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Large-scale Synthesis of Uniform-sized Nanoparticles for Multifunctional Medical Applications

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We developed a new generalized synthetic procedure, called as "heat-up process," to produce uniform-sized nanocrystals of many transition metals and oxides without a size selection process. We were able to synthesize uniform magnetite nanocrystals as much as 1 kilogram-scale from the thermolysis of Fe-oleate complex. Clever combination of different nanoscale materials will lead to the development of multifunctional nano-biomedical 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 uniform-sized magnetite nanoparticles and their medical applications. Uniform ultrasmall iron oxide nanoparticles of < 3 nm were synthesized by thermal decomposition of iron-oleate complex in the presence of oleyl alcohol. These ultrasmall iron oxide nanoparticles exhibited good T1 contrast effect. In in vivo T1 weighted blood pool magnetic resonance imaging (MRI), iron oxide nanoparticles showed longer circulation time than commercial gadolinium complex, enabling high resolution imaging. We used 80 nm-sized ferrimagnetic iron oxide nanocrystals for T2 MRI contrast agent for tracking transplanted pancreatic islet cells and single-cell MR imaging. We reported on the fabrication of monodisperse magnetite nanoparticles immobilized with uniform pore-sized mesoporous silica spheres for simultaneous MRI, fluorescence imaging, and drug delivery. We synthesized hollow magnetite nanocapsules and used them for both the MRI contrast agent and magnetic guided drug delivery vehicle.

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