190d Multi-Scale Assembly of Silica Sphere Particles through Aerosol Assisted Process

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A variety of strategies have been proposed to synthesize mesoporous materials. Among these methods, aerosol-assisted self-assembly using surfactant or block copolymer as template is one of the powerful methods for synthesizing ordered mesoporous particles and thin film. Recently, an important effort has been devoted to control the structure and morphology. In the multi-scale self-assembly process, additional organic species interacts with existing surfactants and/or inorganic species alter the final mesostructure. Despite many investigations of multi-scale self-assembly processes, there is few study on multi-scale self-assembly process of a surfactant and a polymer. In this study, a series of well organized mesoporous and hierarchical porous silica spheres have been synthesized through aerosol-assisted multi-scale self-assembly process using cetyltrimethylammonium bromide (CTAB) or triblock-copolymer F127 as template in the presence of a hydrophobic additive, polypropylene oxide (PPO). Both mesoporous silica particles with high surface area and meso-meso, meso-macro bimodal structured porous silica particles were obtained by adjusting the molecular weight of PPO and the ratio of PPO and surfactants. The interactions between PPO and surfactants dramatically affect the mesostructures of the resulted silica particles. In the system of CTAB/PPO, where the interaction of CTAB and PPO is very weak; PPO molecules tend to aggregate, resulting in porous particles with hierarchical pore structure. In the system of F127/PPO, where the interaction of F127 and PPO is relatively strong, PPO molecules coassemble with F127, changing both pore sizes and mesostructures. The silica particles were characterized by X-ray diffraction, SEM, TEM and N2 isotherm adsorption/desorption. This work demonstrates a general approach towards porous silica particles with controllable pore structure through multi-component dynamic assembly