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Mössbauer Studied of Superparamagnetic Properties $MnFe_2O_4$ Nanoparticles

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Superparamagnetic nanoparticles have been used in biomedicine and biotechnology as contrast agents in magnetic resonance imaging (MRI) and as drug carriers for magnetically guided drug delivery [1]. $MnFe_2O_4$ nanoparticles have been prepared by a sol-gel method. The structural and magnetic properties have been investigated by XRD, SEM, and Mössbauer spectroscopy, VSM. $MnFe_2O_4$ powder that was annealed at 250 °C has spinel structure and behaved superparamagnetically. The estimated size of superparammagnetic $MnFe_2O_4$ ferrite nanoparticle is about 17 nm. The isomer-shifts at 4.2 K for the *A* and the *B* patterns were found to be 0.35 ± 0.01 and 0.33 ±0.01 mm/s relative to the Fe metal, respectively, which are consistent with high-spin Fe^{3+} charge states. The hyperfine fields at 4.2 K for the *A* and *B* patterns were found to be 508 and 475 kOe, respectively. The blocking temperature (T_B) of superparammagnetic $MnFe_2O_4$ nanoparticle is about 120 K. The magnetization versus magnetic field curves of the sample annealed at 250 °C, measured at 60 K and 300 K. At low temperatures, the sample annealed at 250 °C, exhibits a hysteretic behavior, indicating that it has a ferrimagnetic phase. However, at room temperature, the ferrimagnetic hysteresis seems to have disappeared. $MnFe_2O_4$ annealed at 400 and 500 °C has a typical spinel structure and is ferrimagnetic in nature.

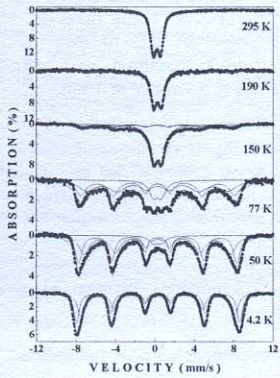

Figure 1: Mössbauer spectra of $MnFe_2O_4$ at various temperatures.

[1] S. H. Im, T. Herricks, Y. T. Lee, and Y. Xia, Chem. Phys. Lett. 401, 19 (2005).

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