2018

FOURTH Quarter

PTC Newsletter

Polymer Technology Center

UPCOMING EVENTS

Mark Your Calendars for the PTC Fall meetings!

Scratch Behavior of Polymers Consortium-SCRATCH

Wednesday, October 10th, 2018
Noon—4:30pm
After the TPO Conference-Troy, MI

Polymer Technology Industrial Consortium-PTIC

October 18th - 19th, 2018
College Station, TX
Texas A&M University

Inside the Newsletter

Introducing Antioxidant Polymers for Corrosion Protection

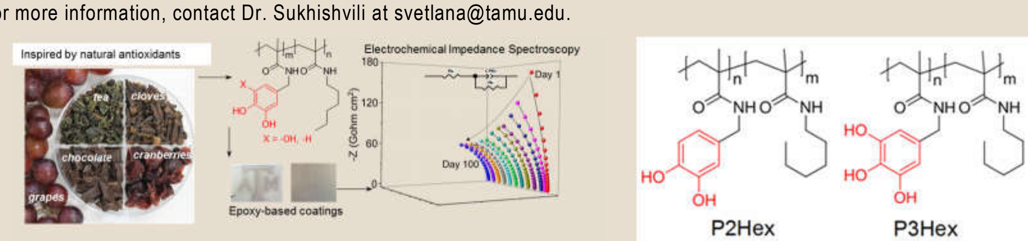
Dr. Svetlana Sukhishvili, Materials Science & Engineering

Small-molecule antioxidant additives are commonly used to enhance anticorrosion properties of organic coatings. However, many of these molecules (such as tannic acid) can be leached from the coatings, thus reducing their corrosion protection capabilities. In Sukhishvili's group, we have introduced synthetic polymeric antioxidants as powerful inhibitors of corrosion of metals which were not leachable from epoxy coatings into water or ethanol.

Moreover, miscibility of the introduced synthetic polymeric antioxidants with anticorrosion barrier coatings (such as epoxies) can be controlled at the step of synthesis antioxidant copolymers containing varied percentage of antioxidant units. Specifically, antioxidant copolymers are designed to have polyphenol, gallol, or catechol moieties along with hydrophobic groups brought by hexyl methacrylamide units. In one example, aluminum alloy 2024-T3 was used as a substrates and the antioxidant polymers were deposited as submicron thick film of individual polymers, or as 10 wt. % additives to epoxy-based ~100 µm thick coatings. Anticorrosion performance of antioxidant-containing coatings was characterized using scanning electron microscopy, optical microscopy, and electrochemical impedance spectroscopy (EIS). Unlike their polymer counterpart which lacked antioxidant functionality, the antioxidant polymers were compatible with standard epoxy coatings, and provided exceptional protection of surfaces in extreme corrosion conditions (0.6 M NaCl solution) for over 100 days. We envision that the introduction of linear polymeric antioxidants and the strategy of controlling their miscibility with organic anticorrosion coatings can constitute a new family of powerful and versatile corrosion inhibitors.

For more information, contact Dr. Sukhishvili at svetlana@tamu.edu.

I



Inspired by natural antioxidants (left), we introduce synthetic antioxidant polymers that can be used as additives to one-pot-prepared epoxy-based coatings that provide corrosion protection of metals (center). Right: The structures of antioxidant polymers, with catechol (left) and gallol (right) functional groups highlighted in red.

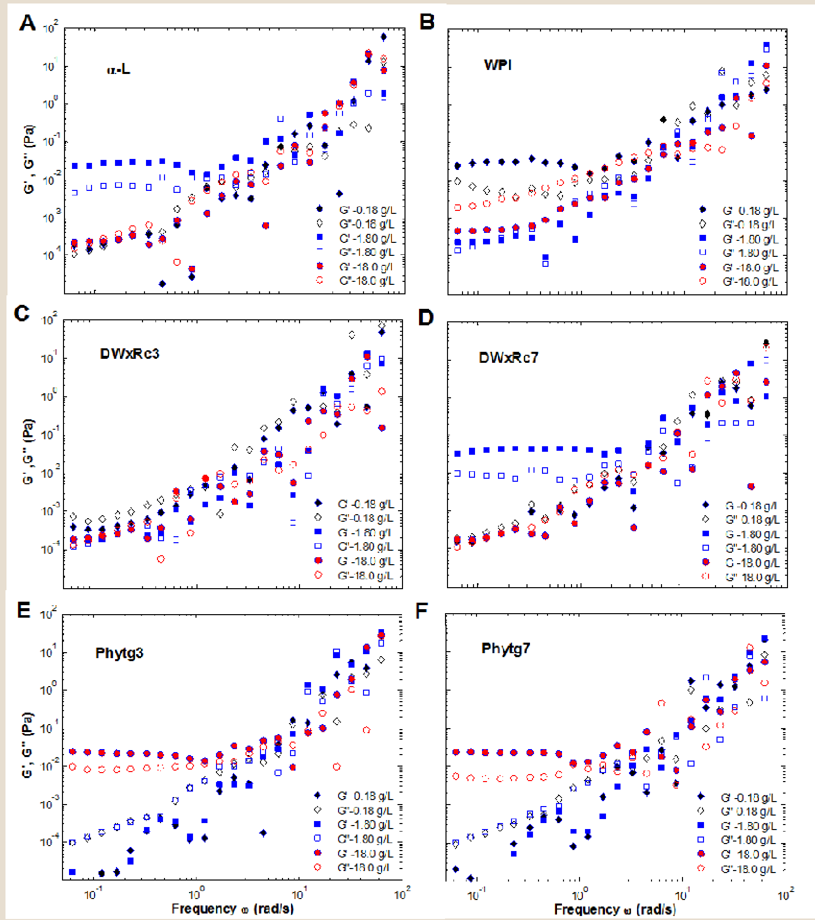
Novel Encapsulation Procedures for Targeted Delivery of Bioactive Compounds

Dr. Elena Castell-Perez, Biological & Agricultural Engineering

The Food Engineering research group in the department of Biological and Agricultural Engineering is interested in the applications of materials science to the development of functional 'soft" materials that promote healthy eating and lifestyle by facilitating the delivery of natural bioactive compounds that maintain their active form during processing and storage, but also retain their maximum bioavailability (in the gut and intestinal tracts). The group, led by Dr. Elena Castell-Perez and supported by Dr. Rosana Moreira, focuses on optimization of structurally-designed food carrier matrices' physicochemical properties that influence the release, mass transfer, accessibility, digestibility, and stability of the active compounds such as plant phenolics. Emphasis is on use of rheological principles to characterize the systems for optimization and targeted delivery.

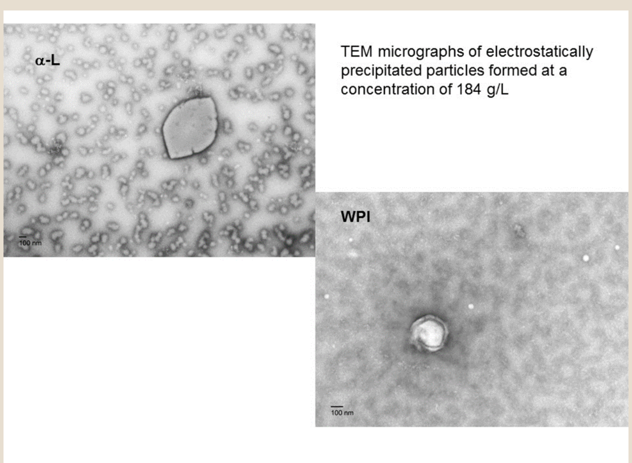
Current projects include the development and characterization of natural and modified biopolymers as a replacement for the high cost and potentially toxic biodegradable polymers like poly(lactic-co-glycolic)acid (PLGA). We assess the potential application of amphiphilic molecules, such as proteins (e.g. b-lactoglobulin, α-lactalbumin, whey protein, soy protein isolate) and different types of surfactants in the food industry. Proteins and polysaccharides are natural food materials, considered GRAS (generally recognized as safe), widely available, and relatively inexpensive. Similarly, polysaccharides such as starch and phytoglycogen have been hydrophobically modified by reaction with octenyl succinate anhydride (OSA) to become strongly surface active and have been successfully handled to impart functional application as rheology modifiers, emulsion stabilizers, surface modifiers, encapsulation matrix for nanoparticles, and drug delivery vehicles.

Our group also confirmed that rheological characterization of biopolymers in aqueous solution using small amplitude dynamic oscillatory tests at 0.01Pa, 23°C, and neutral pH (~7.0) was a suitable method to describe the intermolecular association of amphiphilic biopolymers. The presence of a "λ" slope at a critical frequency value (CFV) can be correlated to the type and size of structure formation thus facilitating design of nanostructures to deliver the bioactive compounds to the intended site of action within the body.



Frequency sweeps for different concentrations of α-lactalbumin (A), whey protein isolate (B), depolymerized 3% OSA-modified waxy rice (C), depolymerized 7% OSA-modified waxy rice (D), 3% OSA-modified phytoglycogen (E), and 7% OSA-modified phytoglycogen (F). Frequency sweep test was performed at 0.01 Pa and 23°C using a controlled stress rheometer Thermo Scientific, Inc.).

TEM micrographs of nanoparticles using α-latcoalbumin and whey protein isolate as carriers



TEES | PTC
POLYMER TECHNOLOGY CENTER
TEXAS A&M ENGINEERING EXPERIMENT STATION
Phone: (979) 458-0918 Website: http://ptc.tamu.edu

Two-dimensional Polymer-grafted Colloids for Emerging Energy Applications

Dr. Zhengdong Cheng, Chemical Engineering

The advanced polymer team, led by Dr. Zhengdong Cheng and doctoral student Minxiang Zeng, is developing new solutions toward current challenges in enhanced oil recovery, smart delivery system, and specialty surfactants. Our research goal is to develop size-controllable, surface-programmable nanosurfactants by embedding flexible functional polymers onto rigid 2D nanostructures. By engineering the surface chemistry and colloidal behaviors of polymer-grafted nanoplates, we are able to manipulate the interfacial properties of nanoparticles at multiple length scale. Current research projects involve asymmetric grafting of functional polymers on 2D nanosurfactants which can behave as nanogates to actively control molecular transport at oil/water interfaces.[1] With close collaboration with oil companies, Cheng's team endeavors to facilitate the emerging trend of transforming conventional oil production into a cleaner and more efficient energy industry.[2]

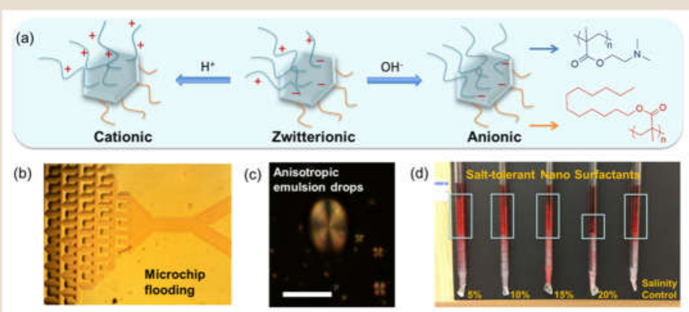


Figure 1. Some examples of integrating functional polymer with nanotechnology for energy applications.

1. Luo, J.; Zeng, M.; Peng, B.; Tang, Y.; Zhang, L.; Wang, P.; He, L.; Huang, D.; Wang, L.; Wang, X.; Chen, M.; Lei, S.; Lin, P.; Chen, Y.; Cheng, Z. *Angewandte Chemie* **2018,** 130, (36), 11926-11931.
2. Peng, B.; Zhang, L.; Luo, J.; Wang, P.; Ding, B.; Zeng, M.; Cheng, Z. *RSC Advances* **2017,** 7, (51), 32246-32254.

Biomedical Engineering Professors Elected to American Institute for Medical and Biological Engineering College of Fellows

The American Institute for Medical and Biological Engineering (AIMBE) has announced the induction of Dr. Duncan Maitland, holder of the Stewart and Stevenson Professorship I and associate department head, and Dr. Melissa A. Grunlan, holder of the Charles H. and Bettye Barclay Professor in Engineering, both in the Department of Biomedical Engineering at Texas A&M University, to its College of Fellows. They were nominated, reviewed and elected by peers and members of the College of Fellows for outstanding contributions to their fields.

A formal induction ceremony was held during the AIMBE annual meeting at the National Academy of Sciences in Washington, D.C. on April 9. Maitland and Grunlan were inducted, along with 156 colleagues who make up the AIMBE College of Fellows Class of 2018.

Full story: **goo.gl/u6o3PM**

Novel Polymer Foam Device Receives FDA Clearance for Cardiovascular Treatments

The IMPEDE Embolization Plug is made from polyurethane-based shape memory polymer foam that expands to a "memorized" larger conformable shape when delivered into a blood vessel, allowing it to obstruct or reduce the rate of blood flow in the vein or artery targeted. Image: *Dr. Duncan Maitland*

A lifesaving device more than 20 years in the making has received 510(k) clearance from the U.S. Food and Drug Administration (FDA). The clearance allows a company, co-founded by Associate Department Head Dr. Duncan Maitland from the Department of Biomedical Engineering at Texas A&M University, to begin to market the medical device.

How it works

The device is made from polyurethane-based shape memory polymer (SMP) foams. While small during insertion, the porous polymeric materials are capable of growing to a "memorized" larger conformable shape when delivered into a blood vessel, allowing it to obstruct or reduce the rate of blood flow in the vein or artery targeted by the doctor.

After blocking flow in a vascular target, there is also concern that one could reform over time. With the IMPEDE Embolization Plug, test results have shown that SMP foams promote long-term health of the areas of the blood vessel, reducing the chances that another treatment is required.

Maitland developed the IMPEDE Embolization Plug, a device that could provide doctors with a more effective and less risky method for treating aneurysms. Image: *Photo courtesy of College of Engineering.*

"The benefit to patients is that they don't get reoccurrence," Maitland said. "This is a less traumatic deliverable device. As it's being delivered, it's not potentially rupturing the blood vessels like some of the current devices would, and it heals the site so they don't have to have it retreated.

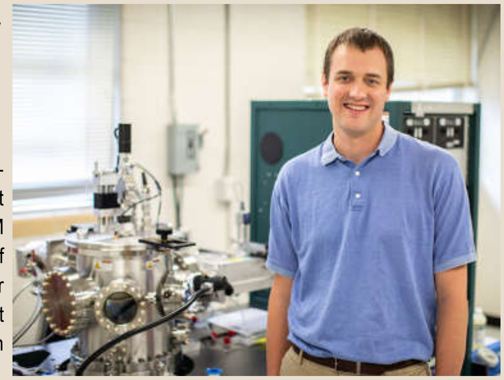
Full story: **goo.gl/XS4s8C**

PTC Faculty Members

Name	E-mail Address	Office #
Mustafa Akbulut	makbulut@tamu.edu	979-847-8766
Amir Asadi	amir.asadi@tamu.edu	979-458-7841
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@tamu.edu	979-862-1449
Homero Castaneda	hcastaneda@tamu.edu	979-458-9844
Elena Castell-Perez	ecastell@tamu.edu	979-862-7645
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
Yossef Elabd	elabd@tamu.edu	979-845-7506
Lei Fang	fang@chem.tamu.edu	979-845-3186
Micah Green	micah.green@tamu.edu	979-862-1588
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
Jodie Lutkenhaus	jodie.lutkenhaus@tamu.edu	979-845-3361
Anastasia Muliana	amuliana@tamu.edu	979-458-3579
Mohammad Naraghi	naraghi@aero.tamu.edu	979-862-3323
K.R. Rajagopal	krajagopal@tamu.edu	979-862-4552
Hung-Jue Sue	hjsue@tamu.edu	979-845-5024
Steve Suh	ssuh@tamu.edu	979-845-1417
Svetlana A. Sukhishvili	svetlana@tamu.edu	979-458-9840
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

Researchers seek to develop better more efficient batteries

Dr. Matt Pharr
Mechanical Engineering Dept.



Dr. Matt Pharr has been a faculty member in the Department of Mechanical Engineering since 2016. Image: *Texas A&M Engineering Communications/Justin Baetge*

As the need increases for more powerful and efficient batteries to support developing technologies, Texas A&M University Assistant Professor of Mechanical Engineering Dr. Matt Pharr is working to do just that: a pursuit that could have wide-ranging impacts in several areas, including sustainable energy, transportation and personal electronics.

Along with his team, Pharr said he is seeking to discover advances to rechargeable, high-capacity lithium-ion batteries by exploring possible solutions to the mechanical degradation suffered during use.

To help with his project, Pharr was one of four researchers recently selected for a gift awarded by the Applied Mechanics Division of the American Society of Mechanical Engineers to support the theoretical and applied mechanics research of new faculty members.

Full story: **goo.gl/9e3uSw**

SPE South Texas section

Upcoming Fall 2018-SPE Student Chapter Seminar schedule

- ⇒ October 31st 6pm **Rui Xie (Huntsman)** Reed McDonald 202
- ⇒ November 13th 5pm **Tim Alford (Exxon)** Reed McDonald 202
- ⇒ December (TBD) (TBD) **Carrie Schindler (Malvern)**

For information on becoming a member of the SPE student chapter at TAMU, please contact the below officers.

President	Fabian Arp	arpfabian@gmail.com
VP Science	Shaoyang Wang	shaoyang.wang@tamu.edu
VP Engineering	Shuoran Du	shuoran920324@tamu.edu
Treasurer	Andy Abbas	aabbas101@tamu.edu

Polymer Specialty Certificate Updates

Students that have applied for the Polymer Specialty Certificate	**77**
Students that have received the Polymer Specialty Certificate	**57**

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

Have Questions?

Dr. Hung-Jue Sue
PTC Director
E-mail: hjsue@tamu.edu

Isabel Cantu
E-mail: icantu@tamu.edu
Phone: 979-458-0918

TEES | PTC
POLYMER TECHNOLOGY CENTER
TEXAS A&M ENGINEERING EXPERIMENT STATION
Phone: (979) 458-0918 Website: http://ptc.tamu.edu

PTC newsletter prepared by: Isabel Cantu