UNIVERSITY OF SOUTHERN CALIFORNIA

DEPARTMENT OF CHEMISTRY

Organic / Materials Chemistry Seminar

"Block Copolymer-based Porous Carbon Fibers and Plasmonic Polymer Nanocomposites"

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Macromolecules Innovation Institute &
Academy of Integrated Science-Nanoscience
Virginia Tech

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12:00 PM
Olah Library

Hosted by Prof. Barry Thompson

Scientific Community is Invited

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Abstract

In the first part of my talk, I will describe the synthesis of a new type of porous carbon fibers. Carbon fibers possess high surface areas and rich functionalities for interacting with ions, molecules, and particles. However, the control over their porosity has remained challenging. Conventional syntheses rely on blending polyacrylonitrile with sacrificial additives, which macrophase-separate and result in poorly-controlled pores. Herein we utilize the microphase-separation of block copolymers to synthesize porous carbon fibers (PCFs) with well-controlled mesopores and micropores. Without infiltrating any precursors or dopants, block copolymers are directly converted to nitrogen and oxygen dual-doped PCFs. Owing to the optimized bimodal pores and interconnected diffusion network, the block copolymer-based carbon fibers exhibit significantly reduced ion transport resistances and ultrahigh capacitances. The approach of utilizing block copolymer precursors revolutionizes the synthesis of PCFs. The advanced electrochemical properties signify that PCFs represent a new platform material for electrochemical energy storage.

Second, I will present the design of plasmonic polymer nanocomposites for uses in tinted glass. The state-of-the-art commercial tinted glass is coated with a full layer of metalized film to decrease the transmittance of electromagnetic waves. In addition to the cost of the metal layer, the key limitation of such light-reflecting glass is the lack of spectral selectivity. To date, there has been no demonstration of stable and spectral-selective glass that covers the entire visible and near-infrared (NIR) spectrum. To address the challenge, herein by judiciously controlling the planar orientation of 2D plasmonic silver nanoplates (AgNPs) in polymer nanocomposites, we effectively harness the transmittance, reflectance, and filtration of any wavelength across the visible and NIR. In contrast to the conventional bulk polymer nanocomposites where plasmonic nanoparticles are randomly mixed within the polymers, our thin-film polymer nanocomposites employ a minimal amount of planarly oriented metal nanoparticles and yet efficiently manage light across the visible and NIR. The thin-film polymer nanocomposites are expected to impact enormously on spectral-selective tinted glass, as well as on sensing, optics, optoelectronics, and photonics.