



**“2<sup>nd</sup> Annual Scientific Meeting of the  
Applied Polymer Technology Extension  
Consortium”**

**“3<sup>rd</sup> Biannual Seminar on Career Paths in  
the Physical Sciences”**

A Joint meeting  
Friday, November 7, 2012  
University Center  
Southeastern Louisiana University

**Organizers:**

Southeastern SEAL  
the Southeastern Louisiana University  
Student Entrepreneurs as Active Leaders  
with Kyle Bentz and Dan Savin of the University of Southern Mississippi

**Industrial/National**

**Participants:**

Woodstone Consulting Group  
Laser Interferometric Gravitational Wave  
Observatory  
Albemarle, Inc.  
Bercen, Inc.

**Sponsors:**

Southeastern Louisiana University  
Student  
Government  
Organization



University of  
Georgia



**Applied Polymer Technology  
Extension Consortium**

## PROGRAM

8:00-8:25 Breakfast and registration (Room 125) / Poster Setup (Concourse Level)

0830-11:30: APTEC POSTERS University Center Concourse Level  
CaPPS Sessions: University Center Room 133

**8:25** Opening Remarks – **Dr. Dan McCarthy** (Dean of College of Science and Technology)

**8:30-8:45 (15 minutes): Speaker – Dr. Debra Dolliver**

Outline employment areas/pay scales/employment numbers in the physical sciences:

- Industry
- Academia
- Government

**8:45-9:30 (45 minutes): Moderator – Dr. Gina Little**

**Panelists – Dr. Brian O'Reilly** (physics, senior scientist, LIGO)  
**Dr. Harold Young** (chemistry, president, Woodstone Consulting Group)  
**Ms. Amber Bordelon** (chemistry, Southeastern alumnus, chemist, Albemarle)  
**Mr. Steven Boone** (chemistry, product development manager, Bercen, Inc.)

Panel of industrial/governmental chemists to talk about

- Their background
- Their jobs
- Recommendations to students about things to study to prepare them for work in industry/government

9:30-9:45 break (15 minutes)

**9:45-10:30 (45 minutes): Moderator – Dr. Thomas Sommerfeld**

**Panelists – Dr. Revati Kumar** (chemistry, Louisiana State University)  
**Dr. Keith Hollis** (chemistry, Mississippi State University)  
**Dr. Jonah Jurss** (chemistry, University of Mississippi)  
**Dr. Sarah Morgan** (polymer science, University of Southern Mississippi)

Panel of professors to talk about

- Their background
- What is involved in their job?
- What do you do to get a job in academia?

10:30-10:45 break (15 minutes)

**10:45-11:00 (15 minutes): Speaker – Dr. Bill Parkinson**

- What is graduate school (masters, Ph.D.)?
- Who pays for graduate school (T.A., R.A., grants, funding opportunities)?
- What is a post doc?

**11:00-11:45 (45 minutes): Moderators – Dr. Mary Reaff (Georgia Tech), Dr. Bill Parkinson**

**Panelists – Katelyn Dreux** (Southeastern alumnus, chemistry, University of Mississippi)  
**Liz Jee** (Southeastern alumnus, chemistry, Louisiana State University)  
**Chris Schneider** (Southeastern alumnus, physics, Louisiana State University)  
**Hannah Box** (Mississippi State University)

Panel of graduate students to talk about

- Their background
- Their experiences applying to grad school
- Their experiences in grad school
- Their future plans

11:45-1:00 Lunch University Center – Room 125

Booths for grad schools, businesses, Chemistry Club, SPS, Chemistry & Physics Department, and more.

## APTEC 2014 Abstracts

### Synthesis and Characterization of Multi-arm cages via “Click” Coupling

Ravinder Elupula(1)(\*), Boyd A. Laurent(1) and Scott M. Grayson(1)

(1) Tulane University, Department of Chemistry, New Orleans, Louisiana.

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A variety of polymer architectures have been synthesized and investigated because of their strong correlation between nanoscale architecture to physical properties. So far, many researchers have developed a variety of synthetic tools to access a wide range of polymeric architectures and tailor the properties of macromolecules for their diverse application. Some of the few examples include hyperbranched perfluorinated/hydrophilic block copolymers for antifouling coatings, branched and dendritic structures for targeted drug delivery, globular polymers for the microelectronics industry, dendrimers for light harvesting applications, and polymer grafted scaffolds for catalysis. Synthetic routes for the preparation of various polymer architectures have long been a goal for polymer chemists, owing to their unique topology and physical properties.

Recently Laurent and Grayson reported an efficient method for synthesizing cyclic macromolecules using “click” chemistry which has proven to be a versatile way for making macrocycles. Also Tezuka reported the synthesis of multicyclic polymers by cyclization via ionic pre-assembly followed by a covalent fixation. Further, the use of multicyclic “cryptands” demonstrated selective and strong interaction with potential guests. Inspired by these concepts, the synthesis of multicyclic “cage” polymers was explored. Controlled radical polymerization techniques, such as atom transfer radical polymerization (ATRP), nitroxide mediated polymerization (NMP), and reversible addition fragmentation transfer polymerizations (RAFT) are powerful tools for preparing well defined polymeric architectures. ATRP is a particularly attractive approach for making star precursors because of the ability to modify the terminal end group in very high yields. The synthesis of polymer “cages” can be achieved by further clicking these end functionalized star polymers with a small molecule alkynylated caps consisting a complementary number of arms with respect to the polymer.

Acknowledgment. National Science Foundation.

## **Interfacial Tension and Elasticity of Cerato-Ulmin Hydrophobin Biofilm**

Xujun Zhang(1), Stephanie Kirby(2), Drew Gorman(1), Cornelia Rosu(1), Yuwu Chen(3), Lynn M. Walker(2), Shelley L. Anna(2), Francisco R. Hung(3), Paul S. Russo(1)(\*)

1) School of Materials Science and Engineering, Georgia Institute of Technology, Atlanta, Georgia, 30332,

2) Center for Complex Fluids Engineering, Carnegie Mellon University, Pittsburgh, Pennsylvania, 15213,

3) Cain Department of Chemical Engineering, Louisiana State University, Baton Rouge, Louisiana, 70803.

\*To whom communications should be sent: paul.russo@mse.gatech.edu

### **Abstract:**

Cerato-ulmin (CU) is a small, hydrophobic protein from the hydrophobin family. All hydrophobins have a low molar mass of about 10 kDa. They are extracted from fungi and each has a conserved pattern of disulfide bonds established between 8 cysteine residues. CU is an amphipathic molecule with well-confined hydrophilic and hydrophobic patches, reminiscent of Janus colloids. Through self-assembly into amphiphilic membranes, hydrophobins are able to convert hydrophilic surfaces to hydrophobic ones and vice versa. CU shows unusual ability to stabilize cylindrical air bubbles and oil blobs and can be used for oil spill remediation and clean-up. In this work, various hydrocarbon-based oils and air were encapsulated by CU in aqueous solution. The appearance of the CU shapes was investigated using optical microscopy. The thickness of the CU biomembrane was estimated from mass balance and analysis of bubble and blob images. More precise dimensions can be obtained by small-angle X-ray scattering, which reflects not only the thickness of the bubbles and blobs, but also their shape and size. The dynamic light scattering results indicated the big CU air bubbles floated out of the measurement volume after about one day and the smaller ones were stable for at least 5 days. The dynamic surface tension and dilatational modulus of the bubble surfaces were characterized using a home-built microtensiometer. The result showed the CU biomembrane at the air/water interface became progressively more solid-like and more rigid due to the CU adsorption.

Acknowledgements: Gulf of Mexico Research Initiative, Consortium for the Molecular Engineering of Dispersant Systems, We also thank Dr. Wayne Huberty and Brad Blalock.

## **Polyacrylonitrile (PAN)/cellulose nanocrystals (CNCs) composite fibers**

Huibin Chang<sup>1,2</sup>, An-Ting Chien<sup>1</sup>, H. Clive Liu<sup>1,2</sup>, Po-Hsiang Wang<sup>1</sup>, Bradley A. Newcomb<sup>1</sup> and Satish Kumar<sup>1,2,\*</sup>

<sup>1</sup> School of Materials Science and Engineering, Georgia Institute of Technology, Atlanta, GA, 30332

<sup>2</sup> Renewable Bioproducts Institute, Georgia Institute of Technology, Atlanta, GA, 30332

\*To whom communications should be sent: Satish.Kumar@mse.gatech.edu

### **Abstract**

Carbon fibers are widely used in high-strength and low-density composite materials. Among different precursors, polyacrylonitrile (PAN) is the predominant precursor for carbon fiber production. Cellulose Nanocrystals (CNCs), which have a near perfect crystal structure, possess high tensile strength (up to 7.5 GPa) and high tensile modulus (110-220 GPa), respectively. By comparison, the tensile strength and modulus of PAN precursor is about 1 GPa and about 20 GPa. It is hypothesized that the incorporation of highly ordered, high strength and high modulus CNCs will contribute to further increase in PAN based carbon fiber strength and modulus. In this study, PAN/CNC composite fibers are gel spun using dimethyl formamide (DMF). Structure, processing, and properties of the PAN/CNC composite fibers will be presented and discussed.

### **Acknowledgements**

Financial support for this work from Renewable Bioproducts Institute at the Georgia Institute of Technology is gratefully acknowledged.

**Determine the equation of state of nanoparticle suspension  
by optical trapping**

Jinxin Fu(1,2)(\*), H. Daniel Ou-Yang(2)

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By adding non-adsorbing polymers to a colloidal suspension, the mixture can phase separate into polymer-rich and colloid-rich phases. This phenomenon can be explained by a polymer crowding induced attractive force between colloidal particles. While the concept that polymer crowding can induce attraction between particles is simple, it is far from simple to

quantify the crowding-induced force because the crowding-induced attraction depends on the chemistry of the particle surface, solvent quality, and for charged

particles or polymers, the Coulomb interactions. This paper reports a study that determines the interaction potential in terms of colloidal osmotic pressure. Colloidal osmotic pressure of polystyrene nanoparticles in a high salt and polymer-crowded solution has been determined as a function of PEG concentration. An optical bottle method that is used to analyze the statistical behavior of multiply trapped colloidal nanoparticles in optical confinement to determine the osmotic bulk modulus is introduced.

Acknowledgment. This work is supported by National Science Foundation DMR-0923299.

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<sup>1</sup> School of Materials Science and Engineering, Georgia Institute of Technology, Atlanta, GA, 30332

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## **Biomedical Applications of Thiol-Acrylate Polymerizations**

Leah Garber(1) and John Pojman(1)

(1). Department of Chemistry, Louisiana State University

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Biomedical applications of thiol-acrylate in situ polymerizations were studied using different monomers and catalysts. The applications include bone defect repair and hydrogels. Polyethylene glycol diacrylate (PEGDA)-co-trimethylolpropane tri-3-mercaptopropionate (TMPTMP) was investigated as a potential bone defect repair material. It exhibited high elastic mechanical strength, which is an important characteristic in tissue engineering. The PEGDA monomer was also used to synthesize a transparent hydrogel for use as a carrier medium for UV-responsive micro-RNA. The hydrogel was synthesized by a thiol-acrylate mechanism containing PBS, PEGDA (700), and ethoxylated trimethylolpropane tri-3-mercaptopropionate (ETTMP-1300). However, the most evaluated application for bone defect repair included pentaerythritol triacrylate-co-trimethylolpropane tri-3-mercaptopropionate (PETA) blended with varying contents of hydroxyapatite (HA), cast as solids or gas foamed. Characterization using SEM and Micro-ct imaging analysis of the polymers showed the morphology and distribution of HA. Different catalysts were used to observe the effect on mechanical strength. A six week in vivo biocompatibility study validate that PETA:HA can be foamed in vivo without serious adverse effects.



**– NO TITLE –**

Elizabeth Jee\* and John A. Pojman, PhD

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Clock Reactions are reactions in which an abrupt change in products can be observed after a set period of time. Based on the reagent concentrations that time can be calculated. Time-lapse polymerizations follow along the same lines, in that, you can program the time at which the polymerization will occur by adjusting the reaction conditions. We have combined these two types of reactions to create the time-lapse polymerization of Poly(ethylene glycol) diacrylate and ethoxylated-trimethylolpropane tris-3-mercaptopropionate which is triggered by the increase in pH of the urea-urease clock reaction. We have also observed isothermal frontal polymerization in thin layers (0.5 mm thickness) and are studying the degradation aspects of the hydrogel formed.

Acknowledgment: NSF Crest Center

## **Stimuli-responsive superparamagnetic nanoparticles functionalized with surface-immobilized fluorescent conjugated polymers**

Sourav Chatterjee, Cornelia Rosu, Evgueni E. Nesterov and Paul S. Russo

Department of Chemistry and Macromolecular Studies Group

Louisiana State University, Baton Rouge, LA 70803

### **ABSTRACT:**

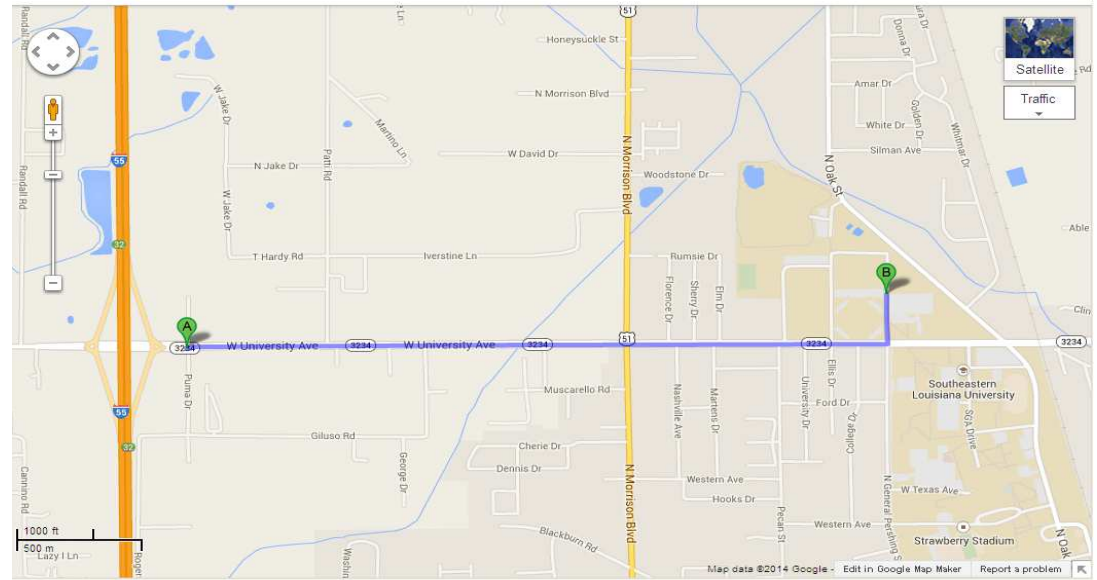
Controlling sensitivity of fluorescent chemo- and biodetection devices can be potentially achieved by varying the magnetic field applied to the hybrid nanoscale systems consisting of fluorescent conjugated polymers (such as polythiophenes) and superparamagnetic (SPM) nanoparticles. In this study, we introduce a novel model to study this magneto-optical phenomenon. The model is based on SPM cobalt@silica nanoparticles as well as bare cobalt nanoparticles modified with covalently attached fluorescent conjugated polymer shell. The shell was prepared via surface-initiated chain-growth polycondensation. Formation of the conjugated polymer shell was confirmed by electron microscopy and fluorescence spectroscopy studies. Preparation of SPM cobalt nanoparticles with and without outer silica layer and their surface modification with covalently attached conjugated polymer is addressed in this presentation. We also report on the effect of magnetic and electromagnetic fields on photophysical properties of conjugated polymers at the nanoscale.

## MAP and Directions to APTEC/CaPPS Meeting:

If your navigation system takes it, the Lat/Long of the University Center is:  
30.521216, -90.473024

(Directions below to I-55 at University)

EXIT #32 from I-55 onto University Ave  
(Sign reads Wardline Rd/University Ave)  
Head East  
Pass Hwy 51 (Morrison Blvd)  
Pass University Center on the Left  
Light at General Pershing St – turn LEFT  
Park behind University Center  
Enter lower level below Gate 5  
Breakfast/Registration in room 125



From the North (e.g., Jackson MS):  
South on I-55

From the South (e.g., NO via LaPlace):  
Along I-10 to I-55  
North on I-55

From the East (e.g., Slidell LA):  
East on I-10 to East on I-12  
North on I-55

From the West (e.g., Baton Rouge LA):  
East on I-10 to East on I-12  
North on I-55