POLYMER TECHNOLOGY CENTER

Fall 2006 Edition

PTC Newsletter

MARK YOUR CALENDAR FOR PTC's NEXT CONFERENCES!

October 12 - SCRATCH
@ Detroit Michigan
November 3 - PTIC
@ Texas A & M University

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Scratch Consortium New Member

PTC is excited to announce our newest member to the Scratch Behavior of Polymers Consortium. Please welcome CABOT Corporation.

NSF CAREER Award Recipient

PTC Faculty Member, Dr. Stephen Miller from the Chemistry Department, recently received an NSF CAREER award for "Catalytic Aldimine Coupling: A Versatile Carbon-Carbon Bond Forming Reaction." More information on this award can be found at http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0548197 To read about his research see page 3.

New PTC Faculty Member, Cris Schwartz Mechanical Engineering Department

Howdy! I'm Cris Schwartz, and I have recently joined the Mechanical Engineering faculty at Texas A&M and the PTC. As I eagerly begin my work here, I wanted to tell you about myself and my research. I have been involved with polymers for a number of years and have always been amazed at the vast number of opportunities for research and development in this interesting field. My current work focuses on the frictional interface between materials and the human body, often called biotribology. I have worked specifically with artificial joint materials such as ultra-high molecular weight polyethylene (UHMWPE) and found ways to improve its wear resistance through processing techniques and the use of reinforcing fillers. Researchers are constantly learning new things about this seemingly simple polymer in regards to its behavior in biomedical devices. I have also investigated the potential for using polyurethanes (PUR) in artificial joints, as well as blends between UHMWPE and PUR. This work is exciting because it reinforces the mission statement of my research group: to focus on using engineering principals to benefit humanity by studying problems with efficiency, teamwork, and integrity.

Before coming to Texas A&M, I earned my Ph.D. at Iowa State University and spent several years in industry at Southwest Research Insitute® in San Antonio, where I was able to work with polyacrylamide (PAM) gels and their applications in non-lethal weaponry. In a more conventional pursuit, I worked with high temperature polymer composites such as polyphenylene sulfide (PPS) with inorganic fillers to reduce their wear and increase their mechanical properties. Interestingly, some of the lessons learned in these projects have contributed greatly to my development of polymers for biomedical applications.

I am excited about joining the PTC team, and I look forward to working with many of you in the months to come. Do not hesitate to email or call me if I may be of assistance to you in any way.

Polymer Specialty Certificate Program

The Polymer Specialty Certificate Program has been approved by all the Committees and the President of Texas A&M University, Dr. Robert M. Gates, who approved the Program on August 11, 2006. The Polymer Specialty Certificate Program will be an official one and only in the State of Texas. PTC is excited to get this program underway. For information regarding this program or how to apply, please contact PTC Program Coordinator, Isabel Cantu at icantu@tamu.edu or call 979-458-0918.

DOT Funded New Research to PTC

Professor H.-J. Sue and his co-PI, Dr. Ben Chang of Polylab, has been awarded a research contract by Department of Transportation (DOT) to address ***External Pipeline Coating Integrity*** for the Oil/Gas Industry. The research will focus on minimizing coating disbondment and developing methodologies to improve coating integrity. The level of funding is $250,000 from DOT and $375,000 from the in-kind support of the industrial partners for two years. The industrial partners include Dow Chemical, ShawCor, 3M, Tuboscope, and William's Gas Pipeline. The project began on September 16, 2006. For additional information, please contact Prof. Sue at hjsue@tamu.edu for details.

Digital Instruments MultiMode SPM System

Scanning probe microscopes (SPM) allow scientists to image, characterize and even manipulate material structures at the nanometer scale. Rather than using lenses and a beam of light/electrons, SPM uses a fine probe that scans over a sample surface and interacts with the sample surface. The type of interaction measured between the probe tip and the sample surface defines the type of SPM being used. A wide variety of material structures and properties can be studied such as man-made and natural systems, including biological systems. Since the invention of the first scanning tunneling microscope (STM) by Heinrich Rohrer and Gerd Binning in 1981, SPM has enabled a burst of nanotechnology achievements that includes the manipulation and arrangement of individual atoms on a surface. The Individual atoms can be spatially resolved with this technique, and 3-D topographical maps can be generated. SPM is a general term used to describe a growing number of techniques. Some examples are STM, AFM (atomic force microscopy), and NSOM (Near-Field Scanning Optical Microscopy).

The Materials Characterization Facility (MCF) in Texas A&M University currently has a Digital Instruments Nanoscope AFM/STM. The system comprises a Nanoscope III system controller fitted to a MultiMode TM scan head. This MultiMode SPM has following accessories/capabilities:

- Contact mode AFM (CM-AFM)
- Intermittent mode (tapping mode) AFM (TM-AFM)
- STM
- Phase contrast AFM
- Lateral force (friction) microscopy (LFM)
- Imaging in liquid environments
- Variety of scanner sizes (a few nm to tens of microns)
- Sample heater (ambient up to 100 °C)

Elcometer 4340 Motorised/Automatic Film Applicator

Film applicators are essential machines for preparing a wide variety of product samples including: paint, varnish, cosmetics, glue, adhesive, etc, with total consistency and reproducibility on various substrates including contrast charts, paper, sheet steel, plastic foils, and glass.

What show in the photo is an Elcometer 4340 Motorised/Automatic Film Applicator. It is designed with 11 pre-set speeds and the test substrates are securely held in place by vacuum tables, which are double channelled. The samples produced are of very high quality and completely comparable, which makes laboratory tests highly reliable. A sample temperature control set will be installed onto this film applicator soon so that the sample temperature can be well controlled for better performance.

Features include:

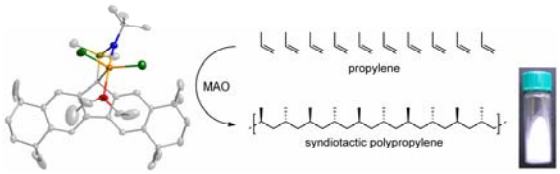
11 pre-set speeds - 0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, and 10cm per second.
Adjustable travel drive carriage with stop at end of travel.
Film thickness control as low as 10 µm.

Dr. Stephen Miller, Department of Chemistry
2006 NSF CAREER Award Recipient
"Catalytic Aldimine Coupling: A Versatile Carbon-Carbon Bond Forming Reaction"

Research Description

Roughly 90% of all manufactured chemicals rely on catalysis sometime during their production. By both necessity and design, our group has developed broad expertise across a number of chemical disciplines related to catalysis. Since 2001 we have identified several new, selective, and efficient catalysts for both small molecule transformations and polymerizations. Our targeted catalysts are often relevant to industrial applications, offering mechanistic insight, improved catalytic behavior, or altogether new pathways for catalytic bond formation.

•*Single-site catalysts*. One of our primary goals has been to devise syndioselective polymerization catalysts for producing new materials that are functional substitutes for polyvinyl chloride. Homopolymers and copolymers based on syndiotactic polypropylene are targeted because of their anomalously high impact strength.



•*Polymers from alternative economies*. We are synthesizing copolymers based on polyoxymethylene, which derives from methanol. Lactide is available from cornstarch and we have developed an efficient sodium based catalyst for its polymerization to polylactic acid (PLA). Copolymers of PLA are targeted to increase its glass transition temperature and expand its operational temperature range.

•*Theoretical polymer chemistry*. The application of analytical equations, Monte Carlo simulations, and density functional theory calculations address a variety of issues, including polyolefin tacticity, polymer mechanical properties, and polymerization thermodynamics.

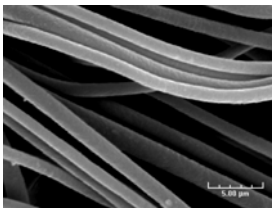
•*Nickel mediated oxidation catalysis*. Nickel (II) salts combined with aqueous bleach form nanoparticles that constitute an inexpensive, practical, and efficient system for the oxidation of a variety of common organic substrates. Usually, this "green" alternative to stoichiometric chromium reagents is effective in water with no organic solvent.

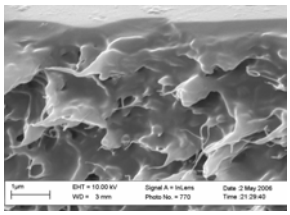
•*Catalytic aldimine coupling*. We have identified the simple cyanide anion (in the form of NaCN) as a catalyst for new, interesting, and useful carbon-carbon bond forming reactions. Through catalytic aldimine coupling reactions, a number of molecular structures have been targeted and realized: carbocycles, heterocycles, macrocycles, dimers, ligands, oligomers, and conjugated as well as non-conjugated polymers.

Ounaies and EMCL Expand Understanding and Research on Multifunctional Materials

Dr. Zoubeida Ounaies, an assistant professor in the Department of Aerospace Engineering at Texas A&M University (TAMU), researches active polymers and polymer nanocomposites. Upon joining TAMU in January 2005, she established the ***Electroactive Materials Characterization Laboratory (EMCL)***, an experimental research facility dedicated to the processing and characterization of novel materials that combine structural integrity with the ability to sense stimuli or actuate in response to an electric field. Through a controlled dispersion of nanoparticles such as ceramic nanopowders and carbon nanotubes, Dr. Ounaies and her group have shown that property enhancements are not limited to mechanical and electrical responses. Their findings reveal an electroactive response in the nanocomposites that is not present in the individual constituents. More recently, they have developed a methodology to manipulate and pattern nanotubes and nanofibers in polymers, with dramatic changes in electrical and stress coupling. The implication of this research is that materials could be engineered with specially tailored multifunctional performance for applications in lightening strike mitigation, EMI shielding, structural health monitoring, and energy harvesting.

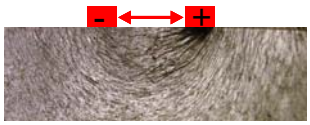
This research is supported by the National Science Foundation (NSF), the Air Force Office of Scientific Research (AFOSR), the National Aeronautics and Space Administration (NASA), and the Texas Space Grant Consortium. For more information, please contact Zoubeida Ounaies at (979) 458-1330 or zounaies@tamu.edu.

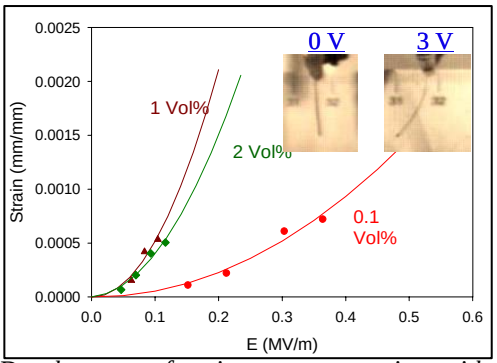




Processing of composite nanofibers and bulk nanocomposites.

Patterning of nanoparticles in polymers using electric field.





Development of active nanocomposites with high actuation strais and low actuation voltage.

Examples of nanostructured polymers being developed at EMCL.

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SPE Scholarships

Congratulations to the following undergraduate students that were awarded the South Texas SPE Dale Walker Memorial Scholarship:

- **Nathanael McIntyre Ince**
- **Matthew Walton**

Also Congratulations to the following graduate students that were awarded the SPE Henry Kahn Scholarship:

Eric Frantz—"Synthesis and Design of Organometallic Transition Metal Catalysts for the Copolymerization of Carbonate Dioxide and Epoxides to Afford Environmentally Favorable Polycarbonates."

Dazhi Sun—Functional ZnO Nanoparticles and Polymer/ZnO Nanocomposites

PTC SEMINARS

Dr. Yee Wang
The Dow Chemical Company
"Plastics Bonding Technology For Automotive Application"
Friday, August 4, 2006, ENPH Room 301@ 10:00-11:30

Janet Wong
University of Illinois
"How things crawl–quantifying the surface effect on molecular dynamics"
Monday, August 28, 2006, ENPH Room 301 @ 10:00-11:00

July 28, 2006 Farewell Dinner

PTC POSTDOC LUYI SUN, Ph.D.

We are sad to see Dr. Luyi Sun leave the PTC. Dr. Luyi Sun has been a great asset to the PTC, because of his dedication, honesty and loyalty we know he will be an asset wherever he may be. PTC wishes the best of luck in his future endeavors. Dr. Sun has joined PTIC Consortium member Total Petrochemicals.

You'll be missed!

PTC Newsletter prepared by: Isabel Cantu
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