2017
Fourth Quarter
PTC Newsletter

Polymer Technology Center

UPCOMING EVENTS

Mark Your Calendars!

Polymer Technology Industrial Consortium-PTIC/Spring meeting

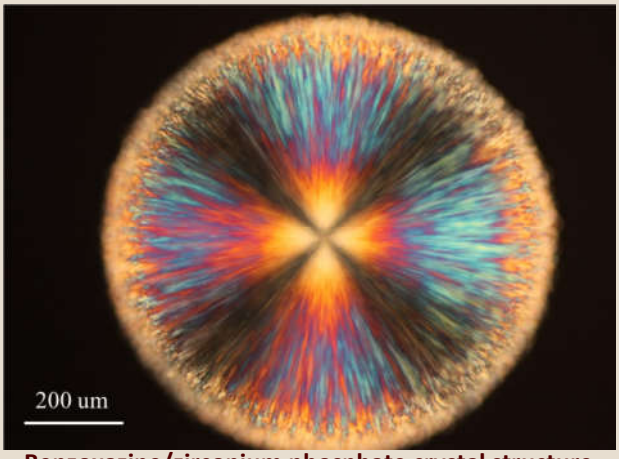
April 19th—20th, 2018
College Station, TX
Texas A&M University

Scratch Behavior of Polymers Consortium-SCRATCH/Spring meeting

Wednesday, May 9th, 2018
Noon/12pm—4:30pm
After ANTEC, Orlando, FL

Inside the Newsletter

Facilitating Industry & University Collaboration in Polymer Research



Benzoxazine/zirconium phosphate crystal structure

The Polymer Technology Center (PTC) is a research organization with the Texas A&M Engineering Experiment Station (TEES) led by Dr. Hung-Jue Sue, TEES Professor. For more than two decades, it has successfully provided new technology and insight to the polymers industry through a focused and synergistic multidisciplinary approach.

The center hosts semi-annual meetings for the Consortium for Advancing Performance Polymers in Energy AppLications–APPEAL, Polymer Technology Industrial Consortium–PTIC and SCRATCH Behavior of Polymers Consortium supporting education, research and training in the specific area of polymer science and technology.

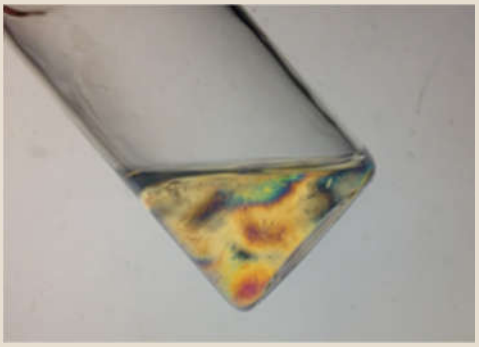
In addition, the PTC offers a Polymer Specialty Certificate Program, the first professional development program of its kind in the state of Texas, for undergraduate and graduate students at Texas A&M. The center awards two scholarships every spring and fall, the Society of Plastics Engineers Scholarship and Kaneka Student Scholarship, to students who display excellence both academically and in their respective research fields.

The center includes more than 27 faculty members from aerospace engineering, biological and agricultural engineering, biomedical engineering, chemical engineering, chemistry, electrical and computer engineering, engineering technology, materials science and engineering, and mechanical engineering.

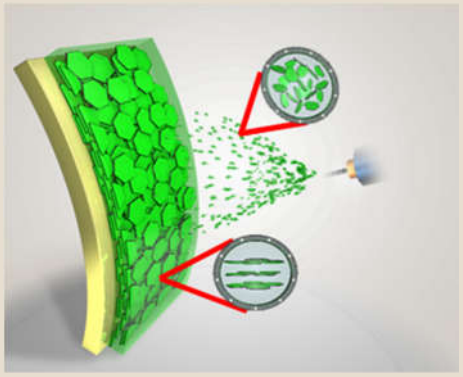
For more information, visit: **ptc.tamu.edu**

Scratch and Corrosion Resistant Epoxy Coatings
Dr. H. -J. Sue, Materials Science and Engineering

Coatings play an important role in protecting steel and other metals from corrosion. Much research has been done to add nanoplatelet fillers to epoxy formulations to reduce the rate that water and oxygen diffuse through the coating, and thereby reduce the corrosion rate. We have developed a synthetic nanoclay that is so well dispersed in epoxy that it exhibits liquid crystalline behavior. After spraying and curing the formulation, the nanoplatelets align parallel to the metal surface, with the layer spacing dependant on the concentration. This morphology has been verified by X-ray scattering and transmission electron microscopy.



Epoxy formulation in polarized light



Morphology development during spray coating

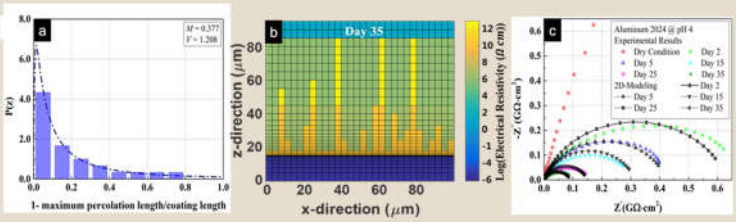
Dramatic reductions (>10x) in oxygen transmission rates were observed versus an unfilled epoxy coating. Measurements by Shawcor, Ltd, with steel test panels showed that significant improvements in corrosion rates were achieved when the nanofilled coating was used as an overcoat to a commercial epoxy coating. This work was partially funded by a Department of Transportation (PHMSE) grant related to improved pipeline coatings.

The scratch resistance of the nanoplatelet-filled coating was also substantially improved. The force required to cause a visible scratch is found to be more than doubled compared to a control. This is important because scratches corrode much more quickly than coated areas.

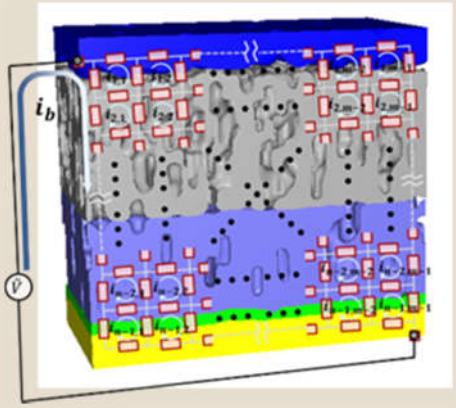
Sue, H. -J., et al, "Scratch behavior of epoxy coating containing self-assembled zirconium phosphate smectic layers", Polymer, 112 (2017) 252-263

Exploring critical parameters of the damage mechanism for Multifunctional coatings systems based on 2D deterministic-probabilistic modeling/validation
Dr. H. Castaneda, Materials Science & Engineering

The layer or coating properties will be related by charge distribution (electronic and ionic); the rate at which the interface can exchange, transfer, or accumulate charge depends on the solid state/electrolyte distribution of the current. Transmission Line Model (TLM) describes complex ion and electron transport in multicomponent electrolytes and complex/heterogeneous multilayer structures. When the materials in the coating/substrate for the base systems are comprehensively characterized through theoretical concepts, the efficient spatial distribution of water infiltration, water-induced degradation of coatings, and water-enabled migration sites are revealed. Also since the overall system is influenced by the charge transfer effect due to the active metal, TLM can produce the overall performance based on the outcome of experimental testing. A multilayer system of coatings was designed for studying the overall electrochemical activities on porous layer based on 2D damage evolution model. Steady state conditions are assumed in this model and deterministic approach is considered in the system comprising a top coat, an epoxy primer, a pretreatment, and metallic substrate. The technique of deterministic-stochastic modeling has been employed for the search of critical parameters following a sensitivity analysis. The deterministic approach based on transmission line model has been developed to represent the local impedance for small segments of the system, and physicochemical properties inherent to the organic coatings and the transport mechanisms have been fully accounted for each segment. In this model, each segment in the designed domain has its own electrical properties including electrical resistivity and capacitance. Each localized impedance can be considered by calculating interfacial impedance between each segment. In addition, the randomly generated structures including coating pore distributions are illustrated by stochastic modeling with probability density function. The detailed quantitative understanding of degradation mechanism from this 2D model is achieved and sensitivity analysis shows consistent results with experimental conditions.



The electrochemical impedance response with time-dependent solution penetrations for degradation mechanism: a) Log-normal probability density function for the pore network distribution, b) The distribution of electrical resistivity at the 35th immersion day, c) Nyquist diagram.



The schematic of 2D networks of electrochemical impedance elements for layer-by-layer composite coating system based on charge and energy conservation

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Material Developed at Texas A&M Could Enable New Facial Reconstruction Treatment
Dr. Melissa Grunlan, Biomedical Engineering

The research by Dr. Melissa Grunlan, associate professor in the university's Department of Biomedical Engineering, is detailed in the scientific journal "Acta Biomaterialia." Working with colleagues at Texas A&M and Rensselaer Polytechnic Institute, Grunlan has created a polymer foam that is malleable after treating with warm saline, allowing it to precisely fill an irregularly shaped bone defect before hardening into a porous, sponge-like scaffold that promotes new bone formation.

By tweaking the polymer scaffold through a chemical process that bonds individual molecular chains, Dr. Melissa Grunlan and her team overcame that issue and produced a sponge-like material with interconnected pores. They also coated the material with a bioactive substance that helps lock it into place by inducing formation of a mineral that is found in bone, she adds. The coating help osteoblasts – the cells that produce bone – to adhere and spread throughout the polymer scaffold. Think of it as a sort of "boost" to the material's healing properties.

[The polymer foam scaffold has interconnected pores that allow bone cells to migrate into the area and begin healing damaged tissue.]

Full story: **goo.gl/WAZd5f**

Materials Science & Engineering Faculty Lead Development of Interdisciplinary Soft Matter Research User Facility
Dr. Svetlana Sukhishvili, Materials Science & Engineering

Researchers from the Department of Materials Science and Engineering at Texas A&M University are spearheading the development of an interdisciplinary soft matter research user facility. The facility will help users conduct research to improve multifunctional polymer-based materials that are used in many applications, including energy, health care and transportation, among others, and will benefit the entire Texas A&M research community.

The project includes 29 faculty members across multiple colleges and centers, including the colleges of engineering, science, and agriculture and life sciences at Texas A&M, in addition to the Texas A&M Health Science Center, representing all entities across the university actively involved in soft materials-related research. The soft matter facility is funded through the Research Development Fund for about $1.7 million, and will be located in the WD Van Gonten Laboratory Building, occupying 3,100 square feet of lab space. It is intended as an avenue to showcase current research in the field of soft materials-related research and encourage other researchers to join and support this interdisciplinary effort.

Dr. Svetlana Sukhishvili and the members of the executive committee are hopeful that collaborative efforts in this facility will enable new discoveries in health care, soft robotics, biomanufacturing and environmental protection by acting as a nucleus of activity for collaborative research efforts not only at Texas A&M, but ideally across the state and nation.

Full story: **https://goo.gl/zP89af**

Balbuena & Seminario Awarded DOE Grant For Battery Study

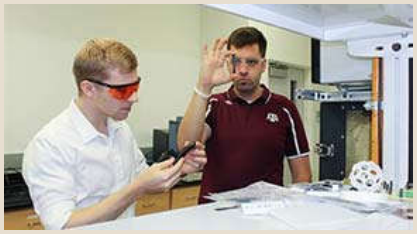
Balbuena

Seminario

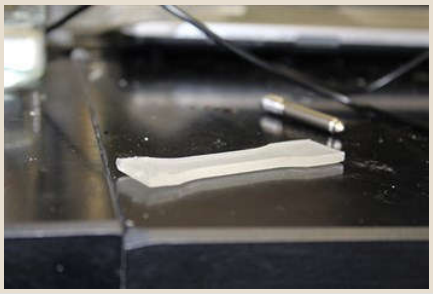
Two faculty members in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, Dr. Perla Balbuena, holder of the GPSA Professorship, and Dr. Jorge Seminario, holder of the Lanatter & Herbert Fox Professorship, were awarded a $400,000 grant for 18 months to study the development of advanced solid electrolyte technology for lithium-sulfur batteries. In this work, set to begin in October, Balbuena and Seminario will use atomistic methods to identify and characterize solid electrolyte materials. The materials selected will be analyzed computationally, and will then be synthesized and tested at DOE national laboratory facilities. Further integrated computational and experimental tests will be used to fully address interfacial issues.

Full story: **goo.gl/bMN9Uz**

Engineering Team Strengthens 3-D Printed Parts For Real-World Use



Ph.D. candidate Brandon Sweeney and his advisor Dr. Micah Green with the Dept. of Chemical Engineering discovered a way to make 3-D printed parts stronger and immediately useful in real-world applications. Sweeney and Dr. Green applied the traditional welding concepts to bond the submillimeter layers in a 3-D printed part together, while in a microwave.



Sweeney began working with 3-D printed materials while employed at the Army Research Laboratory at the Aberdeen Proving Grounds in Maryland.

Full story: **goo.gl/1UKert**

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Meet the TAMU SPE student chapter officers for 2017-18 and their contact information, should questions arise.

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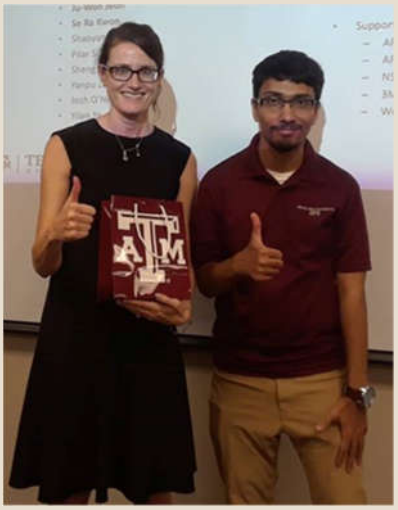
SPE Student Chapter Activities

Howdy! Our SPE chapter was very excited to start our new school year this September by hearing a talk from Dr. Jodie Lutkenhaus at our first meeting on September 15. Next month (October 6) Dr. Melissa Grunlan will come to give a talk in Room 202 of the Reed McDonald building – all are invited to attend!

So far in 2017, we have been involved in many volunteer activities including STEMfest with the Girl Scouts of America, Super Techno Science Night at Southwood Valley Elementary, and Rock Prairie Elementary Science and Technology Night. We look forward to carrying out more volunteer events this fall, including Chemistry Open House in October. We as always are grateful to the SPE South Texas Chapter for its support through donations and scholarships. If you are interested in becoming involved with our chapter, please check out our group on Facebook: https://www.facebook.com/groups/tamuspe/



Dr. Jodie Lutkenhaus (SPE Chapter Advisor) & Mohammed Haque (SPE Chapter President)

Thanks and have a great semester!

Mohammed Y. Haque
SPE President for TAMU Student Chapter

Polymer Specialty Certificate Updates

Students who have applied for the Polymer Specialty Certificate	64
Students who have received the Polymer Specialty Certificate	48

For more information, please visit: http://ptc.tamu.edu/polymer-specialty-certificate/

Have Questions?

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