Synthesis and Characterization of Superparamagnetic Colloidal Multi-Core FE_3O_4/Silica Core/Shell Nanoparticles

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Superparamagnetic iron oxide (Fe3O4) nanoparticles were synthesized by thermal decomposition of Fe(acac)3 (acac = acetylacetonate) in a hot organic solvent. Silica coating process has been applied to the nanoparticles by sol-gel approach. In a typical procedure, iron oxide nanoparticles redispersed in organic solvent, and this suspension was then added to alcoholic medium to produce emulsion drops consisting of aggregates of iron oxide nanoparticles and organic solvent. When silica was added into the system, it hydrolyzed and formed silica coating around each emulsion drop. The thickness of silica could be conveniently controlled by varying the silica concentration. Each of Silica coated nanoparticles is composed of many single iron oxide nanoparticles; the silica spheres retain superparamagnetic behavior at room temperature, where as single-crystalline iron oxide nanoparticle within the same size range would exhibit ferromagnetic behavior. The superparamagnetic behavior and high magnetization make these iron oxide/silica core/shell nanoparticles as a useful system for various important applications such as drug delivery, cell labeling, bioseparation, and magnetic resonance imaging.