12TH JOINT MMM–INTERMAG CONFERENCE

January 14–18, 2013

Chicago, Illinois, USA

2013 Intermag MMM

ABSTRACTS

IEEE MAGNETICS

AIP American Institute of Physics

ticles. As shown, markers 1 and 2 had large fraction and m_B. On the other hand, fraction of the Brownian-type particles was small in the case of sample 3, though m_B was large. Using these results, we can evaluate the markers suitable for liquid-phase immunoassay.

sample	d_h (nm)	τ_B (ms)	m_B (10^{-17} Am^2)	fraction (%)
1	126	0.76	1.12	69
2	112	0.53	1.62	76
3	58	0.074	0.92	22

Table I. Parameters of the markers, Here, d_h and τ_B are the hydrodynamic diameter and the Brownian relaxation time of the markers.

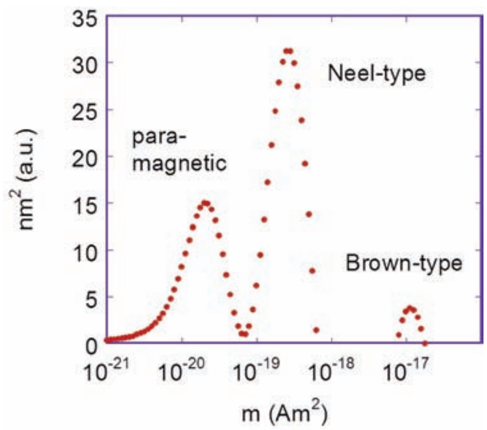

Fig. 1. Magnetic moment distribution of sample 1.

FV-03. Hyperthermia effect in $CoFe_2O_4$-$MnFe_2O_4$ nanoparticles studied by field-induced Mössbauer spectroscopy.

M. Kim[1], S. Hyun[1] and C. Kim[1] *1. Department of Physics, Kookmin University, Seoul, Republic of Korea*

A core-shell combination of hard and soft magnetic materials can be more effective than singular magnetic nanoparticles can be in hyperthermia[1,2]. In this study, core-shell nanoparticles, having hard ferrite $CoFe_2O_4$ as a core and soft ferrite $MnFe_2O_4$ as a shell, were prepared by a high temperature thermal decomposition method to achieve high efficiency in hyperthermia effect. From the Rietveld refinement analysis of the x-ray diffraction pattern, the structure of $CoFe_2O_4$<@>$MnFe_2O_4$ was determined to be cubic spinel with space group of *Fd-3m*. The lattice constant a_0 and molecular ratio of $CoFe_2O_4$ core and $MnFe_2O_4$ shell were 8.3858, 8.3954 Å and 40.25 %, 59.75 %, respectively. Based on Scherrer equation, the average particle size was around 14 nm, which is in good agreement with FE-SEM measurements. The saturation magnetization and coercivity at 295 K were 67 emu/g and 229 Oe, respectively. The heating temperature of $CoFe_2O_4$<@>$MnFe_2O_4$ nanoparticle was characterized by a magnetherm device. At 50 kHz and 25 mT, the temperature reached up to 133 ^oC as shown in Fig. 1. Figure 2 shows the Mö ssbauer spectra taken at 4.2 K with applied field ranging from 0 to 5 T. Based on the isomer shift values, the valence state of Fe ions have been determined to be ferric. The splitting of the hyperfine patterns at A and B sites was observed at 5 T. From the area ratio analysis under 5 T, the area ratio between the A and B sites was determined to be 3 : 7. Also, the line-broadening of absorption lines was observed due to core-shell structure. The canting angle between the applied field and the hyperfine field averaged over A and B sites increased from 15^o to 44^o as the field decreased from 5 to 1 T, suggesting non-collinear spin ordering. We have observed much higher heating temperature than other typical magnetic nanoparticles and the corresponding magnetic properties responsible for such high heating temperature can be explained by Mö ssbauer spectroscopy.

[1] J. Lee, J. Jang, J. Choi, S. H. Moon, S. Noh, J. Kim, J. Kim, I. Kim, K. I. Park, and J. Cheon, Nature Nanotech. **6**, 418 (2011). [2] Q. Song, and Z. J. Zhang, J. Am. Chem. Soc. **134**, 10182 (2012).

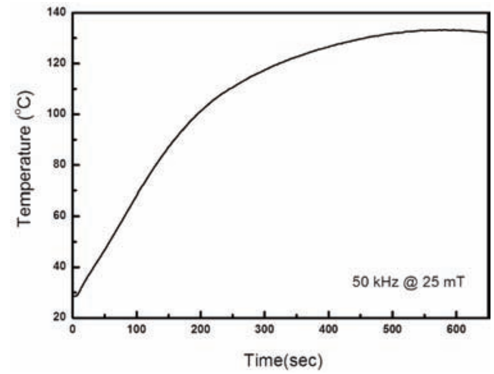

Fig. 1. The heating temperature of $CoFe_2O_4$<@>$MnFe_2O_4$ at 50 kHz and 25 mT.

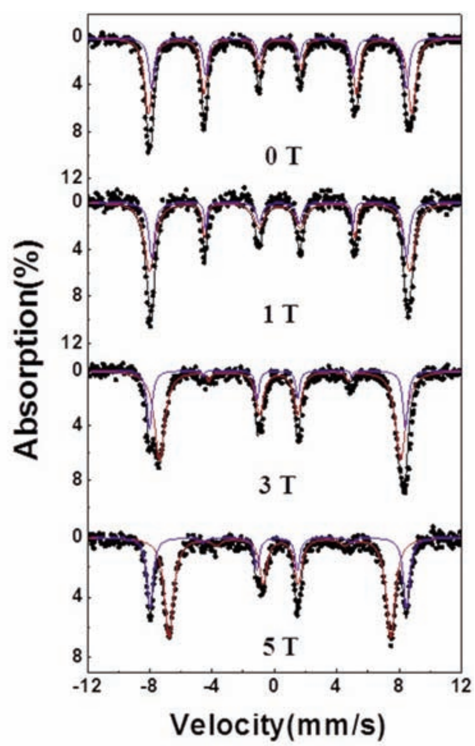

Fig. 2. Mössbauer spectra of $CoFe_2O_4$<@>$MnFe_2O_4$ at 4.2 K, under applied magnetic field from 0 to 5 T.

FV-04. Self-controlled heating characteristics of a new magnetic material for hyperthermia therapy applications.

M. Barati[1], *K. Suzuki*[1], C. Selomulya[2] and J.S. Garitaonandia[3] *1. Materials Engineering, Monash University, Clayton, VIC, Australia; 2. Chemical Engineering, Monash University, Clayton, VIC, Australia; 3. Zientzia eta Teknologia Fakultatea, Euskal Herriko Unibertsitatea, Bilbao, Biscay, Spain*

The aim of this work is to develop new low-T_c magnetic implant materials with a high heat generation for hyperthermia treatments based on a new class of $Mn_{1+x}Ti_xFe_{2-2x}O_4$ spinel ferrite. Magnetic $Mn_{1+x}Ti_xFe_{2-2x}O_4$ ferrites were