UNIVERSITY OF DELAWARE

MATERIALS SCIENCE and ENGINEERING SEMINAR

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Georgia Institute of Technology

Using Processing Strategies to Engineer Structure and Mechanical Performance in Polymers, Nanocomposites, and Fiber Networks

The structure of polymeric materials is inherently multiscale, with length scales ranging from the molecular level up to the bulk scale. This structural complexity offers a rich area for producing structures with polymers and their composites that are present in nature, art, and human imagination. In the Shofner group, we are investigating how to realize some of these structures by using processing strategies that build the needed physical features. In this seminar, I will discuss three topics in our work that are included in this theme: constructing tensegrity-inspired structures, imparting auxetic behavior, and constructing charge-driven nanofiber assemblies in polymer-based materials. For tensegrity-inspired structures, we are mapping the concepts of tensegrity to the components in a polymer nanocomposite to produce microstructures with improved stiffness relative to other available microstructures. In this mapping, the nanoparticles are considered as the compressive elements and the polymer matrix serves as the tensioned web. For auxetic structures, we are achieving a large auxetic response in fiber networks in the form of bonded mats as well as physically entangled structures. These networks are produced at large scale as non-woven fabrics, providing opportunities to produce "commodity" auxetics. For nanofiber assemblies in polymer matrices, we are combining oppositely charged bio-based nanofibers, cellulose nanocrystals and chitin nanofibers, in composite films and hydrogels and exploring when these combinations can be beneficial to mechanical properties. The results indicate that at certain ratios the nanofibers can produce blended structures that improve interfacial interactions and load transfer. Overall, these results of these studies provide pathways for achieving additional materials design options for polymers and composites that can be integrated with current processing/manufacturing methods.

BIOGRAPHY

Dr. Meisha L. Shofner is an Associate Professor and MSE Faculty Fellow in the School of Materials Science and Engineering at the Georgia Institute of Technology. She joined the Georgia Tech faculty, following post-doctoral training at Rensselaer Polytechnic Institute. She received a B.S. in Mechanical Engineering from The University of Texas at Austin and a Ph.D. in Materials Science from Rice University. Prior to graduate school, she was employed as a design engineer at FMC in the Subsea Engineering Division. Dr. Shofner's research interests include processing strategies for polymers and nanocomposites, auxetic and tensegrity structures, bio-based polymers, polymer crystallization, and additive manufacturing. She currently serves on the leadership team of SHAP3D, an NSF-funded Industry University Cooperative Research Center in the area of additive manufacturing, and she is an associate editor for the journal, Additive Manufacturing.

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