Direct Access to Bowl-like Nanostructures with Block Copolymer Anisotropic Truncated Microspheres

Cheng-Hao Sun, Cindy Mutiara Septani and Ya-Sen Sun*

Department of Chemical and Materials Engineering, National Central University,
Taoyuan 32001, Taiwan
yssun@cc.ncu.edu.tw

Abstract

Bowl-like nanostructures have attracted significant scientific and technological interest due to their favorable characteristics, such as high specific surface area, interconnected porous channels and conductivity. However, tailored synthesis of bowl-like nanostructures with well-defined and uniform morphology is still a challenge. Herein, we report a versatile microemulsion assembly approach to prepare bowl-like nanostructures of three different materials: polymer, carbon and platinum. To this end, polystyrene-block-poly(4vinylpyridine), PS-b-P4VP, block copolymer (BCP) microparticles with truncated-sphere shape and comprised of stacks of parallel lamellae were used because those anisotropic microparticles play an important role in the designing of bowl-like nanostructures. To form nanolamellae-within-microparticle morphology, a designed PS-b-P4VP/chloroform/CTAB microemulsion can be facilely obtained in the aqueous medium, where the morphology can be tailored by the interplay between macro-phase separations, BCP self-assembly, and interfacial energies of three phases in the presence of cetyltrimethylammonium bromide (CTAB). Finally, protonation or combination of cross-linking and pyrolysis of those truncated microparticles enables formation of polymer or carbon bowl-like nanostructures, respectively. Upon selective adsorption of Pt precursor salt ions with the pyridyl moieties followed by chemical reduction, subsequent calcination permits the synthesis of Pt bowl-like nanostructures. The microemulsion assembly approach opens up new ways to direct and template bowl-like nanostructures.

Keywords - templating, Block Copolymer, Bowl-like Nanostructure, SelfAssembly, Microemulsion