DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Spring Seminar Series

Nanostructure-Forming Polymers for Sustainability and Human Health

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Wednesday, April 17, 3:00 p.m.
PISB 104

The design, synthesis, and self-assembly of nanostructure-forming block copolymers (BCP)s can facilitate the development of new materials for many emerging applications. In the Epps group, we are focused on elucidating the structure/property/function relationships inherent in nanostructured polymers to create unique systems exhibiting molecular-level assembly. A particular interest in our research group is the coupling of thermodynamic and kinetic constraints in self-assembling polymers for a variety of potential platforms including lithium battery membranes, green and bio-based materials, and drug delivery capsules. Two areas of recent progress in the group involve: (1) designing new stimuli-responsive copolymers for gene therapy applications, and (2) synthesizing new bio-based alternatives, based on lignin, for thermoplastics and adhesives applications. In the first area, we use photo-responsive functionalities, as well as our understanding of solution self-assembly, to create nanoscale nucleic acid delivery vehicles. These systems show increased cellular uptake, stable packaging, on-demand unpackaging, and controlled/tunable/efficient delivery relative to standard nucleic acid transfection agents. In the second area, we modify lignin model compounds and 'real' biomass-derived compounds for use in the controlled synthesis of bio-based materials. One recent task has been the investigation of styrene-alternatives for BCPs with tunable glass transition and degradation temperatures that are suitable for thermoplastic elastomer, pressure sensitive adhesive, and battery electrolyte applications.

Thomas is the Director of the Center for Molecular and Engineering Thermodynamics and the Thomas and Kipp Gutshall Professor of Chemical & Biomolecular Engineering at the University of Delaware (UD) with a joint appointment in Materials Science & Engineering and an affiliated appointment in Biomedical Engineering. He received his B.S. degree in Chemical Engineering from MIT in 1998 and an M.S. degree in Chemical Engineering from MIT in 1999. He completed his graduate research at the University of Minnesota and received a Ph.D. in Chemical Engineering in 2004; he then joined NIST as a National Research Council Postdoctoral Fellow. Prof. Epps joined UD in the summer of 2006.

His research interests include nanostructured assemblies for targeted drug delivery and gene therapy, polymeric materials for bio-separation and ion-conduction membranes, nanostructured soft materials from biobased feedstocks, and polymer films for nanotemplating. Prof. Epps has received several honors and awards including: the John H. Dillon Medal from APS (2016); the Owens-Corning Early Career Award from AIChE (2015); named a Kavli Fellow by the National Academy of Sciences (2014); the Sigma Xi Young Investigator Award (2014); the Martin Luther King, Jr. Visiting Professorship at MIT (2012); the Thomas & Kipp Gutshall Professorship at UD (2012); the UD Alison Society, Gerard J. Mangone Young Scholars Award (2011); the DuPont Young Professor Grant Award (2010); the Presidential Early Career Award for Scientists and Engineers (PECASE) (2009); the Air Force Young Investigator Award (2008); the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) Lloyd N. Ferguson Young Scientist Award (2007), and a National Science Foundation (NSF) CAREER Award (2007) among others. Prof. Epps also is active in the American Chemical Society (ACS Board of Directors Development Advisory Board), American Institute of Chemical Engineers, American Physical Society (Polymers Division), and Sigma Xi. He was elected a Fellow of the American Physical Society in 2017 and a Fellow of the Royal Society of Chemistry (FRSC) in 2018.