Solvay Seminars in Macromolecular Science & Engineering

Macromolecules Innovation Institute (MII)

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Prof. Thomas H. Epps, III

"Generating Functional Materials from Nanostructured Polymers"

University of Delaware
Thomas & Kipp Gutshall Professor of Chemical and Biomolecular Engineering

Host: John Matson

Abstract: The self-assembly of block copolymers (BCP)s can facilitate materials design for many emerging nanotechnologies. In the Epps group, we are focused on understanding and applying the structure/property/function relationships inherent in nanostructured polymers to design, synthesize, and characterize new systems exhibiting molecular-level assembly. A particular interest in our research group is the coupling of thermodynamic and kinetic constraints in self-assembling polymers to develop materials for a variety of potential platforms including lithium battery membranes, green and bio-based materials, mechanical property enhancers, coatings, nanoscale templates, and drug delivery capsules. Three areas of recent progress in the group involve: *(1)* manipulating inter-block interactions to improve ion transport in block copolymers, *(2)* fabricating stimuli-responsive copolymers for gene therapy applications, and *(3)* designing bio-based alternatives, based on lignin, for thermoplastic applications. In the first area, we employ synthetic modifications to the traditional BCP architecture (using chemical tapering between blocks) to control the ordering transitions, glass transitions, and phase behavior in diblock and triblock polymers. Thus, we can create more processable and effective ion-conducting materials for lithium battery membranes. In the second area, we use photo-responsive functionalities, as well as our understanding of solution self-assembly, to create 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 third area, we explore the modification of lignin model 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 applications.

Bio: Thomas is the Thomas and Kipp Gutshall Professor of Chemical and Biomolecular Engineering at the University of Delaware (UD) with a joint appointment in Materials Science and 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.

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), a National Science Foundation (NSF) CAREER Award (2007), and an NRC Postdoctoral Fellowship (2004) among others.

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