220f Size and Shape-Controlled Synthesis of Bifunctional Gold/Fe_3O_4 Nanoparticles

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Au-Fe_3O_4 bifunctional nanoparticles, which combine optical properties of the gold nanoparticles with the magnetic properties of the Fe_3O_4, were synthesized by decomposition of iron acetylacetonate ($Fe(acac)_3$) on the surface of gold nanoparticles in high boiling point solvents. The Au nanoparticles were synthesized using Brust's two-phase method. The size of the Au nanoparticles could be tuned from 3nm to 20nm. The thickness of the Fe_3O_4 shell could be tuned from 1nm to 8nm. By rationally controlling the synthetic parameters, such as heating rate, solvents, and ratio of $Fe(acac)_3$ to Au, the nanoparticle morphology could be controlled to give spherical core/spherical shell, spherical core/cubic shell, or dumbell-like composite particles. The plasmon resonance peaks of the Au-Fe_3O_4 nanoparticles showed up to 55nm red-shift compared to that of pure Au nanoparticles. The magnetic properties of Fe_3O_4 nanoparticles were also affected by the incorporation of the Au cores. This kind of bifunctional nanoparticles may have potential applications ranging from heterogeneous catalysis to magnetophoretic delivery of drugs or genes, to platforms for biological sensing, to magneto-optical switching hardware for information technology.