Journal of the Korean Physical Society, Vol. 70, No. 2, January 2017, pp. 173∼176

Crystallographic and Magnetic Properties of the Hyperthermia Material $CoFe_2O_4$@$AlFe_2O_4$

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(Received 5 October 2016)

Hard/soft $CoFe_2O_4$@$AlFe_2O_4$ core/shell nanoparticles were prepared by using a high temperature thermal decomposition method with seed-mediated growth. The structural, magnetic and thermal properties of the nanoparticles were investigated by using X-ray diffraction, vibrating sample magnetometer, MagneTherm, and Mössbauer spectroscopy. The crystal structure of nanoparticles was determined to be cubic spinel ferrite with space group Fd-3m. The $CoFe_2O_4$ nanoparticles were found to show high magnetization and coercivity while $AlFe_2O_4$ nanoparticles were found to show low magnetization and coercivity. The $CoFe_2O_4$@$AlFe_2O_4$ core/shell nanoparticles showed intermediate values of magnetization and the coercivity between those of $CoFe_2O_4$ and $AlFe_2O_4$. Also, the blocking temperature (T_B) of the nanoparticles (NPs) was observed to be 280, 50, and 225 K for $CoFe_2O_4$, $AlFe_2O_4$ and $CoFe_2O_4$@$AlFe_2O_4$, respectively. The core/shell ferrite shows a T_B near 225 K, associated with the harder $CoFe_2O_4$ NPs. Temperatures below 225 K, the zero-field-cooled curves show changes in their slopes at a temperature near 50 K, corresponding to the second blocking temperature associated with the softer $AlFe_2O_4$ NPs.

PACS numbers: 82.80.Ej, 87.54.Br, 61.46.Df
Keywords: Hyperthermia, Nanoparticles, Core/shell structure, Mössbauer spectroscopy
DOI: 10.3938/jkps.70.173