

AICHE

2008
SOUTHERN REGIONAL CONFERENCE

April 4-6, 2008



AUBURN UNIVERSITY
SAMUEL GINN
COLLEGE OF ENGINEERING

AIChE[®]

Founded in the United States in 1908, AIChE is a professional association of more than 40,000 chemical engineers in 93 countries. Its members work in corporations, universities and government using their knowledge of chemical processes to develop safe and useful products for the benefit of society.

AIChE's Vision is to provide value as the global leader of the chemical engineering profession, serve as the lifetime center for professional and personal growth and security of chemical engineers, and lead as the foremost catalyst in applying chemical engineering expertise in meeting societal.

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Welcome from the Co-Chairs:

April 4, 2008

Dear AIChE Southern Region:

On behalf of Auburn University and the Auburn Student Chapter of AIChE we would like to welcome everyone to Auburn, Ala. for the 2008 Southern Regional Conference. This conference has been two years in the making and without the help of our faculty and the department, as well as our corporate sponsors and student volunteers, this weekend would not be possible.

We will kick off the conference with a plant trip to ExxonMobil on Friday afternoon. The evening activities will begin with a BBQ and Scavenger Hunt at the recently constructed Shelby Center. We then invite you to enjoy downtown Auburn and Tiger Nights - a fun event held on Auburn's Campus.

Saturday morning, the conference will continue with the Paper and Poster Competitions. We will also be holding the Future's Fair which features both companies and graduate schools. We also invite you to participate in one of our many workshops. Whether you choose to go on a brewery tour, a research tour, a paper machine tour, or participate in one of our many roundtable discussions at lunch, you will be sure to have a blast. After lunch the ChemE car competition kicks off. After a morning full of engineering, we invite you to relax and enjoy a nice game of kickball! The banquet that evening will feature Dr. Greg Nelson of Eastman Chemical as the keynote speaker. Then it's off to Pockets to enjoy pool, darts, and dancing.

We sincerely hope you enjoy your time at Auburn and the conference this weekend!

Sincerely

Emily Asher and Josh Citron

2008 Southern Regional Conference Co-Chairs

2008 Southern Regional Conference Chairs

Emily Asher - Co-Chair

Josh Citron - Co-Chair

Faculty Advisor - Steve Duke

Banquet Chair - Efe Sahinoglu

Paper and Poster Competition Chair - Laura Kelley

Car Competition Chair - Kevin Cullinan

Workshop Chair - John McCracken

Food Chair - Stephani Leach

Night Life Chair - Adam McKinnon

Registration Co-Chair - Josh Thompson

Registration Co-Chair - Jenna Bedsole

Futures Fair Chair - Laura Clenney

Plant Tour Chair - Brock Wilson

Logistics Chair - Patrick Mays

Finance Chair - Ashley Thompson

Fundraising Chair - Kevin Cullinan

Kickball Chair - Chris Vaughn

Webmaster - Patrick Mays

Conference Overview

Friday, April 4th

10:30am - 5:00pm	Plant Tour ExxonMobil in LaGrange, Ga.	<i>(Pick up and drop off at the Jule Collins Smith Museum of Fine Art)</i>	
1:00pm - 8:00pm	Registration	Shelby Center	
6:00pm - 9:00pm	BBQ and Scavenger Hunt	Shelby Center	Auburn Pulp and Paper Foundation
8:30pm until . . .	Tiger Nights Social	Foy Union, AU Campus Downtown Auburn <i>(Buses will run to and from downtown to hotels until 2 a.m.)</i>	

Saturday, April 5th

7:30am - 9:30am	Continental Breakfast	Ross Hall Atrium	Southern Company
7:30am - 10:00am	Late Registration	Ross Hall Front Desk	
8:00am - 11:00am	Paper Competition	Ross Hall 136 and Ross Hall 202 and 278	Milliken
9:00am - 12:30pm	Future's Fair	Foy Student Union 217	
9:00am - 11:00am	Poster Competition	Foy Student Union 213	Evonik Degussa
9:00am - 11:00am	ChemE Car Poster Competition	Foy Student Union 213	Boise Paper
11:00am - 12:30pm	Lunch	Tent in front of Ross Hall	Alabama Center for Paper and Bioresource Engineering
11:30am - 12:15pm	Round Table Discussions: <i>What Are You Doing to Save the World?</i> <i>Growing Your Chapter</i>	Ross Hall 136 Ross Hall 278	
12:30pm - 3:00pm	Workshops • Ale House Brewery Tour • Auburn University Research Tour • Auburn University Paper Machine Tour	Meet at front of Ross Hall <i>(Departure times and tour durations vary)</i>	
12:30pm - 3:00pm	ChemE Car Competition	Foy Student Union Ballroom	Boise Paper
3:00pm - 5:30pm	Kickball Tournament	Duck Samford Fields	Southern Company
7:00pm - 9:15pm	Banquet	Auburn University Hotel and Conference Center Ballroom A	Eastman
9:30pm until . . .	Social (Pockets)	<i>(Buses will run to and from hotels until Pockets closes)</i>	

Sunday, April 6th

9:00am - 11:30am	Officer's Breakfast	Haley Center Eagle's Nest	ExxonMobil
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Friday, April 4

Registration

1:00 p.m. - 8:00 p.m.

Shelby Center, Grand Foyer

Plant Tour – ExxonMobil, LaGrange, Ga.

1:00 p.m. - 5:00 pm

Buses will pick up and drop off at your hotel.

ExxonMobil Chemical, is a global leader in the development and manufacture of specialty oriented polypropylene (OPP) films.

The company is in the middle of a significant upgrade of the LaGrange facility to increase its North American capacity for multi-layer white OPP films. The multimillion dollar investment will allow the company to satisfy the rapid growth in demand for specialty OPP films, such as OPPalyte™ white opaque film for candy cold-seal applications, OPPalyte™ WOS-2 and STW white opaque films for ice cream novelty applications and Label-Lyte™ films for wet glue and pressure sensitive labeling.

ExxonMobil Chemical's white opaque OPP films, each specifically tailored for targeted applications, have earned a reputation for outstanding performance that continues to fuel growth in the confectionary and ice cream markets. OPPalyte HM film, to be produced on the upgraded facility at LaGrange, utilizes a proprietary multi-layer technology to achieve exceptional cold seal adhesion. The company's OPPalyte WOS-2 and STW films use proprietary multi-layer designs to provide optimal performance on multilane packaging machines commonly used for ice cream novelties.

This current upgrade is a continuation of ExxonMobil Chemical's strategy to invest in specialty assets for its OPP films business. Since 2002, the company has added two new state-of-the-art orienters, a new coater and two new metallizers in its affiliated worldwide OPP film manufacturing facilities. Additionally, the company continues to upgrade existing assets like at LaGrange.

The Films Business of ExxonMobil Chemical provides multi-layer white opaque films, metallized films and acrylic and PVdC coated films for flexible packaging and labeling applications. It has affiliated production plants in Europe (Virton, Belgium; Kerkrade, the Netherlands; and Brindisi, Italy), and North America (LaGrange, Georgia; Shawnee, Oklahoma; Stratford, Connecticut; and Belleville, Canada). The company and its affiliates have sales offices to support customer needs in countries around the world, including North America, Europe and Asia. Additional information regarding the Films Business can be found at: www.oppfilms.com

BBQ and Scavenger Hunt

6:00 - 9:00 p.m.

Shelby Center, East Portico

Join us for some food and fun.

Sponsor: Auburn Pulp and Paper Foundation

Tiger Nights/Social

8:30 p.m. until ...

Campus and downtown Auburn

Tiger Nights is a fun, late night (7:00 p.m. – 12:00 a.m.) program sponsored by Auburn University Program Council that includes a concert, inflatable games, caricature artists, and other free entertainment. The event will be held in and around Foy Student Union on Auburn's campus. There will be free admission for everyone attending the conference. Transportation to and from all hotels will be provided from Foy until 12 a.m. and from downtown stops until 2 a.m.

Saturday, April 5

Continental Breakfast

7:30 a.m - 9:30 a.m.

Ross Hall Atrium

Late Registration

7:30 a.m - 10:00 a.m.

Ross Hall Front Desk

Paper Competition

8:00 a.m. - 11:00 a.m.

Session A.

Ross Hall 202

Session B

Ross Hall 278

Session C

Ross Hall 136

Sponsor: **Milliken**

Paper Competition Rules

Each entry must be from an undergraduate student that is currently a member of one of the participating student chapters. Others students may present, but cannot be considered for top prizes.

Papers are restricted to undergraduate research. No unit operations labs are allowed.

Each school will be limited to two papers. (Note: Schools can send additional papers to be held on a waiting list if they wish. These papers will be added if there are available spots. If necessary, chapter advisors will be asked to rank the order of the alternate papers from their school.)

Co-authorship of a paper is permitted, but only one person may make the presentation at the Regional Student Paper Competition. This person must have been substantially involved in the project or subject of the presented paper.

There will be multiple presentation rooms. Each room will have a panel of three well-qualified judges made up of an industrial representative, a faculty member, and/or AIChE local section members. These judges' decisions are final. Judges from all rooms will decide on the winners of the overall presentation. Judges will have access to video recordings of the presentations.

A fifteen minute time limit will be in place for the presentation, with an additional three to five minutes provided for questions and answers. Penalties will be enforced for participants who do not observe the time limit.

The first-place overall winner will be invited to compete at the national level. If this winner does not submit their abstract to nationals by deadline, then the second and third-place overall winners will be able to compete at the national level (the abstract for these papers should be submitted before the deadline and will be accepted if the first place overall winner does not submit an abstract).

Paper Competition Prizes

Paper 1st place	\$600 per room
Paper 2nd place	\$400 per room
Paper 3rd place	\$200 per room
Paper 1st overall	\$650.00
Paper 2nd overall	\$450.00
Paper 3rd overall	\$250.00

Paper Competition, Session A

Ross 202 (Chemical Engineering Conference Room)

Paper No.	Time	Name	School	Title
A.1	8:00	Melissa Cook	Mississippi State University	Design of a Laboratory Scale Pyrolysis System for Evaluating the Recycle Potential of CCA-Treated Wood Waste
A.2	8:22	Jake Vestal	North Carolina State University	A Synthetic Lung Surfactant for Treatment of Respiratory Distress Syndrome
A.3	8:44	Robert Smith	FAMU/FSU	The crystalline structure of halogenated polyethylenes studied at SAXS
A.4	9:06	Nickyla Alliowe	University of Tennessee	Photosynthetic Biohydrogen
A.5	9:28	Rosemary Weathersby	Mississippi State University	The Exploration of Electroporation as a Lipid Extraction Method for Oleaginous Micro Organisms
A.6	9:50	Caitlyn Cecil	University of Kentucky	Bioreactive Membranes by Layer-by-layer Assembly
A.7	10:12	Mohammad Biswas	Auburn University	Applications of Molecular Vapor Deposition of Precursor Compounds on Different Surfaces

Paper Competition, Session B

Ross 278 (Mechanical Engineering Conference Room)

Paper No.	Time	Name	School	Title
B.1	8:00	Mohamed Seyam	North Carolina State University	Optimization of Immobilization of Lipases on Various Supports for Transesterification of Tributyrin using Dimethyl Carbonate
B.2	8:22	Zach Scheibal	Louisiana State University	Protein Immobilization on Silicon Nanowires via Electrografting of Hexynoic Acid
B.3	8:44	Steven Mouton	University of South Alabama	The Effect of Calcium and Sodium Deposition on a PEMFC
B.4	9:06	Cari Launiere	Tulane University	Mimicking Microbes to Enhance Flexible Liposome Skin Penetration
B.5	9:28	A. Ashley Anderson	University of Kentucky	<i>In-Vitro</i> Biocompatibility Analysis of Temperature-Responsive Hydrogel Nanocomposites

B.6	9:50	Nemoy Rau	Tennessee Technological University	Designing Effective Trials Regarding Treatments Against Cancerous Tumor Growth
B.7	10:12	Mary Kathryn Sewell	University of Alabama	Multifunctional Magnetic and Thermally Responsive Hydrogels for Anti-Cancer Drug Delivery

Paper Competition, Session C

Ross 136 (Chemical Engineering McMillan Room)

Paper No.	Time	Name	School	Title
C.1	8:00	James Tidwell	University of Kentucky	Fibronectin binding to the Treponema pallidum adhesin Tp0483 on Functionalized Self-Assembled
C.2	8:22	Harold Hatch	Tulane University	Stability of Natively Unfolded Proteins
C.3	8:44	Jared Jones	Mississippi State University	Biomass Gasification: Catalytic Tar Removal Using Fe, Ni and Ru on zeolites
C.4	9:06	Fahmin Basher	University of South Carolina	An Analysis of the Inhibition of Amyloid- β -Induced Inflammation in Alzheimer's Disease
C.5	9:28	Jeney Zhang	Auburn University	Bandage Contact Lenses for Antibacterial and Anti-Inflammatory Therapeutics
C.6	9:50	Jessica Lisane	North Carolina State University	Fabrication and Characterization of Latex Microsphere Colloidal Crystals Controllably Deformed on a Poly(dimethylsiloxane) Substrate
C.7	10:12	Ashley Hawkins	University of Kentucky	Nanocomposite Biodegradable Polymers: Preparation and the Analysis of Heating, Degradation, and Drug Release

Paper Competition – Abstracts

Session A, Ross 202 (Chemical Engineering Conference Room)

A.1

Design of a Laboratory Scale Pyrolysis System for Evaluating the Recycle Potential of CCA-Treated Wood Waste

Name: Melissa Cook

School Name: Mississippi State University

Phone: 662.341.0946

Co-Authors: Amy Parker, Mark Bricka

Since the early 1970's, the most widely used wood preservative has been chromated copper arsenate (CCA), resulting in nearly 80% of all treated wood products in North America being treated with CCA. By the end of 2003 CCA-treated wood was restricted to industrial applications, resulting in a considerable increase in the volume of CCA-treated wood slated for disposal. Landfilling was considered an acceptable means of discarding CCA-treated wood products until recently, leading to approximately 24 million tons of CCA waste. Problems with metals leaching from the landfills and contaminating the surrounding soil and groundwater have generated the need for a safe and efficient disposal method

for CCA-treated wood. Pyrolysis, the heating of biomass at temperatures between 400°C and 650°C in the absence of oxygen, is a well studied technology that can be applied to CCA-impregnated wood waste. Pyrolysis of lignocellulosic material produces char, liquid condensate (bio-oil), and non-condensing gases. The focus of this research is on removing the CCA components from wood while recovering the energy value of the wood. This is accomplished by concentrating the CCA metals in the bio-oil, for possible re-use in wood preservatives, during pyrolysis. A lab-scale pyrolysis system, capable of operating in the desired temperature range under atmospheric and vacuum conditions, was designed. The system allows for the collection of each pyrolysis product so that complete mass balances on the metals can be performed, tracking the fate of the CCA metals. This paper discusses the process of designing the laboratory scale pyrolysis system and preliminary experimental results.

A.2

A Synthetic Lung Surfactant for Treatment of Respiratory Distress Syndrome

Name: Jake Vestal

School Name: NC State University

Phone: 919.819.4801

Lung surfactant (LS) is a complex mixture of lipids and proteins (SP-A, B, C and D) that lowers surface tension in the alveoli, thereby insuring a negligible work of breathing and preventing alveolar collapse upon exhalation. LS is functionally inhibited during Acute Respiratory Distress Syndrome (ARDS) which afflicts 150,000 individuals per year with a 40% mortality rate. ARDS is characterized by elevated levels of serum proteins in the alveoli which interfere with the formation of a LS monolayer at the alveolar air-liquid interface. In a related disorder, Neonatal Respiratory Distress Syndrome (NRDS), premature infants which lack functional LS are successfully treated with animal derived replacement LS. Our objective is to develop a synthetic LS that resists inhibition as seen in ARDS and could also be used to treat NRDS at lower cost and avoiding possible contamination issues.

A Langmuir trough was used to study the surface properties of different LS mixtures, their response to serum protein inhibition, and subsequent inhibition reversal. Studies on Survanta, an animal derived replacement LS which contains SP-B and SP-C, showed that inhibition could be reversed by treatment with chitosan, CaCl₂, and polyethylene glycol. To determine the minimum recipe that would yield a synthetic LS resistant to inhibition, mixtures containing only "Survanta-like" lipids and lipids with SP-B/SP-C peptide analogues were evaluated. Addition of peptide analogs showed improved surface performance of lipids on a clean subphase. However, results showed that no combination of synthetic lipids and/or peptides resists serum protein inhibition as well as Survanta.

A.3

The Crystalline Structure of Halogenated Polyethylenes Studied by SAXS

Name: Robert Smith

School Name: FAMU/FSU College of Engineering

Phone: 904.859.7811

Co-Authors: M. R. Bockstaller, R. G. Alamo

The crystalline structure of halogenated polyethylenes studied by SAXS

R.L. Smith¹, M.R. Bockstaller², R.G. Alamo¹ ¹ FAMU/FSU College of Engineering, Department of Chemical and Biomedical Engineering, Tallahassee, Florida 32310-6046. ² Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, Pennsylvania, 15213

The type of polyethylene crystals can be controlled by selectively substituting hydrogen atoms with hetero atoms along the polymer chain. This work presents changes in the crystalline structure of halogen substituted polyethylenes with fluorine, chlorine, and bromine along the chain. Polymers with a random halogen substitution or with halogens placed at a precise distance have been studied using small-angle x-ray scattering (SAXS). Structural data for the long spacing and thickness of the crystalline and amorphous regions, obtained from simple Lorentz intensity corrections and from the analysis of the one-dimensional correlation function, are comparatively studied. A major general conclusion for precisely substituted polymers is that decreasing the space between the substituents reduces the crystallinity and crystallite thickness while the amorphous region remains basically constant. Increasing the size of the substituents also hinders the crystal formation within polyethylene. A random distribution of the substituents causes a further decrease in the crystallinity of the material. Hence these hetero atoms can be used to cause tunable changes in the properties of polyethylene and to ultimately extend its applications.

A.4

Photosynthetic Biohydrogen

Name: Nickyla Allowe

School Name: University of Tennessee – Knoxville

Phone: 901.508.8074

Co-Authors: Linda MacDonald, LaToyia Thompson

A growing problem in the undeveloped, developing, and industrialized worlds is securing a sustainable, abundant energy supply sufficiently concentrated for practical use. This project focused on producing hydrogen sustainably using the microalgae *Chlamydomonas reinhardtii* to split water by photosynthesis. This photosynthetic route uses a simple technology that can be easily adapted for application in the developed and developing worlds.

This project proposed two major tasks: first, perform a design study to size and determine the operating and capital costs for a bioreactor system for the large scale production of photosynthetic biohydrogen, and second, design and build a laboratory scale bioreactor system. The large scale system is sized to produce sufficient hydrogen for transportation for a small city of 100,000 people, which was determined to be approximately 46 million kilograms of hydrogen annually.

Early design work indicated that some process assumptions needed to be validated in the laboratory, so a series of experimental studies were conducted. The initial laboratory scale experiments were based largely on experimental studies from the relevant research literature (Melis et al, 2000). A three stage process was used and included an algal growth stage, sulfur deprivation and anaerobiosis, and hydrogen production. The initial experimental studies indicated that the algae could be grown on either carbon dioxide or acetic acid as a sole carbon source and that acetic acid supported the highest cell densities and growth rates. Also, it was determined that active pH control was a less expensive and more accurate method of controlling the pH during the growth phase when compared to the use of a pH buffer.

The design study incorporated the results of the experimental work. The final design determined an “at the plant gate” cost for hydrogen produced with current technology of about \$40/kg hydrogen. Transportation costs are estimated to add approximately \$2.80/kg hydrogen for off-site storage, distribution, and delivery. The design is based on a 4 day fed-batch production cycle. The study identified major cost factors and targets for future research studies.

A.5

The Exploration of Electroporation as a Lipid Extraction Method for Oleaginous Micro Organisms

Name: Rosemary Weathersby

School Name: Mississippi State University

Phone: 662.312.4772

Co-Authors: Bobby McComas, R. Mark Bricka

The World consumes 80.1 million barrels of oil per day, and it is projected that the oil consumption will continue to increase 1% annually. In 2030, the world is expected to consume 118 million barrels of oil per day. If this trend continues, fossil fuels supplies will eventually become depleted, which has led to a large amount of research being conducted to discover alternate energy sources. One option is to use oleaginous microorganisms, which can produce by mass up to 70% oil content, rather than petroleum. We at MSU are conducting research using electroporation on the cells to remove oil. Electroporation produces a potential difference across the bilayer lipid membrane. When the critical voltage is reached, pores are formed on the cell. Currently, those pores are being used to insert DNA into the cell, but it is thought that the pores can be used as a method for removing the lipids contained in the cell. The cells are still viable after this process because the bilayer reforms soon after the current is sent through the cell. The cell may then be re-grown to repeat the process. This paper will further discuss the investigations of the possibility of electroporation as a lipid extraction method.

A.6

Bioreactive Membranes by Layer-by-layer Assembly

Name: Caitlyn Cecil

School Name: University of Kentucky

Phone: 859.608.0044

Co-Authors: Saurav Datta, D. Bhattacharyya

Immobilizing enzymes within membrane pores is advantageous because immobilized enzymes exhibit greater stability than free enzymes, and it provides a means of directing the biocatalytic reaction. Two common methods of enzyme immobilization are through covalent bonding and electrostatic bonding. Enzymes attached electrostatically exhibit higher activities than those covalently attached because the active sites are not obstructed. The layer-by-layer (LBL) adsorption technique is a method for assembling a film of layered polyelectrolytes. An advantage of the LBL technique is that the properties of the assembled film, such as its thickness and overall surface charge, can be controlled. Thus, for a membrane functionalized with the LBL technique, the permeability and selectivity of the membrane can be controlled. In this study, glucose oxidase enzymes are immobilized with a layer-by-layer assembled membrane. Glucose oxidase is a dimeric protein with a molecular weight of 160 kDa and a pI of 4.2. Glucose oxidase catalyzes the reaction of beta-D-glucose to hydrogen peroxide and D-glucono 1,5 lactone which is then hydrolyzed into gluconic acid. The effects of the residence time, substrate concentration, and pH on the activity of the immobilized enzyme were considered in this study. Also, studies were conducted to prove that the enzyme could be detached from the membrane while maintaining its activity and fresh enzyme can be reattached to the same assembly.

A.7

Applications of Molecular Vapor Deposition of Precursor Compounds On Different Surfaces

Name: Mohammad Biswas

School Name: Auburn University

Phone: 334.524.1435

Co-Authors: W. R. Ashurst

Surface modification is an important technique used across many industries ranging from life sciences to metallurgy. The chemically modified surfaces can be utilized for several purposes including insulation for microdevices and act as an intermediate step for additional modification. One such technique is a gas phase deposition method called Molecular Vapor Deposition (MVD). This method involves a precursor compound reacting with the surface of a material to deposit multi-layers of silica that have uniform surface coverage. The deposition occurs within a vacuum chamber to allow minimized contamination and more control over the operating conditions to obtain varied coverage for surface modification. Although this technique has been well developed, the precursor compounds to produce the silica are raising concerns. The current precursors contain chlorine. Each of these precursors reacts with the surface in the presence of catalytic vapor to produce hydrogen chloride as by-product, which is an environmental safety concern. There might also be residual chlorine left on the surface as a result of the deposition that can lead to corrosion of the material of interest. The industry is looking to steer away from chlorinated compounds as well as other halogenated compounds due to these reasons. To tackle this issue, alternative compounds are being tested for the production of similar modified surfaces, but none of the chlorine by-products. The potential compounds being tested that have no prior art for MVD are tetramethoxy orthosilicate, tris tert-butoxy silanol, and tetrakis (dimethylamino) silane. The deposited silica film on a surface are analyzed and measured using ellipsometry for thickness of film, using contact angle goniometry to determine hydrophilic behavior, using atomic force microscopy for surface roughness analysis, and using fourier transform infrared (FTIR) spectroscopy for surface chemistry and composition. The thermal decomposition of the compounds can be analyzed by thermal gravimetric analysis (TGA) to assess optimal operating conditions. The overall goal of this research is to be able to apply these precursor compounds using the MVD method on various surfaces such as silicon, plastics and metals under favorable operating conditions.

Regional Paper Competition – Abstracts

Session B, Ross 278 (Mechanical Engineering Conference Room)

B.1 Optimization of Immobilization of Lipases on Various Supports for Transesterification of Tributyrin using Dimethyl Carbonate

Name: Mohamed Seyam

School Name: North Carolina State University

Phone: 919.606.9327

Co-Authors: Archana Trivedi, Steven Peretti

The current methods of producing fatty acid methyl esters involves reacting triglycerides (the substrate) with methanol (the acyl acceptor), catalyzed by a soluble alkaline catalyst, resulting in glycerol as a byproduct. Since the value of glycerol is decreasing, this byproduct is then reacted to form glycerol carbonate derivatives. In this research project, the use of immobilized lipases as catalysts for these types of reactions is being studied. Immobilization of the lipase will allow for easy separation so that the lipase can be reused for multiple reactions. The current focus of the project is to evaluate loading and activity of the lipase by using different supports and cross-linking methods. The substrate we are using is tributyrin and instead of using an alcohol, dimethyl carbonate (DMC) will serve as the acyl acceptor. The reasons for using DMC instead of methanol are twofold: 1) Methanol is toxic while DMC is environmentally friendly, and 2) Using DMC forms glycerol carbonate derivatives readily as the byproduct, thus eliminating one step from the current process.

B.2 Protein Immobilization on Silicon Nanowires via Electrografting of Hexynoic Acid

Name: Zach Scheibal

School Name: Louisiana State University

Phone: 985.264.7587

Co-Authors: W. Xu, J. J.E. Henry, J. Foreman, J.C. Flake

Electrografting provides a novel method for the direct (Si-C) covalent functionalization of silicon surfaces. In this work, cathodic electrografting of hexynoic acid to silicon surfaces and subsequent immobilization of bovine serum albumin (BSA) is demonstrated. Hexynoic acid was cathodically electrografted to dense arrays of silicon nanowires approximately 50-100nm in diameter and 10 μ m in length. Protein immobilization was achieved via amidization reactions with carboxylic moieties of electrografted hexynoic acids. Results show chronoamperometric experiments used in the electrografting process followed by verification of attachment using Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (ATR FTIR) of electrografted hexynoic acid and immobilized BSA. In addition to FTIR analysis, covalently immobilized BSA was further verified using fluorescent detection techniques. Protein binding to silicon nanowires was maintained for long periods including after electrografting and nanowire separation from the parent wafer.

B.3 The Effect of Calcium and Sodium Deposition on a PEMFC

Name: Steven Mouton

School Name: University of South Alabama

Phone: 251.460.6160

Co-Authors: Masato Ohashi, Carl Smith, John W. Van Zee

Even in a low temperature fuel cell such as the Proton Exchange Membrane Fuel Cell (PEMFC) contaminants from bi-polar plates, sealants, and gaskets can leach into the membrane. Here a study of two ions is presented because these ions, sodium and calcium, are present in present-day materials. This study was focused on whether the ions deposit on the sulfonic sites within the membrane electrode assembly (as would be expected through an ion-exchange mechanism) and on whether equal normality poisonings of sodium and calcium (5 mM and 2.5 mM) would produce the same percentage of performance loss. The results confirm the hypothesis of performance loss based on ion charge. This loss for both contaminants was 45 %. However, the data show an unequal recovery after a 48 hour period of constant voltage. This recovery corresponds to 17 % degradation for sodium and 25 % for calcium. Electron microscope results illustrate cationic buildup mainly around areas of high sulfonic sites. The higher recovery for sodium may be characteristic of a monovalent cation contaminant as compared to divalent. Additional experiments are being performed in an effort to generalize the results for all monovalent and divalent cations.

B.4

Mimicking Microbes to Enhance Flexible Liposome Skin Penetration

Name: Cari Launiere

School Name: Tulane University

Phone: 616.450.8857

Co-Authors: Vijay John

Transcutaneous vaccine antigen delivery via liposome carriers offers many advantages over traditional syringe injections. For those in developed nations the biggest advantage of this method is that it is pain free. However, for those in developing nations the advantage will be a significant decrease in cost that could make vaccines available to millions who can not afford the cost of a traditional syringe vaccine. Because the target of vaccine delivery, antigen presenting cells, are present in high concentrations just 10 μm below the skin's surface, liposomes only need traverse the top layer of dead skin cells called the stratum corneum to deliver vaccine antigens. Liposomes are multi and unilamellar lipid vesicles ranging in diameter from 20 nm to over 1 μm . Flexible liposome exteriors are hydrophilic, their attraction down the hydration gradient in the skin creates enough force to deform these liposomes to fit through pores 1/10th their diameter. However, liposomes are also attracted to the highly hydrophilic "spot-welds" that hold epithelial cells together. These spot-welds are intercellular adhesion molecules called corneodesmosomes and are the hydrophilic foci of the stratum corneum. To make transcutaneous vaccine delivery even more inexpensive, the efficiency of liposome diffusion into the skin needs to be improved. By mimicking microbes that have evolved mechanisms for altering the skin's microstructure, reversible disruption of the skin's barriers can be achieved. One class of skin inhabiting bacteria releases antibodies that bind to the corneodesmosome junctions and disrupt intercellular adhesion in the stratum corneum. To mimic this mechanism a short peptide can be created which carries out the same function of binding to and disrupting corneodesmosomes. This can increase the skins permeability to flexible liposomes by opening up hydrophilic pathways through the stratum corneum, the skins main barrier. After a short time the peptide will be degraded by enzymes secreted by the body. This will allow the corneodesmosome intercellular binding proteins to re-associate and return the stratum corneum to its fully functioning barrier state.

B.5

***In-Vitro* Biocompatibility Analysis of Temperature-Responsive Hydrogel Nanocomposites**

Name: A. Ashley Anderson

School Name: University of Kentucky - Lexington

Phone: 859.644.9538

Co-Authors: Samantha A Meenach, J. Zach Hilt, Kimberly W. Anderson

Hydrogels are hydrophilic crosslinked polymer networks that are able to absorb up to a thousand times their dry weight in water while still maintaining their form. A newly explored area of polymers is that of hydrogel nanocomposites which are hydrogels that incorporate nanoparticulate materials into their matrix. This can give hydrogels improved properties such as increased strength due to the addition of nanoparticulate material or the ability to be heated remotely via an alternating magnetic field when magnetic nanoparticles are present in the hydrogel. This project incorporates iron oxide magnetic particles into a poly(N- isopropylacrylamide) (PNIPAAm)-based hydrogel nanocomposite.

One important area of research that is necessary to determine the practical uses of hydrogels is biocompatibility analysis. Biocompatibility depends on the function of the biomaterial and is defined to be specific to a given application. One potential application for the temperature-responsive systems studied includes the implantation of a hydrogel nanocomposite that can be heated externally to provide both hyperthermia and controlled drug delivery capabilities. This could then be used in drug delivery and/or cancer therapy applications within the body in which the biocompatibility of the composite would be of the utmost importance.

This study focused on determining the biocompatibility through cytocompatibility studies of magnetic hydrogel nanocomposites at various crosslinking densities with and without magnetic nanoparticles. Specifically, it has been discovered that murine fibroblast respond favorably to PNIPAAm/iron oxide-based hydrogel nanocomposites.

B.6

Designing Effective Trials Regarding Treatments Against Cancerous Tumor Growth

Name: Nemoy Rau

School Name: Tennessee Technological University

Phone: 317.997.8300

Co-Authors: Ileana Carpen

Cellular adaptation to changing environments is intricately coordinated through many molecular and mechanical responses. As cells evolve, abnormal growth patterns occur (that cannot be controlled by normal mechanisms) leading to cancer. With mathematical modeling we can integrate different characteristics of tumor growth for a non-experimental study of cancer. Through integration of some of the prior clinical, experimental, and mathematical studies, we utilize a cellular automata model to take into account multiple factors affecting tumor growth in healthy tissue. This in silico simulation model of tumor growth is based upon molecular and life cycle features that effect the growth rates of cancer. The life cycle parameters used in this model include replication rate, nutrient concentrations for proliferation and survival, and possible drug effects. This 3-D in silico model is used to study the effects of drugs upon the growth and development of the tumor and optimize a drug treatment protocol under various conditions.

B.7

Multifunctional Magnetic and Thermally Responsive Hydrogels for Anti-Cancer Drug Delivery

Name: Mary Kathryn Sewell

School Name: University of Alabama

Phone: 205.908.3999

A novel combination cancer therapy is created by embedding magnetic nanoparticles in a thermally responsive hydrogel. This platform is ideal for a combination of chemotherapy and hyperthermia for anti-cancer treatments. Drug release can be controlled by in vitro heating experiments that mimic hyperthermia. In this system, a patient receiving hyperthermia treatments would also receive a localized dosage of anti-cancer drug. The combination therapy can increase treatment efficacy and decrease negative side effects currently associated with these treatments.

Using a hyperthermia chamber, radial heating profiles were determined for poly(2-hydroxyethyl methacrylate) gels containing FePt nanomagnets. Results indicate that the heating across the gel is uniform, despite agglomerations of the nanoparticles. Pulsatile release studies of theophylline from thermally responsive poly(N-isopropyl acrylamide-co-acrylamide), P(NIPAAm-co-AAm), gels show reduced diffusion of the model drug at higher temperatures. Another set of drug release studies where theophylline was loaded into P(NIPAAm-co-AAm) gels via equilibrium partitioning was also completed. Results from these experiments indicate faster diffusion at higher temperatures through a "squeezing" mechanism.

Regional Paper Competition – Abstracts

Session C, Ross 136 (Chemical Engineering Conference Room)

C.1

Fibronectin binding to the Treponema pallidum adhesin Tp0483 on Functionalized Self-Assembled

Name: James Tidwell

School Name: University of Kentucky

Phone: 270.933.2109

Co-Authors: Mathew Dickerson, Kimberly W. Anderson, Morgan B. Abney, Caroline E. Cameron

In recent decades, a new branch of biological sciences has developed with the sole purpose of observing and emulating nature to create new biomaterials. These biomimetic materials are not expected to elicit a negative response by the host, nor be unduly inhibited by the host system. Thus, researchers attempt to integrate biomaterial science with natural design. The spirochete bacterium *Treponema pallidum* is the causative agent of syphilis. While significant advancements have been made in understanding and treating the disease in the last century, the pathogenic mechanisms that allow syphilis to remain dormant for up to 50 years following the secondary stage of the infection are not understood. Studies have suggested that *T. pallidum* binds host fibronectin (FN) for the purpose of antigenic disguise. A coat of native protein FN on the outer membrane of *T. pallidum* may effectively hide the bacteria from antibodies and immune effector cells. Cameron and coworkers have recently isolated a putative outer membrane protein of *T. pallidum* capable of binding FN, Tp0483. The overall objective of this research to prepare a surface capable of mimicking the antigenic disguise properties of *Treponema pallidum* by immobilizing Tp0483 onto the surface. To fully understand the possibilities of using Tp0483 for a biomimetic surface, studies were performed to investigate the binding capability of Tp0483 to surfaces with well-defined surface chemistries. Surface Plasmon Resonance (SPR) was used to investigate Tp0483 interactions with hydrophobic, hydrophilic, negatively charged, and positively charged surfaces and subsequent FN attachment to Tp0483 on each of the surfaces. Because numerous studies have suggested that FN binds to *T. pallidum* via the RGD cell-binding peptide, anti-RGD was used to determine if FN binds to Tp0483 through this site. Finally, the adsorption of other plasma proteins to the Tp0483 surface with and without FN was investigated.

C.2

Stability of Natively Unfolded Proteins

Name: Harold Hatch

School Name: Tulane University

Phone: 469.396.6867

Co-Authors: H.S.Ashbaugh

Natively unfolded proteins lack a rigid three-dimensional structure, contrary to traditional ideas of protein shape governing function. A natively unfolded protein's lack of a well-defined shape actually allows newly discovered functions in such eclectic roles as cell signaling, nuclear transport and tissue structure. Semi-empirical correlations have been used to predict unfolded protein stability and function, but a physical basis in terms of realizable variables must be developed to understand natively unfolded protein stability and allow for their ab initio design.

Novel molecular simulations were used to relate the protein charge, hydrophobicity and length to globule (folded) or coil (unfolded) conformations. The coarse-grained model utilized the minimal amount of molecular detail necessary to capture the underlying physics of the natively unfolded proteins seen in experiment. We provide physical insight into the coil-to-globule transition in charge/hydrophobicity space and the reason this transition is independent of protein length.

C.3

Biomass Gasification: Catalytic Tar Removal using Fe, Ni, and Ru on Zeolites

Name: Jared Jones

School Name: Mississippi State University

Phone: 228.-219.1172

Gasification of biomass is an increasingly interesting source of energy, but there are many contaminants in the product stream that need to be removed. One of these contaminants is tars; Tars are a condensable mixture of hydrocarbons, the majority being poly-aromatics larger than benzene. If tars condense in operating lines, corrosion or other problems can occur depending on the end use application. There are various methods to treat tars such as physical treatment methods, modifying the gasifier operating conditions, thermal cracking, catalytic cracking, and the use of plasma. Numerous studies have focused on catalyst cracking as a means of tar removal, but most studies have used Silica/Alumina as a catalyst support. Limited studies have been done using zeolites. This experiment represents the effect of transition metals on ZeoliteY to remove tars. The catalysts used in these experiments are Iron, Ruthenium, and Nickel impregnated on ZeoliteY. The experiments were conducted using a laboratory scale reactor in the presence of synthetic producer gas. The temperature of the catalyst bed will vary from 550°C to 750°C to find correlations in the temperature usage. The findings of these experiments will be shown and their importance of catalyst usage in tar removal efficiency in biomass gasification.

C.4

An Analysis of the Inhibition of Amyloid- β -Induced Inflammation in Alzheimer's Disease

Name: Fahmin Basher

School Name: University of South Carolina

Phone: 803.347.3179

Alzheimer's disease is the most common form of dementia experienced by elderly people and has been determined to be caused, at least in part, by the formation of aggregates of the amyloid- β (A β) protein, referred to as A β plaques, found between neuronal cells. In addition to affecting neuronal cells, A β plaques have the ability to impact other cell types, including immune cells such as microglia and monocytes, and elicit inflammatory responses upon deposition. A β fibrillogenesis occurs through a process of slow nucleation followed by a period of rapid growth of intermediates (protofibrils) by mechanisms of elongation by monomer addition or lateral association. Inhibition of either mechanism results in decreased protofibril growth. Investigation of a library of cyclic organic compounds with structural features shared by previously identified inhibitors is under way to determine relationships between structural aspects of the compound and inhibitory function. The physiological effects of inhibition are also under investigation. In this study, we seek to determine the effectiveness of these compounds in mediating the pro-inflammatory activation of monocytes by A β aggregates. Thus, we have examined the effect of selected cyclic organic compounds, which serve as potential inhibitors, on stimulation of the release of the inflammatory cytokine TNF- α from monocyte cell cultures following treatment with A β aggregates formed in the presence and absence of inhibitors.

C.5

Bandage Contact Lenses for Antibacterial and Anti-Inflammatory Therapeutics

Name: Jeney Zhang

School Name: Auburn University

Phone: 334.332.1932

Co-Authors: M.E. Byrne

The US ophthalmic drug market is valued at approximately \$4.5 billion and conventional topical ocular therapies control approximately 90% of that market, with inflammation treatments accounting for 55% (\$2.5 billion) and ocular infection treatments 24% (\$1.1 billion). However, there is still an unmet need in the ocular therapeutic market for effective drug delivery. A major obstacle facing the traditional topical methods of ocular drug delivery is poor bioavailability with only 1-7% of the applied drug absorbed while the rest is either removed by the lacrimal and tear turnover of the blinking mechanism or enters into systemic circulation. We have rationally designed and synthesized novel contact lenses capable of tailorable loading and extended release of antibiotic and anti-inflammatory ocular medication.

This novel drug delivery system delivers ocular medication through contact lenses in which the drug is released from the hydrophilic, weakly cross-linked polymers of the lens directly onto the surface of the eye. The polymers were synthesized with a cocktail of FDA-approved methacrylate and acrylate monomers that provided similar side-chain functionalities to amino acids present in the binding pockets of the biomolecules as found in nature. Hydrogels were synthesized with macromolecular "memory" site or reservoirs for the antibiotic and anti-inflammatory drugs chloramphenicol and diclofenac salt, respectively. These biomimetic contact lenses demonstrate advantage over hydrogels created without biomimesis by displaying a two-fold increase in drug loading. Further binding studies were conducted with the addition of iniferter to the polymer formulation and a two-fold increase in loading over the recognitive system was exhibited. Dynamic drug release profiles were constructed under in vitro physiological condition and demonstrated that release rates for both biomolecules can be tailored to provide a sustained release in artificial lacrimal fluid for at least 12 hours. Parametric studies to optimize loading and extend release were performed by synthesizing hydrogels with varying monomer to template ratios. Furthermore, these hydrogels present the same ocular clarity and mechanical functionalities as conventional contact lenses and can also offer the same comfort and re-epithelialization as hydrophilic bandage contact lenses (HBCLs).

Our ocular drug delivery system offers a more effective method of ocular therapy by providing a constant and optimal dosage of medication and increasing patient compliance and drug bioavailability to the eye. With structural and molecular homology to biological receptor binding sites, this novel system has great potential for use with a wide spectrum of drugs and should inspire a wholly new approach of contact lens-mediated ocular therapies.

C.6

Fabrication and Characterization of Latex Microsphere Colloidal Crystals Controllably Deformed on a Poly(dimethylsiloxane) Substrate

Name: Jessica Lisane

School Name: North Carolina State University

Phone: 919.559.6582

Co-Authors: Jan Genzer, Orlin D. Velev

Crystals of micro- and nanoparticles have interesting photonic properties that depend on the spacing and arrangement of the particles, which can be manipulated using a flexible substrate. Silicone elastomer networks, such as poly(dimethylsiloxane) (PDMS), provide a flexible substrate upon which organized structures of micro- and nanoparticles can be deposited using convective assembly. Latex microspheres were deposited on the ultraviolet ozone treated PDMS. As the result of deposition, the latex particles formed a crystalline structure on the surface. Single or multi-layer crystals demonstrated a hexagonal laser diffraction pattern, while the transitions between complete layers of crystals demonstrated a square diffraction pattern. As the substrate was stretched and then returned to its original state, the diffraction pattern, originally circular, changes in accord with the extension of the PDMS, becoming an oval as it is stretched. Additionally, when the substrate was illuminated with white light, the crystalline structure of latex particles diffracted the light, revealing the visible spectrum. As the PDMS was stretched, the area covered by each color changed due to a change in the lattice spacing of the particles. A correlation between the percent stretching, the hexagonal laser diffraction pattern and the color from illumination was determined. Thus, this work presents a method for creating and manipulating optically functional nanomaterials with changeable properties. Additionally, the latex on PDMS deposition method can be expanded for the deposition of other nanoparticles on pre-stretched PDMS.

C.7

Nanocomposite Biodegradable Polymers: Preparation and the Analysis of Heating, Degradation, and Drug Release

Name: Ashley Hawkins

School Name: University of Kentucky

Phone: 502.221.0720

Co-Authors: J. Z. Hilt, Nitin Satarkar

Biodegradable polymers are versatile materials that can be used in many applications, but current biodegradable materials exhibit degradation profiles that are pre-programmed. Thus, there is limited or no ability to modulate the degradation once it is applied (e.g., implant, subcutaneous injection, etc.). This research involves the incorporation of nanoscale heat sources into a biodegradable polymer system. It is hypothesized that the heating from the particles can affect the degradation rate and therefore the drug release from the film. For this hypothesis to hold, several requirements must be met. First, the heating obtained from the nanoparticles must be significant. Secondly, the polymer system must have temperature dependent degradation. Finally, the drug must be released through a degradation process as opposed to dissolution. Nanocomposite biodegradable polymers have been designed and developed that exhibit degradation profiles that can be remotely controlled by an alternating magnetic field. In particular, biodegradable hydrogels have been prepared from macromers synthesized through a condensation reaction between a diacrylate and amine. The incorporation of magnetic nanoparticles allows heating of the films, which can therefore affect many of the other properties of the polymer (e.g., degradation rate). Thus, the drug release can be controlled by altering the degradation rate through remote heating of the nanoparticles. Degradable hydrogels with and without iron oxide nanoparticles (and drugs) were successfully prepared. Characterization of the gels was done through viscometer readings and gel permeation chromatography methods. Heating studies were done using an infrared camera. The gels were shown to have temperature dependent degradation based on gravimetric analysis methods, and finally drug release studies were conducted using UV-Vis to analyze the amount of drug released.

Futures Fair

9:00 a.m. - 12:30 p.m.

Foy Student Union 217

Set up: 8:00 a.m. - 9:00 a.m.

Displays open 9:00 a.m. - 3:00 p.m.

Display Breakdown 3:00 p.m. - 4:00 p.m.

Companies

Albemarle Corporation

Representative: George Welsh

Phone: 225.388.7195

Company Interviews: No

Chemical engineering job responsibilities include one or more of the following:

Process development and scale up from bench scale to commercial scale. Plan and execute sample productions of new chemical products for application/customer testing and market development. Guide and support process hazard analyses prior to scale up. Develop speculative economics for new products and processes. Develop and implement safety, quality, environmental and profit improvement projects. Communicate with, travel to, and provide technical support to operating plants worldwide to implement improvements, troubleshoot problems, or help increase production, reduce costs, improve quality, or reduce environmental impact. Job locations:

- Magnolia, AR
- Pasadena, TX
- Baton Rouge, LA
- Orangeburg, SC
- Tyrone, PA

- South Haven, MI

Essential Qualifications:

- BS Chemical Engineering degree
- GPA 2.8 or higher and strong written and verbal communications skills. Albemarle will not hire any individual who is not legally eligible, under the provisions of the Immigration Reform and Control Act of 1986, to work in the United States. Albemarle Corporation offers a competitive benefits and compensation package. Compensation will be determined by applicant experience and qualifications. EOE/AA/MF/D/V. Albemarle Corporation, headquartered in Richmond, Va., is a leading global developer, manufacturer, and marketer of highly engineered specialty chemicals for consumer electronics, petroleum and petrochemical processing, transportation and industrial products, pharmaceuticals, agricultural products, construction, and packaging materials. The Company operates in three business segments, Polymer Additives, Catalysts and Fine Chemicals, and serves customers in approximately 100 countries, generating annual revenue of approximately \$2.4 billion.
- Learn more about Albemarle at <http://www.albemarle.com>

DuPont

Representative: Paula Hietpas

Phone: 302.774.1460

Company Interviews: No

Today's world is powered by knowledge and science. This is a time when dynamic science is both important and essential. At DuPont, we believe in a nurturing environment for innovative ideas and groundbreaking solutions. DuPont products are making a difference in markets as varied as agriculture, nutrition, electronics, communications, safety and protection, home and construction, transportation and apparel. Looking for opportunity and advancement in a science and engineering-driven environment? We live in exciting times, and at DuPont, revolutionary breakthrough is a way of life. DuPont is currently looking for Chemical, Mechanical, and Electrical Engineers. We currently have early career Engineering opportunities in our Field Engineering Program as well as direct hire opportunities at our various plant sites. These positions may include assistance to operations, process engineering, maintenance and reliability, R&D, or Process Control.

Stop by our booth at the Futures Fair and learn more about the exciting career opportunities at DuPont or visit us at www.dupont.com/careers.

Eastman Chemical Company

Representative: Amy Jackson

Phone: 423.229.2354

Company Interviews: No

Process Improvement/Development (Kingsport, TN & Longview, TX)

- Provide process engineering expertise used to develop new processes, produce definition packages for new plants, and support existing manufacturing operations.
- Hands-on opportunity to apply learned skills to a variety of chemical processes.
- Analyze and document economic value of proposed process solutions and new process concepts.
- Document learned information, improvements, and value generated & communicate effectively.
- Ensure health, safety, and environmental concerns for all projects have been addressed and assist in ensuring a safe work environment.
- Assignments in Development can provide a fulfilling long-term career within Technology, or serve as a springboard into Manufacturing or Business leadership positions Engineer Development Program (Kingsport, TN)
- As a Process Improvement Engineer in the Eastman Engineer Development Program you will have the hands-on opportunity to apply your skills to a variety of batch and/or continuous chemical processes in Kingsport as you become familiar with Eastman process. Your initial assignment will be in one of the development organizations with Technology in Kingsport (Chemicals, Specialty Polymers, Cellulose Esters).
- You will likely become involved in supporting one of the many growth projects within Technology and be positioned to take assignments in the start-up and operation of new chemical facilities in the US.
- Assignments in the Engineer Development program can provide a fulfilling long-term career within Technology, or serve as a spring board into Manufacturing or Business leadership positions.

- Candidates should be interested in relocating from Kingsport within 3-5 years of initial employment.

Chemical Process Technology (Kingsport, TN)

- Provide process engineering expertise used to develop new processes, to produce definition packages for new plants, and to support existing manufacturing operations.
- Initial work assignments might involve process de-bottlenecking studies, developing process heat and material balances, and designing process equipment

Process Control Technology (Kingsport, TN)

- Chemical Engineers in this group provide process control technology design and support for the company's chemical plants.
- Their design work includes the development of process control strategies for chemical plants, dynamic modeling of chemical processes, and the development and implementation of advanced control systems.
- Support work includes assisting with new plant start-ups, commissioning of new control loops and new control strategies for existing facilities, and control loop troubleshooting.
- In addition to providing traditional control technology design and support for Eastman Chemical Company, Advanced Controls Technology engineers develop new control technology.
- Current development activities include the integration of process design and control strategy design, the application of model predictive control, dynamic process simulation, and process data analysis for continuous and batch processes.
- The group is responsible for implementing both continuous and batch process control technology.

Comments:

This position is for an entry-level Chemical Engineer.

Education: Bachelor's or Master's (BS/MS) Degree in Chemical Engineering

Qualified Candidates should submit their resumes online to Requisition 524 at: <http://www.careers.eastman.com>

Eastman is an equal opportunity/affirmative action employer.

Evonik

Representative: Joe Bulger

Phone: 251.443.4332

Company Interviews: No

Design Process Engineer

- Provide technical assistance to defined production areas (e.g. increase of a plant's availability, reduction of investment and production costs, debottlenecking, quality improvement, etc.)
- Support the recommendation of concepts for expansions, quality increase, production availability, etc.
- Provide technical support in basic engineering, detail engineering, construction and commissioning of production processes.
- Prepares basic process documentation (PFDs, P&IDs, Equipment Specifications) on capital projects and/or ESRs.
- Support projects with universities/research institutes/equipment manufacturers to find new, more efficient technologies.
- Provide exchange of information with other Degussa plants in order to utilize these valuable resources for improvements. Participates in technology transfers to and from Europe.
- Provide development work and define the scope for these projects, as well as prepare time schedules and cost estimates.
- Independently completes assigned ESRs.

ExxonMobil Corporation

Representative: Scott Arvin

Phone: 281.834.2923

Company Interviews: No

ExxonMobil offers Engineering Careers with initial US starting assignments primarily located in Louisiana, Texas and Virginia. We have a wide variety of career opportunities for Chemical Engineers in our Upstream, Downstream, Chemicals and Global Services organization. Additional career information can be found online at www.exxonmobil.com/careers.

Firestone Polymers

Representative: Mitchell Toon

Phone: 337.882.5354

Company Interviews: No

Jr. Chemical Engineer

Interacts with process engineering group, mechanical engineering group and manufacturing group in solving plant operating problems. Monitors production operations to assure that established specifications and procedures are followed. Assists in startup of new equipment. Review technical aspects of safety procedures and operating procedures. Maintain, review, and interpret operating data to maintain, improve and modify equipment and polymerization. Updates polymerization process control philosophies for start-up and production.

Milliken & Company

Representative: Crystal Stoudemire

Phone: 864.503.1803

Company Interviews: No

Process Engineer

As a Process Engineer, you are a member of the location's process improvement team. Your focus will be on project work related to operational issues. You will be responsible for facilitating the efficient production of a product line and solving complex process issues. Process Engineers work with the entire supply chain dealing with both internal and external customers. You will work closely with teams of associates empowering them to achieve continuous improvement and meet location performance goals. You will interact and communicate with all associates at the location as well as upper management. The Process Engineer can anticipate promotions and opportunities in many career fields as abilities and opportunities allow.

Summer Internship

Milliken & Company provides exceptional opportunities for qualified students in our summer internship process. As an intern, you will be assigned to a specific project and manage all aspects of the project including regular presentations on the progress and results. Project assignments are linked to significant areas of the company and ensure practical experience is gained. Interns can also participate in the summer volunteer process with local Boys & Girls Clubs. Volunteering is conducted during your work schedule. In June, all interns attend a 2 day forum at the corporate headquarters. At the completion of the internship, all interns return to the corporate headquarters and present their project results to Senior Management and University Faculty.

Olin Corporation

Representative: Melodye Baker

Phone: 423.336.4255

Company Interviews: Yes

Olin Chlor-Alkali, a major bulk chemical manufacturer of chlorine and caustic, is seeking entry-level engineers in mechanical, electrical and chemical engineering disciplines for our Career Development program. Career Development Engineers may experience multiple site assignments and exposure to different functional areas such as production, maintenance, and logistics during their first 24-36 months. Assignments may be at any of Olin's Chlor Alkali manufacturing sites including the Southeast, Gulf Coast, Northeast, and West Coast. Once the developmental assignment is completed, the engineer will be placed in a role consistent with business needs, individual strengths and interest.

To schedule an interview, please visit our website at www.OlinChlorAlkali.com, click on Employment, College Grads, Career Development Opportunities, and view open positions and apply for 1305.

Southern Company

Representative: Ed Healy, Aileen Foster

Phone: 205.992.5212, 404.506.0227

Company Interviews: No

Southern Company, one of America's largest generators of electricity, provides power to more than 4 million people everyday. We are made

up of over 25,000 talented and diverse professionals each building a unique career. Join us and we will help you build an amazing career at a Fortune 500 leader.

Syngenta Crop Protection, Inc.

Representative: Carla Blaine

Phone: 336.632.7922

Company Interviews: No

Crop Protection Supply Chain Leadership Development Program

This program is designed to recruit a few, high-potential, highly motivated people for accelerated development.

Selected candidates will be placed in a series of wide ranging assignments, over a 24 month period, designed for broad exposure to our Crop Protection Supply Chain. At the end of the development program, participants' performance and interests will be assessed in conjunction with business needs for future career opportunities.

Candidates must be flexible; eager for responsibility and challenges; comfortable working within diverse teams; and willing to relocate anywhere within NAFTA (US, Canada and Mexico).

Graduate Schools:

Auburn University

Representative: Jin Wang

Phone: 334.844.2020

We are looking for highly motivated students interested in doing cutting-edge research in chemical engineering. At Auburn, both faculty and graduate students strive to make contributions in both engineering and science. The research topics range from catalyst, nano material to biomedical and systems engineering. Chemical Engineering at Auburn hosts outstanding facilities, including \$30 million in renovations which were finished recently, with ongoing investments in new research equipment. Various fellowships are offered to outstanding PhD candidates, including Dean's fellowships up to \$32,000 per year GAANN fellowships up to \$30,000 per year, Department fellowships \$21,400 per year, with additional fellowships for highly qualified applicants In addition, tuition waiver is awarded to all students on fellowship.

Clemson University

Representative: Chris Kitchens

Phone: 864.656.2131

Company Interviews: No

Graduate Research Assistant positions at Clemson.

University of Kentucky

Representatives: Tom Dziubla, Scott Lewis

Phone: 859.257.8028

We are looking for highly motivated students interested in research in chemical engineering. We are interested in both students looking for both traditional PhD programs and students interested in an Integrative Graduate Education and Research Traineeship (IGERT) program in biological material interfaces. This program, supported by the National Science Foundation, is a multi-disciplinary doctoral fellowship program for students interested in the science and engineering of bioactive interfaces and devices. Faculty members involved in the IGERT program are from the Departments of Chemistry, Chemical and Materials Engineering, Electrical and Computer Engineering, Anatomy and Neurobiology, Molecular and Cellular Biochemistry, the Center for Biomedical Engineering and the College of Pharmacy. Graduate students participating in the IGERT program receive their Ph.D. in one of these areas while benefiting from a host of multidisciplinary education and research activities in bioactive interfaces and devices. The research program is focused around three integrative themes Novel Bioactive Architectures, Cell/Protein Interactions at Interfaces, and Integration in to Devices.

Louisiana State University

Representative: James Henry

Phone: 225.578.1750

M.S. and Ph.D research assistantships in the Cain Department of Chemical Engineering. Master's stipends are \$17,500 per year while doctoral stipends start at \$21,200 per year and can range as high as \$30,000 per year for highly qualified students. Full tuition waivers are provided for students holding assistantships as well as non-resident fees. Health insurance benefits up to \$350 per semester are also available if enrolling in an LSU sponsored health insurance program.

Tennessee Tech University

Representative: Ileana C. Carpen

Phone: 931.372.3474

Tennessee Tech University's ChE Department blends scholarship and research with advanced studies, offering excellent opportunities to graduate students. The dynamic and flexible graduate program offers an M.S. in Chemical Engineering and a Ph.D. in Engineering with a concentration in Chemical Engineering. Core faculty members enhance student opportunities by working closely with faculty in Electrical Engineering, Environmental and Civil Engineering, Mechanical Engineering, Chemistry, Biology, and Manufacturing and Industrial Technology to build a unique and effective environment for graduate research and learning. Opportunities to mentor undergraduate students in research and in the use of instruments such as NMR, electron microscopy, x-ray diffraction and microflow visualization lead to well-rounded training, as does the department's partnership with TTU's Centers of Excellence.

Poster Competition

Sponsor: Evonik

9:00 a.m. – 11:00 a.m.

Foy Student Union 213

Poster Competition Rules

Posters should be no greater than 3.5 x 3 feet. Foam boards or bulletin boards will be provided on site. Push pins will also be available. Posters can be in color, or black and white. Landscape or a vertical format for the poster is fine.

Suggested topics to include in the posters include a title (project title, author names, and affiliations), abstract, project objectives, background, materials and methods, theory, results, conclusions and future plans.

A large font is recommended – use at least 18 point font. Lengthy paragraphs are hard to read, so bulleted lists are encouraged. Photographs, graphs, and schematics are best with descriptive figure titles.

Make sure the poster is easy to read and not overcrowded.

Posters and presenters will be judged by a panel of well-qualified industrial representative, faculty, and/or AIChE local section members. These judges' decisions are final.

This competition does not determine eligibility for the national competition.

Cash prizes will be awarded for 1st, 2nd, and 3rd place overall.

Categories may be created depending on number of entries.

Student authors may participate in both the paper and poster competitions; however an award in the paper competition may disqualify the author from an award in the poster competition.

There are no limits on the number of participants.

Poster Competition Awards

1st place (one best in show) \$500

2nd place (2 given) \$300

3rd place (2 given) \$200

Poster Competition Schedule

Poster Number	Poster	School
P.1 Armfield	Renewable Resource Polymers for Biomedical Applications: Poly-hydroxyalkanoates (PHA) and Poly-lactic Acid (PLA)	Clemson University
P.2 Biechler	Modeling Shear Stress during Cardiac Valve Formation	University of South Carolina
P.3 Blakely	Bubbling Bed Gasifiers vs. Circulating Fluidized Bed Gasifiers: A Comparison of Fluidized Bed Technology for the Purpose of Gasifying Biomass	Mississippi State
P.4 Blakely	Design, Construction, and Operation of a Cold Flow Model Circulating Fluidized Bed Gasifier: A Technical Overview	Mississippi State
P.5 Blaylock	Fe/ZSM-5 as a Catalyst for Fischer-Tropsch Synthesis	Mississippi State
P.6 Blue	Development of Cobalt Ferrite and P(NIPAAm-co-AAm) Hydrogel Composite Material for Combined Hyperthermia and Chemotherapy for Cancer Treatment	University of Alabama
P.7 Castillo	Biochemical Modification of Linear DNA for Use in Gene Therapy	Tulane University
P.8 Davis	Inhibition of Amyloid- β Protein Aggregation in Alzheimer's Disease	University of South Carolina
P.9 Empting	Reconciling Molecular and Macroscopic Descriptions of Mass Transport Using Multiscale Materials Models	University of Tennessee – Knoxville
P.10 Frailie	Polymer-Silica Mixed Matrix Membranes for Solute Separation from Water	University of Kentucky
P.11 Fugit	Cellular Responses to Magnetic Nanoparticles	University of Alabama
P.12 Hatch	Stability of Natively Unfolded Proteins	Tulane University
P.13 Henry	Single Walled Carbon Nanotubes Non-Covalently Modified with Chlorophyll-a	Auburn University
P.14 Jackson	Novel Corticosteroid Development via I-QSAR with Signature	Tennessee Technological University
P.15 Jones	Biomass Gasification: Catalytic Tar Removal Using Fe, Ni, and Ru on Zeolites	Mississippi State University
P.16 Kemmerlin	Surface Modification of Cellulose Membranes by ATRP for CO ₂ Separations	Clemson University
P.17 Lamb	Physio-Chemical Properties of Lung Tissue	Mississippi State University
P.18 Meyer	Optical Tomography of Three-Dimensional Reaction-Diffusion Waves in the Excitable Belousov-Zhabotinsky Reaction	Florida State University
P.19 Moffitt	Phase Behavior of Aqueous Suspensions of Cellulose Nanocrystals	Clemson University
P.20 Murphy	Identification of Inhibitors Effective at Preventing Aggregation of the Amyloid-B Protein Involved in Alzheimer's Disease	University of South Carolina
P.21 Ponta	Mechanical Analysis of Thermosensitive Hydrogels for Drug Delivery	University of Alabama
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Poster Competition Abstracts

P.1

Renewable Resource Polymers for Biomedical Applications: Poly-hydroxyalkanoates (PHA) and Poly-lactic Acid (PLA)

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Currently most polymers are derived from non-renewable sources such as fossil fuels. In this work, bio-based polymers, which are currently being used in medical, packaging, and textile applications, are investigated as possible replacements for conventional polymers. The mechanical, thermal, and degradation properties of varying blends of poly-hydroxyalkanoate (PHA) and poly-lactic acid (PLA) are examined. In order to find the optimum blend of the two polymers, films are produced using a DSM Xplore microcompounder with the cast film attachment at compositions of 50, 70, 80, 90, and 100% PLA. These films are then characterized using differential scanning calorimetry (DSC), x-ray diffraction (XRD), tensile testing, uniaxial stretching, microscopy (SEM), and rheology to study the effect of varying PHA content on the final properties. Increasing amounts of PHA in the film composition results in an increase in the percent crystallization for all films. In addition, the percent elongation increases up to the 30% PHA composition, while the tensile strength increases up to the 50% PHA composition. From microscopy, distinct layers are apparent in films of higher PHA compositions along with an increased number of pores found on the surface that are not seen in lower compositions of PHA.

P.2

Modeling Shear Stress during Cardiac Valve Formation

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Developmental heart defects are the most common birth defects and heart valve defects are the most common cardiac defects. Therefore, defining the mechanisms of cardiac valve development is critical to our understanding and treatment of these debilitating disorders. At the early stages of cardiac development the heart is a simple two-cell layered tube, which divides into separate atrial and ventricular regions. The area between the atria and ventricles is called the atrioventricular (AV) canal and is the site of future AV valve formation. Early in the formation of cardiac valves, small, mound-like structures, called cushions, form. As valve development continues, these mounds fuse and thin into valve leaflets. Our group has previously described an in vitro model of valve leaflet development. A longstanding hypothesis proposes that mechanical forces, such as shear stress, are critical in shaping the cushions into leaflets. We are currently using our in vitro model system to test this hypothesis. As part of this investigation, we sought to mathematically model the key force, shear stress, which occurs in our in vitro model system using the COMSOL engineering program. The shear stress values obtained from this model will then be compared to values obtained from prior experimental quantification in the developing chick heart.

P.3

Bubbling Bed Gasifiers vs. Circulating Fluidized Bed Gasifiers: A Comparison of Fluidized Bed Technology for the Purpose of Gasifying Biomass

Name: John A. Blakely

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Co-Authors: Richard Lusk, R. Mark Bricka

Throughout the past decade, biomass gasification has received much attention as a viable alternative for the production of renewable electricity, chemicals, and fuels. Reactor design, which has a direct influence on gas quality and temperature, particulates, and tars, is perhaps the most important factor when considering a gasification unit. Most of the attention has been focused on the use of fluidized bed gasifiers. Fluidized bed reactors have several advantages over other types of gasifiers, such as low restrictions on feed characteristics, high heating rates, low residence

times, the ability to be scaled to industrial size, and the capability to produce syngas. There are two main types of fluidized bed gasifiers, bubbling fluidized beds (BFB) and circulating fluidized beds (CFB). This paper compares the two types of fluidized bed gasifiers directly, examining the pros and cons of each for the purpose of gasifying biomass, and discusses where the technology for each system is today.

P.4

Design, Construction, and Operation of a Cold Flow Model Circulating Fluidized Bed Gasifier:

A Technical Overview

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Throughout the past decade, biomass gasification has received much attention as a viable alternative for the production of renewable electricity, chemicals, and fuels. Reactor design, which has a direct influence on gas quality and temperature, particulates, and tars, is perhaps the most important factor when considering a gasification unit. Most of the attention has been focused on the use of fluidized bed gasifiers. Fluidized bed gasifiers have several advantages over other types of gasifiers, such as low restrictions on feed characteristics, high heating rates, low residence times, the ability to be scaled to industrial size, and the capability to produce syngas. There are two main types of fluidized bed gasifiers, bubbling fluidized beds (BFB) and circulating fluidized beds (CFB).

CFB technology has been shown to be a viable option for the gasification of biomass on the industrial scale. However, the design of CFB gasifiers are much more complicated than that of their BFB counterparts. Operating conditions, entrance and exit geometries, and particle separation techniques all play important roles in the hydrodynamics of CFB gasifiers. This paper discusses the design, construction, and operation of a cold flow model CFB gasifier. The reactor (constructed from clear PVC) consists of a 2" ID and stands 144" tall. Silica sand, sieved to different particle diameters, are used as the bed material. The effects of different return leg geometries (J-leg and an air driven loop seal), particle sizes, superficial riser velocities, and solids circulation rates on riser flow regimes are presented.

P.5

Fe/ZSM-5 as a Catalyst for Fischer-Tropsch Synthesis

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Fischer-Tropsch process is a well researched technology to convert syngas ($\text{CO} + \text{H}_2$) to liquid hydrocarbons.1.) Currently there are at least five commercial plants in the world that convert syngas obtained from coal gasification or natural gas reforming to liquid fuels. Fe, Co and Ru are well known Fischer-Tropsch catalysts. One of the problems with these catalysts is the lack of selectivity towards any particular group of hydrocarbons. The US consumes about 45% of the total gasoline produced in the world which makes it a valuable commodity in view of the current oil prices. One of the well known ways to produce gasoline is to convert alcohols to gasoline over ZSM-5 catalyst.2.) Olefins are important intermediates which are responsible for producing gasoline range molecules inside the ZSM-5 pores. It is known that Fe produces appreciable amount of olefins during the syngas conversion at temperatures which are ideal for alcohols to gasoline conversion process.3.) So, we decided to test various Fe/ZSM-5 for syngas to gasoline conversion.

Fe/ZSM-5 of varying amounts of Fe were prepared by incipient wetness technique. They were physically characterized by techniques such as TPR, XRD and BET. They were then tested for syngas conversion activity under varying conditions of temperature, pressure and space velocity. The results of these tests will be presented here.

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P.6

Development of Cobalt Ferrite and P(NIPAAm-co-AAm) Hydrogel Composite Material for Combined Hyperthermia and Chemotherapy for Cancer Treatment

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Cancer therapy is generally a combination of anti-cancer medication, surgery, and radiation. Presently, these options do not provide the most optimal care— even when combination therapy is used. A more novel approach of hyperthermia treatment has recently become of interest, especially with the capability to target tumors and minimize patient side effects. Because cancerous tissues do not have a well-formed vasculature, they are more susceptible to heat than healthy cells; therefore, by raising the temperature experienced by a cancer cell it is possible to create a more effective cancer treatment. Magnetic nanoparticles offer a unique opportunity to provide effective heating in localized areas- by exposing the particles to an external alternating magnetic field the particles heat through a phenomenon known as Neel relaxation. However, heating also causes negative side effects. Therefore, a self-limiting hyperthermia system is of interest. This would allow localized heating to a temperature greater than cancer cells can tolerate, but not detrimental to healthy tissue. This idea is central to optimal hyperthermia treatment.

The heating caused by an AC magnetic field could be used to trigger drug release. By incorporating magnetic nanoparticles with thermally-sensitive hydrogels, it is possible to trigger the release of an anti-cancer agent simultaneously with the therapeutic heating. Therefore, this magnetic nanoparticle hydrogel composite material may provide insight into localized hyperthermia, anti-cancer drug release combination therapy.

Cobalt ferrite (CoFe₂O₄) and poly(N-isopropyl acrylamide-co-acrylamide), (P(NIPAAm-co-AAm)) hydrogels were chosen as the components for the composite nanoparticle hydrogel. CoFe₂O₄ has been found in initial studies to be non-toxic. Also, cobalt ferrite nanoparticles provide a relatively high specific absorption ratio (SAR) and saturation magnetization essential to effective heating. Synthesis of CoFe₂O₄ nanoparticles allowed for direct control over particle size and magnetization, which studies show a direction correlation to heat generation.

P(NIPAAm-co-AAm) was chosen due to its thermally-sensitive nature. P(NIPAAm-co-AAm) hydrogels experience a negative swelling effect, as increased temperature results in hydrogel "squeezing". By synthesizing the hydrogel with a specific ratio of monomers, a polymer with a lower critical solution temperature (LCST) favorable for hyperthermia treatment is created. P(NIPAAm-co-AAm) gels were characterized through swelling behavior studies and Differential Scanning Calorimetry. Experiments were performed to simulate hyperthermia and measure the heat generation as a function of concentration of CoFe₂O₄ magnetic nanoparticles within P(NIPAAm-co-AAm). Finally, drug release studies were performed to characterize the effects of magnetic nanoparticles on drug release, and results yielded modulated drug release based on temperature.

P.7

Biochemical Modification of Linear DNA for Use in Gene Therapy

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A crucial technique in gene therapy is transfection, the introduction of DNA to a cell such that the cell expresses it. Commonly, circular pieces of DNA called plasmids are used to transfect cells. However, plasmids are usually much larger than the gene we are interested in expressing. Also, plasmids are usually amplified in bacteria, which makes them unfavorable for medical gene therapy applications. It would be convenient if we could transfect cells using only the linear gene of interest, as the DNA transfected would be smaller and could be amplified quickly and efficiently using PCR instead of bacteria. It has been shown, though, that the cell quickly recognizes and degrades foreign linear DNA. We hypothesize that this is due in large part to the exposed 3' and 5' ends of linear DNA. In light of that, we have used standard biomolecular engineering techniques to ligate small, custom-designed fragments of DNA onto the ends of the linear gene of interest, creating novel transfection constructs with "masked" ends. We hope to show that these constructs display a comparable transfection efficiency to plasmids, and will perform cell culture experiments to that end.

P.8

Inhibition of Amyloid- β Protein Aggregation in Alzheimer's Disease

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Co-Authors: Francisco Gonzalez, Melissa Moss

The cause of Alzheimer's disease (AD) has been associated with the aggregation and deposition of protein plaques in and around brain cells, causing neurocellular death. The protein primarily responsible for the extracellular plaques has been identified as the amyloid- β protein ($A\beta$). During the plaque formation process, $A\beta$ has been shown to exist as a series of unique structures: single monomer, partially soluble aggregation intermediates and fully formed insoluble fibrils. Further research has shown that $A\beta$ aggregates formed in aqueous solutions and $A\beta$ aggregates formed in solutions with polar-nonpolar interfaces differ in their molecular structure. Inhibiting the formation of any or all of the observed $A\beta$ aggregates could prove to be a therapeutic method to retard the progression of Alzheimer's disease.

This project examined the inhibitory characteristics of a library of cyclic chemical compounds that could potentially inhibit $A\beta$ aggregation. Potential inhibitors were first scanned for their ability to inhibit fibril formation from monomer in aqueous solutions. Effective inhibitors were then introduced into assays that isolate unique growth mechanisms, termed elongation and association, in aqueous solutions. Assays in buffer and 2.5% hexafluoroisopropanol were then performed to quantify inhibition in solutions with polar-nonpolar interfaces. Finally, inhibitor concentrations were varied to examine the dose-response relationship of inhibitors on $A\beta$ aggregation. Results demonstrate that several bi-cyclic and tri-cyclic compounds inhibit monomer aggregation in a dose dependent manner in both aqueous solutions and solutions with polar-nonpolar interfaces. Further results demonstrate that some compounds selectively target association of partially soluble aggregation intermediates.

P.9

Reconciling Molecular and Macroscopic Descriptions of Mass Transport Using Multiscale Materials Models

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At the continuum level, the description of mass, momentum and energy transport is typically comprised of a set of partial differential equations (PDEs) that represent mass, momentum and energy balances. The solution of this set of PDEs requires, as input, parameters such as the diffusivity, viscosity and thermal conductivity. In molecular dynamics (MD) simulations, the solution of Newton's equations of motion at the molecular level can be coupled with an understanding of statistical mechanics to yield, as output, transport properties such as the diffusivity, viscosity and thermal conductivity. The transport properties generated by MD simulations are equivalent to the transport properties required by continuum level equations, only if proper care is taken to make sure that the same nonequilibrium fields (e.g. composition gradient, velocity gradient, temperature gradient) are present in both the macroscopic and molecular-level models.

The simultaneous inclusion of multiple nonequilibrium fields in MD simulations is not well-established. In this work, we demonstrate for a model system, composed of a binary Lennard-Jones fluid, how one constructs an MD simulation to be completely consistent with the macroscopic description. Moreover, we show how the integrated multiscale materials modeling algorithm can be used to iteratively generate transport properties that provide a consistent description of mass, momentum and energy transport at both the macroscopic and molecular-level.

P.10

Polymer-Silica Mixed Matrix Membranes for Solute Separation from Water

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This study investigates the preparation of polymer-silica mixed matrix membranes, the effect of silica upon membrane water flux, permeability, and hydrodynamic pore diameter, and the ability of functionalized silica particles to capture silver (Ag^+) ions in solution. Polysulfone and Cellulose Acetate membranes were synthesized using the phase inversion technique. The membranes were characterized by flux, permeability,

and silver capture experiments. When casting the membranes, room temperature, relative humidity, and evaporation time were held constant, as well as gelation bath temperature, which was held around 23.0oC. It was found that the incorporation of functionalized silica particles significantly increased the capture of Ag⁺ when compared to membranes that did not contain the functionalized particles. It was also found that the permeabilities of the mixed matrix membranes were significantly lower than that of the blank polysulfone membrane. Once the Ag⁺ capture experiments had been completed the data for the three types of silica were compared, and it was found that the maximum capture was largely a function of the surface area of the silica.

P.11

Cellular Responses to Magnetic Nanoparticles

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Many new properties have been discovered for materials while working with them on the nanoscale. Because of these new properties, these materials must be investigated at the nanolevel to determine how they interact with cells. For instance, magnetic nanoparticles can be localized in vivo and heated through an AC field. To this end, the development of magnetic fluid hyperthermia systems to treat cancer is being widely investigated. These particles can be used for either hyperthermia (less than 45°C) or cell ablation (higher temperatures) to slow the growth of or effectively kill cancerous cells. Using a custom-built magnetic coil hyperthermia chamber, thermal profiles were measured using an infrared camera for different magnetic nanoparticle compositions, sizes, and concentrations. The effectiveness of magnetic heating for cell ablation was observed using a *Drosophila* fruit fly cell culture. The cytotoxicity of nanoparticles is also an important consideration in biological systems, so the cell cultures were used to screen magnetic nanoparticles against positive and negative controls. The surfactant used to disperse nanoparticles in aqueous solution may also impact toxicity. To determine the affinity cells have for these nanoparticles, confocal laser scanning microscopy was used to study colocalization with cell membranes. Nanoparticles were tagged with a red fluorescent probe while the cellular membranes were tagged with a green probe. In this way, we observed whether the nanoparticles can pass through the cell membrane and where they prefer to localize in a cell (cytoplasm, lipid bilayer, etc.). These results will aid in the preparation of magnetic nanoparticles for the design of a diagnostic and therapeutic platform for human cancer therapy.

P.12

Stability of Natively Unfolded Proteins

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Natively unfolded proteins lack a rigid three-dimensional structure, contrary to traditional ideas of protein shape governing function. A natively unfolded protein's lack of a well-defined shape actually allows newly discovered functions in such eclectic roles as cell signaling, nuclear transport and tissue structure. Semi-empirical correlations have been used to predict unfolded protein stability and function, but a physical basis in terms of realizable variables must be developed to understand natively unfolded protein stability and allow for their *ab initio* design.

Novel molecular simulations were used to relate the protein charge, hydrophobicity and length to globule (folded) or coil (unfolded) conformations. The coarse-grained model utilized the minimal amount of molecular detail necessary to capture the underlying physics of the natively unfolded proteins seen in experiment. We provide physical insight into the coil-to-globule transition in charge/hydrophobicity space and the reason this transition is independent of protein length.

P.13

Singled Walled Carbon Nanotubes Non-Covalently Modified with Chlorophyll-a

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A solution of singled walled carbon nanotubes (SWNTs) and chlorophyll-a in an aqueous CTAB medium has been created with the intention

of creating stable thin films with predictable electronic and photoelectric properties. Based on previous and well documented research, the chlorophyll-a molecule's pyrrole group will non-covalently interact to the π - π orbital located on the side of the SWNT molecule while the phyt chain of the chlorophyll-a molecule will induce hydrogen bonding parallel to the length of the nanotube. The non-covalent interaction allows for a predictable nanotube alignment due to the chlorophyll-a molecule's π - π orbital overlapping the SWNT's π - π orbital; the orbital responsible for the SWNT's electronic properties. Particular self-aggregation will consequently lead to the formation of thin film layers with varying electronic properties and may then be distributed into stable thin films for use in industrial applications. The approaches discussed here incorporate a variety of techniques and methodologies from previous experiments and led to the characterizations described in the following results. The purpose of this initial experiment is to construct a consolidated foundation for developing a wide variety of advanced organic materials with various industrial applications.

P.14

Novel Corticosteroid Development via I-QSAR with Signature

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The research discussed here involves the development of a class of preventative asthma medications named corticosteroids. Corticosteroids such as hydrocortisone have commonly been the therapy of choice where an anti-inflammatory or immunosuppressive treatment is required. However, systemic side effects such as dependency, Cushing's syndrome, growth inhibition, osteoporosis, and cataract formation continue to limit the drug's use as a sustained treatment. The focus of this research is to develop novel corticosteroids that are highly selective toward the lungs and are promptly removed from the body when exposed to the main circulation. We look to use the Inverse-Quantitative Structure-Activity Relationship (I-QSAR) algorithm with Signature to generate new drugs based upon the structures and corresponding activities of 61 previously studied corticosteroids. I-QSAR explores possible combinations of atom connectivity, and structural filters are used to predict and collect the best candidates for further study. Our work currently focuses upon filtering the 300 million solutions generated from the inverse problem, leaving a database possessing only characteristics such as high receptor binding affinity, high systemic clearance, high plasma protein binding, and low oral bioavailability. Structures will then be generated and further research can be performed to confirm that the aforementioned properties are exhibited in vivo by the predictions.

P.15

Biomass Gasification: Catalytic Tar Removal Using Fe, Ni, and Ru on Zeolites

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Gasification of biomass is an increasingly interesting source of energy, but there are many contaminants in the product stream that need to be removed. One of these contaminants is tars. Tars are a condensable mixture of hydrocarbons—the majority being larger than benzene. If tars condense in operating lines, corrosion or other problem can occur depending on the end use application. Various methods for treating tars include physical removal, modifying the gasifier operating conditions, thermal cracking, catalytic cracking and the use of plasma. Numerous studies have focused on catalyst cracking as a means of tar removal, but most studies have used Silica/Alumina as a catalyst support. Limited studies have been done using zeolites. This experiment represents the effect of transition metals on Zeolyte Y to remove tars. Experiments were conducted using a laboratory scale reactor in the presence of synthetic producer gas. Findings of these experiments will be shown and their importance of catalyst usage in tar removal efficiency in biomass gasification.

P.16

Surface Modification of Cellulose Membranes by ATRP for CO₂ Separations

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The goal of this research program is to successfully modify the surface of commercially available cellulose membranes to enhance their CO₂ absorption properties, as needed for gas separations. Poly(ionic liquid)s (PILs), which are known to selectively absorb CO₂ over hydrocarbon and permanent gases, are grafted from commercially available cellulose membranes. In this poster, we discuss the modification strategy, in which we initially graft [2-(methacryloyloxy)ethyl] trimethylammonium chloride monomer from the membrane surface via atom transfer radical polymerization. Fourier-transfer infrared (FTIR) spectroscopy is used to verify that polymerization has taken place. In a second step, the membranes undergo anion exchange reactions to replace chlorine (e.g., with BF₄⁻) in an attempt to enhance CO₂ absorption. X-ray photoelectron spectroscopy used to verify that the anion exchange reactions were successful. Once modified the membranes are tested for their ability to permeate CO₂ and other gases (e.g., N₂).

P.17

Physio-Chemical Properties of Lung Tissue

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By studying the contact angles of saliva and drug doped saliva on lung tissue and mucin layer samples, appropriate deposition and adsorption boundary conditions will be developed to be implemented in fluid dynamic simulations. In order to measure the contact angle between these surfaces and the probe liquids, a Krüss Easy Drop contact angle goniometer was used to take digital images of the sessile drops and software was used to determine surface contact angle using several different models. Of the methods testing for the fitting of hydrophilic (<) sessile drop contact angles, a circle fitting method was (°90) found to be most accurate. The pendant drop method was used to measure surface tension of the probe liquids including, pH 7 phosphate buffer solution and HPLC water. Time-dependent studies indicate that at 4 min. residence time, both HPLC water and pH 7 buffer solution reach equilibrium on bovine lung tissue. Future work will include investigation of the saliva and drug-doped saliva as the probe liquid on both lung tissue and mucin layers.

P.18

Optical Tomography of Three-Dimensional Reaction-Diffusion Waves in the Excitable Belousov-Zhabotinsky Reaction

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Traveling fronts and wave patterns exist in numerous excitable systems including living cells, tissue and organs as well as homogenous and heterogeneous catalyzed reactions. We study self organized wave structures in the auto-catalytic Belousov-Zhabotinsky reaction monitoring self-absorption changes of the employed redox catalyst Fe[batho(SO₃)₂]₃. An algorithm based on filtered-back projection is employed to obtain high resolution three-dimensional reconstructions of the catalyst's concentration. Specifically, we present the first example of three-dimensional waves in systems with anomalous, finite bandwidth, dispersion relations. This research is supported by the National Science Foundation under Grant No. 0513912.

P.19

Phase Behavior of Aqueous Suspensions of Cellulose Nanocrystals

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Cellulose nanocrystals (CNCs) derived from renewable feedstocks have shown promise in advanced materials applications. We have synthesized nanocrystals from cotton cellulose powder and wood pulp in an aqueous solution via sulfuric acid hydrolysis of the amorphously bonded regions of the cellulose. The crystalline regions of the cellulose fibers remained intact, yielding rigid, rod-shaped nanocrystals with lengths ranging from 50nm to 350nm (with an average length of 120 nm) and diameters of approximately 10 nm. The CNCs' phase behavior was studied by determining the relative volume and concentration of each phase for different total cellulose concentrations. Phase equilibrium was observed between an isotropic and an anisotropic phase, where the smaller particles were in the isotropic phase, as seen in transmission electron

microscopic (TEM) images. Observation of the isotropic and anisotropic phases in cuvettes containing different concentrations of cotton cellulose nanocrystals at a temperature of 20°C revealed that crystals tend to exist only in the isotropic phase when the solution's cellulose weight fraction is below 5.26% while crystals tend to exist in both phases when the solution's cellulose weight fraction is between 5.26% and 11%. The phase behavior was also studied at 40°C and 50°C. Potentially, the data resulting from phase behavior will be used to fractionate the particles according to size, thus yielding narrow size distributions of nanoparticles to improve the tunability of nanocomposite properties. Research of the properties of CNC will be continued to understand the interactions of the nanocrystals as a function of size and concentration as well as their solvent properties for future applications with polymer nanocomposite materials.

P.20

Identification of Inhibitors Effective at Preventing Aggregation of the Amyloid- β Protein Involved in Alzheimer's Disease

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Alzheimer's disease (AD) is a progressive degenerative disorder that is characterized by loss of memory, confusion, and cognitive disabilities. One hallmark of AD is the deposition of extracellular plaques in the brain. These plaques are composed primarily of amyloid- β ($A\beta$) protein, which aggregates from the harmless $A\beta$ monomer. Once it has aggregated into amyloid fibrils, $A\beta$ gains toxicity and can affect the surrounding neuronal cells. The objective of the research is to identify inhibitors which prevent $A\beta$ monomer from undergoing aggregation and to further assess the effectiveness of these inhibitors.

Aggregation of SEC-purified $A\beta$ monomer was induced by agitation and physiological ionic strength and typically showed a lag phase, followed by quick growth, then ending with a stationary phase. Aggregation assays were performed in the absence and presence of inhibitors to assess the ability of inhibitors to prolong the lag phase. Inhibitors were screened at a concentration five-fold in excess of $A\beta$ monomer, then effective inhibitors were examined at lower concentrations, including equimolar with the monomer, to identify the most effective inhibitors.

These assays were conducted using the fluorescent dye Thioflavin T (ThT). ThT binds to the β -sheet structure of aggregates, resulting in shifted fluorescent properties of ThT, which reflects the extent of aggregation. However, assessment of the inhibitors was limited because many of the cyclic compounds had overlapping emission spectra with that of ThT. Thus, a new fluorescing agent resveratrol, which has an emission spectrum at a different wavelength than ThT has been implemented, allowing for assessment of previously incompatible inhibitors

A small library of cyclic inhibitors was tested. Several inhibitors considerably increased the lag time to aggregate formation. Among the effective inhibitors, some exhibited diminishing effectiveness as the concentration approached equimolar with monomer. Other compounds retained their effectiveness at equimolar concentrations, but lost activity at substoichiometric concentrations.

P.21

Mechanical Analysis of Thermosensitive Hydrogels for Drug Delivery

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Mechanical analysis was conducted on thermosensitive hydrogels to determine their suitability for use in a triggered-release chemotherapy system. These thermosensitive materials phase separate when they are heated, and understanding their structure is crucial for optimal design of a controlled release drug carrier. Gels were tested in their hydrated state to mimic physiological conditions. Four types of polymer gels were tested: non-responsive poly(2-hydroxyethyl methacrylate) or PHEMA, negatively thermosensitive poly(N-isopropylacrylamide) or PNIPAAm, negatively thermosensitive poly(N-isopropylacrylamide-co-acrylamide) or P(NIPAAm-co-AAm) and positively thermosensitive PHEMA grafted with oligomers of NIPAAm-co-AAm or P(HEMA-g(NIPAAm-co-AAm)).

The PHEMA gels create a good baseline test since they are thermally non-responsive. PHEMA gels can be tuned to release drugs at a certain rate by altering the crosslinking ratio. The negatively thermosensitive gels based on PNIPAAm or P(NIPAAm-co-AAm) shrink as they are heated, turning diffusion off. Positively thermosensitive PHEMA gels grafted with oligomers of NIPAAm-co-AAm open to release a drug when heated. This

grafted design is ideal for combination with magnetic nanoparticles that can be heated in vivo using an AC magnetic field, as the magnetic field can act as a trigger to initiate drug delivery. The gels are affected by various factors including temperature, type of crosslinking agent, amount of crosslinking agent and the graft density. Varying one factor while keeping the others constant showed the effect each has on the polymer mesh structure.

Results confirm the shrinking/swelling behavior of the P(NIPAAm-co-AAm) gels and show that the grafted oligomers may alter the physical structure of PHEMA gels. Because the drug release rates depend on the organization of the polymer mesh, these results are useful in designing release systems for various chemotherapeutic agents.

P.22

Synthesis of Lactic Acid from Waste Whey Permeate

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The synthesis of lactic acid using cheese whey permeate was modeled using Aspen Plus. Lactic acid is commonly produced by fermentation of such raw materials as corn and molasses from sugar production. Government subsidies intended to fuel the growth of ethanol as an alternative energy option has led to increases in the cost of traditional raw materials for the lactic acid process. A new process involving the recycling of whey waste streams from cheese and milk processing has been developed to cut the cost of raw materials in the production of lactic acid. The waste whey stream undergoes a transformation to lactic acid by the fermentation of lactose to produce lactate. The lactate then passes through a series of cation exchange resin beds to acidify the stream generating lactic acid. The lactic acid stream then goes through an anion exchange resin bed before undergoing reverse osmosis and evaporation in order to further purify and concentrate the stream. A new polymer has been designed that utilizes lactic acid, which could increase the demand for lactic acid as a raw material.

P.23

Optimizing the Synthesis of PK3 for Drug Encapsulating Microparticles

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School Name: Georgia Tech

Phone: 404.290.3717

Poly(lactic-co-glycolic acid) (PLGA) is a biodegradable polymer with physical properties that have granted it FDA approval and made it's commercial use very practical. One identifiable limitation of PLGA is its usage as a microparticle delivery agent under acidic conditions, such as intracellular delivery (pH 4.5), where the hydrolysis byproducts have been documented as inflammatory agents. In Dr. Niren Murthy's lab, polyketals are being investigated as a new alternative to PLGA. One of the most promising advantages of the polyketals, particularly poly(cyclohexane-1,4-diyl acetone dimethylene ketal)(PK3), lies with its acid hydrolysis byproducts, 1,4-cyclohexanedimethanol and acetone. The major limitation in the implementation of polyketals as drug delivery vehicles is the efficiency of encapsulation. From a previously established correlation between the molecular weight of the polymer and it's drug encapsulation efficiency, the objective of this project was to optimize the technical process of making polyketals and thereby to improve the quality of the polymer produced. Sensitivity studies were done on reaction temperature, ratio of reactants to solvent, and collection/reaction time frame to determine the optimum conditions for synthesis. The technical improvements from this experiment increased the molecular weight of the polymer produced by 164% and increased the yield of a single batch by 215%. With these improvements to the synthesis protocol, further studies can be conducted to test the feasibility of using polyketals for microparticle drug delivery vehicles.

P.24

Evaluation for the Potential of Surfactant Aided Conversion of Synthesis Gas to Ethanol

Name: David Cole Shields

School Name: Mississippi State

Phone: 662.397.2960

Co-Authors: Bryant Brooks, Mark Bricka

Ethanol production from Synthesis Gas (Hydrogen, Carbon Monoxide, Carbon Dioxide, Methane, and Sulfur) is a more recent attempt to extend

the reach of biofuels in our society. Historically, ethanol production is based on the conversion of lignocellulosic biomass. However, concerns both economical and political drive researchers to attempt to find other methods to augment current ethanol production and alleviate our dependence of petroleum based fuels.

Synthesis Gas is produced in a thermal process called Gasification. Gasification starts with Pyrolysis, which is the thermal decomposition of lignocellulosic material at 400 to 600 °C. The yield is char, tar, gas, and some volatile compounds. The char can be further gasified into more synthesis gas. To make use of the synthesis gas, bacteria were discovered that could convert the components into commodity chemicals. In particular, ethanol by anaerobic fermentation. However, the mass transfer limitations of gases into solution, coupled with the operating parameter of the conversion bacteria limit the amount of ethanol yield during a fermentation process.

Surfactant chemistry may present a solution to the mass transfer limitations inherent in gas solubility. Surfactants (surface acting agents) are used extensively in the production of cosmetics, toiletries and household, industrial, and agricultural products. They can be used as dispersants, emulsifiers, foaming agents, wetting agents, and spreading agents. In sufficient concentrations, the hydrophilic head, and hydrophobic tail of a surfactant will form an array of structures that can augment the mass transfer properties of the aqueous media. It is because of this ability that testing has begun to reduce the cost of ethanol production from synthesis gas while overcoming the mass transfer limitation of dissolving synthesis gas into fermentation broths. This paper will discuss the characterization of surfactants and surfactant chemistry, the lab-scale gas solubility system, and the evaluation of the ability of select surfactants to enhance mass transfer limitations.

P.25

Atomistic Simulation of Interfacial Metal Ion Extraction

Name: R. Bryan Smith

School Name: University of Tennessee, Knoxville

Phone: 865.771.3781

Co-Authors: Bamin Khomami, Shengting Cui, Xianggui Ye

The reprocessing of spent nuclear fuel is typically performed by way of liquid-liquid extraction: the metal of interest is placed in an aqueous solution and mixed with a liquid hydrocarbon solution, which contains an extractant molecule specifically chosen for its affinity with the dissolved metal ion. Sufficient mixing (e.g. by centrifugal contactor) allows the extractant to complex with the metal and return to the organic phase, effectively separating the metal from its original solvent. Current models of this process are mostly empirical and thus limited to the most common solutions. The goal of this research is to develop a computational model for such metal ion extraction, using molecular dynamics simulations and existing molecular models. Specifically, a solution of uranyl ion ($[UO_2]^{2+}$) with nitrate ($[NO_3]^-$) and water is simulated at an interface with an organic liquid containing tributyl phosphate ($[C_4H_9]_3PO_4$ or TBP). The project at hand involves the examination of the uranyl/aqueous phase, and the complexation that occurs between uranyl, nitrate, and hydronium. Depending on the number of each ion attached to it, the uranyl ions may be attracted to or repelled by the organic phase. Molecular dynamics simulations have shown that, although uranyl quickly forms complexes with nitrate, the nitrate molecules eventually drop away and are replaced by hydronium. These uranyl-hydronium complexes then begin to cluster together; it is not yet clear whether this facilitates or impairs transfer to the organic phase. Continuing work will see to the analysis of the organic/aqueous interface, and the behavior of uranyl and TBP as they approach it.

P.26

High Temperature Aluminum Thin Film Deposition on Silicon Substrates

Name: William Sweet

School Name: Vanderbilt University

Phone: 410.409.4779

Co-Authors: Ben Schmidt, Bridget Rogers

The excellent insulation properties of ceramic materials make them suitable for electrical applications as high-k gate dielectrics in complimentary metal-oxide-semiconductor devices, as well as high temperature applications as thermal barriers for atmospheric re-entry vehicles. Military research of ultrahigh temperature ceramic materials (UHTCs) has found suitable candidates based on the oxides, borides, and carbides of Al, Hf, Zr, and Si. Mechanisms of high temperature performance are not well understood. Oxidation testing is difficult to reproduce due to the standard powder pressing and sintering of these composites, and variability in test samples conceals the impact of porosity and composition at grain boundaries. Alternative processing techniques like chemical vapor deposition (CVD) provide high levels of compositional, interfacial, and phaseal control. The fundamental investigation of smaller materials systems can then provide insight into more complex systems.

In this work, aluminum oxide thin films have been deposited on silicon substrates by CVD of dimethylaluminum isopropoxide (DMAI) and oxygen. DMAI is a hybrid of two popular aluminum-based precursors, trimethylaluminum (TMA) and aluminum isopropoxide (AIP). The films have been characterized by an array of techniques including X-ray photoelectron spectroscopy (XPS), spectroscopic ellipsometry (SE), Rutherford backscattering spectrometry, and medium energy backscattering spectrometry. Dynamics of film deposition have also been investigated by in situ SE. Precursor design is important in CVD for large deposition windows and contamination-free films. The effects of different ligands on the metal center can be understood by comparisons of our results with those utilizing TMA and AIP.

P.27

Creation and Passivation of Aluminum Nanoparticles using High Energy Ball Milling Name: Whitney Stoppel

School Name: Tulane University

Phone: 985.956.0232

Co-Author: Brian S. Mitchell

The creation, functionalization, and passivation of nanoparticles is an important field of research. The passivation of aluminum nanoparticles has been analyzed both computationally and experimentally. Umezawa et.al. performed a molecular dynamics study on the decomposition and chemisorption of 1,3,5-trinitro-1,3,5-triazine on Al (111) surface. Experimentally, passivation has been shown on aluminum oxide and oxide-free surfaces using many different chemicals. A variety of methods have been used, but this research focuses on the use of high energy ball milling, due to the feasibility in scaling up the procedure. Passivation on oxide-free surfaces of aluminum nanoparticles with both benzene and benzaldehyde has recently been shown by Sardar et.al. The use of high energy ball milling (to create aluminum nanoparticles passivated with benzaldehyde was explored. High energy ball milling has commercial potential, allowing for the creation of an unoxidized aluminum surface without the use of harsh chemicals or difficult procedures. This method of mechanochemical synthesis has been explored with silicon and alkene or alkyne solvents by Heintz, et.al.. The application of Heintz's method to the creation and passivation of aluminum nanoparticles is the focus of this research.

P.28

Design and modification of Gas Permeation Apparatus for Low Pressures and Permeation Rates of Membranes

Name: Nick Sturgis

School Name: Clemson University

Phone: 717.487.6656

Co-Authors: Ashley Hart, Nick Sturgis

The overall objective of this project is to design and setup an apparatus that would be capable of measuring permeability and selectivity of membrane samples. This apparatus will be used for pressures up to 100psi, and low permeation rates. The measurements necessary for calculating diffusion coefficient and pressure gradient will be taken by digital pressure gauges upstream and downstream of the membrane. The permeability can be related to the diffusivity and pressure gradient, which are measured by pressurizing the apparatus and allowing the upstream and downstream pressures to equilibrate. The membrane holding cell uses an o-ring, but due to significant leaking this setup has been changed to use the membrane itself as a seal. Results thus far are insignificant and inconclusive, and more work will be required to reduce leakage. Major changes to the apparatus designed to improve experimental results are in progress, specifically a pressure transducer that will directly measure the pressure difference and provide digital data over time.

P.29

Manganese Ferrite Nanoparticles – Heat Generation Study for Magnetic Hyperthermia Cancer Therapy

Name: Ynhi Thai

School Name: The University of Alabama

Phone: 228.547.7320

Co-Authors: Dong-Hyun Kim, Christopher S. Brazel

Recently, manganese ferrite (MnFe₂O₄) nanoparticles show promising potential for hyperthermia cancer treatment due to their high magnetic moment and biocompatibility. Furthermore, the nanoparticles should heat rapidly to shorten treatment time and minimize discomfort from

prolonged heating. To accomplish this, the Specific Absorption Rate (SAR), which is the power of heating a magnetic material per gram, should be maximized. The heating effect depends on the size of the particles as well as the frequency and amplitude of the applied AC magnetic field. MnFe₂O₄ nanoparticles ranging in size from 7.1 to 12.1 nm were synthesized via a thermal decomposition method. The dependence of the heat generation on the amplitude of the applied AC magnetic field was investigated at frequencies of 231 and 266 kHz with fields ranging from 131 to 653 Gauss. An Infrared Thermacam® was used to monitor the temperature rise in the samples. The SAR was calculated to compare the efficiency of heating each sample for the various applied magnetic fields. The results suggested an optimum size around 10.5 nm of magnetic MnFe₂O₄ nanoparticles for effective heat generation. This study provides suggestions for efficient heat generation of MnFe₂O₄ nanoparticles under an external AC magnetic field, offering interesting possibilities of improving magnetic hyperthermia cancer therapy. Future work includes investigation of these nanoparticles as a multifunctional platform to combine imaging with drug targeting and delivery in hydrogel and core-shell systems.

ChemE Car Poster Competition

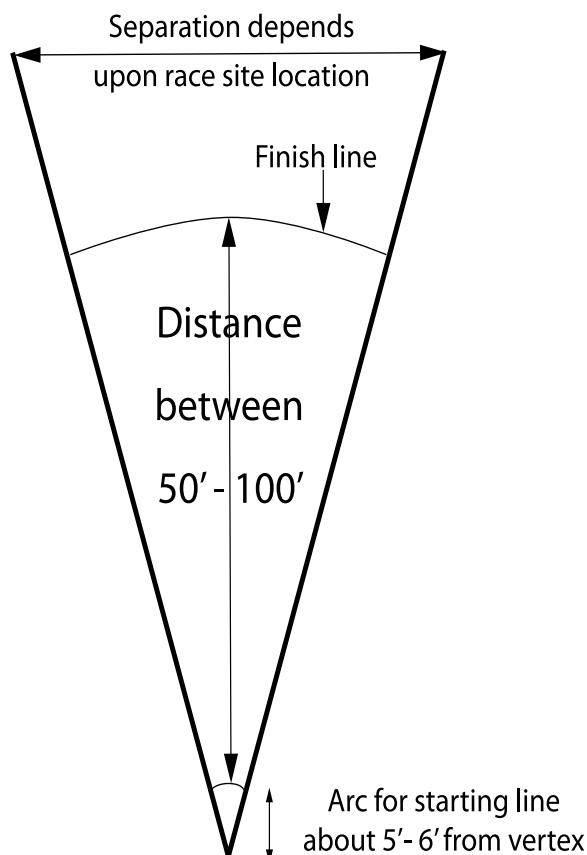
9:00 a.m. – 11:00 a.m.

Foy Student Union

Sponsor: **Boise**

Competition Information

The annual regional ChemE car race is a chance for students studying Chemical Engineering around the Southern Region to come together to display their creativity and have fun competing against schools at the same time. Each team designs a car powered by some form of a chemical reaction. This vehicle must be designed to also carry a specified cargo. The teams will be told at the time of the competition the distance that the car must travel and the specified cargo that the vehicle will carry. Using their knowledge of chemistry and previous trials they must decide the proper amount of “fuel” to use to power the car the specified distance. The top five teams are eligible to compete in this fall’s national conference in Philadelphia. Each team is required to abide by the national rules set by national AIChE office.



The rules can be found at:

<http://www.aiche.org/Students/Conferences/chemecar.aspx>

In addition to the competition portion, there is also a Poster competition during which teams get the chance to present to the judges their team’s car and explain the reaction used to power it. The poster should describe how the car is powered using the chemical reaction, the unique features of the car, and the environmental and safety features in the design. Appropriate documentation on the design and testing of the vehicle must be available for inspection by the judges at the poster competition. This documentation must include: Material Safety Data Sheets (MSDS), Job Safety Analysis form (JSA), relief valve sizing calculations, and testing results. If obvious safety violations have occurred, the judges will disqualify the entry. Entries will also be judged on creativity in the propulsion system and the appearance of the vehicle.

Awards	
Performance	Poster
1st Place Ribbon and \$650	1st Place Ribbon
2nd Place Ribbon and \$450	2nd Place Ribbon
3rd Place Ribbon and \$250	3rd Place Ribbon
4th Place Ribbon	Most Creative Drive System
5th Place Ribbon	Most Creative Vehicle Design
Spirit of the Competition	

ChemE Car Poster/First Round Car Schedule

Car/Poster	Name	University
CC.1	CoKi Turbo	University of Puerto Rico, Mayaguez
CC.2	The Green Bull	University of South Florida
CC.3	Swamp Buggy	University of Florida
CC.4	Colbert Eagle	Tennessee Technological University
CC.5	Spellbound	University of Tennessee – Knoxville
CC.6	ElectrolyzeThis	Florida Institute of Technology
CC.7	Chem E Car	University of Alabama in Huntsville
CC.8	Eye of the Tiger	Auburn University
CC.9	The Yeast Beast	Tennessee Technological University
CC.10	Taking it to the Limit	Louisiana Technological University
CC.11	The Black Box Project	Louisiana Technological University
CC.12	ChemE Carrrr v2.0	University of Kentucky

ChemE Car Teams

CC.1

University of Puerto Rico, Mayaguez

Car Name: *CoKi Turbo*

Team Leader: Joshua Leon

Phone: 787.697.9045

Team Advisor: David Suleiman

Email: dsuleiman@uprm.edu

Phone: 787.832.4040 ext. 5

Team Members:

- Joshua J. Leon-Ricardo
- Wanda Palacio-Velez
- Edgardo Lebron-Crespo
- Annie Ramirez-Velazquez
- Jose Mattei-Sosa
- Ruben Gonzalez-Ocasio
- Edwin J. Colon-Rivera

CoKi Turbo: Hydrogen Peroxide Powered Car

Abstract: CoKi Turbo is the next generation of the CoKi Chem-E-Car family. It is a shoebox-sized car, powered by the decomposition of Hydrogen Peroxide using Potassium Iodide as catalytic agent. This reaction produces large amounts of oxygen, which is used to power an air motor, which makes the car move.

CC.2

University of South Florida

Car Name: *The Green Bull*

Team Leader: Minh Nguyen

Phone: 727 415 8699

Team Advisor: Dr. Wolan
Email: wolan@eng.usf.edu
Phone: 813. 974.6250

Team Members:

- German Naranjo
- Fabian Smith
- Ryan Cates
- Sinsze Koo
- Nagy Wassef
- Aunshisa Tongtharadol
- Isauro Contreras

The Green Bull

Abstract:

The USF Team will be using Gallium and aluminum alloy with excess water to produce hydrogen to fuel the 5-stage fuel cell. The fuel cell does not require pure oxygen. However, the team will make an additional reaction of manganese dioxide with 3% hydrogen peroxide to produce oxygen for increased fuel cell efficiency. The team will be running on a heavily modified frame from an RC car. The frame is made as light as possible. The car is designed to fit the theme of the USF Bulls.

CC.3

University of Florida

Car Name: *Swamp Buggy*

Team Leader: Kristina Denoncourt

Phone: 954.907.0494

Team Advisor Information

Name: Aravind Asthagiri

Email: aasthagiri@ufl.edu

Phone: 352.392.0868

Team Members:

- Nicole Vaupel
- Michael Devivero
- Stephanie Knight
- Nathaniel Nelson
- Brittany Cooley
- Tim Van Cleve
- Matt Blackburn
- Bart Licht
- Eric Mondor
- Corene Cano

Swamp Buggy

Abstract:

The Swamp Buggy uses a high performance Proton Exchange Membrane (PEM) electrode assembly fuel cell, which generates electricity to power a small motor. The fuel cell is fed with oxygen from the air and hydrogen which is made by splitting water using an electrolyser.

CC.4 Tennessee Technological University
Tennessee Technological University

Car Name: *The Colbert Eagle*

Team Leader: Braxton Sluder
Phone: 423.741.4989

Team Advisor: Ileana Carpen
Phone: 931.372.3474

Team Members:

- Braxton Sluder
- Haley Hunter
- Trey Brooks
- Jeff DeLoach
- Matt Erwin
- Christy Holt
- Ryan Pavlovsky
- Tony Ponzio
- Nemoy Rau
- Megan Shannon

The Colbert Eagle

Abstract: The car is a three-wheel design with an electric motor powered by zinc-air fuel cells. The fuel cells run off of 6 M KOH and Zinc. The wiring for the car runs through a strip of aluminum foil. To stop the car, different concentrations of NaOH are added to the foil to break the circuit and stop the car.

CC.5
University of Tennessee - Knoxville

Car Name: *Spellbound*

Team Leader: Jared Johnson
Phone: 931.334.1732
Team Advisor: Paul Frymier
Email: pdf@utk.edu
Phone: 865.974.4961

Team Members:

- Nickyla Alliove
- Kristen Dobrodziej
- Bradley Harris
- Jared Johnson
- Lauren Johnson

Spellbound

Abstract:

The University of Tennessee (UT) Chem-E-Car is powered by pure hydrogen gas. A hydrogen fuel cell is used to convert the supplied hydrogen into electrical energy, which is used to power the motor on the car. The hydrogen reacts with atmospheric oxygen on a platinum catalyst to produce water vapor. The creation of water vapor is an exothermic reaction, and the energy released is converted to electrical energy. The energy produced from the fuel cell is stored in a bank of capacitors that are placed on board the car to provide a regulated supply of energy to the car motor. By means of a chemical timing mechanism, this capacitor-motor circuit is broken at the appropriate time as indicated by a calibration

curve that takes into account the specified load and distance. The chemical timing mechanism consists of a magnesium strip immersed in hydrochloric acid (HCl), and the HCl concentration is varied to achieve the desired results. Utilizing this design, the UT Chem-E-Car team aims to achieve superior results in competition.

CC.6

Florida Institute of Technology

Car Name: *Electrolyze This*

Team Leader: David Piryk

Phone: 860.977.0137

Team Advisor: Maria Pozo de Fernandez

Phone: 321.674.8838

Team Members:

- David Piryk
- Nick Milano
- Gilbert Castillo
- Cody Narcisco
- Christine Flemming
- Charmaine Flemming
- Mike Murphy
- Kelly Johansen
- Michelle Congdon
- Leslie Stark

What "Electrolyze This" Is All About

Abstract:

"Electrolyze This" from Florida Institute of Technology utilizes two reversible hydrogen fuel cells as its source of power. The two cells have separate hydrogen and oxygen storage tanks which are connected to the cells via poly tubing. When the cells are charged with a battery pack to the preferred amount of fuel, the cells recombine the hydrogen and oxygen to produce an electric current which is used by a motor to propel the car. The circuit to deliver the power to the motor is controlled by a switch that has been integrated into system and is located on the side of the car. The circuit is wired in series to provide an even distribution of current to the motor which ensures accuracy.

These fuel cells and tanks are mounted on a custom designed chassis. We started with an RC car racing chassis. After the build was complete, there were obvious implications that led to the modifications. The size of our motor required a fabricated motor mount and custom gears to properly propel the car forward. Steering modifications also include a servo in a fixed position to ensure a straight line of travel.

CC.7

University of Alabama in Huntsville

Car Name: *UAH Mini*

Team Leader: James Karigan

Phone: 256.658.4325

Team Advisor: Katherine Taconi

Phone: 256.824.3595

Team Members:

- Evan Grimes
- Lauren McDearmond
- Neema Atashi
- Cody Holland

- James Karigan

UAH Mini

Abstract:

Our car will use a hydrogen fuel cell to produce a small voltage. This voltage will then be run through an electrical circuit that will increase the voltage to an adequate amount. The new voltage will then be applied to a small electric motor to propel the car. The fuel cell is reversible, so the amount of hydrogen and oxygen supplied to the fuel cell can be varied by changing the amount of time the voltage is applied to the fuel cell. Additionally, a load can be applied to the circuit to consume excess voltage.

CC.8

Auburn University

Car Name: *Eye of the Tiger*

Team Leader: Amar Tiwari

Phone: 205.447.2627

Team Advisor: W. R. Ashurst

Phone: 334.332.3121

Team Members:

- Amar Tiwari
- Steven Crace
- Justin Gorman
- Mohammad Biswas
- Jeney Zhang

Eye of the Tiger

Abstract:

This year's Eye of the Tiger utilizes a commercial internal combustion engine and fuel synthesized by the students. We use ethanol made from biomass through the distillation and fermentation labs in Auburn. The ethanol is mixed with oil to create a synthetic student fuel mixture. Ethanol combusts with the oxygen present in the air to form carbon dioxide and water. The car will be stopped when the fuel is run out.

CC.9

Tennessee Technological University

Car Name: *The Yeast Beast*

Team Leader: Joshua Jackson

Phone: 615.594.1032

Team Advisor: Ileana C. Carpen

Phone: 931.372.3474

Team Members:

Chris Heckman

Adrian Mether

Nemoy Rau

Trey Brooks

Jeff Thompson

The Yeast Beast

Abstract:

This car is driven by CO₂ production from *Saccharomyces cerevisiae* during its fermentation period. This in turn creates a pressure build-up within the fermentation vessel which is released to power a pneumatic engine. Temperature, glucose concentration, yeast concentration and anti-foaming agents are all tightly controlled to maximize CO₂ production and provide a means of controlling the distance the car can travel.

CC.10

Louisiana State University

Car Name: *Taking It to the Limit*

Team Leader: Chuck Combs

Phone: 985.807.4589

Team Advisor: James Henry

Phone: 225.578.1750

Team Members:

- Matthew Stephens
- Arpan Seth
- David Orth
- Josh Wiggins
- Brendan Flynn
- Kirk Rollins
- Blake Kliebert
- Matt Daniel
- Lon Huengh

Taking It to the Limit

Abstract:

Using stout construction and strength to give reliability. Combined with an advanced biological reaction to give a competitive edge and consistent operation.

CC.11

Louisiana State University

Car Name: *The Black Box Project*

Team Leader: Chuck Combs

Phone: 985.807.4589

Team Advisor: James Henry

Phone: 225.578.1750

Team Members:

- Matthew Stephens
- Arpan Seth
- David Orth
- Kirk Rollins
- Josh Wiggins
- Brendan Flynn
- Blake Kliebert
- Matt Daniel
- Long Huengh

A Slightly Different Approach

Abstract:

Taking a different take on a train's steam engine. Using pistons that react well to diatomic molecules, and running a peroxide and catalyse reaction. Again using robust reliable and safe construction, with extra safety precautions to ensure the safe handling of the oxygen that the car runs on.

CC.12

University of Kentucky

Car Name: *ChemE Carrrr v2.0*

Team Leader: Peter Frailie

Phone: 859.494.7256

Team Advisor: Dibakar Bhattacharyya

Phone: 859.257.8028

Team Members:

- Don Johnson
- Brett Thompson
- Lauren Rosenbeck
- Megan Bush
- Joel Vice
- Alex Montague
- Peter Frailie

ChemE Carrrr v2.0

Abstract:

This car utilizes the ferrous chloride catalyzed reaction between sodium borohydrate and water to supply hydrogen gas for the fueling of a hydrogen fuel cell. To control the distance traveled by the car, a cutoff mechanism was designed using the reaction between hydrogen peroxide, potassium iodide, and sodium thiosulfate, commonly called the iodine clock reaction.

Lunch

11:00 a.m. – 12:30 p.m.

Tent in front of Ross Hall

Sponsor: **Alabama Center for Paper
and Bioresource Engineering**

Round Table Discussions

11:30 a.m. – 12:15 p.m.

Ross Hall 136 and 278

What are you doing to save the world? - Applying your engineering skills to increase energy efficiency

Bob Sylvester, DuPont

11:30 – 12:15

Pick up a lunch meal and bring it to Ross Hall 136

Have you given thought to what you might do in your personal life to reduce the amount of money which you spend on energy? To reduce the dependency of the US on imported oil? To be a better steward of the environment? To illustrate the practical application of chemical engineering skills to your family and friends?

Bob Sylvester works with DuPont businesses to reduce their environmental footprint while improving profitability. He has taken learnings from this experience and applied it to his personal life. His conclusions are:

- Energy use is key to environmental footprint and also a major expense
- When we apply our engineering skills to issues of energy use, we can see opportunities hidden to others
- Engineers need to be advocates for energy efficiency throughout our economy

He will give a brief presentation and lead a round table discussion.

Bob is a principal consultant of process technology in the DuPont Engineering Research and Technology organization. He has received 8 corporate level awards for excellence in process and environmental engineering. He has taught at the University of Delaware and for the AIChE and was a director of the Environmental Division of the AIChE. Bob was awarded the “2008 Outstanding Alumnus” Award by the Auburn Chemical Engineering Department faculty.

Growing Your Chapter: A Workshop for Chapter Leaders

Lowell Aplebaum, AIChE

11:30 – 12:15

Pick up a lunch meal and bring it to Ross Hall 278

At least one President or Vice President from your chapter is encouraged to participate.

An opportunity to encounter some of the best practices going on in AIChE student chapters throughout your region. Bring any challenges your chapter faces for discussion. Additionally, discuss what new tools and programs national AIChE has planned for next year as part of the ScaleUp initiative.

Lowell Aplebaum has a B.A. in sociology from Columbia University as well as a M.A. in education. For over 10 years he has worked with university students, developing leadership curriculum and non-profit organizational structure. Lowell oversees AIChE's student membership initiative – ScaleUp – which has doubled the national student membership of AIChE. He previously has traveled cross country eight times, and looks forward to visiting five AIChE Student Regional Conferences this spring.

Workshops

12:30 a.m. – 3:00 p.m.

Meet in front of Ross Hall. **Check for departure times.**

The Ole Auburn Ale House Tour

Ever wondered exactly how beer is made? Take advantage of this cool opportunity to check out the local brewery and pub at The Ole Auburn Ale House. In this workshop you will get to meet the local brew master as he will give a tour of the brewery. Check it out!

Paper Machine Tour

Check out the fully functional small scale paper machine. During this workshop you will get to learn how paper is made as well as learn about some of the amazing research associated with it.

Research Tour

Take this great opportunity to see first hand all the amazing research being done here at Auburn University. This research includes drug delivery through the use of contact lenses, alternative energy sources from hemicelluloses, nanotechnology, and more!

ChemE Car Competition

12:30 p.m. – 3:00 p.m.

Foy Student Union Ballroom

Sponsor: **Boise Paper**

Kick Ball Tournament

3:00 p.m. – 5:30 p.m.

Duck Samford Fields

Sponsor: **Southern Company**

Banquet

7:00 p.m. – 9:15 p.m.

Auburn University Hotel and Conference Center

Sponsor: **Eastman**

Keynote Speaker

Gregory W. Nelson

Vice President, Corporate Technology

Eastman Chemical Company

Nelson is a native of Birmingham, Alabama. He received his Bachelor's of Science degree in 1984 from the University of Alabama and a Ph.D. in Analytical Chemistry from Emory University in 1988. He completed the Advanced Management Program at Harvard Business School in 2007.

After graduation Nelson joined Eastman Chemical Company and conducted individual research in laboratory automation, polymers processing, polymer chemistry, and spectroscopic analysis of polymer systems and processes.

Nelson has held positions as:

- Market Development Manager for the Performance Plastics Business
- Group Leader for the Polymer Stabilization and Colorants Research Laboratory
- Technology Manager for the Flexible Plastics Business
- Business Unit Manager for the Polyethylene Business.
- Vice President, Technology for Voridian, a Division of Eastman Chemical Company.
- Vice President, Polymers Technology, Eastman Chemical Company

In 2007, Nelson was appointed to his current position.

Nelson is a member of the American Chemical Society and has held a position on the Board of Industrial Advisors to the University of Alabama Chemistry Department.

Social (Pockets)

9:30 a.m. until

Buses will run to and from hotels until Pockets closes

We have rented out Pockets Billiards for free pool on Saturday night from 9:30 p.m. to 2:00 a.m. Last Episode will be playing in one room and D.J. Ozz will be putting on show in another. Pockets will provide happy hour prices all night long. Transportation to and from all hotels will be provided until 2:00 a.m.

Sunday, April 6

Officer's Breakfast

9:00 a.m. – 11:30 a.m.

Haley Center Eagle's Nest

Sponsor: ExxonMobil

Samuel Ginn College of Engineering

- The 2008 U.S. News & World Report ranked Auburn's undergraduate engineering program 34th and the graduate program 45th among the nation's public universities.
- The college offers the state's largest engineering program, according to the American Society for Engineering Education, and awards more than \$1 million in scholarships annually.
- Auburn Engineering ranks 20th nationally in the number of bachelor's degrees awarded to African-Americans and 40th in the number of degrees awarded to women.
- The university offers the nation's first and only bachelor's degree in wireless engineering, graduating the first students in 2004. It is the first program in the Southeast to offer bachelor's and master's degrees in software engineering and the only state university offering a polymer and fiber engineering program.
- Auburn Engineering students comprise approximately 25 percent of those who graduate with honors university-wide and 80 percent of co-op students.
- Beyond the classroom, students gain hands-on, real-world experience on student competition teams for Formula SAE race cars, SAE Mini Baja all-terrain vehicles, and SAE Aero Design unmanned aerial vehicles, as well as fuel cell powered cars, robotics, ergonomics and materials handling design.
- The college has educated four of Auburn's six NASA astronauts – Jim Voss, Ken Mattingly, Jan Davis and Clifton Williams; three directors of the Kennedy Space Center – Richard Smith, James Kennedy and Forrest McCartney; and three members of the prestigious National Academy of Engineering – John Junkins, Oliver Kingsley and Philip Lett.
- Auburn Engineering houses nine departments, offering 13 majors, four minors and 12 research centers, and conducts approximately half of the university's annual research. Research areas include transportation technology, food safety, materials processing, information technology, wireless engineering, aerospace engineering, bioprocess/environmental engineering, highway/asphalt technology, microelectronics, vehicle electronics, fiber technology, pulp and paper, occupational safety and ergonomics, and technology management.
- The college is highly ranked in research funding per faculty member. Ongoing investments in new research equipment, more than \$30 million in renovations and \$108 million in new construction are ensuring that the college's facilities remain state-of-the-art.

Samuel Ginn College of Engineering
108 Ramsay Hall • Auburn, AL 36849
Phone: (334) 844-2308 • Fax: (334) 844-4487
Email: webmaster@eng.auburn.edu • Website: eng.auburn.edu

Larry D. Benefield, Dean

Bachelor's degree offerings: 13 programs with four minors
Graduate degree offerings: 26
Fall 2007 enrollment: 3,765
Undergraduate: 3,092
Graduate: 673

Sponsor Profiles

Alabama Center for Paper and Bioresource Engineering

AC-PABE provides undergraduate, graduate and continuing education in science and engineering relevant to the needs of the pulp, paper and bio-resource industries; conducts fundamental and applied research in line with the industry's research agenda, to develop and transfer technology to the industry consistent with the industry's technology vision and to provide timely technical information to the operating sector of the industry.

<http://eng.auburn.edu/center/pnp/pnp.htm>

Albermarle (NYSE: ALB)

Albermarle provides innovative development, manufacturing and marketing of complex chemicals and services that create customer value and shareholder wealth. Focusing on "Chemistry for life", we are a global supplier of specialty chemicals that provide an overall benefit to the world in which we live.

A diversified mix of products is sold to a wide range of customers and end markets. With over 3400 customers spread over 100+ countries, our products are sold into end markets that are vital to the global economy, including consumer electronics, petroleum refining, packing, construction, automotive, pharmaceuticals and agrichemicals.

Over 3700 employees direct their efforts on solving our customers' toughest problems. We relish a challenge and this is reflected in our motto, "We Can Do That." Due to the commitment and support of our employees, our customers, and our shareholders, Albermarle is well positioned to deliver critical, value-adding solutions that truly provide "Chemistry for Life."

www.albemarle.com

Auburn Pulp and Paper Foundation

The Foundation exists for the purpose of supporting the pulp and paper and related technical programs at Auburn University.

<http://www.eng.auburn.edu/organizations/APPF/index.html>

BE&K

Since its founding in 1972, Birmingham-based BE&K, Inc. - through a variety of construction and engineering subsidiaries - has been a major force in pulp and paper, power and heavy industrial construction, as well as design and maintenance. BE&K, Inc. currently ranks #45 on Engineering News-Record's (ENR) prestigious list of Top 400 Contractors and is one of the Southeast's largest employee-owned and privately held companies. BE&K has been recognized as an industry leader in family friendly workplace practices, honored as a recipient of Working Woman magazine's "Diversity Champion" award, included in Fortune listing of "Best Places to Work in America," and is on Forbes listing of the "Top 400 Privately Held Companies in the U.S."

www.bek.com

Boise (NYSE:BZ)

Boise Inc. was formed following the Aldabra 2 Acquisition Corp. purchase of the paper and packaging assets of Boise Cascade, L.L.C., in February 2008. The company is listed on the NYSE under ticker symbol BZ.

We manufacture a wide range of specialty and premium paper products, including papers for pressure-sensitive and flexible packaging applications. We manufacture containerboard and corrugated products, imaging papers for office and home, printing and converting papers, newsprint, and market pulp.

Boise Inc. has a significant presence in linerboard, corrugated containers, and specialty label and release products markets. We're the third largest North American player in uncoated free sheet paper.

Our values guide all of our actions: we work safely and with integrity, and manage our business to sustain environmental resources for future generations.

www.boiseinc.com

Eastman Chemical Company (NYSE: EMN)

Eastman manufactures and markets chemicals, fibers and plastics worldwide. It provides key differentiated coatings, adhesives and specialty plastics products; is a major supplier of cellulose acetate fibers; and produces PET polymers for packaging.

As a Responsible Care® company, Eastman is committed to achieving the highest standards of health, safety, environmental and security performance. Founded in 1920 and headquartered in Kingsport, Tenn., Eastman is a FORTUNE 500 company with 2007 sales of \$6.8 billion and approximately 11,000 employees. For more information about Eastman and its products, visit

www.eastman.com.

Emerald Performance Materials

Emerald Performance Materials, LLC is a leading manufacturer of chemical additives and polymers used in diverse consumer and industrial products around the world. Its products play a variety of roles in the products that are consumed and used every day enabling them to last longer, look, smell, taste or perform better. Emerald products are used in aerospace, food, beverages, cosmetics, toothpaste, household products, paint, tires, automobiles, sports gear and many other applications. Headquartered in Cuyahoga Falls, Ohio, Emerald has six operations and over 600 employees.

www.emeraldmaterials.com.

Evonik Degussa GmbH

Evonik Industries is the creative industrial group from Germany which operates in three business areas: Chemicals, Energy and Real Estate. Evonik is a global leader in specialty chemicals, an expert in power generation from hard coal and renewable energies, and one of the largest private residential real estate companies in Germany. Our strengths are creativity, specialization, continuous self-renewal, and reliability. Evonik is active in over 100 countries around the world. In its fiscal year 2006 more than 43,000 employees generated sales of about Euro 14.8 billion and an operating profit (EBIT) of over Euro 1.2 billion.

<http://www.degussa.com/degussa/en/>

ExxonMobil (NYSE:XOM)

ExxonMobil uses innovation and technology to deliver energy to a growing world. It is the world's largest publicly traded international oil and gas company, providing energy that helps underpin growing economies and improve living standards around the world. The company is committed to meeting the world's growing demand for energy in an economically, environmentally and socially responsible manner. It operates facilities or markets products in most of the world's countries and explores for oil and natural gas on six continents.

www.exxonmobil.com

Milliken

Milliken & Company, the world's largest privately held textile and chemical manufacturer, is based in Spartanburg, South Carolina. With 100+ years of stewardship, the company continues to introduce green innovations and explore regenerative performance to improve working and living conditions for its associates, customers and communities around the globe.

Milliken's rich history of technological innovation has resulted in more than 2,000 patents and the development of the largest textile research center in the world. We have over 10,000 associates located at more than 55 facilities worldwide working with more than 19,000 different textile and chemical products.

Milliken makes a variety of fabric, yarn and chemical products that keep astronauts safe, make major league baseball players comfortable and adorn homes and businesses around the globe. Our products also give tennis balls their soft texture and Jell-O pudding its creamy smoothness.

www.milliken.com

Olin (NYSE: OLN)

Olin Corporation is a Virginia Corporation, incorporated in 1892, having its principal executive offices in Clayton, MO. We are a manufacturer concentrated in two business segments: Chlor Alkali Products and Winchester.

We have been involved in the U.S. chlor alkali industry for more than 100 years and are the 3rd largest producer in the North American chlor alkali market. Chlor Alkali Products manufactures chlorine and caustic soda, sodium hydrosulfite, hydrochloric acid, hydrogen, potassium hydroxide and bleach products.

Winchester is in its 140th year of operation and its 76th year as part of Olin. Winchester products include sporting ammunition, reloading components, small caliber military ammunition and components, and industrial cartridges.

www.olin.com

Southern Company (NYSE:SO)

With nearly 4.4 million customers and more than 42,000 megawatts of generating capacity, Atlanta-based Southern Company is the premier energy company serving the Southeast, one of America's fastest-growing regions. A leading U.S. producer of electricity, Southern Company owns electric utilities in four states and a growing competitive generation company, as well as fiber optics and wireless communications. Southern Company brands are known for excellent customer service, high reliability and retail electric prices that are significantly below the national average. Southern Company has been listed the top ranking U.S. electric service provider in customer satisfaction for eight consecutive years by the American Customer Satisfaction Index (ACSI).

www.southerncompany.com

Syngenta (NYSE: SYT)

Syngenta is a world-leading agribusiness committed to sustainable agriculture through innovative research and technology. The company is a leader in crop protection, and ranks third in the high-value commercial seeds market. Sales in 2007 were approximately \$9.2 billion. Syngenta employs over 21,000 people in more than 90 countries. Syngenta is listed on the Swiss stock exchange (SYNN) and in New York (SYT).

<http://www.syngentacropprotection-us.com/>

Temple-Inland

Temple-Inland Inc. is a manufacturing company focused on corrugated packaging and building products. The fully integrated corrugated packaging operation consists of five linerboard mills and one corrugated medium mill, which produce 3.5 million tons of containerboard per year, and 64 converting facilities, which produce 3.6 million tons of corrugated packaging per year. The building products operation manufactures a diverse line of building products for new home construction, commercial and repair and remodeling markets.

www.templeinland.com.

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