Polymer Technology Center

UPCOMING EVENTS

Mark Your Calendars for the PTC Fall meetings!

Scratch Behavior of Polymers Consortium-SCRATCH	Polymer Technology Industrial Consortium-PTIC
Wednesday, October 9th, 2019 Noon—5pm After the TPO Conference-Troy, MI	October 17th-18th, 2019 College Station, TX Texas A&M University

Inside the Newsletter

PTC is pleased to announce and welcome the newest member to the Polymer Technology Industrial Consortium-PTIC

ALBEMARLE®

The Albemarle Corporation is a chemical company with corporate headquarters in Charlotte, North Carolina. It is a specialty chemical manufacturing enterprise. The company employs approximately 5,400 people and has customers in approximately 100 countries.

2019 Patent & Innovation Awards

On Thursday, April 18th, 2019 the Texas A&M Technology Commercialization Office held their Annual Patent and Innovation Awards luncheon which was held at Annenberg Presidential Conference Center, George Bush Presidential Library Complex.

The Innovation Awards recognized individuals whose research exemplifies the spirit of innovation within the Texas A&M University system. The individuals receiving the Innovation Award this year were:

Carolyn L Cannon, MD, PhD, Microbial Pathogenesis & Immunology
Scott V. Dindot, PhD, Vet Med pathobiology
Hung-Jue Sue, PhD, Materials Science & Engineering

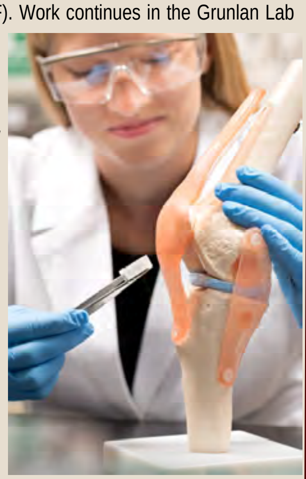
L-R: Dr. Balakrishna Haridas, Executive Director | TEES Division of Commercialization & Entrepreneurship and Dr. Hung-Jue Sue | TEES Professor and PTC Director at the Materials Science & Engineering Department

Synthetic Cartilage from Mechanically Robust Hydrogels

Professor Melissa A. Grunlan
Departments of Biomedical Engineering, Materials Science & Engineering and Chemistry

When articular cartilage of the knee is damaged, it can cause serious pain and may ultimately lead to degenerative joint disease or osteoarthritis. Current treatments such as microfracturing and osteochondral autograft transplantation are limited, often requiring the need for a total knee replacement (TKR). In the USA alone, the number of TKRs is expected to rise to over three million annually by 2030. More recently, focal resurfacing strategies to replace the localized defect area have been explored, but are hindered by the use of devices based on metals and hard plastics whose mechanical mismatch with surrounding tissue is linked to implant loosening. Hydrogels are desirable candidates for cartilage resurfacing due to their high water content and lubricity but are limited in their poor mechanical properties. Specifically, simultaneously achieving a high cartilage-like modulus and strength without reducing hydration necessary for lubricity is key.

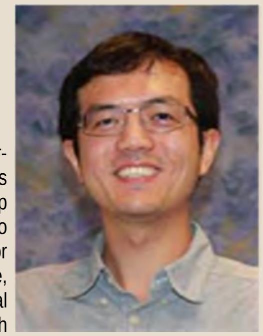
The research group of Prof. Melissa Grunlan recently reported a new hydrogel that has potential to be used as synthetic cartilage for focal resurfacing of knee joints (*Biomacromolecules* 2019, *20*, 2034-2042). In a study led by Dr. Kristen Means, a recent Ph.D. graduate from the lab, a double network (DN) hydrogel was developed whose strength, modulus and hydration paralleled that of native cartilage. While DN hydrogels have achieved notable strengths, the simultaneous achievement of cartilage-like modulus and hydration had not yet been realized. The Grunlan Lab prepared DN hydrogels composed of a poly(2-acrylamido-2-methylpropane sulfonic acid) (PAMPS) 1st network and a poly(*N*-isopropylacrylamide-*co*-acrylamide) [P(NIPAAm-*co*-AAm)] 2nd network. These PNIPAAm-based DNs demonstrated remarkably high compressive strength (~25 MPa) while maintaining a cartilage-like modulus (~1 MPa) and hydration (~80%). By directly comparing to native cartilage, it was confirmed that these membranes were not only able to parallel the strength, modulus and hydration of native articular cartilage but also exhibited a 50% lower coefficient of friction (COF). Work continues in the Grunlan Lab to form this synthetic cartilage into a device suitable for implantation and integration with the surrounding tissue for stability.



The Grunlan Lab is focused on developing new polymeric biomaterials for medical devices and regenerative medicine. More information can be found at grunlanlab.tamu.edu and @MGrunlanLab.

Porous Polymer Networks

Assistant Professor Lei Fang
Chemistry



Porous Polymer Networks (PPNs) are organic materials featuring high surface areas and abundant pores with various sizes and functionalities. PPNs are synthesized in a bottom-up manner via irreversible bond formation that leads to amorphous structures. Their structural versatility allows for tailored properties suitable for various applications. Meanwhile, the stable covalent bond frameworks impart excellent thermal and chemical stabilities for applications in extremely harsh conditions. The Fang group synthesized and investigated the following PPN materials for energy storage and industrial separation applications.

1. **Entropically Favorable Methane Storage by Porous Ladder Polymer Networks**
   To improve methane storage capacity of porous organic materials, this work proves the concept that a rigid ladder-type backbone is more entropically favorable for gas adsorption and leads to a high gas uptake per unit surface area. A porous ladder polymer network was designed and synthesized as the model material via cross-coupling polymerization and subsequent ring-closing olefin metathesis, subsequently characterized by solid state NMR spectroscopy. This material exhibited a remarkable methane uptake per unit surface area, which outperformed those of most reported porous organic materials. Variable-temperature thermodynamic adsorption measurements corroborated the significantly less negative entropy penalty during high pressure gas adsorption compared to its non-ladder type counterpart. This rigid backbone strategy provides an orthogonal way to multiply volumetric methane uptake capacity of porous materials. This entropic approach also offers the opportunity to increase deliverable gas upon pressure change while mitigating the high temperature adsorption decline.

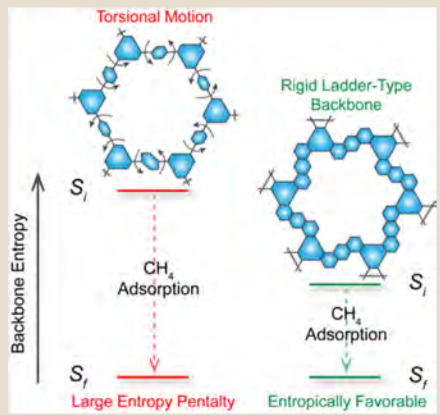


Figure 1. ladder type backbone in Porous Ladder Polymer Networks leads to much less negative entropy penalty during high-pressure methane storage.

2. **PPN membranes for organic solvent nanofiltration (OSN)**
   Aromatic porous polymer network membranes were fabricated by *in-situ* cross-linking based on aldol triple condensation, where methane sulfonic acid served as both the catalyst and the solvent. These PPN membranes possessed rich yet narrowly distributed micropores, resulting in high permeability and sharp selectivity in organic solvent nanofiltration (OSN) tests. Due to the highly stable aromatic backbones, these PPN membranes maintained structural integrity in harsh chemical environments and performed steady. The OSN tests were efficient in the presence of either strong acid or strong base for extended amounts of time. The combined properties of outstanding chemical stability, high permeability, and excellent selectivity rendered these PPN membranes promising candidate materials for challenging next-generation OSN applications.

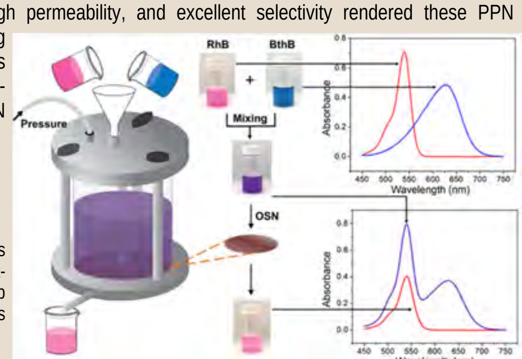


Figure 2. PPN membranes equipped with narrowly distributed micropores shows sharp selectivity of molecular weights in OSN tests.

TEES | PTC POLYMER TECHNOLOGY CENTER
TEXAS A&M ENGINEERING EXPERIMENT STATION
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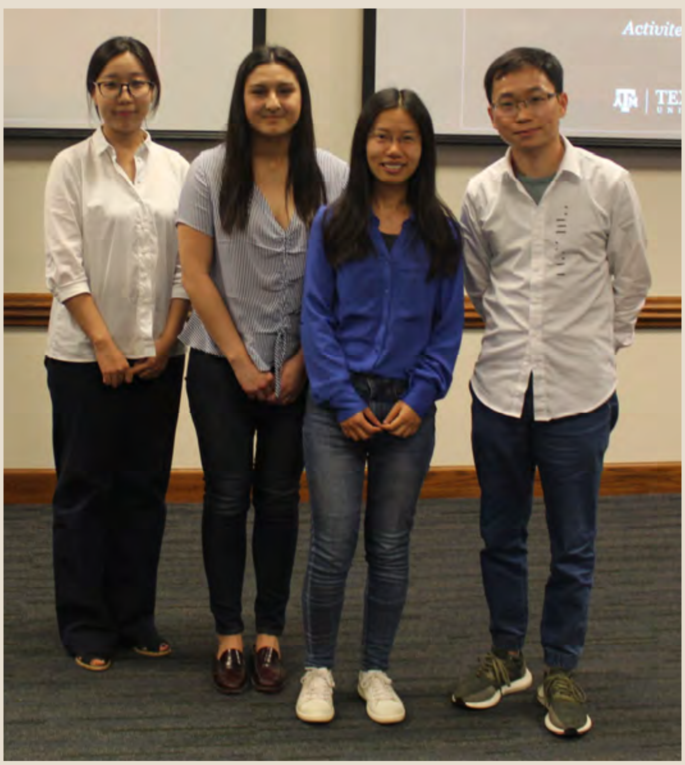
THE KANEKA FOUNDATION
Kaneka

On April 12th, 2019 at the PTIC Spring meeting, Dr. Masahiko Miyauchi, Kaneka's Liaison, awarded the Kaneka Junior Faculty award to Dr. Matthew Pharr from the Department of Mechanical Engineering.

The students below were also recognized for being the Kaneka scholarship recipients.



Left to right: Mei Dong, CHEM; Camila Rodriguez Perales, CHEM; Dr. Xi Zhang, Kaneka's Liaison; and Mingfeng Chen, CHEN

SPE South Texas section

Also, on April 12th, 2019 at the PTIC Spring meeting the SPE student scholarship recipients were recognized.

L-R: Dr. David Hansen, SPE Liaison, Xiaozhou Ji, CHEM and Shaoyang Wang, CHEN.

Lights, camera, fracture: Assistant Professor Matthew Pharr, Department of Mechanical Engineering makes breakthrough discovery in stretchable electronics materials

By using the elasticity of polymers such as silicone, these emerging technologies are made to move in ways that mimic skin.

This sheds light on why Smooth-On Ecoflex, a substance most commercially used to create molds and movie masks and prosthetics, is the most prominent silicone elastomer (a rubber-like substance) found in research.

"I have done some work in the area of stretchable electronics, so I have a lot of materials from when I was a postdoc. We had to store samples in our office and, likewise, I had some here because we were going to use them in a project that we ended up not doing. I'm a nervous fidgeter and while I was playing with it, I noticed something weird," said Pharr.

Full story: https://engineering.tamu.edu/news/2019/05/lights-camera-fracture-pharr-makes-breakthrough-discovery-in-stretchable-electronics-materials.html

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PTIC student poster recipients

	Polymer Technology Industrial Consortium (PTIC) Student Poster Session		
	April 11th-12, 2019		
MAJOR		Students Name	Students Poster Title
CHEN	1	Paraskevi Flouda	"Interfacial Engineering of Reduced Graphene Oxide for Aramid Nanofiber-Enabled Structural Supercapacitors"
CHEM	2	Christopher Komatsu	"An Environmentally-friendly Synthesis for Polyurethanes Using a Glucose as a Biorenewable Co-monomer?"
CHEN	3	Shaoyang Wang	"Real-time insight into the doping mechanism of organic radical polymers"

SPE South Texas section

The 2019-2020 SPE student chapter new officers. For information on becoming a member of the SPE student chapter at TAMU, please contact the below officers.

President	Ying-Hua Fu	yinghuafu95@tamu.edu
VP Science	Yue Song	ysong@tamu.edu
VP Engineering	Ming-Uei Hung	muhung@tamu.edu
Treasurer	Chia-Ying Tsai	tsaicying@tamu.edu
Secretary	Alice Chang	alicechange29@tamu.edu
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Webmaster/Social Media Coordinator	Kasturi Sarang	Kasturi_0402@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?

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