework (ZIF) Membranes for Olefin/Paraffin Separations," **National Science Foundation,** 1/2012-12/2015 (PI).

"Nanocomposite Membranes for Light Gas Separations," **The Dow Chemical Company,** 1/2010-5/2014 (PI).

"Support for 6th International Zeolite Membrane Meeting," **National Science Foundation,** 3/2013-2/2014 (PI).



KATY C. KAO

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Dr. Kao's research interests include genomics, systems biology and biotechnology. In the lab, she utilizes related tools to observe microbial adaptation in various environments. Kao studies the evolution of microorganisms such as yeast and *E. coli* for their enhanced tolerance to the toxicity of desired bioproducts, such as biofuels. She uses ultrahigh throughput sequencing technology and monitors transcriptome and metabolism in an effort to identify the cellular components responsible for the selected traits. In 2014, Kao was promoted with tenure to her current position.

RESEARCH

"CAREER: Visualizing Evolution in Real-Time (VERT)," **National Science Foundation,** 3/2011-2/2016 (PI).

"Interspecific Hybrids as a Tool for Genetic Determination of Complex Phenotypes in Bacteria," **Texas Higher Education Coordinating Board,** 7/2012-12/2014 (PI).

ASSOCIATE PROFESSORS

REFEREED JOURNAL PUBLICATIONS

Cheng, C.; Kao, K. C. How to Survive Being Hot and Inebriated. *Science* **2014,** *346* (6205), 35-36.

Peabody, G. L.; Winkler, J. D.; Kao, K. C. Tools for Developing Tolerance to Toxic Chemicals in Microbial Systems and Perspectives on Moving the Field Forward and into the Industrial Setting. *Curr. Opin. Chem. Eng.* **2014,** *6*, 9-17.

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Winkler, J. D.; Kao, K. C. Complementation of a Temperature Sensitive *Escherichia Coli* rpoD Mutation Using Lactobacillus Sigma Factors. *bioRxiv* **2014,** 003152.

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Dr. Wilhite's research includes the study of interactions between chemical kinetics and transport processes for process intensification. Areas of investigation include the design of multilayer catalytic and/or perm-selective membranes for natural gas processing and hydrogen production; synthesis of electroceramic membrane material for CO_2 capture and reuse; heat-exchanger microreactor technologies for natural gas processing and catalytic gas-liquid-solid reactor design. In 2014, he spoke at the National Academies' Chemical Sciences Roundtable: Mesoscale Chemistry.

RESEARCH

"CAREER: Composite Catalytic Micromembranes—Tailoring Reaction and Transport at the Microscale for Efficient Hydrogen Extraction from Green Hydrocarbons," **National Science Foundation,** 9/2010-7/2014 (PI).

"CFD Design Simulations of RMR: Assessment of Thermal Loads, Catalyst Stress and System Performance," **Power and Energy,** 8/2013-7/2014 (PI).

"EAGER: LbL Polymer Thin Films for Reaction-Assisted Acid Gas Removal," **National Science Foundation,** 3/2012-2/2014 (PI).

"EAGER: Revisiting Catalyst Design in Heat-Exchanger Microreactors," **National Science Foundation,** 3/2013-2/2015 (PI).

"Layer-by-Layer Polymer Assemblies as Size-Selective Gas Separation Membranes," **National Science Foundation,** 9/2014-8/2017 (PI).

"Trickle-Bed Reactor Modeling," **Eastman Chemical Company,** 2/2014-1/2016 (PI).

REFEREED JOURNAL PUBLICATIONS

Butcher, H.; Quenzel, C. J. E.; Breziner, L.; Mettes, J.; Wilhite, B. A.; Bossard, P. Design of an Annular Microchannel Reactor (AMR) for Hydrogen and/or Syngas Production via Methane Steam Reforming. *Int. J. Hydrogen Energy* **2014,** *39* (31), 18046-18057.

Kim, D.; Tzeng, P.; Barnett, K. J.; Yang, Y.-H.; Wilhite, B. A.; Grunlan, J. C. Highly Size-Selective Ionically Crosslinked Multilayer Polymer Films for Light Gas Separation. *Adv. Mater.* **2014,** *26* (5), 746-751.

Zhang, H.; Suresh, A.; Carter, C. B.; Wilhite, B. A. Electrochemical, Catalytic and O2-Permeation Studies of Iron-Doped Barium Zirconates for Membrane Reactor Applications. *ECS Trans.* **2014,** *61* (1), 307-318.

ASSISTANT PROFESSORS

MUSTAFA B. AKBULUT

Ph.D., University of California, Santa Barbara
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Dr. Akbulut's research interests include the fundamental issues of surface and interface science including adsorption, desorption, surface-nanoparticle interactions, inter-nanoparticle forces, assembly of nanoparticles, adhesion, friction, wear, tribochemical reactions and corrosion; with the overarching objective of advancing nanotechnology and biotechnology through rationale design.

RESEARCH

"Biomechanical Investigation of Insect Leg Joints," **National Science Foundation,** 9/2014-8/2017 (PI).

"CNC – Polymer Composites," **Essentium Materials, LLC,** 1/2014-8/2014 (Co-PI).

"FFATA: Transport of Nanomedicine in the Environment," **National Science Foundation,** 9/2012-8/2015 (PI).

"Roles of Produce Surface Topography and Physico-Chemistry on Development and Application of Novel Interventions to Inhibit Pathogen Attachment," **USDA National Institute of Food and Agriculture,** 2/2011-8/2015 (Co-PI).

"TAP – CNC Composites Collaboration with Essentium Materials, LLC," **Essentium Materials, LLC,** 9/2014-5/2015 (Co-PI).

"Young Faculty Award (YFA): Next Generation Solders Involving Dispersion of Soft Ligand Functionalized Boron Nitride Nanoribbons or Nanosheets in Alloys as Thermal Interface Materials (TIMs)," **DOD-Advanced Research Projects Agency,** 8/2013-7/2016 (PI).

REFEREED JOURNAL PUBLICATIONS

Chen, I.-C.; Yegin, C.; Zhang, M.; Akbulut, M. Use of pH-Responsive Amphiphilic Systems as Displacement Fluids in Enhanced Oil Recovery. *SPE Journal* **2014,** *19* (6), 1035-1046.

Zhang, M.; Yang, F.; Pasupuleti, S.; Oh, J. K.; Kohli, N.; Lee, I.-S.; Perez, K.; Verkhoturov, S. V.; Schweikert, E. A.; Jayaraman, A.; Zevallos, L.-C.; Akbulut, M. Preventing Adhesion of *Escherichia coli* O157: H7 and Salmonella Typhimurium LT2 on Tomato Surfaces via Ultrathin Polyethylene glycol Film. *Int. J. Food Microbiol.* **2014,** *185*, 73-81.

M. M. FARUQUE HASAN

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Dr. Hasan's research focuses on modeling, simulation and optimization of complex and multiscale systems. The overarching goal is to develop novel pathways and transformative technology to utilize fossil fuels while minimizing emissions. He develops application-oriented theories, algorithms and computational methods for the design and discovery of advanced materials, processes and supply chains for clean energy. Applications include CO2 capture and conversion, shale gas utilization and hybrid energy processes.

REFEREED JOURNAL PUBLICATIONS

First, E. L.; Hasan, M. M. F.; Floudas, C. A; Discovery of Novel Zeolites for Natural Gas Purification through Combined Material Selection and Process Optimization Approach. *AIChE Journal* **2014,** *60* (5), 1767–1785.

Guzman, Y. A.; Hasan, M. M. F.; Floudas, C. A. Performance of Convex Underestimators in a Branch-and-Bound Framework. *Optimization Letters* **2014,** DOI: 10.1007/s11590-014-0799-6.

Hasan, M. M. F.; Boukouvala, F.; First, E. L.; Floudas, C. A. Nationwide, Regional and Statewide CO2 Capture, Utilization and Sequestration Supply Chain Network Optimization. *Ind. Eng. Chem. Res.* **2014,** *53* (18), 7489–7506.

ASSISTANT PROFESSORS

Onel, O.; Niziolek, A. M.; Hasan, M. M. F.; Floudas, C. A. Municipal Solid Waste to Liquid Transportation Fuels - Part I: Mathematical Modeling of a Municipal Solid Waste Gasifier. *Comput. Chem. Eng.* **2014,** *71*, 636–647.

JODIE L. LUTKENHAUS

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Dr. Lutkenhaus' research interests include the design of organic thin films and nanostructures to enable the development of novel organic energy systems and smart coatings. Areas of investigation include the behavior of polymer thin films and coatings, thermal analysis, polyelectrolytes and electroactive polymers for energy storage. In 2014, Lutkenhaus received the Montague CTE Scholar Award and the George Armistead, Jr. '23 Faculty Excellence Teaching Award. Other honors this year include the 3M Non-Tenured Faculty Award and the Kaneka Junior Faculty Scholarship.

RESEARCH

"Curvature-Directed Crystallization of Polymer Dielectrics," **American Chemical Society,** 9/2011-8/2014 (PI).

"Discovering the Rich Electrochemistry of Nitroxide Radical-Modified Conjugated Polymers," **Robert A. Welch Foundation,** 6/2014-5/2017 (PI).

"EAGER: LbL Polymer Thin Films for Reaction-Assisted Acid Gas Removal," **National Science Foundation,** 3/2012-2/2014 (PI).

"FFATA: CAREER: Internal Structure and Properties of Confined Layer-by-Layer Films and Nanotubes," **National Science Foundation,** 3/2011-2/2016 (PI).

"Hybrid Block Copolymer Electrodes for Electrochemical Energy Storage," **National Science Foundation,** 9/2013-8/2016 (PI).

"Layer-by-Layer (LbL) Metal Pretreatments for Liquid and Powder Coating Anticorrosion Applications," **Axalta Coating Systems, LLC,** 7/2014-7/2015 (PI).

"Nanoparticle Enhanced High-K Dielectricts by Layer-by-Layer Deposition," **Lockheed Martin Corporation,** 2/2014-2/2015 (PI).

"Organic Electrodes for Structural Energy and Power," **DOD: Air Force, Office of Scientific Research,** 3/2013-3/2016 (PI).

"Template Synthesis and Solution-Assembly of Polyaniline for Organic Energy Storage," **Robert A. Welch Foundation,** 6/2011-5/2014 (PI).

"Thermal Transitions in Polyelectrolyte Multilayers and Complexes," **National Science Foundation,** 8/2013-7/2016 (PI).

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Mike, J. F.; Shao, L.; Jeon, J.-W.; Lutkenhaus, J. L. Charge Storage in Decyl- and 3,6,9-Trioxadecyl-Substituted Poly (dithieno[3,2-b:2,3-d]pyrrole) Electrodes. *Macromolecules* **2014,** *47* (1), 79-88.

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Shao, L.; Jeon, J.-W.; Lutkenhaus, J. L. Polyaniline Nanofiber/Vanadium Pentoxide Sprayed Layer-by-Layer Electrodes for Energy Storage. *J. Mater. Chem. A* **2014,** *2*, 14421-14428.

Sung, C.; Hearn, K.; Lutkenhaus, J. L. Thermal Transitions in Hydrated Layer-By-Layer Assemblies Observed Using Electrochemical Impedance Spectroscopy. *Soft Matter* **2014,** *10* (34), 6467-6476.

Sung, C.; Vidyasagar, A.; Hearn, K.; Lutkenhaus, J. L. Temperature-Triggered Shape-Transformations in Layer-by-Layer Microtubes. *J. Mater. Chem. B* **2014,** *2* (15), 2088-2092.

Zhou, J.; Pishko, M.V.; Lutkenhaus, J. L. Thermoresponsive Layer-by-Layer Assemblies for Nanoparticle-Based Drug Delivery. *Langmuir* **2014,** *30* (20), 5903-5910.

ASSISTANT PROFESSORS

CHAD V. MASHUGA

Ph.D., Michigan Technological University
mashuga@tamu.edu

Dr. Mashuga's research interests are centered on experimental process safety, including flammability, gas and dust explosions, calorimetry, energetic materials testing and internal combustion. His teaching interests include chemical process safety, process analysis and design, process control and chemical reaction engineering, among others. Mashuga brings 15 years of industrial experience from BASF and The Dow Chemical Company in the field of chemical engineering, along with six years of chemical engineering teaching experience from Wayne State University.

REFEREED JOURNAL PUBLICATIONS

Castellanos, D.; Carreto-Vazquez, V. H.; Mashuga, C. V.; Trottier, R.; Mejia, A. F.; Mannan, M. S. The Effect of Particle Size Polydispersity on the Explosibility Characteristics of Aluminum Dust. *Powder Technol.* **2014,** *254*, 331-337.

Castellanos, D.; Lewandowski, A.; Diaz, A.; Mejia, A. F.; Carreto, V.; Mashuga, C. V.; Rangwala, A. S.; Cheng, Z.; Mannan, M. S. Influence of Particle Size and Crystalline Level on the Efficiency of Dust Explosion Inhibitors. *Ind. Eng. Chem. Res.* **2014,** *53* (28), 11527–11537.

PHANOURIOS TAMAMIS

Ph.D., University of Cyprus
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Dr. Tamamis' research includes computational methods in the area of protein structure prediction, de novo protein design and the development of novel frameworks. He targets treatment of diseases such as HIV, cancer and diabetes, studied at atomic and molecular levels. Similarly, he develops bionanomaterials for applications in biomedicine, nanotechnology and energy.

REFEREED JOURNAL PUBLICATIONS

Khoury, G. A.; Smadbeck, J.; Tamamis, P.; Vandris, A. C.; Kieslich, C. A.; Floudas, C. A. Forcefield_NCAA: Ab Initio Charge Parameters to Aid in the Discovery and Design of Therapeutic Proteins and Peptides with Unnatural Amino Acids and their Application to Complement Inhibitors of the Compstatin Family. *ACS Synth. Biol.* **2014,** *3* (12), 855-869.

Khoury, G. A.; Tamamis, P.; Pinnaduwage, N.; Smadbeck, J.; Kieslich, C. A.; Floudas, C. A. Princeton_TIGRESS: Protein Geometry Refinement Using Simulations and Support Vector Machines. *Proteins* **2014,** *82* (5), 794-814.

Tamamis, P.; Floudas, C. A. Elucidating a Key Anti-HIV-1 and Cancer-Associated Axis: The Structure of CCL5 (Rantes) in Complex with CCR5. *Sci. Rep.* **2014,** *4* (5447), 1-9.

Tamamis, P.; Floudas, C. A. Elucidating a Key Component of Cancer Metastasis: CXCL12 (SDF-1α) Binding to CXCR4. *J. Chem. Inf. Model.* **2014,** *54* (4), 1174-1188.

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SREERAM VADDIRAJU

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sreeram.vaddiraju@tamu.edu

Dr. Vaddiraju's research includes the development of vapor phase techniques for the mass production of organic and inorganic nanostructures and the development and implementation of in-situ and ex-situ schemes for the large-scale integration of these nanostructures into energy conversion devices. He employs the study of novel electrical, electronic and mechanical properties of ultrathin nanowires in the gravitation of efficient thermoelectrics and solar cells. Vaddiraju was the 2014 recipient of the Fluor Distinguished Teaching Award.

ASSISTANT PROFESSORS

RESEARCH

"A POC, Simple Diagnostic for Norovirus," **Lynntech, Inc.,** 2/2014-7/2014 (PI).

"ALARM: Next Generation Food-Borne Pathogen Detection," **Lynntech, Inc.,** 10/2014-2/2016 (PI).

"NSF/DOE Thermoelectrics Partnership: Inorganic-Organic Hybrid Thermoelectrics," **National Science Foundation,** 1/2011-12/2014 (PI).

REFEREED JOURNAL PUBLICATIONS

Brockway, L.; Vasiraju, V.; Asayesh-Ardakani, H.; Shahbazian-Yassar, R.; Vaddiraju, S. Thermoelectric Properties of Large-Scale Zn_3P_2 Nanowire Assemblies. *Nanotechnology* **2014,** *25* (14), 145401.

Brockway, L.; Vasiraju, V.; Sunkara, M. K.; Vaddiraju, S. Engineering Efficient Thermoelectrics from Large-Scale Assemblies of Doped ZnO Nanowires: Nanoscale Effects and Resonant-Level Scattering. *ACS Appl. Mater. Interfaces* **2014,** *6* (17), 14923-14930.

Brockway, L.; Vasiraju, V.; Vaddiraju, S. Compositional Disorder and its Effect on the Thermoelectric Performance of Zn_3P_2 Nanowire–Copper Nanoparticle Composites. *Nanotechnology* **2014,** *25* (12), 125402.

Kang, Y.; Vaddiraju, S. Solid-State Phase Transformation as a Route for the Simultaneous Synthesis and Welding of Single-crystalline Mg_2Si Nanowires. *Chem. Mater.* **2014,** *26* (9), 2814–2819.

Nie, A.; Cheng, Y.; Zhu, Y.; Asayesh-Ardakani, H.; Tao, R.; Mashayek, F.; Vaddiraju, S.; Shahbazian-Yassar, R. Lithiation-Induced Shuffling of Atomic Stacks. *Nano Lett.* **2014,** *14* (9), 5301-5307.

Ramos-Sanchez, G.; Albornoz, M.; Yu, Y-H.; Cheng, Z.; Vasiraju, V.; Vaddiraju, S.; El Mellouhi, F.; Balbuena, P. B. Organic Molecule-Functionalized Zn_3P_2 Nanowires for Photochemical H2 Production: DFT and Experimental Analyses. *Int. J. of Hydrogen Energy* **2014,** *39* (35), 19887-19898.

Vasiraju, V.; Kang, Y.; Vaddiraju, S. Non-Conformal Decoration of Semiconductor Nanowire Surfaces with Boron Nitride (BN) Molecules for Stability Enhancement: Degradation-Resistant Zn_3P_2, ZnO and Mg2Si Nanowires. *Phys. Chem. Chem. Phys.* **2014,** *16* (30), 16150-16157.

HUNG-JEN WU

Ph.D., Texas A&M University
hjwu@tamu.edu

Dr. Wu's research includes nanotechnology and bioengineering. He integrates nanostructured materials and analytical tools to study the organization, dynamics and functions of biomolecules at biological interfaces. The applications of the developed techniques include infectious disease screening, imaging of complex biological networks that are critical to the development of disease, exploration of cell membrane function and drug discovery. Wu also focuses on synthetic mimics of the cellular surface to enable the development of novel materials and catalysis.

RESEARCH

"Microvesicle Isolation from Mycobacterium tuberculosis Infected Macrophage Using Multi-Stage Microfluidic Channel," **National Institutes of Health,** 06/2014-05/2018 (PI).

REFEREED JOURNAL PUBLICATIONS

Fan, J.; Niu, S.; Dong, A.; Shi, J.; Wu, H.-J.; Fine, D. H.; Tian, Y.; … Zhao, Y. Nanopore Film Based Enrichment and Quantification of Low Abundance Hepcidin From Human Bodily Fluids. *Nanomedicine* **2014,** *10* (5), 879-888. [Cover article]

Iversen, L.; Tu, H.-L.; Lin, W.-C.; Christensen, S. M.; Abel, S. M.; Iwig, J.; Wu, H.-J.; ... Groves, J. T. Ras Activation by SOS: Allosteric Regulation by Altered Fluctuation Dynamics. *Science* **2014,** *345* (6192), 50-54.

Wu, H.-J.; Li, Y.; Fan, J.; Deng, Z.; Hu, Z.; Liu, X.; ... Hu, Y. Antibody-Free Detection of *Mycobacterium Tuberculosis* Antigen Using Customized Nanotraps. *Anal. Chem.* **2014,** *86* (4), 1988-1996.

RESEARCH PROFESSOR

GILBERT F. FROMENT

Ph.D., University of Gent,Belgium
gilbert-f-froment@tamu.edu

Dr. Froment's research includes the kinetic modeling, based on the single event concept and the process modeling of hydrocracking, catalytic cracking, catalytic reforming, hydrodesulfurization, synthesis gas production by steam reforming, Fischer-Tropsch synthesis and olefin production by thermal cracking.

REFEREED JOURNAL PUBLICATION

Froment, G. F. On Fundamental Kinetic Equations for Chemical Reactions and Processes. *Curr. Opin. Chem. Eng.* **2014,** *5,* 1-6.

SENIOR LECTURERS

JOHN BALDWIN

Ph.D., Texas A&M University
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Dr. Baldwin's focus is on design, having been the primary instructor for the department's plant design course since joining the university. He also assists with design-oriented research as needed. He has served as a senior lecturer since 1995, following a 30-year career with Union Carbide (now part of The Dow Chemical Company), M. W. Kellogg (now KBR) and Heat Transfer Research (HTRI).

CHARLES E. ISDALE

M.B.A., Southern Illinois University-Edwardsville
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Isdale came to Texas A&M after working for 30 years in the industry as a chemical process engineer, which remains his main area of interest. He teaches four different classes for the department.

SENIOR LECTURERS

RAY A. MENTZER

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Dr. Mentzer has more than 28 years of experience in the upstream oil and gas industry, with a variety of technical and management assignments in safety/environment, design, operations, finance and research. He teaches courses on oil and petroleum processing, chemical process safety, and industrial safety and health. As a member of the Mary Kay O'Connor Process Safety Center, his research includes various aspects of process safety management and metrics, personnel safety, inherently safer technology and liquefied natural gas.

REFEREED JOURNAL PUBLICATIONS

Kim, B. K.; **Mentzer, R. A.**; Mannan, M. S. Numerical Study on Physical Mechanisms of Forced Dispersion for an Effective LNG Spill Mitigation. *Ind. Eng. Chem. Res.* **2014,** *53* (22), 9488–9498.

Mannan, M. S.; **Mentzer, R. A.**; Rocha-Valadez, T.; Mims, A. Offshore Drilling Risks – 1: Study: Risk Indicators Have Varying Impact on Mitigation. *Oil Gas J.* **2014,** *112* (5), 112-113.

Mannan, M. S.; **Mentzer, R. A.**; Rocha-Valadez, T.; Mims, A. Evaluating Offshore Drilling Risks – 2 (Conclusion): Global, Regional Statistics Show Continuing Improvement. *Oil Gas J.* **2014,** *112* (6), 66.

Mentzer, R. A.; Zhang, J.; Xu, W.; Mannan, M. S. What Does 'Safe' Look and Feel Like? *J. Loss Prev. Process Ind.* **2014,** *32*, 265-275.

Murray, S. L.; Harputlu, E.; **Mentzer, R. A.**; Mannan, M. S. Modeling Operators' Emergency Response Time for Chemical Processing Operations. *Journal of Emergency Management (Weston, Mass.)* **2014,** *12* (6), 479-486.

Rocha-Valadez, T.; **Mentzer, R. A.**; Hasan, A. R.; Mannan, M. S. Inherently Safer Sustained Casing Pressure Testing for Well Integrity Evaluation. *J. Loss Prev. Process Ind*. **2014,** *29*, 209-215.

J. DOUG WHITE

B.S., Texas A&M University
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White has more than three decades of industrial experience. His teaching focus is in the unit operations labs where students blend theory classes with actual operation of equipment and processes. A key element of these labs includes effective communication of technical subjects in line with industry expectations. He also serves as the departmental safety officer helping ensure the safe operation of the diverse research and teaching laboratories in chemical engineering.

LECTURERS

ALIM DEWAN

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Dr. Dewan's research focuses on biofuels and bioenergy. Currently he is investigating the population dynamics of single-cell microalgae using microfluidic techniques. The goal of the project is to understand cellular growth phenomena relating to algal biofuel productivity. He is also developing alternative power sources based on sediment microbial fuel cells, aiming to replace the batteries used for electronic devices deployed on the seabed.

REFEREED JOURNAL PUBLICATION

Dewan, A.; Ay, S. U.; Karim, M. N.; Beyenal, H. Alternative Power Sources for Remote Sensors: A Review. *J. Power Sources* **2014,** *245*, 129-143.

WILLIAM J. ROGERS

Ph.D., The Ohio State University
wjrogers@tamu.edu

Dr. Rogers is a research scientist at the Mary Kay O'Connor Process Safety Center, where he has been a scientist since 1979. His current research interest is a systems approach to engineering risk and uncertainty modeling and management using traditional and Bayesian models.

CHRISTIN M. WILSON

Ph.D., The Ohio State University
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Dr. Wilson teaches technical writing, drawing upon a scientific background in linguistics. She has taught undergraduate writing courses for several years and edited the 11th edition of *Language Files*. Wilson's research interests include socio-historical linguistics and language processing.

COURTESY/JOINT APPOINTMENTS

MARIA A. BARRUFET

Professor, Petroleum Engineering
Baker Hughes Endowed Chair
Ph.D., Texas A&M University
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Dr. Barrufet's research interests include the evaluation of different methods used to desalinate oilfield brines. She studies unit operation aspects of evaporators, membranes, osmotic separation, heat transfer, energy and mass balance computations. Barrufet advances the discussion on enhanced oil recovery, studying thermodynamics and transport phenomena applied to chemical, miscible and thermal recovery processes. She also evaluates rock and fluid properties in addition to multiphase flow.

TAHIR CAGIN

Professor, Materials Science and Engineering
Ph.D., Clemson University
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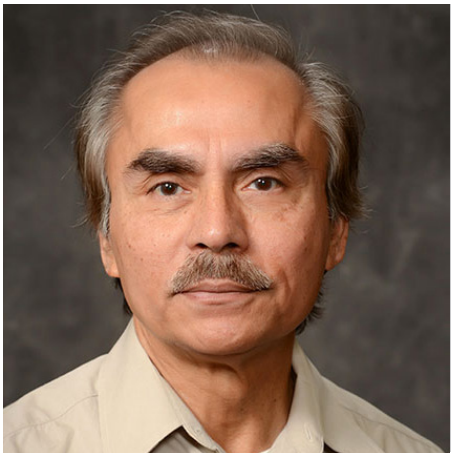
Dr. Cagin's research includes computational materials science and nanotechnology with emphasis on design, characterization and development of multifunctional, nanostructured materials for device and sensor applications. He performs fundamental studies on transport phenomena (heat, mass and momentum) at nanoscale and in confined media. Cagin studies thermal, mechanical, electronic and magnetic properties, phase behavior of materials, materials for thermal management, power generation and energy harvesting, and development and application of multiscale simulation methods.



A. RASHID HASAN

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Dr. Hasan is an expert in the subject of production engineering. He focuses on modeling complex transport processes in various components of petroleum production systems. Hasan's research group has pioneered systematic modeling of heat transfer in wellbores and one of the most recognized impacts of this research is in production safety analysis. Hasan's solutions to problems involving transient heat flow situations have found application in flow assurance, flow metering and pressure transient testing.

COURTESY/JOINT APPOINTMENTS

ZIVKO L. NIKOLOV

Dow Professor, Bioprocess Engineering
Associate Director, National Center for Therapeutics Manufacturing
Ph.D., Iowa State University
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Dr. Nikolov's research interests include recovery of recombinant biomolecules, bioprocessing of transgenic plants and algae, protein purification and bioprocess design and economics.

MICHAEL V. PISHKO

Professor, Biomedical Engineering
Stewart and Stevenson Professor II
Director, National Center for Therapeutics Manufacturing
Ph.D., The University of Texas, Austin
mpishko@tamu.edu

Dr. Pishko's research interests include microfabricated biosensors, neovascularization of implanted biomaterials and "smart" drug delivery systems. Pishko has co-authored more than 90 peer-reviewed research publications and developed 19 U.S. patents.

KUMBAKONAM RAJAGOPAL

Distinguished Professor
Regents Professor
J. M. Forsyth Chair, Mechanical Engineering
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Dr. Rajagopal is recognized internationally for his significant contributions to the world of continuum mechanics, computational mechanics, biomechanics and technology. He was elected to the Hall of Fame for Engineering, Science and Technology (HOFEST), which includes such luminaries as George Eastman, Thomas Alva Edison, Albert Einstein, Henry Ford, Bill Gates, Louis Pasteur and George Westinghouse.

COURTESY/JOINT APPOINTMENTS

MARLAN O. SCULLY

Distinguished Professor
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Dr. Scully's research interests include laser physics, quantum optics, non-equilibrium statistical mechanics and bioengineering. His bioengineering work includes the first real-time measurement of small amounts of anthrax. Experiments were carried out in his Jack E. Brown lab. The Scully-Lamb quantum theory of the laser was the first theoretical treatment that yielded laser photon statistics, laser line-width and all higher-order photon correlations. The theory was later extended to explain behavior of the single photon maser. Scully and his coworkers have demonstrated that the laser master equation analysis also provides a good quantitative description of the fluctuations in the Bose-Einstein condensate.

KAREN L. WOOLEY

University Distinguished Professor
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Dr. Wooley's research includes the fundamental development of synthetic methodologies that allow for the construction of increasingly complex polymers and nanostructured materials, including their hierarchical assembly into functional devices. Specific functional targets include nanoparticles for the treatment of infectious diseases and cancer of the lung and urinary tract; amphiphilic polymer coatings for anti-biofouling applications with emphasis on the marine environment; anti-icing polymer coatings and hybrid polymer-inorganic nanoparticles for oil-spill cleanup.

MASHUGA STUDIES DESTRUCTIVE, FIERY DUST

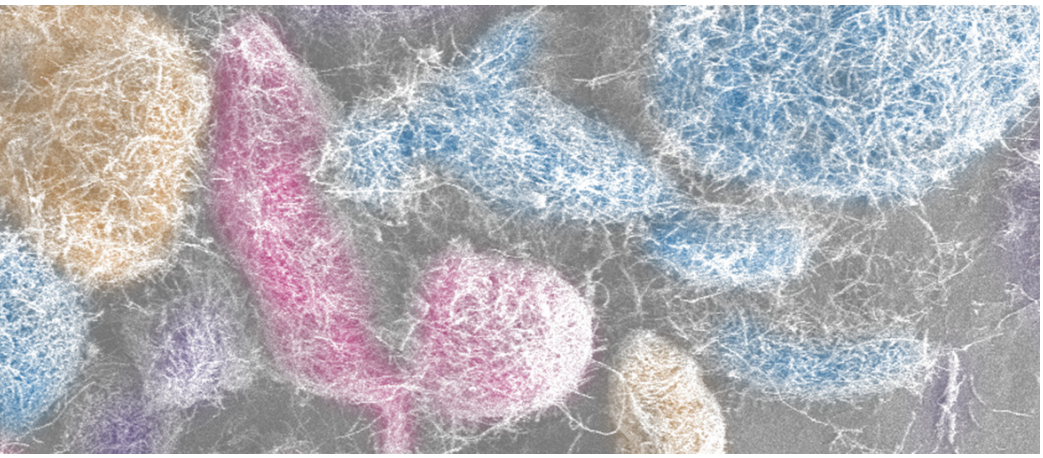


Illustration: Carbon nanofiber agglomerates studied for dust explosion potential

Dr. Chad Mashuga joined the Artie McFerrin Department of Chemical Engineering in fall 2014.

For Dr. Chad Mashuga, assistant professor of chemical engineering, explosive conditions create valuable learning opportunities. He pursues experimental process safety in the research of perfect storms: scenarios involving varieties of dust which create powerful bursts of energy and fire when stressed by other factors. Not new to industry, Mashuga joined the department in 2014 after having contributed 15 years of related expertise for The Dow Chemical Company and BASF.

As a faculty fellow with the Mary Kay O'Connor Process Safety Center, Mashuga feels his research remains ever timely.

"Dust hazards are not always recognized and accidents do occur. Attempts to understand dust explosions from a more fundamental standpoint are worthwhile," he said.

As reported by the U.S. Chemical Safety and Hazard Investigation Board, between 1980 and 2005 there were 281 combustible dust incidents that led to the deaths of 119 workers, injuries to 718 and extensive damage to numerous industrial facilities.

Given the "prevalence of solids as raw materials or as intermediates" in production and manufacturing, etc., Mashuga wants to advance the fundamental understanding of the ignition, combustion and explosion processes of these materials.

"Dust hazards are not always recognized and accidents do occur."

For such an explosion to occur, there must simultaneously exist an oxidizer, ignition source and a dispersed combustible dust in confinement. While metals are typically not viewed as explosive, during manufacturing shavings, granules and dust often form from even common materials such as aluminum and iron. The resulting metallic explosions are brilliant, said Mashuga.

Similarly, dust explosion potential can be hidden in common items such as cornstarch, coffee creamer, grains, paper and dyes which can create a flash fire if a proper particle cloud is formed and an ignition source is available.

Mashuga studies permeations of the dust fuel in these explosions; for example, the impact of size distribution and chemical structure. His research in this area shows that traditional reporting of size distribution can be inadequate and suggests an alternative that better represents the true dust hazard.

He has examined methodologies in preventing dust explosions. In 2014, Mashuga published research on the fundamental nature of inert dusts as a means to extinguish dust explosion hazards.

"I am also suggesting new ways of using existing test equipment to have alternative mitigation strategies for dust explosions, at more pertinent process conditions," said Mashuga.

Learn more.

NANO FACTOR: TINY, PECULIAR RODS TO CONVERT ENERGY AND PUBLIC OPINION

Dr. Sreeram Vaddiraju

Alternate forms of energy bubble over in breakthrough. From solar to wind and water sources, change has a way of driving new technology. Devices to convert and utilize these various forms of energy are becoming increasingly popular. Streamlining an affordable, mass-manufacturing process for energy platforms requires broad distribution and ultimately recycling methodologies to protect the environment.

"We take a holistic perspective," said Dr. Sreeram Vaddiraju, assistant professor of chemical engineering, whose research group fabricates energy conversion devices using nanowires—nanoscale rods made of semiconducting materials. The most compelling discovery for Vaddiraju is the new properties he has uncovered within the nanowires, thereby achieving, for him the "holy grail of nanotechnology."

"If you make a material very small (3-4nm), you'll see properties which are new," said Vaddiraju. "A brittle material suddenly becomes elastic." Large-scale assembly would include a collection of these nanomaterials, all still exhibiting their new properties and not losing any new characteristics, he explained.

Zinc phosphide, zinc oxide and other earth abundant materials comprise the nanowires used in Vaddiraju's research.

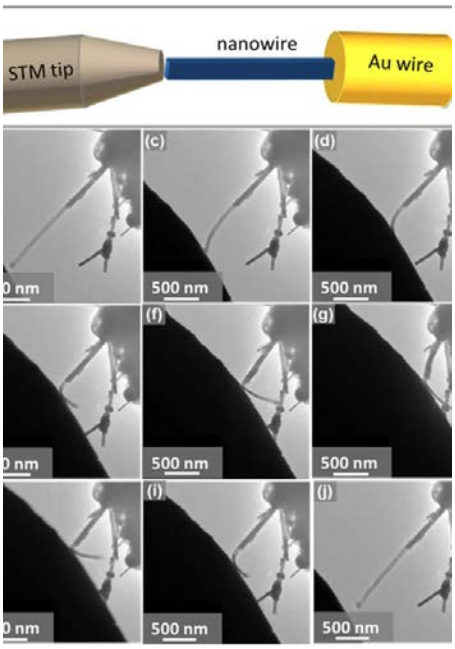
> ***"A brittle material suddenly becomes elastic."***

Using a high-density assembly process, his group takes a cluster of nanowires and compresses them together in round, pellet-shape disks. These wires, though incredibly compacted, do not break. Electricity abounds through them. Vaddiraju developed an energy conversion device that is degradation resistant to environmental conditions (i.e., moisture), and stable in the presence of water and heat. Furthermore, he proved nanowire stability in acid, and that nanowires can be welded together. This all-inclusive portfolio of stability has not been done before, said Vaddiraju.

For Vaddiraju, the production process of the energy conversion devices would closely mirror that of aspirin manufacturing and assembly. The environmental footprint is very important to his research. Highlighting recycling processes, he said, "we think of the whole life cycle of nanomaterials." The energy conversion devices can be used in solar cells, thermoelectric platforms and infrared detectors (e.g., night vision goggles) in hydrogen fuel production and lithium-ion batteries, to name a few examples.

Attention toward alternate energy platforms is due in part to dwindling sources of fossil fuels, said Dr. Rakesh Agrawal, distinguished professor of chemical engineering at Purdue University and Faculty Fellow for Texas A&M University's Institute for Advanced Studies, who envisions a solar economy. He said, "The rate at which we consume fossil resources is much faster than the rate of their formation. This means eventually we will run out [of fossil fuels]. Development of renewable energy resources is essential for the long-term viability of the human race."

"The Artie McFerrin Department of Chemical Engineering is at the forefront of renewable energy. Sreeram is developing novel thermoelectric materials that will allow us to harness thermal energy at high efficiencies and at low cost. That will be important as we move towards harnessing solar energy," Agrawal said.



Nanowire bending and returning to its original shape

Learn more.

EL-HALWAGI EXPLORES ENERGY, WATER NEXUS

Dr. Mahmoud El-Halwagi

Dr. Mahmoud El-Halwagi, professor of chemical engineering and holder of the McFerrin Professorship, has pursued the study of issues surrounding sustainability for nearly three decades. The interplay of water and energy, especially as it relates to industrial processes, informs his present research funded in 2014 by the Qatar National Research Fund—a three-year, one- million dollar project to begin in May for which he serves as a co-principal investigator. Dr. Patrick Linke, professor of chemical engineering at Texas A&M University at Qatar, is the principal investigator.

Water, in its many forms, has a direct relationship with the fulfillment of energy demands, said El-Halwagi. The duo, water and energy, is met with financial trade-offs and environmental implications. While these topics are usually studied independently, the duo is rarely separable.

"In order to produce energy, typically you need water. In order to transform energy from one form to another, you also need water. However, in order to use water, you need to treat it, and that usually requires energy. So, these two are intertwined," said El-Halwagi.

As an example of the pressing opportunity for his methodologies, El-Halwagi considers the chemical conversion of natural shale gas to fuel, a process that produces a substantial amount of water as a result of the reaction.

"In Qatar, they have the world's largest gas-to-liquid plants. In the U.S., we will also be building gas-to-liquid plants. So, if a country like Qatar, or a state like Texas, is blessed with energy resources such as shale gas, we are also implicitly blessed by water within that gas. You just have to properly get it out," he said.

The end goal is broad, deep and interconnected with reality and necessity. The nexus is influenced by the needs of a given industrial objective and balanced by the environmental considerations. El-Halwagi said that his conceptual approach is for the ultimate benefit of industrial, agricultural and residential sectors, for which there is often a shared water source. "In terms of balancing water usage, discharge and environmental impact, one needs to step back and look at the bigger picture for a whole region," he said.

If we as a society are able to do this, he said, "This will translate into reduced cost and improvement of environmental performance, and more sustainable manufacturing. Not only is it good for the environment, but it's also good for the business."

Advancing this science and technology in mainstream application is only part of the objective. Academically, there is much potential in the classroom, he said. "I always endeavor to bring these advanced techniques to my undergraduate students so they are always at the cutting edge of technology."

Learn more.

"I always endeavor to bring these advanced techniques to my undergraduate students so they are always at the cutting edge of technology."

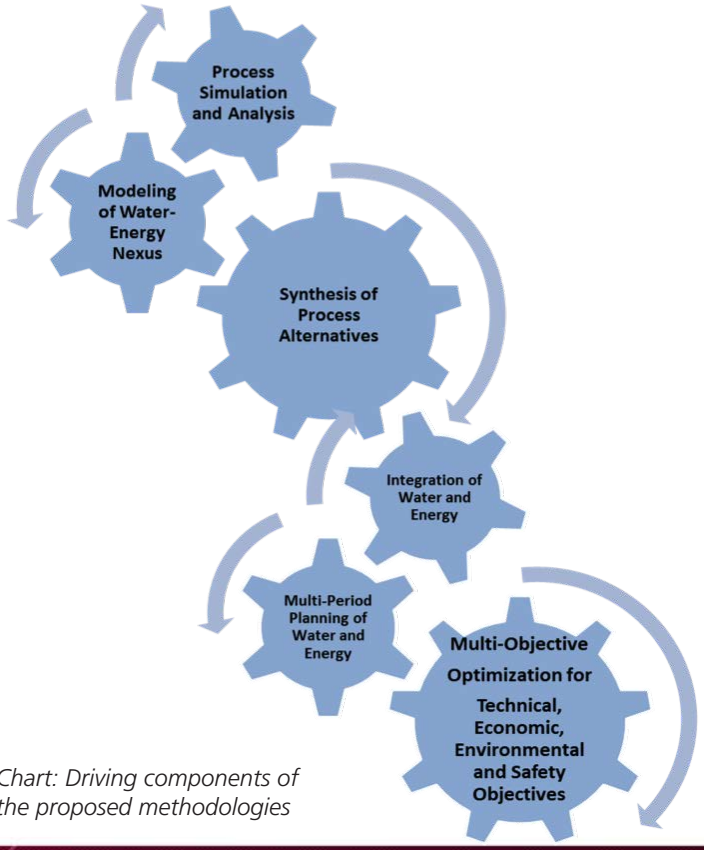


Chart: Driving components of the proposed methodologies

GREEN'S GRAPHENE RESEARCH INNOVATES NANOTECHNOLOGY

Dr. Micah Green joined the Artie McFerrin Department of Chemical Engineering in fall 2014.

SCIENTISTS like Dr. Micah Green, associate professor of chemical engineering, utilize electron microscopes to behold nanotechnology's newest wonder. Graphene, with a sheer lattice-like structure, is complex, pliable and filled with technological potential.

Graphene emerged only recently, identified formally in 2004. In its most desired form, graphene is highly electrically and thermally conductive and can bear a great mechanical load—100 times that of steel.

Since its discovery, many have tried to engineer graphene for industrial purposes but the particles can reaggregate to graphite and lose their advanced function if not managed properly. "If you treat graphene incorrectly, it will aggregate. It will go back to graphite. It won't even stay a nanomaterial. The way you process it, that's what chemical engineers do," Green said.

Spray drying is one way to process graphene, using water droplets suspended in a stream of warm air. The surface tension of the evaporating droplets causes the suspended graphene sheets to crumple like pieces of paper, said Green. Crumpled graphene powder can then be used in films and sheets for a wide array of industrial purposes.

All atoms are exposed to a surface, which is significant to application, said Green. This innovation supports heat transfer/dissipation in electronics, gas adsorption, catalysis and advances in other areas.

Graphite is naturally occurring within mined carbon; at the nanoscale of graphite, graphene appears. With its atomic-layer thickness and expansive specific surface area, the high aspect ratio of graphene positions itself center stage in all things nanotechnology.

For comparative assessments, the current market value of graphene is $2,000/kg; graphite is $1,400/ton. However, it's more than the numbers for Green, whose approach is far-reaching and multifaceted.

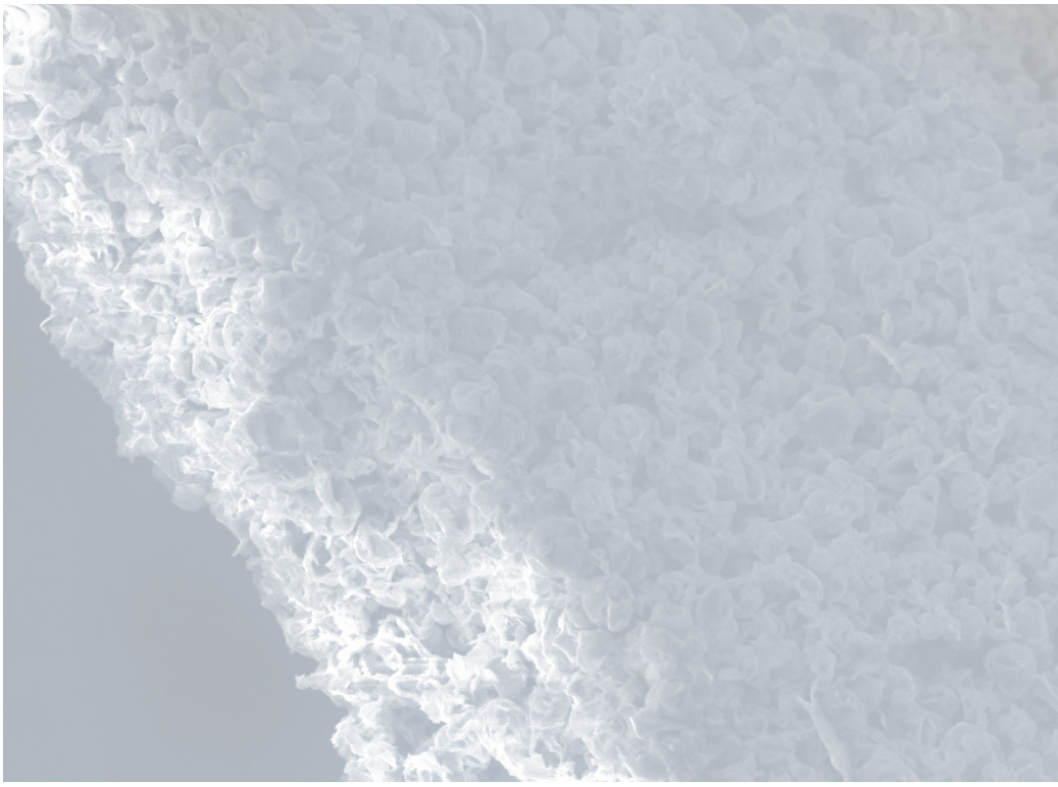
"I want to bring chemical engineering as a discipline to bear on nanomaterials. "

"I want to bring chemical engineering as a discipline to bear on nanomaterials. Part of that means scaling up. How do I take this little experiment and elevate it for industrial purposes, where bulk quantities of graphite are transformed into bulk quantities of graphene in such a way that it is scalable and cost effective?"

Green received the prestigious CAREER research award from the National Science Foundation in 2013: "Processing Structure Property Relations For Aggregation-Resistant Graphene." The $400,000 award supports a five-year research term, a project in which findings have already begun to attract interest from industry. In 2014, Green received the DuPont Young Faculty Award for his research in the area of crumpled graphene.

Learn more.

Illustration: Crumpled graphene film



BALBUENA AND PURDUE UNIVERSITY PERFORM LITHIUM-SULFUR BATTERY RESEARCH

Dr. Perla Balbuena

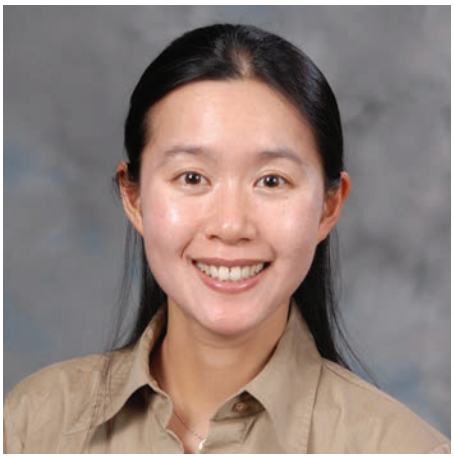
Video teleconference with Dr. Balbuena's research group and Purdue University

Dr. Perla Balbuena, professor of chemical engineering and GPSA Professor, was awarded $990,000 from the Department of Energy. Balbuena leads a project, in affiliation with Purdue University, to research design improvements and optimization of lithium-sulfur (Li/S) batteries in their application as plug-in electric vehicles (PEV) batteries.

Her research will explore a phenomenon called the "internal shuttle effect" within the Li/S battery and evaluate a multitude of other impacts to the battery's chemistry. Her research project is one of 19 sponsored by President Obama's EV Everywhere Grand Challenge that seeks to equalize affordability and convenience in PEVs for consumers, in comparison to current gasoline-powered vehicles.

"Our faculty members are consistently at the forefront of emerging technologies and cutting-edge research," said John Sharp, chancellor of the Texas A&M University System.

KAO STUDIES YEAST STRAIN AND HUMAN PATHOGEN: *CANDIDA GLABRATA*



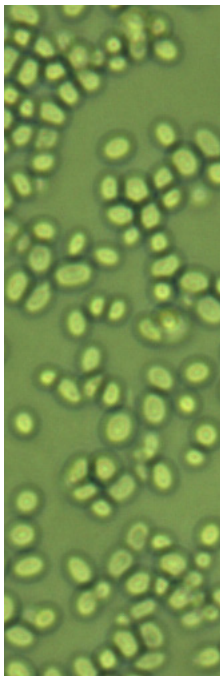
Dr. Katy Kao

For the past two years, Dr. Katy Kao has studied a type of yeast known as *Candida glabrata* with the objective of fundamentally understanding this "robust, opportunistic human pathogen," said Kao. *C. glabrata*, an organism found naturally on the skin and in the GI tract, has been used industrially since the 1990s by a company in Japan, to produce pyruvic acid.

This strain of yeast is more closely related to baker's yeast than *Candida albicans,* the major opportunistic human fungal pathogen. From an academic perspective, Kao considers ways to engineer *glabrata* mutants in order to better understand them.

"The maximum level of robustness that we can achieve in one organism is going to be limited by its genome code. The more important a pathogen, the more effort will go into characterizing it. There have been fewer groups studying this organism. It is less characterized than *albicans* or baker's yeast," said Kao.

Ph.D. student Mian Huang presented the latest research on *Candida glabrata* at the annual AIChE meeting in November 2014, in Atlanta. Kao works closely with her research group on these studies and is collaborating with Dr. Arul Jayaraman on gaining a deeper understanding on the adaptation of this organism.



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