RA08

Size-Dependent Magnetic Properties of $MnFe_2O_4$ Nanoparticles Synthesized by Coprecipitation

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Nanoparticles of $MnFe_2O_4$ ferrite have been prepared by an aqueous phase coprecipitation method. Their crystal structure and lattice constant were determined by X-ray diffraction measurements (Fig.1). The size of nanoparticles were observed and they are from less than 8 nm to about 25 nm depending on the temperature and duration of the reaction. The size dependent superparamagnetic properties of $MnFe_2O_4$ nanoparticles have also been systematically studied. The Curie temperature and coercivity of the nanoparticles increase with increasing size of the nanoparticles (Fig.2).

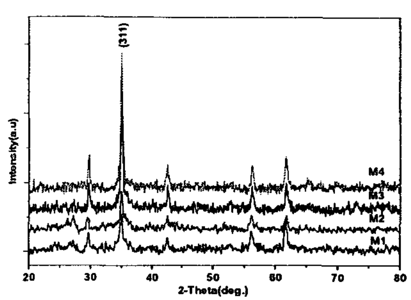

Fig. 1: X-ray powder diffraction patterns for $MnFe_2O_4$ nanoparticles samples

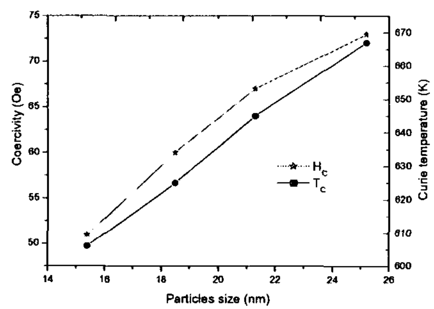

Fig. 2: Change in the coercivity and Curie temperature with the size of nanoparticles $MnFe_2O_4$

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RA09

Magnetic Nanoparticles with Core/shell Structures

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Magnetic properties of thecore/shell nanoparticles can be tailored by controlling the core/shell dimensions, and by tuning the material parameters of both core and shell. Such structures are not only ideal for studying proximity effects but also suitable for structure stabilization as the shell layer protects the core from oxidation and corrosion. Additionally, the shell layer provides a platform for surface modification and functionalization, such as exchange-coupling between the core and the shell, thus may yield finely tailored materials for various nanomagnetic applications.

In this article, we have described the structure and properties of core-shell magnetic nanoparticles for the construction of functional, nanostructured materials. In the examples that were chosen, it was shown that: (i) the nonmagnetic coating, such as silica, alumina, could provide protective layers surrounding the magnetic metal cores to enhance their stabilities. Moreover, the insulated shell gives an improvement in performance at high frequency over conventional soft magnetic materials. The magnetic properties of the nanocomposites with insulated shells remain relatively stable over a range of frequencies; (ii) when the magnetic oxide shell covered the electric core nanoparticles or other special particles, the nanostructures could exhibit enhanced properties and new functionality; (iii) the assembly of core/shell nanoparticles into ordered 2D arrays is quite significant for fundamental micromagnetism and possible applications in magnetoelectronic devices. The ordered arrangements of the silica-coated iron nanoparticles through colloidal template and sol-gel processing, which sets a starting point for a more-detailed study of the magnetostatic coupling interaction (i.e. the magnetic dipolar interaction), which plays a major role in determining the magnetic behavior of the nanoparticles, and other effects exist in the ordered core/shell system.