

FALL 2015

CLEMSON[®]

CHEMICAL AND BIOMOLECULAR ENGINEERING

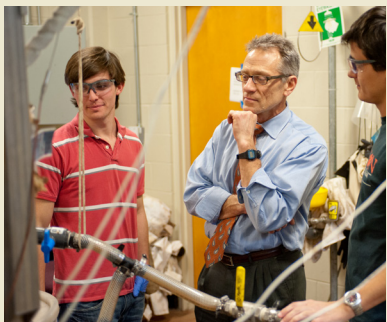
Dr. Mark Thies Elected Fellow of AIChE



Professor Mark Thies was elected Fellow in the American Institute of Chemical Engineers and was honored at the organization's annual meeting in November. Dr. Thies is a Dow Chemical Professor of Chemical and Biomolecular Engineering. Election as Fellow recognizes "service to the profession" and "significant professional accomplishment."

Contribution in one of these areas must be outstanding, and some contribution in both areas is necessary. The institute has more than 45,000 members and lists 877 Fellows on its website. That puts Fellows in the top 2 percent of the organization. "This honor reaffirms the high esteem with which your colleagues and peers view your distinctive professional achievements and accomplishments," according to an award statement the institute sent to Thies.

Thies has been on the Clemson faculty since 1985. He is the author of more than 80 refereed journal publications, three patents, and three book chapters, and has directed more than \$12 million in externally funded research. Douglas Hirt, chairman of the Department of Chemical and Biomolecular Engineering, said Thies's election was a well-deserved honor. "Election as Fellow is outside recognition that recipients are highly accomplished and are among the world's top chemical engineers," Hirt said.



Thies' research interests include thermodynamics, phase behavior, and separations, with an emphasis on the application of supercritical fluids to the fractionation and molecular characterization of poorly defined, oligomeric systems. Current systems of interest include lignin and liquid crystalline PAH oligomers for energy and materials applications.

(excerpts from article written by Paul Alongi, College of Engineering and Science)

New Faculty Member Dr. Eric Davis



We are pleased to announce that Dr. Eric Davis has joined the Department of Chemical & Biomolecular Engineering this Fall as an Assistant Professor.

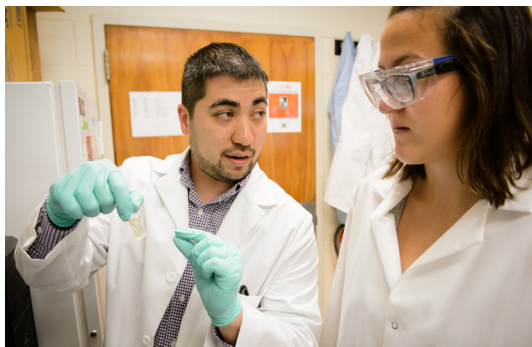
Dr. Davis received his B.S. in Chemical Engineering from Clemson University and his Ph.D. from Drexel University. Prior to accepting his position at Clemson, Dr. Davis held a postdoctoral research appointment at the National Institute of Standards and Technology in the United States Department of Commerce in Maryland. Dr. Davis' postdoctoral research focused on two main projects: measure and model both structure and water transport in hybrid membranes used for vanadium flow batteries, and investigate the effect of confinement on water diffusion in Nafion thin films used in proton exchange membrane fuel cells. Both projects have yielded high-impact results for the energy storage/delivery community and helped deepen the understanding of water transport in ionomer membranes.

At Clemson, Professor Davis' research will be centered on the fundamental relationship between polymer structure, transport phenomena, and polymer physics. His current research focuses on the development of structure-processing-property relationships of polymer membranes for energy storage and delivery applications including fuel cells and redox flow batteries, as well as membranes for water desalination and moisture barrier applications. In these efforts, Dr. Davis hopes to shed light on polymer physics phenomena, as well as aid in the development of next-generation polymer membranes for a number of real-world applications.



Dr. Davis assisted with teaching Unit Operations II and, in the spring, will teach Fluid Flow and Heat Transfer.

Dr. Mark Blenner receives \$600,000 NASA Early Career Faculty Award



Dr. Mark Blenner, Assistant Professor of Chemical & Biomolecular Engineering, recently received an **Early Career Faculty Award** from the **National Aeronautics and Space Administration (NASA)** to study microbial synthesis of nutraceuticals and materials to enable long-term space exploration. The project entitled “**Synthetic Biology for Recycling Human Waste into Nutraceuticals and Materials: Closing the Loop for**

Long-Term Space Travel” was among 8 awards NASA has selected to study innovative, early stage technologies that will address high-priority needs of America’s space program. The award funds 3 years of research for \$600,000.

It is impractical for astronauts to travel with all necessary supplies in future long-term space exploration missions. Therefore, it is imperative that technologies enabling the production of food, nutraceuticals, medicine, and materials from extraterrestrial resources are developed. These resources found in space include minerals and feedstocks found on distant bodies, waste generated by humans and space shuttle operation, and solar energy. Together with synthetic biology-driven technology for engineering microorganisms that can reliably, efficiently, and flexibly utilize such “in situ resources”, astronauts will be able to generate the food, nutraceuticals, medicine, and materials they need to carry out their mission. Due to potential uncertainty in resource availability, this proposal focuses on engineering yeast to convert respiration carbon dioxide, algae biomass, and human urine into nutritional omega-3 fats and 3D printable plastics. The technology developed through this project will not only be limited to applications in space. The Blenner Research Group is also interested in figuring out how to convert municipal and industrial waste streams into more valuable products, such as biofuels, and renewable lubricants and plasticizers. The lessons learned from utilizing space waste may be translated to developing new bioprocesses on earth.

NASA’s Early Career Faculty efforts are an element of the agency’s Space Technology Research Grants Program. This program is designed to accelerate the development of technologies originating from academia that support the future science and exploration needs of NASA, other government agencies, and the commercial space sector.

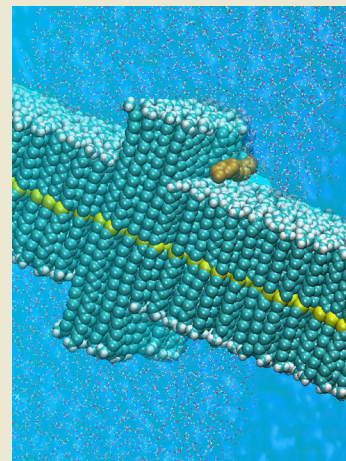
DR. SARUPRIA LEADS TEAM ON A CLEAN WATER RESEARCH AWARD

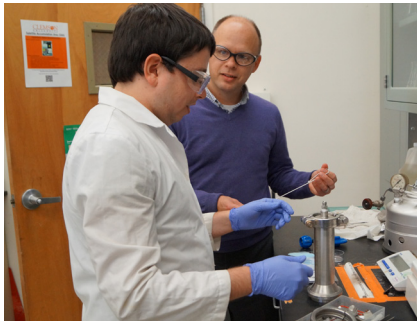


Dr. Sarupria and her fellow researchers at Clemson in collaboration with Dr. Ilenia Battiato at San Diego State University were awarded a \$1.2 million (\$970K to Clemson) DMREF research grant from NSF entitled “**DMREF: An integrated multiscale modeling and experimental approach to design fouling-resistant membranes.**”

The research team at Clemson includes **Drs. Sarupria, Scott Husson** (Chemical Engineering), and **David Ladner** (Environmental Engineering). Dr. Sarupria will provide the molecular modeling expertise, Dr. Husson is an expert in membrane design and synthesis, and Dr. Ladner is an expert on membrane based water treatment processes.

The project addresses a grand challenge facing society today ~ **how to make clean water available to a growing population at low cost.** Membranes used in water treatment processes are exposed to feed waters containing organic, inorganic, and biological species, which lead to fouling and loss of membrane productivity over time. Fouling propensity of a membrane depends greatly on its surface properties such as chemistry and morphology. The goal of this project is to develop the multiscale mathematical framework to predict fouling behavior on the surfaces of membranes with different geometric patterns and chemical coatings. The ability to predict fouling properties of new membrane surfaces in silico will accelerate the discovery of novel membrane designs and decrease the time from lab- to-market.

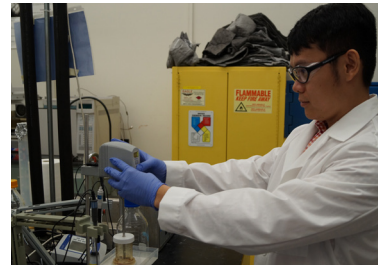




Dr. Scott Husson Works to Provide Water to Fast-Growing World

(article written by Paul Alongi, College of Engineering and Science)

If you want to know how busy **Scott Husson** has been, take a look at the bulletin board outside his Earle Hall office. Eleven research papers are pinned to the board, all published in the print editions of academic journals in 2014 or 2015. Husson's name

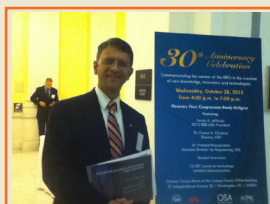


is on every one, making him one of the most prolific researchers in Clemson University's College of Engineering and Science. A lot of what Husson does involves making better membranes, which are useful in purifying water. He also applies his expertise to capturing carbon, purifying drugs and detecting radionuclides. The pace of his work is nowhere close to letting up. In three weeks over summer break, **Husson received word that three projects on which he is a collaborator have either been approved or recommended for funding, altogether totaling about \$2.1 million.** Husson, a professor of chemical and biomolecular engineering, expects to hire as many as five more Ph.D. students to handle the additional workload. He is quick to share credit with the members of his research group. Husson now has a team of five Ph.D. students and three postdoctoral researchers that had expenditures last year exceeding \$600,000. **"If you look at those papers on the bulletin board, I'm not first author on any of them,"** he said. **"It's really those individuals who are dedicated to identifying the problems and are doing the work to discover the solutions. I'm there for support."**

Husson is a key member of Clemson's Water-Energy Consortium. As part of their work with the consortium, about 40 faculty members from various disciplines have joined forces to more closely examine how to make water and energy systems more sustainable. Water is a common theme through several of Husson's ongoing research projects. **"I think there's a lot of interest in water right now,"** Husson said. **"That's an area where I've been working for some time. I just happen to have an interest in making materials for an application that is an important one right now."** Tanju Karanfil, an associate dean for research and graduate studies, said that Husson's research addresses a grand challenge facing global society. **"Dr. Husson and his group are working to make clean water available to a growing population at a low cost,"** Karanfil said. **"In the Western world, we take clean water for granted. But nearly 800 million people around the world still do not have access to clean water."** One recently funded project received nearly \$1 million from the National Science Foundation. The team will use computers to design more effective materials for water purification. Sapna Sarupria, an assistant professor of chemical and biomolecular engineering, serves as the principal investigator. Co-principal investigators are Husson and David Ladner, an assistant professor of Environmental Engineering and Earth Sciences. The collaboration across departments illustrates how the Husson group has been able to broaden its reach. **"A lot of the success we've had has come about because we've been able to identify outstanding people to collaborate with,"** Husson said. **"My students are very effective in going outside the group boundary to identify the people who can help them at the university and beyond. That has allowed us to identify the right groups to work with, as much as me going out and seeking that. The willingness of other groups to collaborate has been excellent."**

Husson is also building a startup company, Purilogics, LLC, based on his research into purification of protein drugs using membranes. The Greenville-based company develops membrane products that could enable biopharmaceutical manufacturers to increase production capacity and simultaneously lower the cost of biologics, which are a class of drugs in high demand. They treat severe and chronic conditions, including cancer and cardiovascular and rheumatoid diseases. Purilogics was selected as an SC Launch Client Company and an SCBIO QuickStart participant in 2015. (To view a recent video about Purilogics, please go to <https://youtu.be/CllgWwtwxIs>).

FACULTY HIGHLIGHTS



Prof. Amod Ogale (Dow Chemical Professor, Director of CAEFF) was invited for the 30th Anniversary celebration of the National Science Foundation Engineering Research Centers program at the U.S. Capitol Hill. He spoke in the Panel of Directors of graduated ERCs.

Prof. Scott Husson has been awarded several research grants recently: High-performance Membranes for Engineered Osmosis, National Science Foundation, Husson PI, \$359,066 (2015-2018); DMREF: Collaborative Research: An integrated multiscale modeling and experimental approach to design fouling-resistant membranes, National Science Foundation, Sarupria PI, Husson co-PI, Ladner co-PI \$969,089 (2016-2020); I-Corps Teams: Membrane Adsorbers for Biologics Purification, National Science Foundation, Husson PI, \$50,000 (2015-2016); Robust Extractive Scintillating Resin and Adsorptive Membranes for Plutonium Isotopic Analyses of Aqueous Media, DOE-NNSA, DeVol PI, Husson co-PI, \$750,000 (2016-2019).



STUDENT HIGHLIGHTS



Undergraduate Sean Dix is a senior who has been working in Dr. Rachel Getman's computer lab since May 2013. He is working on a project funded by the National Science Foundation through the Designing Materials to

Revolutionize and Engineer our Future program.

The project is part of the Materials Genome Initiative and is aimed at designing catalysts. To improve selectivity, the catalyst materials, which are comprised of metals supported on metal oxides, have been encapsulated within a metal-organic framework (MOF), which is a three dimensional porous structure. The pore structure limits which species can access the catalyst surface (e.g., molecules that are larger than the pore diameter cannot diffuse through the MOF to the catalyst). They also control how molecules interact with the catalyst surface. In his work, Sean is studying catalytic oxidation of n-butane to 1-butanol, using pore structures that force n-butane to stand upright on the catalyst surface that limit the interaction to the butane terminus and force the chemistry to occur at the terminal carbon only.

He has been studying the catalysis computationally, using quantum chemical calculations to determine the reaction energies and activation barriers involved in the catalytic mechanism, and using microkinetic modeling to identify the dominant reaction pathway, rate limiting steps, and other features of the catalysis.

Sean has submitted three research manuscripts since July with impact factors of 4.5 and 4.6. The latest manuscript provides insights for designing catalyst materials as well as reaction conditions for the catalysis. Sean will present these to our experimental collaborators at Northwestern University in early December.

He plans to attend grad school after graduation.



ChBE Band Members Blake Jenkins, Beau Bennett, Tyler Wiseman, Mark Payne, and Sean Stewart helped provide the excitement at the ACC Championship Game in Charlotte on December 5th. Without the Clemson band playing, the stadium would sound pretty dull!
TIGERS ARE #1!!!!

Graduate students Adam Klett and Juan Wang received AICHE Separations Division Graduate Student Research Awards at the recent AICHE Annual Conference in Salt Lake City, Utah. They each received a plaque and \$200. Adam's advisor is Dr. Mark Thies, and Juan's advisor is Dr. Scott Husson. The AICHE Separations Division award honors students who have a high level of interest in the field of separations, have strong work ethics, and are the primary author on a research paper that has contributed to separations fundamentals or applications and has been published or accepted. The purpose of the award is to encourage graduate students to excel and to identify future leaders in the separations field.



Murtaza Shabbir-Hussain won second place amongst graduate students presenting at the South Carolina Meeting of the American Society of Microbiology. Dr. Gabriel Rodriguez won a travel award from the CU Postdoctoral Association to travel to AICHE in Salt Lake City. Their advisor is Dr. Mark Blenner.



Graduate Students Steven Weinman, Nikki Chitpong, and Christine Duval attended the American Filtration and Separations Society meeting in Franklin, TN. Each gave an oral presentation and a poster presentation. In the student poster competition, Christine Duval won 1st place with her poster entitled, "Rapid Uranium Isotopic Analysis using Ultrafiltration and Alpha Spectroscopy." Nikki placed second and Steven was fourth. Their advisor is Dr. Scott Husson.



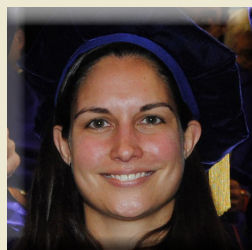
In Dr. Sarupria's research group, undergraduate David Barton received the SC Space Grant Consortium Undergraduate Research Award in the amount of \$6,000. Walter (Judge) Hanger, a Computer Engineering major, was accepted to present a poster at the XSEDE15 conference.



PhD GRADUATES



Dr. Margarita Arcila-Velez
Dissertation: "Design and Synthesis of Polymer, Carbon and Composite Electrodes for High Energy and High Power Supercapacitors"
Advisor: Dr. Mark Roberts
Current Position: December Graduate



Dr. Bethany Carter
Dissertation: "Synthesis of Renewable Aromatic Chemicals and Fuels From Biomass Derived Lignin and Lignin Model Compounds"
Advisor: Dr. David Bruce
Current Position: Principal Chemist
Ecolab Kay Chemicals
Greensboro, North Carolina



Dr. Felipe Polo-Garzon
Dissertation: "Optimization of Pyrochlore Catalysts for the Dry Reforming of Methane"
Advisor: Dr. David Bruce
Current Position: Postdoc--Catalytic Reactions
Oak Ridge National Lab
Oak Ridge, Tennessee

HOMECOMING ALUMNI REUNION

ChBE hosted its Annual Homecoming Alumni Drop-In tailgate before the football game on October 17th. It was great fun, food, and weather!! A special thank you to all of our alumni and their families that took the time to attend our tailgate. We had classes represented from 1964 through 2015. We also had several members from the Class of 1985 here for their 30th Class Reunion, and many members had not been in Earle Hall since they graduated. It was fun getting to know everyone. Thanks again to all of our alumni and their families for making this a great event. We hope you come back next year!!



Class of 1985 (L-R): Don Cain, Steve Strickland, Brent Bailey, Kim Bowers, Susan Wilson, Brad Gantt, Bob Jones, and Ron Sassard. Present but not pictured: Sim Hogan and Tom Monaghan

MESSAGE FROM THE CHAIR

Dear Alumni and Friends of the Department:

You may have met them when you were a student. You may have met them when you visited the Department, or when you attended one of our tailgating events. I am referring to our ChBE staff, who are critical to our success as a Department.



Terri McAllister
Office Manager &
Fiscal Analyst



Joy Rodatz
Undergraduate
Program



Diana Stamey
Graduate
Program



Bill Coburn
Technologist



The job-title designations that I've listed above appear to be straight-forward. They are not. For example, Bill takes care of Unit Operations labs, research labs, computer systems, safety programs (including training), building renovations, and much more. There are also many events that need to be planned and executed – graduation receptions, senior receptions, advisory-board meetings, tours, dinners, seminars, graduate student recruiting weekends, etc. All of these, and more, are handled with aplomb. As in any successful organization, the staff goes above and beyond the call of duty to make the operation run smoothly, and we appreciate the work of each and every one of them.

Go Tigers !!
Best regards, Doug Hirt

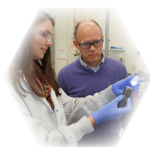


Department of Chemical and Biomolecular Engineering
 127 Earle Hall, Box 340909
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The Department of Chemical and Biomolecular Engineering would like to honor the following donors to our department from FY2015 (07/01/14- 06/30/15). Financial support is always critical to the operation of the department - without it we would not be able to fund our initiatives that help us attract the best students and faculty. Thank you so much to the donors listed below. Your generosity is sincerely appreciated!

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