Polymer Program

INSTITUTE OF MATERIALS SCIENCE

Seminar: 11:15 am Friday, August 30, 2024

Science 1: Room 1002

Host: Luyi Sun

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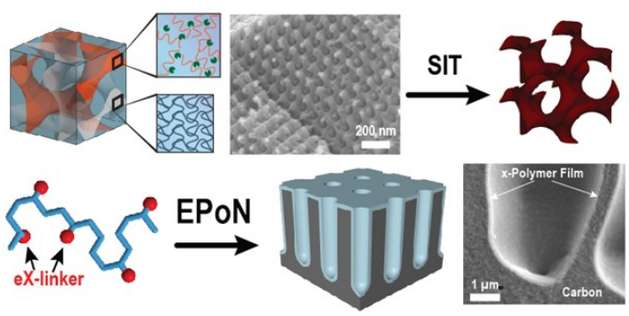
Nanoconfined Fabrication in Polymer Systems for Energy and Sustainability Technologies

Abstract: Application-tailored materials for many energy and sustainability technologies requires nano- and micro-scale control over macroscopic bulk materials fabrication. While many methods for nanoscaled objects and surface patterns have been discovered and developed over the past decades, scalable processes to achieve 3D nano/micro-architected materials or coatings with extended macroscopic dimensions remain inadequate. To overcome this challenge, we study the self-assembly and nanoconfined synthesis in soft matter to find novel ways of creating extended mesoscale structures. In this talk, I will first introduce monolithic gels with periodically ordered and chemically distinct nanophases from self-assembled block copolymers that contain a single selectively crosslinked block (xBCP). The nanostructured gels include gyroidal 3D periodic network architectures and exhibit macroscopic and nanoscopic structural integrity even when swollen with liquid fractions above 85 vol%. I will demonstrate the use of these solvent-laden bulk materials for Selective Infusion Templating (SIT) as a novel highly adaptable nanofabrication concept. In the second part, I will present our recent discovery of a novel thin-film deposition paradigm - the Electrodeposition of Polymer Networks (EPoN), which enables conformal coatings of tunable 10-100s nm on conductive substrates of arbitrary topographies. EPoN makes use of novel electrochemical crosslinkers at fractions as low as 1%, enabling the surface-confined, self-limiting, and defect-correcting deposition of pre-synthesized polymers independent of their properties and functionalities. I will highlight the versatility of EPoN in the context of ultrathin polymer solid electrolytes, stimuli-responsive coatings, as well as reactive polymer interphases and applications in carbon capture.



Website: https://sites.bu.edu/wernerlab/

Bio: Joerg Werner received his Diplom (M.S.) in Chemistry in 2011 from the Johannes Gutenberg University in Mainz, Germany, and his Ph.D. in 2016 from the Department of Chemistry at Cornell University under the guidance of Prof. Uli Wiesner (MSE). After his postdoc in the group of Prof. Dave Weitz at Harvard University, he started his independent research group at Boston University in 2020 as an Assistant Professor in the Department of Mechanical Engineering and the MSE Division. His group focuses on spatially controlled synthesis and bottom-up fabrication methods to study the interplay of functional materials with 3D structures across scales, utilizing polymer self-assembly, phase separation, and electrochemistry. He received a DARPA Young Faculty Award in 2023 and BU's Dean's Catalyst Awards in 2020 and 2022. Prof. Werner is a core faculty of the *Institute for Global Sustainability* and co-founded *BU's Energy and Sustainability Technology* (BEST) Lab in 2023, a multi-PI virtual lab that serves as a community for students and faculty to exchange ideas and accelerate their research by open collaboration.