"Bio-inspired Pathways to Manipulating Architecture and Mechanics in Polymeric Materials"

Virtual Seminar
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Abstract

Fiber constructs are prevalent in natural systems, from collagen fiber networks in tendon to tough, spider silk fibers. Recent innovations in multilayer co-extrusion technology have translated to the fabrication of melt-extruded fiber-reinforced composites, reminiscent of the nanoscale features of the Brown Recluse Spider. Distinct advantages of this modular approach over other traditional techniques include scalability, environmentally-friendly conditions, and the ability to obtain cross-sectional dimensions on the nanoscale. Here, we describe the mechanics and structural features of biologically-relevant, reinforced hydrogels via an in situ approach. This manufacturing strategy allows for strategic control of hydrogel architecture, fiber (single component and blends) alignment and loading, and compressive stability and stiffness. Promising results related to cell adherence and growth, and controlled degradation rates, are highlighted for these extruded hydrogel scaffolds.

Supramolecular interactions may hold the key to the development of elastomers with a tailored elastic response and improved mechanics, such as observed in the muscle protein titin and polychaete worm jaw. It is the dynamic nature of the supramolecular interaction that we have exploited in the design of tough supramolecular elastomers that superimpose covalent and non-covalent interactions to tailor tensile response. In this research, concepts of interfacial control of self-assembly, composition, and dynamics as it relates to mechanical behavior are examined. Supramolecular blends, nanocomposites and interpenetrating networks have been investigated to achieve gradient mechanics, shape memory response, and bilayer actuation. These systems show promise in smart coating applications and for the development of functional polymer blends.

Bio

LaShanda T.J. Korley, Ph.D. is a Distinguished Professor of the Departments of Materials Science and Engineering, and Chemical and Biomolecular Engineering at the University of Delaware (UD). Previously, she held the Climo Associate Professorship of Macromolecular Science and Engineering at Case Western Reserve University, where she started her independent career in 2007. Professor Korley is the director of the recently awarded Energy Frontier Research Center – Center for Plastics Innovation (CPI), funded by the Department of Energy, and also the co-director of the recently announced Materials Research Science and Center – UD Center for Hybrid, Active and Responsive Materials (UD CHARM). She is also the principal investigator for the National Science Foundation Partnerships for International Research and Education (PIRE) and the co-director of the Center for Research in Soft matter & Polymers (CRiSP) at the University of Delaware.

She received a B.S. in both Chemistry & Engineering from Clark Atlanta University, as well as a B.S. in Chemical Engineering from the Georgia Institute of Technology in 1999. Professor Korley completed her doctoral studies at MIT in Chemical Engineering and the Program in Polymer Science and Technology in 2005, and was the recipient of the Provost's Academic Diversity Postdoctoral Fellowship at Cornell University in 2005. She was named a DuPont Young Professor in 2011 and was selected for the National Academy of Engineering Frontiers of Engineering symposium. She was a Kavli Fellow of Japanese/American Frontiers of Science Symposium from 2012-16. Recently, Professor Korley was elected as Fellow of the American Institute of Medical and Biological Engineering and was awarded the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) Lloyd N. Ferguson Young Scientist Award for Excellence in Research. Her research focuses on bio-inspired polymeric materials, film and fiber manufacturing, polymer recycling and upcycling strategies, stimuli-responsive composites, peptide-polymer hybrids, fiber-reinforced hydrogels, and renewable materials derived from biomass.

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