Magnetic-property enhancement of sized controlled cobalt-gold core-shell nanocrystals

ABSTRACT

Cobalt nanoparticles and cobalt-gold core-shell nanoparticles were synthesized via reverse-micelle microemulsion method with emphasis on size control. Cobalt nanoparticles become easily oxidized therefore coating a gold shell on cobalt nanoparticles was necessary and can effectively reduce the oxidation of Co while maintaining most of its magnetic properties. Controlling the size of nanoparticles was performed by adjusting the water to surfactant ratio of reverse micelle solution during synthesis. X-ray diffraction data was used to calculate the crystallinity percentage and percentage of phases presented in Co-Au core-shell nanoparticles. The results from transmission electron microscopy, and field emission electron microscopy combined to energy dispersive x-ray spectroscopy provide direct evidence for shell growth. The average coating layer (shell thickness) in all cases observed to be 4-5 nm. Magnetic properties of samples were investigated using a vibrating sample magnetometer before and after annealing. Magnetic properties enhanced after annealing in all cases. An increase in saturation magnetization after annealing was due to increase in cystallinity percentage. A simple method was applied to measure a totally intrinsic blocking temperature in zero field cooled-warmed (ZFC-W) curves without employing an external magnetic field. The B-field dependence temperature data of Co-Au nanoparticles before and after annealing showed an intrinsic blocking temperature of 45 and 40 K respectively.

Keyword: Cobalt-gold core-shell; Coercivity; Crystallinity; Magnetic nanoparticles; Intrinsic blocking temperature; Reverse-micelle microemulsion