SEMINAR סמינר

Nitrogen-containing, Emulsion-templated Porous Carbons with Hierarchical Porosities

Adi Horowitz

The Grand Technion Energy Program
Department of Materials Science and Engineering
Technion – Israel Institute of Technology, Haifa 32000, Israel

Porous carbons are being developed for a range of energy-storage applications including super capacitors, batteries, fuel cells, and hydrogen storage. This research has focused on the generation of nitrogen-containing monolithic carbons with hierarchical porosities through the pyrolysis of emulsion-templated porous polymers termed polyHIPEs. PolyHIPEs are macroporous monoliths that are usually synthesized within surfactant-stabilized water-in-oil (w/o) high internal phase emulsions (HIPEs). It should be possible to introduce microporosity and/or mesoporosity into polyHIPE-based carbons using porogens and/or carbon activation.

The objectives of this research were to generate monolithic porous carbons with macro-, meso-, and microporous architectures, to characterize the resulting polymers and carbons, and to describe the effects of the synthesis and pyrolysis parameters on the resulting materials. Two different polyHIPE systems were investigated. One system was based on polyacrylonitrile (PAN) crosslinked with divinylbenzene synthesized in w/o HIPEs. Different porogens were evaluated including solvents, nanoparticles, degradable comonomers, and degradable oligomers. The other system was based on the hydro-thermal carbonisation (HTC) of a renewable resource material (e.g. glucose) in the presence of hydrophilic monomers (e.g. hydroxyl ethyl methacrylate (HEMA) crosslinked with *N,N*'-methylenebisacrylamide) within oil-in-water HIPEs. The resulting macroporous structures, atomic compositions, macromolecular structures, specific surface areas (A_{SP}), microporosities, and thermal properties were characterized.

Generally, the PAN-based polyHIPEs exhibited relatively closed-cell structures, before and after pyrolysis. The as-synthesized PAN-based polyHIPEs had densities of around 0.07 g/cc, relatively low A_{SP}, around 11 m^2/g and N/C ratios of 0.22. Microporous carbons with A_{SP} of 500 m^2/g were produced by introducing porogens into these polyHIPEs, with micropores of around 0.71 nm and micropore volumes of around 0.21 cc/g. HTC generated open-cell polyHIPEs with densities of around 0.06 g/cc. Carbons with A_{SP} of 100 m^2/g were produced through pyrolysis of these polyHIPEs. N/C ratios were enhanced, increasing from 0.04 to 0.10, through the addition of nitrogen-containing monomers. Carbons with A_{SP} of 1500 m^2/g were produced through chemical activation of the HTC polyHIPEs, with micropores of around 0.74 nm and micropore volumes of around 0.62 cc/g. While, carbon activation did not enhance the A_{SP} in the PAN-based carbons, it did generate a more open-cell structure.

Supervisor: Prof. Michael S. Silverstein

ההרצאה תתקיים ביום ראשון, ה- 03 ביולי 2016 בשעה 14:30
באודיטוריום ע"ש דיוויד וואנג, קומה 3, בנין דליה מידן

The lecture will take place on Sunday, July 3rd, 2016 at 14:30
David Wang Auditorium, 3rd floor Dalia Maydan Bldg.

כיבוד קל יוגש לאחר הסמינר