The 8th International Conference on Advanced Materials and Devices

ICAMD 2013

December 11~13, 2013  Ramada Plaza Jeju Hotel, Jeju, Korea

Organized by

KPS Applied Physics Division, The Korean Physical Society
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Thermal properties for $\text{Mg}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ nanoparticles

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We have fabricated Mg$_{0.5}$Zn$_{0.5}$Fe$_2$O$_4$ nanoparticles by a high temperature thermal decomposition process.[1,2] The prepared sample was determined to be cubic spinel with space group $Fd-3m$ and the lattice constant ($a_0$) of 8.41 Å from Rietveld refinement analysis. Based on the Scherrer equation, the average size of nanoparticles was determined to be 11 nm. The saturation magnetization ($M_s$) and coercivity ($H_c$) of the nanoparticles were 81.0 emu/g and 34.6 Oe, respectively at 295 K. From the distribution probability, we analyzed Mössbauer spectra of the nanoparticles as 3 sets of six-line. Hyperfine fields of the nanoparticles at A, B$_1$ and B$_2$ sites were $H_A = 427$ Oe, $H_{B1} = 458$ Oe, and $H_{B2} = 384$ Oe at 4.2 K without external field. To separate A, B$_1$, and B$_2$ sites, the Mössbauer spectra of Mg$_{0.5}$Zn$_{0.5}$Fe$_2$O$_4$ nanoparticles were obtained at 4.2 K with applied field of 5 T. From the detailed analysis of Mössbauer spectra, the spin canting angles and the anisotropy energies at A, B$_1$ and B$_2$ sites were determined. The canting angle between the applied field and hyperfine field at A, B$_1$, and B$_2$ sites were obtained by Mössbauer spectrometer with external magnetic field of 5 T. To characterize the thermal properties of the samples, Mg$_{0.5}$Zn$_{0.5}$Fe$_2$O$_4$ nanoparticles were measured by magneTherm device at 50 kHz and 25 mT. The self-heating temperature of the nanoparticles determined 124.33 °C in Mg$_{0.5}$Zn$_{0.5}$Fe$_2$O$_4$ nanoparticles.