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Mössbauer studies on the superparamagnetic behavior of CoFe_2O_4 with a few nanometers

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Abstract

CoFe_2O_4 nanoparticles with a cubic spinel structure are prepared by a high-temperature thermal decomposition method. The average particle sizes are 4.6 and 5.7 nm for CoFe_2O_4 made with two kinds of solvents by TEM. Mössbauer spectra of 4.6 nm particles displayed a superparamagnetic behavior as demonstrated by a single line with zero hyperfine fields, but that of 5.7 nm particles did not at room temperature. It is considered that anisotropy energy was still more superior to thermal energy because of particle size of 5.7 nm CoFe_2O_4 . Furthermore, Mössbauer spectra exhibited the typical spectrum shapes of the CoFe_2O_4 at 4.2 K. The spectrum at 4.2 K was fitted using two magnetic components of hyperfine fields $H_{\text{hf}} = 540.4, 512.6$ kOe and isomer shifts $\delta = 0.40, 0.30$ mm/s for 4.6 nm and $H_{\text{hf}} = 542.7, 512.8$ kOe and $\delta = 0.41, 0.29$ mm/s for 5.7 nm corresponding to Fe^{3+} ions at site A and site B, respectively.

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