הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar
Reznik Hall (3rd floor meeting room), Wolfson Department of Chemical Engineering,
Tuesday, May 22nd at 1:30pm

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Block Copolymer-based Porous Carbon Fibers and Plasmonic Nanoparticles

First, I will describe a new method for synthesizing nanoporous carbon fibers. Nanoporous carbon fibers possess high surface areas and rich surface functionalities for interacting with guest ions, molecules, and particulates. However, the control over the carbon fiber porosity, including pore size, pore size distribution, and pore position, has remained challenging. Herein we utilize the microphase separation of block copolymers for synthesizing hierarchical porous carbon fibers with highly controlled mesopores and micropores. Without infiltrating any additional carbon precursors or dopants, block copolymers are directly converted to nitrogen and oxygen-doped porous carbon fibers. Owing to the highly optimized bimodal pores, interconnected diffusion network, and chemical composition, the block copolymer-based carbon fibers exhibit significantly reduced ion transport resistances and an ultrahigh surface-area normalized capacitance as binder-free, conductive-additive-free electrodes in supercapacitors.

Second, I will present our recent progress on the utilization of plasmonic nanoparticles in polymer sensing and photovoltaics. Currently the synthesis of plasmonic nanoparticles for sensing mostly focuses on the shape because it is believed that nanoparticles with sharp tips provide higher sensitivities than those without. By measuring and analyzing the sensitivities of more than 74 types of nanoparticles of various shapes, sizes, and compositions, we find that, contrary to the common belief that shape matters the most, aspect ratio is instead the key parameter that controls the nanoparticle sensitivity. Based on this finding, we select Ag nanodisks as sensors to probe the kinetics of polymer brush formation. Unitizing the unique plasmonic properties of Ag nanodisks, we demonstrate *in situ* the three-regime kinetics of polymer brush grafting process, and importantly, for the first time we experimentally reveal the cause of a latent regime in the process of polymer brush grafting onto a surface. The latent regime is a period of time that polymer molecules stop grafting onto the surface before molecule saturation, the cause of which has been a long-lasting puzzle in the field of polymer brush. At the end of the talk, the polymer functionalized nanoparticles are applied in organic photovoltaics and significantly improve the power conversion efficiency.