Synthesis of double mesoporous core-shell silica spheres with tunable core porosity and their drug release and cancer cell apoptosis properties.

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Abstract:

In this work, we demonstrate a simple two-pot approach to double mesoporous core-shell silica spheres (DMCSSs) with uniform size of 245-790 nm, shell thickness of 41-80 nm and surface area and total pore volume of 141-618 m(2) g(-1) and 0.14-0.585 cc g(-1), respectively. First, solid silica spherical particles were synthesized by the Stöber method and used as a core. Second, a mesoporous shell could be formed around the silica cores by using an anionic surfactant and a co-structure directing agent. It was found that mesopores can be anchored within dense silica cores during mesoporous silica shell formation, synchronously the base group with surfactant assistant can etch the dense silica cores to re-organize new mesostructure, so that double mesoporous core-shell silica sphere (DMCSS) structure can be obtained by a single surfactant-templating step. The spherical size and porosity of the silica cores of DMCSS together with shell thickness can be tuned by controlling Stöber parameters, including the concentrations of ammonia, solvent and tetraethoxysilane and the reaction time. DMCSS were loaded with ketoprofen and thymoquinone, which are an anti-inflammatory and a potential novel anti-cancer drug, respectively. Both drugs showed controlled release behavior from the pores of DMCSS. Drug uptakes within DMCSS were ~27 and 81 wt.% for ketoprofen and thymoquinone, respectively. Furthermore, DMCSS loaded with thymoquinone was more effective in inducing cancer cell apoptosis than uncontained thymoquinone, because of the slow release of the drug from the mesoporous structure.

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