Polymer Technology Center

FALL 2012

NEWSLETTER

Mark Your Calendars for upcoming events:

* Scratch Consortium = October 3rd
  Detroit Michigan
* APPEAL Consortium = November 1st
  Texas A&M University, College Station, TX
* PTIC Consortium = November 1st-2nd
  Texas A&M University, College Station, TX

UPCOMING SEMINAR

Atsushi Takahara

Molecular Aggregation States and Physicochemical Properties of (Organic/Inorganic) Nanohybrids based on Aluminosilicate Nanotubes

Friday, October 19, 2012 in MEOB Room 301 @ 10am

See page 3 for more info

Thermal Analysis of Ultra Thin Films

Jodie L. Lutkenhaus, Chemical Engineering

We specialize in several techniques that allow for the measurement of glass transitions or curing in ultra thin films, particularly in layer-by-layer (LbL) assemblies. Continue on Page 2 with full story.

Next-Generation, Bio-Inspired, Precisely-Nanostructured Nanocomposites

Mustafa Akbulut, Chemical Engineering

The significant enhancements in mechanical and tribological properties of nanocomposites are achieved through the incorporation of hierarchical structures into such materials via bio-inspiration. Continue on Page 2 with full story.

Inside the Newsletter...

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TEXAS A&M UNIVERSITY

Thermal Analysis of Ultra Thin Films

Jodie L. Lutkenhaus, Chemical Engineering

The thermal analysis of ultra thin polymeric films (50 to 300 nm thick) can be especially difficult because of challenges in performing conventional measurements such as differential scanning calorimetry (DSC). We specialize in several techniques that allow for the measurement of glass transitions or curing in ultra thin films, particularly in layer-by-layer (LbL) assemblies. This area of research is particularly interesting because polymers in thin films can behave markedly differently from polymers in the bulk.

Recently, we shown that the glass transition temperature (Tg) of hydrogen bonded LbL assemblies consisting of poly(ethylene oxide) (PEO) and poly (acrylic acid) (PAA) increases as the film thickness decreases. These films were constructed by alternately exposing a substrate to PEO and PAA for several cycles. The film behaves as a miscible blend, and has a single Tg. To measure the Tg in this thin film, we used a technique called temperature-controlled ellipsometry in which film thickness was measured using polarized light. As temperature increased, the film expanded according to its coefficient of thermal expansion (CTE). At the Tg, the CTE changed. The increase in Tg was attributed to attractive interactions between the film and the SiO2 surface.

In a newer technique, we have used quartz crystal microbalance with dissipation (QCMD) to monitor Tg's in thin films. QCMD allows for the measurement of the film's viscoelasticity, which changes at the Tg. An LbL film was deposited onto a gold-coated quartz crystal and its change in resonant frequency and dissipation were monitored as a function of temperature. At the Tg, a step change in dissipation (ΔD) was observed. An added feature of this technique is that the Tg can be probed at different vertical locations within the film. Both of these aforementioned techniques can be applied to conventional polymeric thin films and are not limited to just LbL assemblies.

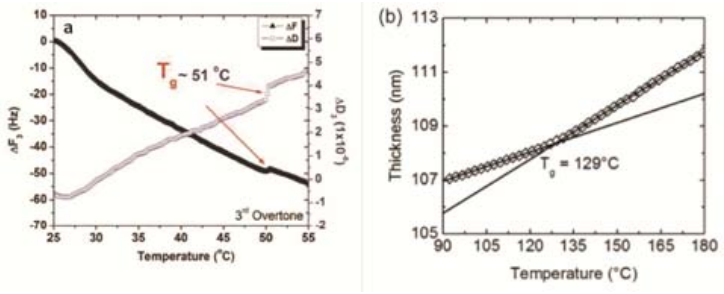

Figure 1. LbL Tg's measured via (a) QCM-D and (b) temperature-controlled ellipsometry.

Next-Generation, Bio-Inspired, Precisely-Nanostructured Nanocomposites

Mustafa Akbulut, Chemical Engineering

The significant enhancements in mechanical and tribological properties of nanocomposites are achieved through the incorporation of hierarchical structures into such materials via bio-inspiration.

As of now, nanocomposites, such as those consisting of evenly distributed nanoparticles, perfectly aligned nanoparticles, and aggregated nanoparticles, are the main types of nanocomposites engineered in a robust and reproducible manner. This limited control hinders the development of next-generation polymer nanocomposites with superior mechanical and tribological properties, which are needed for various strategic applications. Our group seeks to alleviate this deficit by bringing to bear novel assembly strategies on nanocomposite science, such as sequential Langmuir-Schaefer assembly, assembly via a hierarchically oriented external field, and assembly via simultaneous multiple external fields. In particular, we are currently interested in the development of bio-inspired nanocomposites. This interest is motivated by the literature on biological materials indicating that hierarchical nanostructures can give rise to exceptional mechanical and tribological properties. For example, mollusk shells typically contain 95–99% calcium carbonate and 1–5% organic component by weight. The resulting hierarchically nanostructured composite has a fracture toughness ~3000 times greater than that of the building blocks themselves. In a quite recent study, we show that insect joints having highly hierarchical nanostructures have very low coefficients of friction and exceptional wear resistances. In essence, it is clear that to enable potential breakthroughs in mechanical and the tribological performance of engineered nanocomposites, the incorporation of hierarchical structures into such materials via bio-inspiration must be considered.

In this context, we have developed nanocomposites involving polyurathane and BN nanowires/nanotubes/nanoplates. We have shown that the nano-architecture of nanowire assembly can be controlled using electric field or nano-confinement (Figure 1). These structures give rise to up to 50% decrease in the coefficient of friction and wear rates in comparison to the nanocomposites without any structural control.

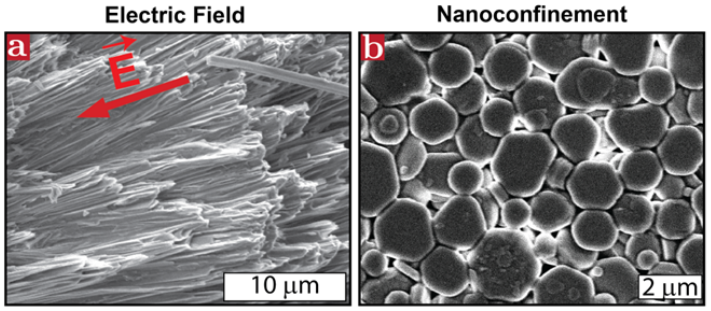

Figure 1. (a) The alignment boron nitride (BN) nanowires via an electric field. (b) The organization of BN nanoplates via nano-confinement.

TAMU NEWS

A&M Ranks Second Nationally In Washington Monthly Poll

Texas A&M President R. Bowen Loftin said it is "gratifying" to see a focus on factors such as research and service, in addition to the polls that emphasize traditional aspects, including academic quality, "best buy" and employer-satisfaction considerations — all factors in which Texas A&M also fares well.

Full story: http://tamutimes.tamu.edu/2012/08/27/am-ranks-second-nationally-in-washington-monthly-poll/

A&M No. 2 Among Public Universities In U.S. News "Great Schools, Great Prices" Rankings

Texas A&M University is the only public university in Texas to rank among the top 50 national universities in the "Great Schools, Great Prices" category of the 2013 ratings by *U.S. News & World Report* – and it maintains its overall second-place ranking in that key assessment of national public institutions.

Full story: http://tamutimes.tamu.edu/2012/09/12/am-no-2-among-public-universities-in-u-s-news-great-schools-great-prices-rankings/?utm_source=tamutimes&utm_medium=email&utm_campaign=2012-09-14

Josh Byerly, Class of 1999, serves as the voice of Mission Control.

Aggies At NASA: Having Fun & Careers At Warp Speed

Hundreds of Aggies work at NASA, with roles ranging from engineers, flight technicians, and astronauts to the actual "voice of Mission Control."

Full story see: http://tamutimes.tamu.edu/2012/09/05/aggies-at-nasa-having-fun-and-great-careers-at-warp-speed/

Aggies aid in Mars exploration

The mere question of the possibility of life on other planets has captivated mankind since we first gazed upon the stars. For centuries, the possibility of even obtaining answers was an elusive dream. Now, with the advent of groundbreaking scientific discoveries and technological advancements, mankind now has the ability to search for those answers.

Texas A&M has provided former students and professors with the resources and knowledge to participate in the search for these answers.

Full story can be found at: http://www.thebatt.com/aggies-aid-in-mars-exploration-1.2889997#.UFnTyLJlTkc

PTC NEWS

Rajagopal receives honorary doctorates, recognized by journals

Dr. K.R. Rajagopal, Distinguished Professor, Regents Professor and the Forsyth Chair in the Department of Mechanical Engineering at Texas A&M University, has received the Honoris Causa (D.Sc.) from Charles University in Prague, as well as the University of Pretoria and the University of Isai.

Full story: http://engineering.tamu.edu/news/2012/05/04/rajagopal-receives-honorary-doctorates-recognized-by-journals/

UPCOMING SEMINAR

Molecular Aggregation States and Physicochemical Properties of (Organic/Inorganic) Nanohybrids based on Aluminosilicate Nanotubes

Friday, October 19, 2012 in MEOB Room 301 @ 10am

Atsushi Takahara

Institute for Materials Chemistry and Engineering, Kyushu University[1], JST ERATO Takahara Soft Interface Project[2], Fukuoka 819-0395, JAPAN

Organic/inorganic nanohybrids by dispersing inorganic nanostructures in organic matrices are attracting a great deal of research passion. Imogolite and halloysite are naturally occurring aluminosilicate minerals with a hollow nanotube structure. Imogolite is composed of single-wall nanotubes with stoichiometry of Al_2SiO_3 $(OH)_4$, where silanol (Si-OH) groups are in the inner part of the tube. Halloysite has a 1:1 Al:Si ratio and a stoichiometry $oAl_2Si_2O_5(OH)_4.nH_2O$, with siloxane groups in the outside part of the tube. In this study, the authors propose several techniques for surface functionalization of imogolite and halloysite nanotubes and the preparation of novel polymer nanohybrids.

We introduced three approaches for dispersing imogolite nanotubes into synthetic polymer matrices, including both of the hydrophobic and the hydrophilic polymers, to prepare binary or ternary nanohybrids.[1,2] Due to the well dispersion and the transparency feature of imogolite itself, transparent polymer/imogolite nanohybrids were successfully prepared. Mechanical properties of the original polymers were improved by the interaction with imogolite. Moreover, the capability of imogolite for gel formation of biomolecules was demonstrated by fabricating imogolite nanotube-based enzyme and DNA hybrid hydrogels.

Selective hydrophobization of halloysite nanotube's inner surface was demonstrated. Aqueous phosphonic acid was found to bind to alumina sites at the tube lumen and did not bind the tube's outer siloxane surface. Spectroscopic measurements of selectively modified tubes proved binding of octadecylphosphonic acid within the halloysite lumen through bidentate and tridentate P-O-Al linkage. Selective modification of the halloysite clay lumen creates an inorganic micelle-like architecture with a hydrophobic aliphatic chain core and a hydrophilic silicate shell. An enhanced capacity for adsorption of the modified halloysite toward hydrophobic derivatives of ferrocene was observed.[3] Furthermore, Surface-initiated atom transfer radical polymerization (SI-ATRP) was performed through selectively adsorbed initiator with Dopa unit to form polymer brush into the nanotube lumen[4]

References

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2. W. Ma, W. O. Yah, H. Otsuka, A. Takahara, J. Mater. Chem. DOI: 10.1039/C2JM31570J.
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SPE South Texas section

Howdy!

The Society of Plastics Engineers (SPE) student chapter at Texas A&M continues to demonstrate our role as the most active student chapter in the South Texas Section. We are off to a good start for the year and hope to continue last year's tradition of involvement and success.

We had our first meeting on September 10 and had an awesome turnout! We were fortunate enough to have Dr. Jodie Lutkenhaus, an assistant professor in the chemical engineering department at Texas A&M, present her research on Layer-by-Layer Assemblies. We are thankful to have Dr. Lutkenhaus as our new faculty advisor and look forward to working with her this year.

The student chapter also participated in a "Baseball Kick-off Mixer" at the Astros game with the SPE South Texas Section. The student chapter joined members of the SPE South Texas Section for a fun and eventful night. Everyone in the Texas A&M group was excited to get a chance to interact with industry members. We are very grateful to the SPE South Texas Section for including us and particularly to Suzanne Diecks for organizing the event. We would also like to thank our new Texas A&M liaison, Dr. Don Witenhafer, for putting us in contact with the SPE South Texas Section for the event.

We have a busy and exciting semester ahead of us with the following events:

10/01: Monthly Seminar: Dr. Hannah Crampton from Dow Chemical Company will be speaking in CHEN 112 @ 6PM.

10/27: Annual Chemistry Open House: This is a free event sponsored by the American Chemical Society and various departments at Texas A&M. We will need volunteers throughout the day, so if you are interested in helping out please contact our activities coordinator, Danielle Policarpio at policarpiodm@gmail.com.

11/1-2: PTIC Poster Session: Student poster session sponsored by the Polymer Technology Industrial Consortium. Multiple student awards including a top prize of $500.

11/5: Monthly Seminar: Dr. Michael Killough from INEOS will be speaking in CHEN 112 @ 6PM.

12/3: Monthly Seminar: Dr. Don Witenhafer our new Texas A&M liaison will be speaking in CHEN 112 @ 6PM.

TBA: Fall Plant Tour: We are hoping to have the opportunity to attend the annual plant tour with the SPE South Texas Section.

Monthly seminars are open to everyone, but if you are interested in taking part in our plant tours or other events, you will need to become a national SPE Member. If you are interested please email me at jacqueline.pope@chem.tamu.edu for an application. The fee is $31 for student members, but we will subsidize part of the cost for you to bring the price down to $25.

If you have any questions or suggestions, contact us at plastics@plastics.tamu.edu. Be sure and visit our newly updated website at http://plastics.tamu.edu for chapter news, seminar information, events, member information, research highlights, and chapter photos.

Thanks and gig'em,
Jacqueline Pope
SPE President, Texas A&M Student Chapter

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For more information: http://ptc.tamu.edu/certificate.html	

TAMU/SPE Student Chapter

To find out more about the TAMU/SPE Student Chapter please contact Jacqueline Pope at: jacqueline.pope@chem.tamu.edu

Visit the SPE Student Chapter website at: http://plastics.tamu.edu

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