

FALL 2013

CLEMSON[®]

CHEMICAL AND BIOMOLECULAR ENGINEERING

Dr. Amod Ogale and Dr. Mark Thies Named Dow Chemical Professors



We are pleased to announce that the title of Dow Chemical Professor has been bestowed upon both Drs. Amod Ogale and Mark Thies.

The Dow Chemical Professorship Fund in ChBE was established in 1992 by the Dow Chemical Company to support teaching, research, and affiliated activities and to recognize outstanding achievements in those areas. Both Drs. Ogale and Thies were chosen for this honor, as they are internationally known in their respective research fields and have contributed significantly to the department and the university.

A reception in their honor was held on October 9th. Representatives from Dow Chemical Company and Dr. Doug Hirt, Department Chair, presented Dr. Ogale and Dr. Thies with plaques commemorating their Dow Professorships. Congratulations!!



Pictured above L-R: Nathan Wiker (Dow-ChBE Class of 2004), Jim Haney (Dow-ChBE Class of 1989), Dr. Ogale, Dr. Hirt, Dr. Thies, Dean Anand Gramopadhye, Monty Heins (Dow-ChBE Class of 1986).

New Faculty Member Dr. Joseph Scott



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

Dr. Scott received his B.S. in Chemical Engineering from Wayne State University, and his M.S. and Ph.D. from MIT. Prior to accepting his position at Clemson, Dr. Scott held a postdoctoral research

appointment in the Department of Chemical Engineering at MIT.

Throughout his doctoral and postdoctoral research at MIT, Dr. Scott developed strong expertise in the areas of numerical methods, dynamic simulation, optimization, and process control.

Dr. Scott's research group will be focused on building an active, multi-disciplinary research program dedicated to solving real-world energy problems through the development of innovative mathematical and computational methods that support the design, operation, and control of complex chemical processes. Two main areas of interest will be optimal design and operation of renewable energy systems and fault detection and fault-tolerant control.

Dr. Scott is also looking forward to working with our undergraduate and graduate students through teaching and mentoring. His teaching interests include engineering problem formulation and modeling, process design and control, optimization techniques, and all aspects of numerical methods and computation.

We welcome Dr. Joseph Scott to the ChBE Team!! His background and expertise will be a great asset to our department and to the College of Engineering and Science.

The Versatile Carbon: Super-Strong Fibers for High Performance Composites



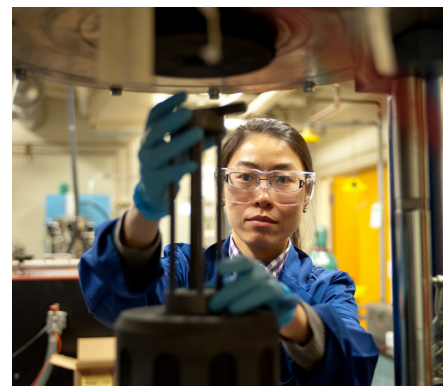
Marlon Morales and Dr. Ogale inspect some high-strength carbon fibers.

Graphite, a hexagonal crystalline form of carbon, possesses the highest known electrical and thermal conductivity and high temperature lubricity, whereas its diamond form is an expensive, hard material that is an excellent thermal conductor but electrical insulator. In its *macro*-form, carbon is used as electrodes that are over 10 m long, whereas in its *nano*-form, it is used as carbon nanotubes and graphene in emerging applications. This wide range of properties leads to real-world application of carbon in a wide range of fields, including structural carbon fibers, the primary focus of various research projects being undertaken by Prof. Amod Ogale, who is the 2013 Graffin Lecturer of the American Carbon Society.

Carbon in its fiber form is one of the strongest materials yet known to mankind. Carbon fibers derived from PAN precursors can possess a tensile strength of 7 GPa, which make them almost five times stronger than the best grade of steel. Mesophase pitch-derived carbon fibers possess a thermal conductivity of 1,000 W/m-K, almost thrice that of copper. However, their high cost (relative to reinforcing glass fibers) has limited carbon fiber application in defense, aerospace, and aircraft (Dreamliner 787) applications, where their low density is desirable. Recent “light-weighting” requirements in automotive and industrial applications have led to a renewed search for novel precursors and cost-efficient processing routes, which Prof. Ogale and his students are addressing.

Recent studies conducted in Prof. Ogale’s group by Marlon Morales (PhD ‘13) have addressed the UV-assisted stabilization of wet-spun polyacrylonitrile precursor fibers. This mechanism successfully led to the development of carbon fibers using the efficient route to cut heat treatment time by half! Dr. Billy D. Harmon, R&D Director, Cytec Carbon Fibers, Greenville, SC, notes that, “Cytec Carbon Fibers, R&D group is pleased with our interaction with Prof. Ogale and Marlon Morales, and excited by the top notch work Marlon has done in conjunction with our Air Force contract on advanced polyacrylonitrile-based carbon fibers for military aircraft. He has done a fantastic job and we look forward to more exciting and breakthrough research from Marlon and the Ogale group at Clemson.”

As with other industrial processes, conversion of PAN to carbon involves generation of undesirable by-products. This environmental problem can potentially be overcome by the use of naturally occurring biomass, including lignin. However, most current grades of lignin and their melt-spinning lead to rather poor properties of carbon fibers. Therefore, in a project sponsored by the Army Research Labs, Ms. Meng Zhang (PhD student) and Prof. Ogale are investigating controlled acetylation of a softwood kraft lignin for *dry-spinning* of precursor fibers. In recent results, they have reported the highest tensile strength attained for carbon fibers produced from dry-spun lignin. Also, these crenulated carbon fibers have 35% larger surface area (as compared with equivalent circular fibers that are typically obtained by melt-spinning) and will lead to higher fiber-matrix interfacial bond strength required for high-performance composites.



Meng Zhang setting up fiber heat treatment furnace to 2400°C.

MESSAGE FROM THE CHAIR



Dear Alumni and Friends of the Department:

Membranes. Lignin. Nanomaterials. Composites. Energy systems. Polymer processing. Curriculum integration. These encompass the technical sessions I attended at the recent AIChE Annual Meeting. The amazing thing to me is that these represent just a tiny fraction of the number of sessions organized for the meeting – a look at the overall technical program demonstrated the broad array of areas in which chemical engineers are involved, from atomic-level simulation to process design, and reinforces why a chemical engineering degree is so valuable in terms of its flexibility and its focus on fundamental principles.

The vast majority of the presentations at the AIChE Meeting focused on basic science and applied R&D, mirroring our Departmental research at all levels of student engagement. For example, we have an active, research-based Honors program in which juniors and seniors participate in a four-course sequence, working with faculty and graduate students on an original research project and culminating with an Honors thesis and graduating with Departmental Honors. This semester 15 juniors, out of a class of 60, entered the program, which represents the largest percentage of participants since we initiated the research-oriented sequence many years ago. Perhaps not surprisingly, most of these students also participate in additional activities, including co-op/internship programs and study abroad.

Best regards,
Doug Hirt, Professor and Chair

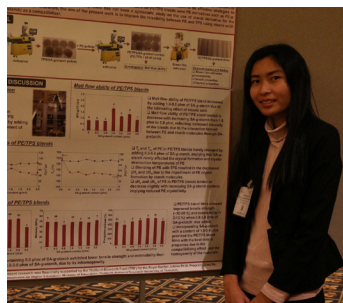
STUDENT HIGHLIGHTS



In July, several of our undergrads participated in the ChBE Study Abroad program in Vienna, Austria. This month-long intensive course is an approved substitute for the senior lab ChE 407 and helps reduce the demanding fall senior schedule for those undergrad students who participate. Since 2002, Clemson University has partnered with the University of Wisconsin and Technische Universitat



Wien (TU Vienna), both members of Global E3, to offer a summer Unit Ops lab that provides an international experience for U.S. ChE students. Participating in this academically rigorous laboratory program this summer were Kiah Baker, Matt Bell, John Clark, Michelle Coburn, Grace Custer, Davis Cyr, Jacob Johnson, Laura McLean, Sid Parasnavis, Julie Robinson, Steve Schofield, and Heather Snyder.



Nattaporn Khanoonkon is shown with her poster titled "Effect of Stearic Acid-Grafted Starch on Processability and Properties of Polyethylene/Thermoplastic Starch Blends" at the 2013 AIChE Conference. She is a visiting PhD student from Kasetsart University (Bangkok, Thailand) and is being co-advised by Prof Rangrong (Thailand) and Prof. Ogale.

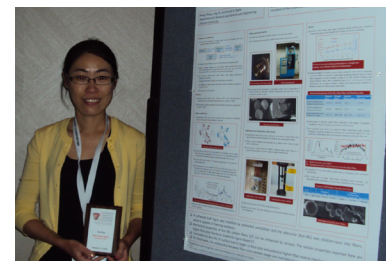


Kimberley Owen, ChBE Junior, was this year's Homecoming Build Coordinator for Habitat for Humanity. It was her job to organize the Habitat build on Bowman field for Homecoming in September. During the Homecoming festivities, 500 Clemson students worked to turn part of Bowman Field into a full sheetrocked house! This Homecoming marked the 20th year of building a Habitat house on Bowman.

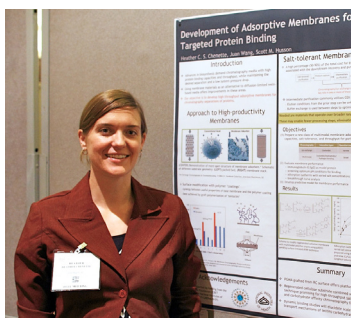


The Southeastern Catalysis Society (SECS) Symposium was held in September in Asheville, NC. The SECS is a division of the North American Catalysis Society. This year, the SECS Symposium attracted experimental and computational researchers from academia, industry, and government from locations in South Carolina, North Carolina, Tennessee, Georgia, Alabama, Florida, and Virginia. Members of both Dr. Rachel Getman's and Dr. David Bruce's research groups attended and presented their research. (L-R: Seth Elliott, Dr. Rachel Getman, Baxter Ward, Cameron Bodenschatz, Lizzie Bollman, and Jeremy Arvay.)

Meng Zhang, a PhD student in Prof. Amod Ogale's research group, recently received first prize of \$750 in the poster competition (among 32 entries) at the Automotive Composites Conference (ACCE), Society of Plastics Engineers. They announced that Meng was the unanimous choice of the judges for her poster entitled, "Carbon Fibers Derived from Sustainable Precursors." Congratulations, Meng!!



Margarita Arcila-Velez, a PhD student in Prof. Mark Roberts' research group, recently received a 2013 SACNAS Student Presentation Award for her exemplary presentation at the SACNAS conference in San Antonio, Texas. Her work was titled, "Enhanced Charge Storage Capacity of Conducting Polymer Electrodes by the Entrapment of P-Benzoquinone." Over 1,400 students and nearly 2,000 professionals attended this conference. Out of the attendees, over 730 posters and 95 oral presentations were delivered. Therefore, we are very proud that Margarita's communication skills and command of her research topic stood out from her fellow presenters. Congratulations!



The 2013 AIChE Annual Meeting was held in San Francisco in November. Presenters this year were: **Bethany Carter**, “Catalytic Depolymerization of Lignin Extracted from Kraft Black Liquor”; **Heather Chenette** (pictured left), “Development of Adsorptive Membranes for Targeted Protein Building”; **David Esguerra**, “Fractionation and Molecular Characterization of Pyrene Oligomers”; **Ashley Hart**, “Investigation of Ligand Binding and Exchange on Gold Nanoparticles with Isothermal Titration Calorimetry”; **Jesse Kelly**, “Control of Electrochemical Properties with Thermally-Responsive Polymer Electrolytes”; **Adam Klett** (pictured right), “Recovering a Liquid-Lignin Phase from Paper Mill Black Liquors”; and **Felipe Polo-Garzon**, “Optimization of Pyrochlore Catalysts for the Dry Reforming of Methane”.



PhD GRADUATES



Dr. Iris Cordova
Dissertation: “Novel Ceria-Zirconia-Yttria Mesostructures: Synthesis, Characterization, Diffusional Studies & the Effects of Morphology on their Properties”
Advisor: Dr. David Bruce
Current Position: Senior Materials Develop. Engineer
AVX Corporation
Greenville, South Carolina



Dr. David Esguerra
Dissertation: “Pyrene Oligomers: Their Isolation, Molecular Characterization, and Phase Behavior”
Advisor: Dr. Mark Thies
Current Position: DIC Process Engineer
Intel Corporation
Hillsboro, Oregon



Dr. Ming He
Dissertation: “A Computational Approach for the Rational Design of Bimetallic Clusters for Ethanol Formation from Syn-Gas”
Advisor: Dr. David Bruce
Current Position: Software Engineer
Huawei Technologies
Santa Clara, California



Dr. Milagro Marroquin
Dissertation: “Advanced Imaging as a Novel Approach to the Characterization of Membranes for Microfiltration Applications”
Advisor: Dr. Scott Husson
Current Position: Quality Assurance Project Manager
StarPak Ltd.
Houston, Texas



Dr. Mary Mitchell
Dissertation: “Degradation of Aliphatic Polyesters: Poly(lactic acid) and Poly(butylene succinate-co-adipate)”
Advisor: Dr. Douglas Hirt
Current Position: Senior R&D Engineer
PepsiCo
Hawthorne, New York



Dr. Marlon Morales
Dissertation: “UV-Assisted Stabilization of Polyacrylonitrile-Based Carbon Fiber Precursors”
Advisor: Dr. Amod Ogale
Current Position:
December Graduate



Dr. Jose Orellano
Dissertation: “Advanced Biomaterials from Renewable Resources: An Investigation on Cellulose Nanocrystal Composites and CO₂ Extraction of Rendered Materials”
Advisor: Dr. Christopher Kitchens
Current Position: Student
University of Dallas



Dr. Byron Villacorta
Dissertation: “Effect of Graphitic Carbon Nanoparticles on the Electromagnetic Shielding Effectiveness of Linear Low Density Polyethylene Nanocomposites”
Advisor: Dr. Amod Ogale
Current Position: December Graduate



Dr. Jinxiang Zhou
Dissertation: “Perfluorocyclobutyl Polymer Thin-Film Composite Membrane Fabrication, Plasticization and Physical Aging”
Advisor: Dr. Scott Husson
Current Position: Post Doc
Clemson University
Clemson, SC

HOMECOMING ALUMNI REUNION



Joe Alexander(Class of 1955) and Ruth Alexander

ChBE hosted its Annual Homecoming Alumni Drop-In tailgate before the football game on September 28th. 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. We had classes represented from 1955 through 2013. We also had several members from the Class of 1976 who returned this year. Thanks again to everyone and come back next year!!



Tommy Kicklighter (Class of 1964) and Anite Kicklighter



Class of 1976



Advanced Materials
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 Energy
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 Molecular Modeling and Simulation

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The Department of Chemical and Biomolecular Engineering would like to honor the following donors to our department from FY2013 (07/01/12- 06/30/13). 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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