Designed Fabrication of Multifunctional Nano-systems based on Nanoparticles and Nanoporous Materials for Biomedical Applications

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Nanotechnology offers tremendous hopes for future bio-medical technology. Clever combination of different nanoscale materials will lead to the development of multifunctional nanomedical platforms for simultaneous targeted delivery, fast diagnosis, and efficient therapy. In this presentation, I would like to present some of our group's recent results on the designed fabrication of multifunctional nanostructured materials based on nanoparticles and nanoporous materials and their bio-medical applications.

We reported on the fabrication of monodisperse nanoparticles embedded in uniform pore-sized mesoporous silica spheres. Monodisperse magnetite and CdSe/ZnS nanocrystals (quantum dots) dispersed in organic media were transferred to aqueous phase using CTAB stabilization. The subsequent sol-gel reaction of TEOS generated monodisperse nanocrystals embedded in spherical mesoporous silica particles with an average particle size of ~ 150 nm. The controlled release of ibuprofen was demonstrated for the silica spheres [1].

We developed a simple, reproducible, and general method of preparing multifunctional nanoparticle assembled silica spheres. Magnetite nanoparticles synthesized in the organic phase were covalently bonded on silica spheres, and subsequently nanoparticles of Au, CdSe/ZnS, and Pd were assembled [2].

We synthesized magnetic mesocellular carbon (Mag-MCF-C) through a simple synthetic method and used for the construction of magnetically switchable bioelectrocatalytic system. The crosslinked glucose oxidase (GOx) in large mesocellular pores of Mag-MCF-C exhibited high enzyme loading capacity and exceptional stability. Such advantageous characteristics of Mag-MCF-C/CLEA-GOx together with controlled positioning by magnetic force were successfully utilized in developing a magnetically switchable bioelectrocatalytic system [3].

We will also discuss more recent results on the application of magnetic oxide nanoparticles for the efficient separation of proteins [4], and fabrication of magnetite nanoparticle-embedded gold nanoshells for combined MRI and targeted NIR therapy [5].

Reference

1. *J. Am. Chem. Soc.* **2006**, 128, 688.
2. *Angew. Chem. Int. Ed.* **2006**, 45, Early view.
3. *Angew. Chem. Int. Ed.* **2005**, 44, 7427.
4. *J. Am. Chem. Soc.* **2006**, 128, in revision.
5. submitted.