Newsletter Fall 2011 Edition

Polymer Technology Center

APPEAL & SCRATCH Consortium P.1
PTC Faculty Research Highlights P.2
TAMU News/PTC News P.3
SPE TAMU Student Chapter P.4

PTC is pleased to announce the newest Advanced Performance Polymers in Energy AppLications (APPEAL) member.

HALLIBURTON

Scratch Behavior of Polymers Consortium
October 5, 2011

The SCRATCH Consortium meeting held its semi-annual meeting at Troy Michigan with the following companies in attendance:

- *Advanced Composites, Inc.*
- *AkzoNobel Specialty Plastics*
- *Altuglas International Division Arkema*
- *Dow Chemical Company*
- *ExxonMobil*
- *Flint Hills Resources*
- *Ford*
- *GM*
- *Imerys Talc*
- *International Automotive Components*
- *Milliken*
- *MyTex Polymers*
- *Phillips Sumika Polypropylene Company*
- *TechmerPM Polymer Modifiers*

Fixture Evaluation: Vacuum Pressure @ 5” Hg

Polymer Technology Center
Texas A&M University
MS 3123
College Station, TX 77843-3123
Hung-Jue Sue, Director
(979) 845-5024
hjsue@tamu.edu
Isabel Cantu
(979) 458-0918
icantu@tamu.edu or
Website: http://ptc.tamu.edu

MARK YOUR CALENDAR FOR PTC’S UPCOMING CONFERENCES!

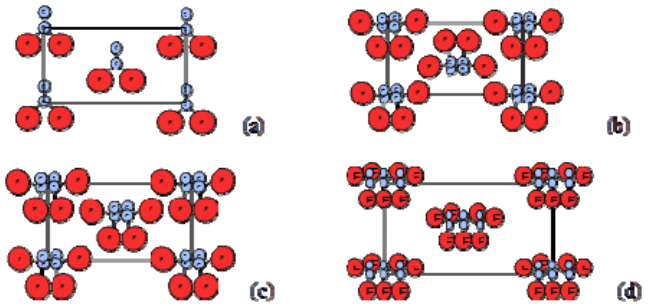
- **October 27th-28th—PTIC**
  @ Texas A & M University
- **November 3rd—APPEAL**
  @ Texas A & M University

Phase Transformation in Poly (Vinylidene Difluoride) for Energy Harvesting

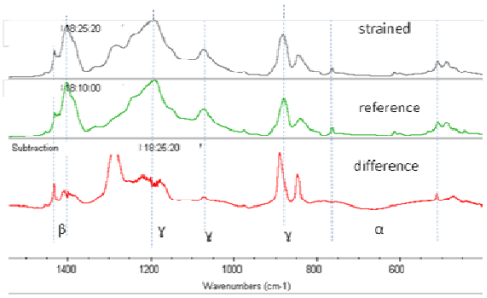
Dr. Hong Liang
Mechanical Engineering

The poly (vinylidene difluoride) (PVDF) has been of great interests for energy conversion of MEMS devices. In the present research, we investigate effects of microstructures of the PVDF on its piezoelectricity for energy harvesting. Using various experimental techniques, we observed the power density generated by a mechanical force was correlated with the phase transformation between amorphous, α, β, and γ phases. The transformation was time dependent in a non-linear manner. Such transformation influences the energy transition and storage of small devices.

Since its discovery in 18th century, piezoelectricity has become of great interests in development of materials and devices. Piezoelectric polyvinylidene difluoride (PVDF) was first reported in 1969[i] and found to have significant piezoelectricity when films were subjected to the process of stretch and poling. Studies have since shown that PVDF has significantly larger piezoelectricity than any other polymer.[ii] The mechanisms of piezoelectricity originates from the alignment of the polymer chains under an electrical field or mechanical force, and is generally discussed based on physical dimensions or polarization. PVDF is a semi-crystalline polymer with five crystallographic forms (α, β, γ, δ and ε), which are shown in the figure below. The latter four structures exhibit permanent dipole moments.



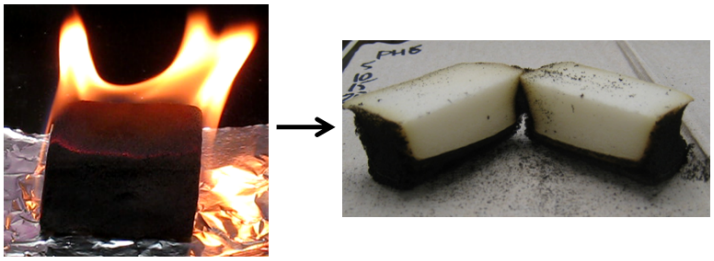
There are many industrial applications using PVDF due to its outstanding energy conversion property. Examples are, ultrasonic transducers, hydrophones, electroacoustic transducers, many others such as actuators, fuel cells, piezomotors, power generators, and sensors. In our lab, we have been involved in development of hybrid micromachines where power generation remains to be a challenging issue. To understand the mechanisms of energy conversation, we investigated the phase transformation of the material. We found that a mechanical stress induces the transformation between amorphous, α, β, and γ phases. Specifically, the amorphous phase transformed into the β phase when the bending force was applied. This leads to roughening of the PVD film surface. In addition, the transformation observed was time and direction dependent. The figure below highlights the change observed in FTIR analysis. This understanding helps us to design an energy harvesting device via optimization of the microstructure of PVDF.



"Flame Retardant Thin Film Assemblies from Completely Renewable Materials"

Dr. Jaime Grunlan
Mechanical Engineering

Polyurethane (PU) foam is an extremely versatile material that is used in bedding, upholstery and building insulation. Unfortunately, PU foam is very flammable, often resulting in dripping of melted material that enhances flame spread through the formation of a pool fire under the burning object. Brominated flame retardant compounds (e.g. pentabromodiphenyl ether) have been used to reduce foam flammability but there is growing evidence that these chemicals are toxic to the environment and living organisms. In an effort to create an environmentally-friendly flame retardant system, layer-by-layer thin films were assembled using "green" materials obtained from completely renewable sources. Ten bilayers of chitosan, which is extracted from the shells of crustaceans, as the cationic layer, and montmorillonite clay as the anionic layer, were deposited on flexible PU foam. These polymer-clay thin films resemble nano brick walls, with chitosan acting as the mortar holding the clay bricks together. After being exposed to the direct flame from a butane torch for 10 seconds, only the outermost surface was charred for coated foam. When cut open, undamaged white flexible foam was revealed under a black char layer. Cone calorimetry revealed that this protective nanocoatings significantly reduced peak heat release by 52% relative to the uncoated control. This work demonstrates the first fully renewable flame retardant treatment made via layer-by-layer assembly and provides an environmentally benign alternative to commonly used halogenated materials. This work was presented by Galina Laufer, a PhD student in Jaime Grunlan's research group, at the 242nd American Chemical Society National Meeting in Denver on August 31, 2011. Additionally, this work was highlighted in the News of the Week section of the September 5th issue of *Chemical & Engineering News*.



PU foam coated with 10 bilayers of chitosan-clay during burn test (left image) and same sample cut through the middle after the test (right image).

TAMU NEWS

2011 TAMU FALL ENROLLMENT IS UP FROM PREVIOUS YEARS

2011 enrollment	=	**50,050**
Increase over last year	=	**921**
2011 freshmen class	=	**9,540**

President congratulates the Texas A&M Women's Basketball on their 2011 NCAA championship.

Thusday, October 6, 2011 -President Obama welcomed the Texas A&M University women's basketball team to the White House to celebrate their 2011 NCAA championship. The President also recognized the Aggies' efforts to give back to their community and for being role models to young girls — including his two daughters, Sasha and Malia.

Top 10 Most Influential Colleges

Since the last time the schools were ranked, there have been some big changes. Texas A&M, who wasn't even on the list earlier this year, is now at the top of the class. To see the schools that ranked, visit: http://corp.klout.com/blog/2011/09/top-10-most-influential-colleges/

Texas A&M Joins SEC

This is an historic time in Aggieland. Recently on September 25, 2011, the Southeastern Conference (SEC) -- the nation's preeminent collegiate athletic conference -- invited Texas A&M to become its 13th member, effective July 1, 2012. And we have accepted enthusiastically.

By charting our own course, we can ensure that Texas A&M will be part of the athletic conference that will provide us with national visibility, as well as greater financial opportunity and conference stability, starting next summer and for decades to come.

Like Texas A&M, eight of the 12 current SEC member institutions owe their origins to the Morrill Act of 1862, which revolutionized higher education through the creation of land-grant universities. And, like Texas A&M, SEC members have achieved national and international prominence. For example, two universities -- Vanderbilt University and the University of Florida -- are members, with Texas A&M, in the elite Association of American Universities, which has just 61 members in the United States and Canada.

Our counterparts in the SEC are much like Texas A&M in other fundamental ways as well: they celebrate their rich histories and perpetuate their unique traditions, they are passionate on the playing field and in the stands, and they are united in their commitment to instilling core values that will prepare future generations of leaders for our nation and world.

Finally, the SEC provides a national platform for its member institutions. As you know, Texas A&M has made great strides in becoming a national brand that is synonymous with excellence in all of its many forms.

We are ready for the national spotlight.

It's time for Texas A&M. And today, it's time for the Aggie Family -- our record 50,000 current students and some 360,000 former students around the world -- to celebrate.

PTC NEWS

Dr. Cris Schwartz, MEEN invited to NAE Frontiers of Engineering Education symposium in November

Dr. Cris Schwartz, assistant professor in the Department of Mechanical Engineering at Texas A&M University, has been invited to participate in the National Academy of Engineering's Frontiers of Engineering Education symposium Nov. 13 -16 at the National Academies' Beckman Center in Irvine, Calif.

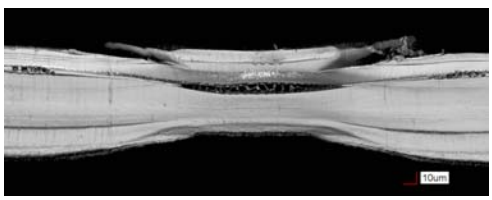
Dr. Schwartz received his Ph.D. degree in mechanical engineering from Iowa State University. His research interests are in artificial joints; modeling of soft tissues; protection of skin from shear injuries; active biomaterials; biotribology; polymerst; tribological composites; tissue engineering; life-cycle engineering design; design education; and manufacturing of biomedical devices.

Scratch-Induced Damages in Multi-Layer Packaging Films

The ASTM/ISO scratch test has already been demonstrated to effectively evaluate scratch resistance of bulk polymers, as well as coating integrity and adhesion under varying conditions. Its flexibility has allowed it to adapt to a wide range of applications, one of the most recent being the evaluation of single- and multi-layer flexible films, such as those used in food packaging. Through the use of a special vacuum fixture, which allows ambient air pressure to apply an even force over a test specimen, it has been demonstrated that a linearly increasing load scratch machine can consistently and effectively rank and evaluate packaging films. The flexibility of the machine and the developed test methodology allows a number of test parameters to be varied in order to provide testing conditions that correlate to real world damages, including the use of different tips, backing materials, scratch rates, and environmental conditions.

Following the development of the testing methodology, a method for sectioning a scratch-damaged sample was developed and used to effectively view the evolution of scratch damage along a film surface. The benefit of this method is that it allows a layer-by-layer analysis of a packaging film's structure, and allows insight into how each layer influences the scratch behavior of a film. Through this, direct comparisons can be observed between different films, including delaminations and stress distribution. The test methodology and imaging has been used to differentiate between an adhesive laminated and extrusion laminated film system that have the same structure, including scratch test results and layer-by-layer analysis.

This article was submitted by Brian A. Hare, whom graduated in August 2011 receiving his Masters Degree and is now working for Petroleum Geo-Services, in Austin, TX. Mr. Hare was a student and advised by Dr. H-J Sue.



PTC Faculty

Name	E-mail Address	Office #
Perla Balbuena	Balbuena@tamu.edu	979-845-3375
Dave Bergbreiter	bergbreiter@tamu.edu	979-845-3437
Janet Bluemel	bluemel@tamu.edu	979-845-7749
Tahir Cagin	cagin@che.tamu.edu	979-862-1449
Elena Castell-Perez	ecastell@tamu.edu	979-862-7645
Xing Cheng	chengx@ece.tamu.edu	979-845-5130
Zheng D Cheng	zcheng@tamu.edu	979-845-3413
Abraham Clearfield	a-clearfield@tamu.edu	979-845-2936
Terry Creasy	tcreasy@tamu.edu	979-458-0118
Donald Darensbourg	d-darensbourg@tamu.edu	979-845-5417
Jaime Grunlan	jgrunlan@tamu.edu	979-845-3027
Melissa A. Grunlan	mgrunlan@tamu.edu	979-845-2406
Wayne Hung	hung@tamu.edu	979-845-4989
Helen Liang	hliang@tamu.edu	979-862-2623
Anastasia Muliana	amuliana@tamu.edu	979-458-3579
Ozden Ochoa	oochoa@tamu.edu	979-845-2022
K.R. Rajagopal	krajagopal@tamu.edu	979-862-4552
J.N. Reddy	jnreddy@tamu.edu	979-862-2417
Cris Schwartz	cschwartz@tamu.edu	979-845-9591
Dan Shantz	shantz@tamu.edu	979-845-3492
Hung-Jue Sue	hjsue@tamu.edu	979-845-5024
Steve Suh	ssuh@tamu.edu	979-845-1417
Jyhwen Wang	jwang@tamu.edu	979-845-4903
John Whitcomb	whit@aero.tamu.edu	979-845-4006
Karen L. Wooley	wooley@tamu.edu	979-845-4077
Nicole Zacharia	nzacharia@tamu.edu	979-845-2204

National SPE Member

To all TAMU students: if you want to enjoy the benefits of being a member of SPE you need to apply to become a National SPE Member. Some of the SPE member benefits include: Scholarships, Registration for SPE Polyolefins conference, online chats and msg board @ **www.4spe.org**, participation in TAMU Polymer Technology Industrial Consortium (PTIC), subscription to Plastics Engineering magazine, and resume display on the SPE website for those who are close to graduation.

Also, this year we took plant tour to BASF, which was one of the benefits of being a member. The cost for becoming a National member is $20; we are subsidizing part of the cost for you!

If you are interested in becoming a National member and enjoying the benefits, please email me at: jacqueline.pope@mail.chem.tamu.edu and I will send you a membership application. Also, for those of you who are currently members and need to renew your membership, email me and I will send you a renewal application.

Jacqueline Pope, **jacqueline.pope@mail.chem.tamu.edu**
SPE Secretary

SPE BASF Plant Tour October 10
5pm in Houston, TX

At BASF we will have a presentation and tour that is expected to be about 1 hour 15 minutes. We will be touring the polyurethanes and foams plant .

This trip is also special because we will be going along with the SPE South Texas section, which is the branch of SPE that funds our student chapter. This section includes many high-ranking individuals in the plastics industries around Houston. The plant tour will be a great way to talk with professionals from many different companies and network for possible future job or internship opportunities.

To attend the plant tour, you do need to be a national member as we are now making all plant tours with our chapter a member benefit. However, if you are not yet a member, you can contact Jacqueline Pope at jpope87@tamu.edu to get the application. As long as you have completed the application and paid the $20 fee by Oct. 10th, you are definitely eligible to attend the tour.

Everyone must register individually for the tour via https://www.spe-stx.org/registration.php?id=7. You do not need a member number at the time of registration because you simply need to select "Student/Unemployed" to get the discounted rate. There is NO cost associated with the actual plant tour, but there is a dinner at Papa's BBQ following the tour, which will cost only $10 for students. If you can stay for dinner, it will be a great way to continue talking with all the SPE STX members. If you cannot stay, then simply register like normal but select the "Check" payment option, so no money will be required upfront.

You MUST email Casie Hilliard at: chilliard@mail.chem.tamu.edu if you are planning to attend the plant tour. In the email please confirm that you have already registered for the tour, please tell me if you plan to attend dinner (I must know to email Suzanne Diecks), and lastly please indicate if you'd be willing to drive a group to Houston (gas is fully reimbursed). Remember you MUST email me.

This is going to be a great trip. Please email me after you registered or let me know if you have any questions.

Thanks

Casie Hilliard, chilliard@mail.chem.tamu.edu
SPE Vice President

Polymer Specialty Certificate Updates

Students that have applied for Certificate	**25**
Students that have received the Polymer Specialty Certificate	**16**

For more information:

http://ptc.tamu.edu/certificate.html

TAMU/SPE Student Chapter

Kevin White, SPE Student Chapter President

To find out more about the TAMU/SPE Student Chapter please contact Kevin White at: **whitek@tamu.edu**

Visit the SPE Student Chapter website at:

http://plastics.tamu.edu/

PTC Newsletter prepared by: Isabel Cantu
Edited by: Garrett Nowak & Kevin White