PURDUE UNIVERSITY

Birck Nanotechnology Center

Critical Measurements to Enable the Use of Polymers in Membranes, Composites, and Impact Mitigation

Christopher Soles

Wednesday, February 6, 2019
11:00am – 12:00pm
MRGN 121

Dr. Christopher L. Soles leads the Functional Polymers Group in the Materials Measurement Laboratory at the National Institute of Standards and Technology (NIST). His research group focuses on measurement strategies that help commercialize the use polymeric materials in technologies related to semiconductor fabrication, printed and flexible electronics, membranes for ion transport and water filtration, structural composites, and impact mitigation. His research in all these areas has always focused on the relationship between polymer dynamics and material function in these technology sectors. He received Bachelor of Science degrees in both Mechanical Engineering (ME) and Materials Science and Engineering (MSE) in 1993, and his Doctorate in MSE in 1998, all from the University of Michigan. He then moved to the NIST Polymers Division as a NRC Postdoctoral Fellow, making the transition to a Staff Scientist in 2002. For the past 10 years he has led the Functional Polymers Group in the Materials Science and Engineering Division.

New polymeric materials are being developed for a wide-range of applications where their functional properties play a critical role in advancing performance of the technology. Examples that are of interested to my research group include polymer matrix composites with improved mechanical properties at the fiber-matrix interface under hot-wet conditions, transport membranes that can selectively transport or separate specific species for applications at the energy-water nexus, and tough polymers that mitigate impact. In support of the NIST mission, develop advanced measurement methods that facilitate development and commercial deployment of polymeric materials in these areas of technological and societal importance. We work closely with industry to identify the technical roadblocks inhibiting these technologies and then work with materials developers to identify and validate design cues that are needed design new and improved polymers that advance the state-of-the-art. In this presentation I will present an overview of my research groups activities in these three areas, highlighting the importance of polymer structure and dynamics in establishing the functional properties of the polymers that enable the technology. For the sake of this presentation, I will emphasize the importance of polymeric materials for advanced transport membranes for technologies at the energy-water nexus, including fuel cells, desalination and water purification, and chemical separations. We will discuss in details the different transport mechanics of water, ions, and small molecule solvents in these different systems, describing the similarities and differences. We will make the case that understanding the mechanisms of transport at the molecular scale is critical for optimizing the transport mechanisms in these different situations and developing the design cues that are needed to design new membranes.

PURDUE UNIVERSITY Discovery Park