Synthesis Strategy of Hollow Silica Nanospheres for Efficient Material Transportation

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Hollow silica nanospheres (HSNs) have a porous structure with high surface area, a huge vacancy in a hollow space, and good thermal and chemical stabilities due to the nature of silica framework. In this study, HSNs were synthesized using cyclic diammonium molecule (CDM) as the solid-state transforming agent for colloidal silica nanospheres (CSNs). The synthesis studies with variation of synthetic parameters revealed that CDM can inhibit the remote migration of external silica during the dissolution process by NaOH, resulting in the preservation of spherical structure of CSNs and transformation to mesoporous shell. The synthesis strategy is generalizable to the synthesis of HSNs with controlled sphere sizes and with metal nanoparticles encapsulated inside the hollow space. We confirmed that the Pt nanoparticles encapsulated in HSNs were thermally stable inside the hollow space without sintering at 600°C, whereas Pt nanoparticles supported on mesoporous silica SBA-15 were aggregated to notably bigger particles. In addition, HSNs show much larger storage capacity for drug molecule, removal performances for bulky dye molecule as compared to the nonporous CSNs.