Study on hyperthermia effect of $Co_{1-x}Mn_xFe_2O_4$ nanoparticles using Mössbauer spectroscopy

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Hyperthermia has been used to combat tumors and reduce their effects. $Co_{1-x}Mn_xFe_2O_4$ nanopaticle structures are one of the magnetic materials that has potential in hyperthermia treatment applications. The manganese substituted cobalt ferrite, $Co_{1-x}Mn_xFe_2O_4$ ($0.2 \leq x \leq 0.8$) were prepared by a high temperature ture thermal decomposition method with seed-mediated growth. The crystal structure and magnetic properties of the compounds were observed by X-ray diffraction (XRD), vibrating sample magnetometer (VSM), and Mössbauer spectrometry. XRD analysis confirmed that all of the synthesized $Co_{1-x}Mn_xFe_2O_4$ nanoparticles had a single-phase cubic spinel structure with space group *Fd-3m*. The lattice contant increased with inceasing Mn ions due to the ionic radius Mn^{2+} (0.80 Å) is larger than that of Co^{2+} ions (0.74 Å) ions. The VSM equipments measured the values of coercivity (H_c) and saturation magnetization (M_s). The value of saturation magnetization was found to be the highest among the result values at $Co_{1-x}Mn_xFe_2O_4$ (x=0.6). The thermal properties of $Co_{1-x}Mn_xFe_2O_4$ nanoparticles were investigated under conditions below 250 Oe magnetic fied at 50 kHz and 112kHz using a MagneTherm equipment. The self-heating temperature of $Co_{1-x}Mn_xFe_2O_4$ (x=0.6) was the highest 102 ℃ at 50 kHz and 119 ℃ at 112kHz. The Mössbauer spectra analyzed containing A-site and B-site of six lines. The charge state determined to be ferric (Fe^{3+}) according isomer shift(δ).

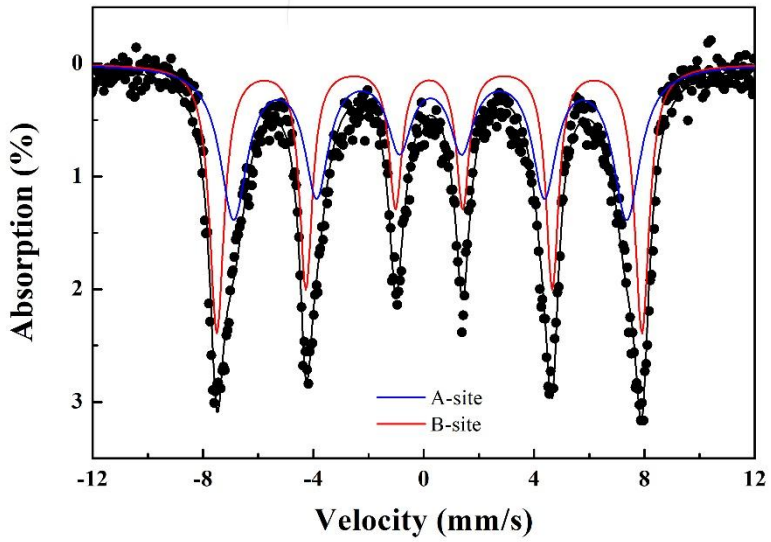

Fig. 1. The Mössbauer spectra of $Co_{0.4}Mn_{0.6}Fe_2O_4$ at 295 K.

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