Investigation of Fe_3O_4 Core/Mesoporous SiO_2 Shell Microspheres Based on Mössbauer Spectroscopy

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The Fe_3O_4 core/mesoporous SiO_2 shell (Fe_3O_4@SiO_2) microspheres were prepared by a solvothermal reaction method. The crystal structure was determined to be cubic spinel with lattice constant a_0 of 8.395 Å for core Fe_3O_4. Based on transmission electron microscopy (TEM) measurements, the core of Fe_3O_4 particle diameter is 300–500 nm and shell thickness of 50 nm. From the magnetic hysteresis curves measured under 10 kOe, magnetization of Fe_3O_4 and Fe_3O_4@SiO_2 microspheres is determined to be 77.0 and 17.0 emu/g, respectively, at room temperature. The M-T curve confirmed that the magnetic moment transition temperature was around 110 K in Fe_3O_4 and 32 K in Fe_3O_4@SiO_2. The Mössbauer spectra of the samples were analyzed with three six-line hyperfine patterns. It is noticeable that from the Mössbauer absorption area ratio between $A(8a)$ and $B(16d)$ sites, the area ratio of sextet increases from 40:60 for Fe_3O_4 to 56:44 for Fe_3O_4@SiO_2, respectively. The Fe valence state of A site was determined to be ferric, and B (B_1, B_2) site was ferric (B_1 site) and ferrous (B_2 site) from the isomer shift values.

Index Terms—**Fe_3O_4@SiO_2, Mössbauer spectroscopy, transition temperature, transmission electron microscopy (TEM).**