

Growth of silica shell on hydrophobic upconverting nanocrystals : mechanism and control of porosity.

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The method based on the oil/water biphasic system appears as the most effective for the growth of mesoporous silica shell on hydrophobic nanocrystals. In this paper the influence of various synthesis parameters, such as catalyst, solvent, temperature or hydrophobic chain length of surfactant, on porosity and thickness of silica layer grown on up-converting nanocrystals (UCNPs) was systematically investigated. The key factor determining morphology of silica shell and allowing to control its porosity is a kind of solvent used for TEOS dilution. For solvents of low polarity index silica shell has dendrimeric structure with pore size of 4–5.5 nm, while for solvents with high polarity index the silica shell is non-porous. The pore size can be also controlled in the range from 2 to 5.5 nm through selection the catalysts type. The morphology of the silica shell is also influenced by alkyl chain length of the cationic surfactant as well as temperature. Based on these new experimental results the mechanism of formation of mesoporous silica shell on inorganic nanoparticles was proposed and discussed. It was also proved, that the organic dyes, like Rhodamine B can be effectively incorporated inside the pores of mesoporous UCNPs@SiO₂ nanoparticles. This signify that such hybrid functional materials, which in addition exhibit stability of water dispersions and possibility of biofunctionalization, offer great potential for development of biomarkers or drug carriers.

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