POLYMER TECHNOLOGY CENTER

Fall 2007 Edition

PTC Newsletter

Undergraduate Polymer Specialty Certificate Program

TAMU students can apply for this program. Please visit:

http://essap.tamu.edu/polymer.htm

MARK YOUR CALENDAR FOR PTC's NEXT CONFERENCES!

October 11 - SCRATCH
@ Detroit, Michigan

October 25-26 - PTIC
@ Texas A & M University

Polymer Technology Center
Texas A&M University
MS 3123
College Station, TX 77843-3123

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Two Companies Become PTIC Members

PTC is excited to announce that two companies have joined the Polymer Technology Industrial Consortium. Please help us in welcoming INEOS Olefins & Polymers USA and MyTex Polymers as new PTIC members.

INEOS Olefins & Polymers USA

MYTEX POLYMERS

PTC Faculty Research - Dr. Dave Bergbreiter, Chemistry Department

"Bergbreiter Group" – Synthesis Using Polymers and Oligomers

Dave Bergbreiter is in his 67th semester of teaching Aggies Organic and Polymer Chemistry. He presently holds an Eppright Professorship for undergraduate teaching excellence and was one of two Presidential Professors for Teaching Excellence named by President Gates in 2006. He has an internationally recognized research program in organic, polymer, and catalysis chemistry. His Ph.D. was with Whitesides in 1974. He is from Chicago but after over three decades considers himself an immigrant to Texas with two native-Texas daughters (both, alas, engineering majors with one even pursuing an academic career as a professor).

The research in Bergbreiter's group has three broad thrusts. First, his group has been a pioneer in using soluble polymers in catalysis, developing Green Chemistry routes to separate soluble catalysts from products after a reaction. This includes the first example of a 'smart' homogeneous catalyst and work where the catalysts useful self-separate from polymeric products (cf. Fig. 1). His group also is actively studying the fundamental chemistry that underlies thermoresponsive polymer solubility, developing new methodology to study phase separation and probing the effects of polymer structure on phase separation in thermomorphic liquid/liquid or liquid/solid systems (cf. Fig. 2). Finally, his group has a 20-year history in surface modification, focusing on developing new ways to modify polyolefin surfaces (cf. Fig. 3). Recently this has involved covalent layer-by-layer assembly of suprahydrophobic PE surfaces. Contact numbers are 979-845-3437; bergbreiter@tamu.edu and http://www.chem.tamu.edu/faculty/faculty_detail.php?ID=34.

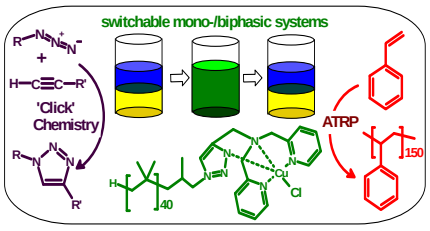


Fig. 1. Phase separable catalysts.

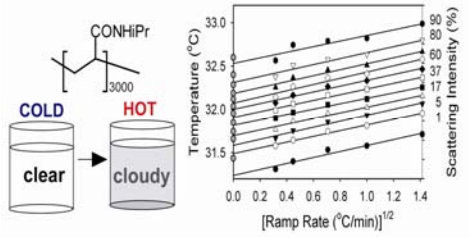


Fig. 2. LCST studies of thermoresponsive polymers

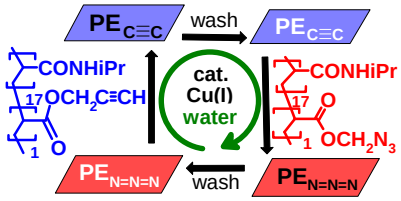


Fig. 3. Covalent layer-by-layer PE grafts.

Collaboration Between PTC and The Institute for Innovation and Design in Engineering (IIDE)
Dr. Steve Suh, Department of Mechanical Engineering

Among the recent sponsored projects, the one funded by Defense Logistics Agency (DLA) is an example of synergizing polymer material technology with advanced computer-aided engineering (CAE) and product and manufacturing development. A collaboration between PTC and the Institute for Innovation and Design in Engineering (IIDE), the project aims to develop a cost-effective, novel insulated beverage dispenser (IBD) design whose performance and short fabrication cycle would positively impact the combat readiness of our military forces when high demand and quick delivery are of priority.

All levels of design activity are addressed within the collaborative project, from the conceptualization of core technical ideas to selection of injection-molding materials to details of design execution. The CAE environment integrating CAD/CAM, FEA, CFD, flow simulation, and 3D rapid prototyping will be employed to drive design iterations [see Fig. 1]. Continual virtual validation and testing will be performed till an optimal IBD configuration is emerged and prototype-ready. The configuration will be finalized upon successful physical examination of the prototype for meeting all functional and fit-and-form requirements set forth for the design [see Fig. 2]. The information gained will be utilized as a guide for an appropriate choice(s) of IBD polymer material that possesses required processing, mechanical properties, and cost attributes. The knowledge base established in creating the feasible prototype will then be applied to create a manufacturing-ready prototype along with the required mold tooling.

IIDE is instrumental in initiating and supporting the interdisciplinary capstone design education in the College of Engineering at Texas A&M University. The Institute studies the theory of interdisciplinary engineering design, develops advanced methodologies and tools for improved design practice, and explores ways to increase the effectiveness of the management of the innovation process [see Fig 3]. In addition to researching and promoting transdisciplinary approaches to innovation and design essential for maintaining the competitive advantage of our country in the ever-flattening world, IIDE also provides the platform that advances the involvement and participation of industry in higher education. 3M, Boeing, Ford Motor, Halliburton, Schlumberger, FMC, Sandia National Labs, Shell and U.S. Air Force are among the current participants.

Figure 1

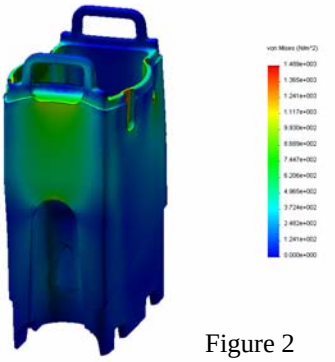


Figure 2

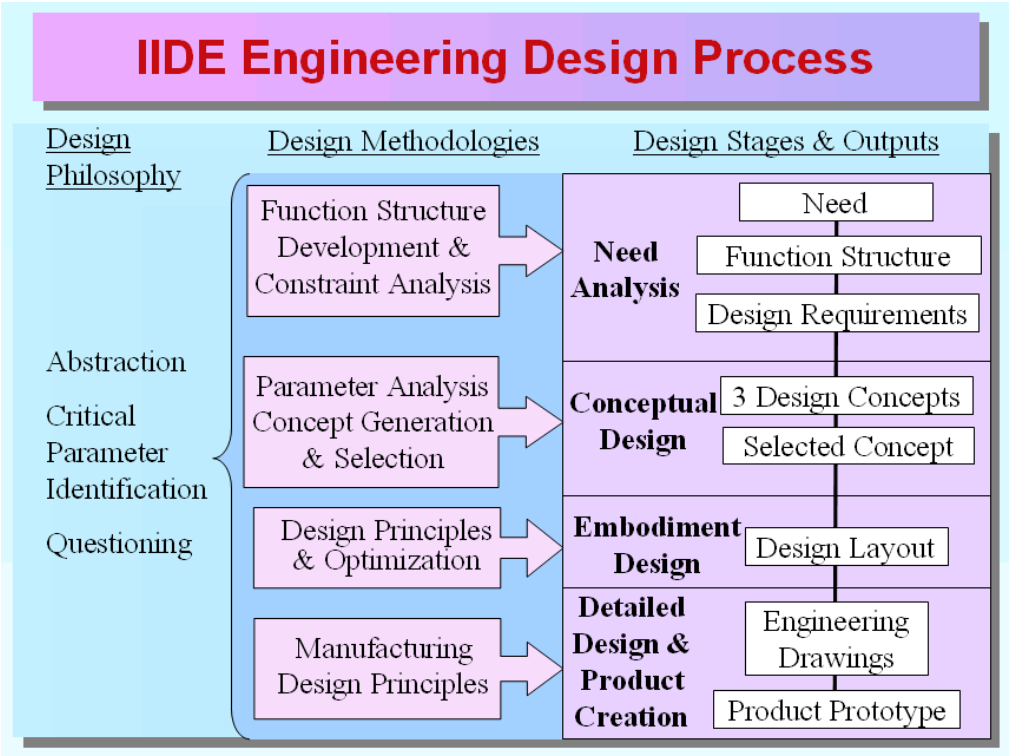
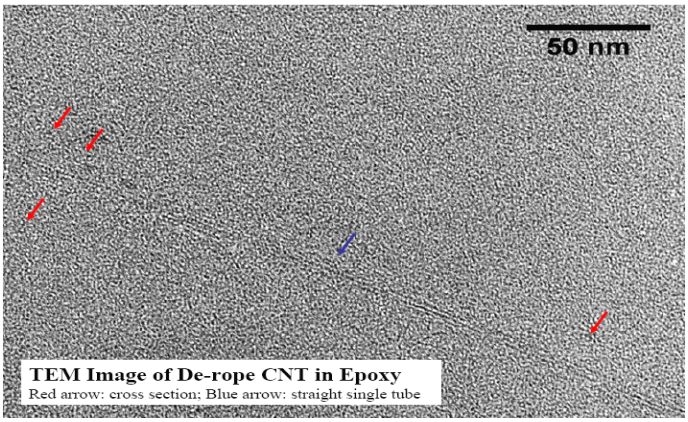


Figure 3

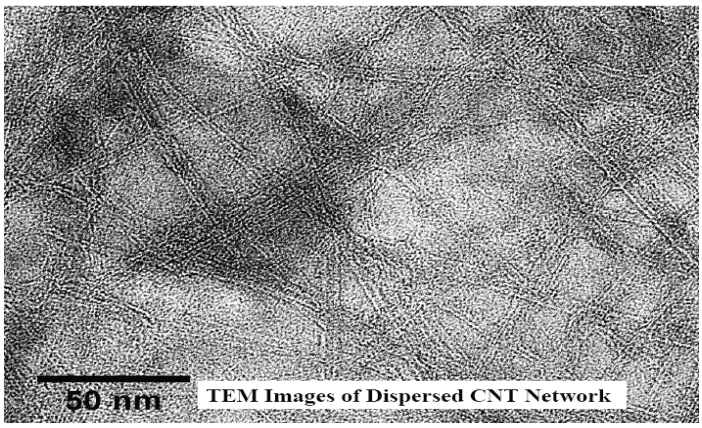
De-Roping of Carbon Nanotubes

D. Sun, C.-C. Chu, and H.-J. Sue

Our group has recently achieved preparation of highly de-bundled CNTs in various solvents, polymers, and inorganic matrices. Upon exfoliation, straight CNTs in epoxy are observed (left picture). By manipulating CNT packing and alignment, the de-bundled tubes can form 2-D network (right picture). Broad range research is underway to determine performance in a wide range of applications.



TEM Image of De-rope CNT in Epoxy
Red arrow: cross section; Blue arrow: straight single tube



TEM Images of Dispersed CNT Network

PTC's Visiting Scholars from Japan and Korea

Howdy! My name is SHINJI IIO and I came here as a visiting research scholar from Japan. I work for TOKAI RUBBER INDUSTRIES, LTD.(http://www.tokai.co.jp/english/index.html), and I have been working at Tokai Rubber Industries for eleven years. Through collaborations with Polymer Technology Center and Tokai Rubber Industries in 2006, I was able to take part in this program. I really appreciate our company and Dr. Sue for giving me the opportunity to study and research in a new environment. I adjusted very quickly in my new environment in Texas, and would like to enjoy myself to the fullest.

My specialty is rubber and resin material development of hoses for automobiles, especially adhesion of resin and rubber and rubber compounding techniques. I am looking forward to studying nanotechnology, learning new analytical approaches, and discussing technical matters with fellow PTC members. I believe that everything I learn here will be very useful for our company and me.

Howdy! My name is Dr. Si Yong Song, and I work for KRICT (Korea Research Institute of Chemical Technology), which is supported by the Korean government, and I came here to research the scratch performance of polymeric materials with Dr. Sue's group as a visiting scholar for one year. My first impression of College Station is a calm and friendly town. I enjoy a very special experience that birds are singing in the morning and squirrels pass through the bushes, which is very rare in my hometown. I am also glad to meet many friends from all over the world such as China, Taiwan, Japan, Iran and the US.

My main interests focus on surface characterization related to the change of scratch resistance of polymers according to the thermal or ultra-violet degradation. I hope that my research capabilities will be broadened through this research activity here at TAMU.

Finally, I really appreciate Dr. Sue for inviting and providing me with this valuable experience.

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Short Course: Scratch and Wear Behaviors of Polymers and Composites

Proposed Date: April 2008

By Professor Klaus Friedrich
Institute for Composite Materials
University of Kaiserslautern

Professor H.-J. Sue
Polymer Technology Center
Texas A&M University

Basic Fundamentals

* Fundamentals of Friction and Wear of Polymers & Composites
* Fundamentals of Scratch and Mars of Polymers & Composites
* Modeling of Structure-Property Relationship
* Test and Evaluation Methodology

Applications

* Aerospace Examples
* Automotive Examples
* Design Principles
* Laboratory Practices

For more information, please contact Isabel Cantu @ 979-458-0918 or icantu@tamu.edu.

SCHOLARSHIPS

PTC would like to congratulate the following students who received SPE Scholarships in Fall 2007.

Henry Kahn Scholarship-Graduate Students

Sumanth Banda research in: "Electric Field Manipulation of Polymer Nanocomposites: A Route Towards Multifunctional Polymers by Design"

Kevin Plumlee research in: "Novel Composite Materials for use in Artificial Joints"

Dale Walker Scholarship-Undergraduate Students

Nancy Pinto major in Chemical Engineering

Luke Osterhus major in Mechanical Engineering

PTC Seminars

Exfoliation of Natural Clays by Amphiphilic Copolymers to Random Platelets and their Industrial Applications for Antimicrobial and Nanoparticle-Dispersing Agents

Abstract

We have developed a new process of isolating random-silicate-**platelets** via ionic exchange reaction of smectite clays with Jeffamine Amine derivatives (amphiphilic polyamines). The novel **platelet** material has been commercialized in 100 kg scale in Taiwan, trade name as C-Pian and (奈米矽片). The nanoscale silicate platelets (NSP) possess unique characteristics of high aspect-ratio (*ca.* 80 x 80 x 1 nm in polygonal shape), intense ionic charges (*ca.* 18,000 ions/platelet) in a single platelet, and properties of antimicrobial and dispersing agents. For example, the NSP product has a strong tendency for associating with inorganic ions such as NaCl, Cr3+, Fe+2 metal ions, and polar organics such as DNA, protein, bioorganic macromolecules. The antimicrobial behavior was evidenced for a broad spectrum of bacterial species including gram-negative (*Pseudomonas aeruginosa*), gram-positive (*Staphylococcus aureus*), as well as silver-resistant bacteria. The mechanism is proposed as physical trapping between the ionic NSP and microorganisms, rather than a conventional chemical phenomenon. Modified with polymers, the NSP can be further converted into powder forms which are excellent dispersants for TiO2, CNT, pigments, Ag, etc. We expect this newly developed nanomaterial will find its invaluable applications in broad areas of biotechnology and nanotechnology, specifically nanoparticle dispersion, and materials for EMI, solar cell, and environmental controls.

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