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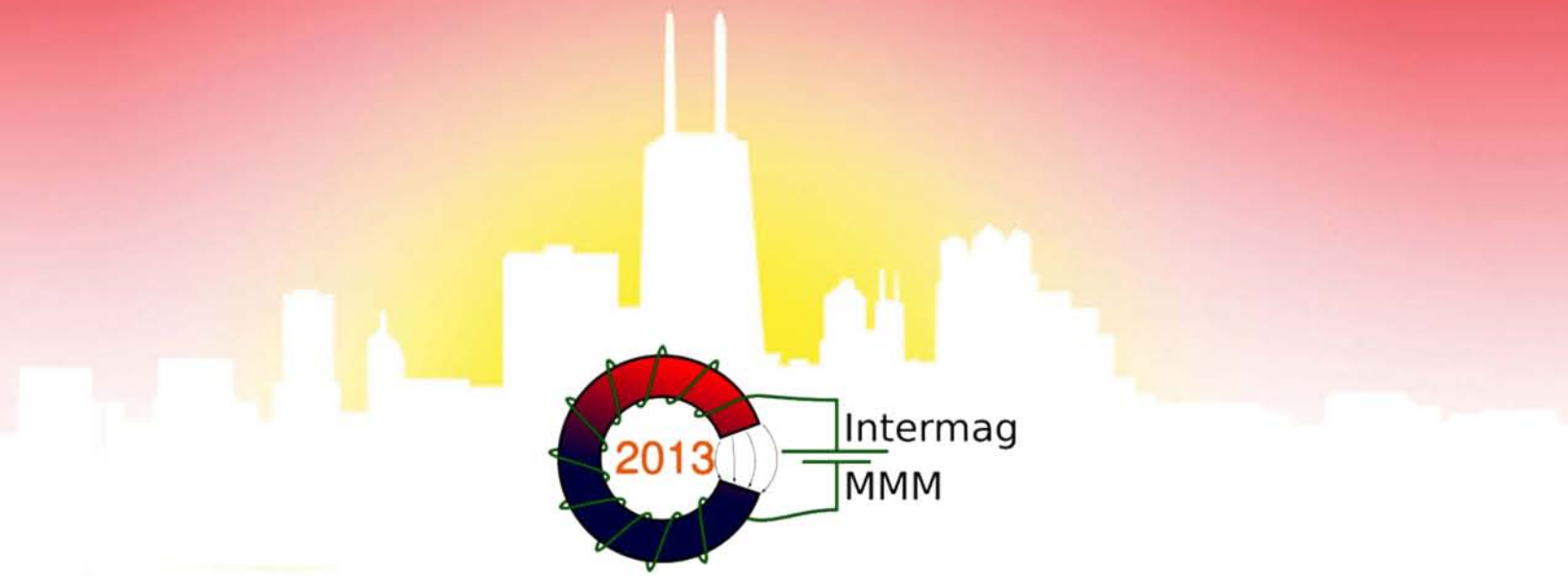

ABSTRACTS

IEEE MAGNETICS

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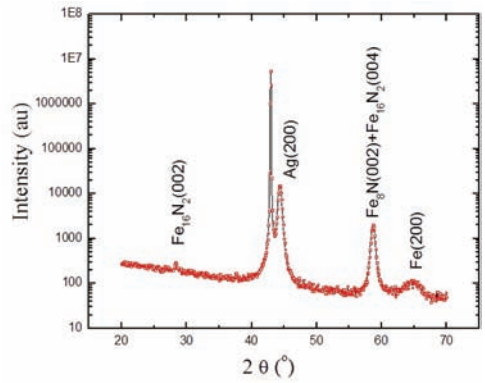
CS-10. Anomalous Hall Effect of $Fe_{16}N_2$ Thin Film on Ag Under Layer. *M. Yang*[1,2], X. Zhang[1], G. Yu[2] and J. Wang[1] *1. The Center for Micromagnetics and Information Technologies (MINT) and Department of Electrical and Computer Engineering, University of Minnesota, Minneapolis, MN; 2. Materials Physics and Chemistry, University of Science and Technology, Beijing, China*

$Fe_{16}N_2$ thin films have recently attracted a great attention because of its possession of giant saturation magnetization, large spin polarization ratio and large perpendicular magnetic anisotropy constant [1]. In this work, partially ordered $Fe_{16}N_2$ thin films were successfully formed by post-annealing Fe_8N thin films that were fabricated by a facing target sputtering process [2]. The films were prepared on (001) Ag under layer using single crystal (001) MgO substrates as shown in Fig. 1, which is different from our previous report using Fe buffer layer on GaAs substrate. The anomalous hall effect of those films was measured and investigated at different temperature. $Fe_{16}N_2$ thin film exhibits much higher perpendicular anisotropy at lower temperature . Its coercivity increases more sharply than Fe8N thin film with the decrease of the temperature. The ordering of FexN cluster in $Fe_{16}N_2$ films may contribute to the high perpendicular anisotropy at low temperature compared with Fe_8N [2].

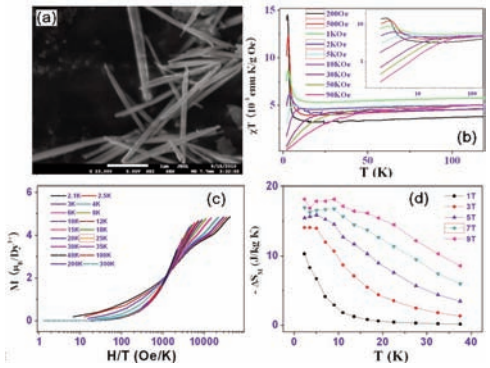
1. N. Ji, M. Osofsky, V. Lauter, L. F. Allard, H. Ambaye, E. Lara-Curzio, X. Li, K. Jensen and J. P. Wang, Phys. Rev. B 84, 245310 (2011). 2.J. P. Wang, N. Ji, X. Liu, Y. Xu, C. Sanchez-Hanke, F.M.F. de Groot, Y. Wu, L. F. Allard and E. Lara-Curzio,IEEE Tran. Mag. in press (2012).



X ray diffraction of MgO substract/Fe(5nm)/Ag(40nm)/FeN(40nm)/Ru(7nm) film.

CS-11. Spin super-exchange and magnetocoloric effects in Dy(OH)3 nanorods. *R. Zeng*[1,2] *1. SETG, SCEM, University of Western Sydney, Penrith, NSW, Australia; 2. ISEM, UOW, Wollongong, NSW, Australia*

Systematic magnetic measurements have been performed in Dy(OH)3 nanorods synthesized by a facile hydrothermal method. Unusual magnetic phenomena;-spin super-exchange interaction has been observed in this system, which in the originate nature of anisotropy Dy3+ ion. The magnetocaoloric evaluation indicated the super-exchange coupling have significant effect on the MCE, which derive the MCE much lower than other similar rare-earth hydroxides.



CS-12. Crystal and magnetic structure of orthosilicate Li_2FeSiO_4 by Mössbauer analysis. *I. Lee*[1], S. Kim[1], T. Kouh[1] and C. Kim[1] *1. Department of Physics, Kookmin University, Seoul, Republic of Korea*

Lithium metal orthosilicate (Li_2MSiO_4) polymorphs are becoming of next-generation electrode materials for rechargeable Li-ion battery because of their thermal stability, suitable operating voltage and capacity. Crystal structure of Li_2FeSiO_4 can be classified with three types of polymorph as β_{II} ($Pmn2_1$), γ_s ($P2_1/n$) and γ_{II} (Pmnb) according to the arrangement of cation filled tetrahedral. In this study, the crystal and magnetic structure of orthosilicate Li_2FeSiO_4 has been investigated with the x-ray diffraction (XRD) and Mö ssbauer analysis. Vacuum-sealed solid-state method to prepare the Li_2FeSiO_4 polycrystalline powder was performed by reaction of Li_2CO_3 (99.99 %), SiO_2 (99.8 %) and $FeC_2O_4.2H_2O$ (99.9 %) at 800 °C for 10 hours. Rietveld analysis of XRD patterns indicates that Li_2FeSiO_4 sample crystallized in γ_s-type (Space group: $P2_1/n$) monoclinic with the measured lattice constants of a_0=8.231, b_0=5.020, c_0=8.228 Å and β=99.24°. In order to investigate the magnetic structure in terms of Fe nucleus, temperature dependent Mö ssbauer spectrum recorded at various temperatures ranging from 4.2 to 295 K. The room temperature Mö ssbauer spectrum shows one-doublet with the measured values of ΔE_Q=2.41 mm/s and δ=0.85 mm/s indicating the Ferrous (Fe^{2+}) ions occupied in FeO_4 tetrahedron. The Mö ssbauer spectra at 4.2 K for Li_2FeSiO_4 exhibit as asymmetrical absorption line which can be analyzed by eight Lorentzians having the experimental values of H_{hf}=121 kOe, ΔE_Q=2.46 mm/s, δ=0.97 mm/s, θ=5°, ϕ=20° and η= 1.0. With increasing temperature, spectrum shape changes with decrease of magnetic hyperfine field (H_{hf}), and then it shows double phase at 20 K which is antiferromagnetic magnetic ordering temperature (T_N). From these results, ferrous (Fe^{2+}) ion in FeO_4 tetrahedron induced the strong electric quadrupole interaction which can be enhanced the asymmetric Mö ssbauer spectrum line below T_N.

[1] D.-H. Seo, H. Kim, I. Park, J. Hong, and K. Kang, Phys. Rev. B 84, 220106 (2011)

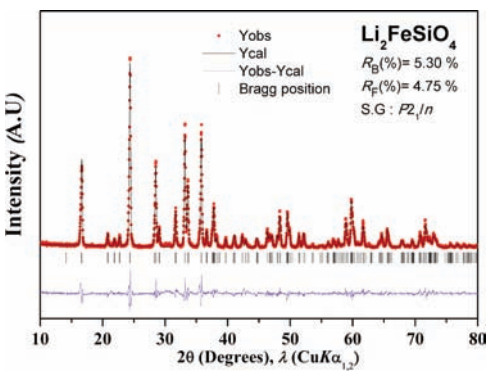


Fig. 1 Refined XRD pattern of the Li_2FeSiO_4 at room temperature.

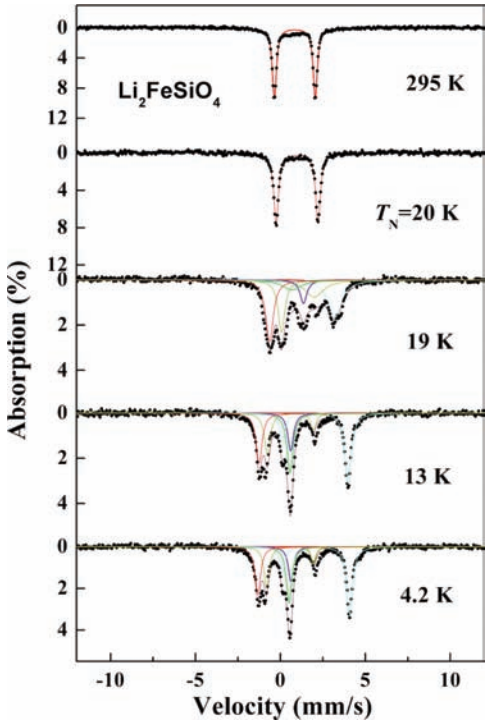


Fig. 2 Mössbauer spectra of the Li_2FeSiO_4 at various temperatures.

CS-13. Magnetic Compton scattering study of magneto-dielectric $Ba(Co_{0.85}Mn_{0.15})O_{3-\delta}$. *R. Shinoda*[1], M. Itou[2], Y. Sakurai[2], H. Yamamoto[3], N. Hirao[3], Y. Baba[3], A. Iwase[1] and T. Matsui[4,1] *1. Department of Materials Science, Osaka Prefecture University, Sakai, Osaka, Japan; 2. Japan Synchrotron Radiation Reserch Institute (JASRI) SPring-8, Sayo, Hyogo, Japan; 3. Japan Atomic Energy Agency (JAEA), Tokai, Ibaraki, Japan; 4. Research Organization for the 21st Century, Osaka Prefecture University, Sakai, Osaka, Japan*

We have ever found that $Ba(Co_{0.85}Mn_{0.15})O_{3-\delta}$ (BCMO) sintered samples show a ferromagnetic behavior below around 50K. The origin of their magnetic ordering was speculated to be super-exchange coupling of $Co^{4+}(d^3)$–O^{2-}–$Mn^{4+}(d^3)$ [1]. However, we have not yet succeeded in clarifying it in details. Here, it is worthwhile mentioning that magnetic Compton scattering is a unique probe for spin-polarized electron moment distribution of ferromagnetic materials, and that its cross section is proportional only to spin component of magnetization. Hence, in the present studies, the magnetic Compton profile (MCP) of the BCMO sintered sample was evaluated. We discuss the magnetic origin of BCMO in conjunction with the 1D projection of the momentum density of the spin polarized electrons of the systems. BCMO was prepared through a conventional ceramic process from the desired amount of $BaCO_3$, Co_3O_4 and Mn_3O_4 powders. MCP measurements were performed at SPring-8–BL08W. The sample was set on the cold head of the refrigerator, which was attached to the vacuum chamber for MCP measurements. The MCP was measured at 8K, 20K, 30K, 40K and 50K using circularly polarized 182 keV X-rays. We have also carried out the magnetization measurements using a superconducting quantum interference device (SQUID) magnetometer. The valence state of *3d* transition metal ion was measured by soft X-ray photoelectron spectroscopy (XPS) at KEK-BL27A. The SQUID measurement results show that the ferromagnetic-paramagnetic transition occurs at around 32K. The magnetization at 8 K is about 10 emu/g and the coercivity is about 1 T. The temperature dependence of the magnetic spin momentum calculated by the MCP, exhibits similar behavior as that of the magnetic moment by the SQUID measurements. This clearly indicates that the magnetic polarization of BCMO is mainly ascribed to spin momentum. We will discuss the possible magnetic origin of BCMO through the discussion of the spatial distribution of the momentum density of the spin polarized electrons of BCMO, as well as of the valence state of the *3d* transition metal ion.

[1] T. Inoue, T. Matsui, N. Fujimura, H. Tsuda and K. Morii, IEEE Trans. Magn., vol. 41, No. 10, (2005).

CS-14. Effect of temperature on the crystal growth, size, shape and magnetic properties of spinel $CuCr_2Se_4$ nanocrystals. *M. Shaikh*[1], C. Lin[1], M. Chen[2], H. Hsu[3], G. Huang[1] and P. Chien[3] *1. Institute of Nanotechnology and Department of Mechanical Engineering, Southern Taiwan University of Science and Technology, Tainan, Taiwan; 2. Department of Electro-optical Engineering, Southern Taiwan University of Science and Technology, Tainan, Taiwan; 3. Department of Physics, National Pintung University of Education, Pintung, Taiwan*

$CuCr_2Se_4$ nanocrystals have a Curie temperature above 400K, are ferromagnetic and display a large-magneto optical effect at room temperature. Their unique magneto- dielectric and magneto- transport properties coupled with high spin polarized characteristics makes them useful in many applications. A facile solution based method involving the thermal decomposition of metal chloride precursors in selenium using oleyamine(OLA) as a solvent and stabilizing agent is used. The Cu-Cr – OLA complex prepared at 175°C and cooled to room temperature(RT) is rapidly injected into Se – OLA mixture which has been heated to 330°C. The temperature of Se –OLA at time of injection is varied from 330°C down to RT. Upon injection the reaction is heated to 330°C, 340°C, 350°C and 360°C and kept at each temperature for a holding time of 0, 60,120 and 180 minutes. Finally solution precipitated, washed, centrifuged and dried. TEM images a-c show 24.8nm average size cubic to tetrahedron shaped nanocrystals prepared when the metal precursors were injected into the Se mixture at 330°C. Images d-f show nearly monodisperse 68.1nm hexagonal crystals prepared when injection was done at RT. Different final temperatures resulted in different mean crystal sizes. XRD patterns show well defined crystalline peaks for samples provided the Cu: Cr: Se ratio was 1:2:8-10(lack of excess selenium resulted in formation of secondary phases). The mean crystallite size from XRD matched well with TEM results. M-H curves show a soft ferromagnetic behavior with higher retentivity and magnetic saturation as the crystal size increased. However increased temperature caused decrease in the saturation and coercivity (negligible at room temperature) for all crystal sizes. A super paramagnetic relaxation is observed as the field cooled(FC) and zero field cooled(ZFC) curves bifurcate while lower than bulk Curie temperature is a result of surface spin canting. The electron spin resonance (ESR) data shows hybridization between localised $3d^3$ electrons of Cr^{3+} and delocalised holes of Se 4p band, confirming correct phase formation. Broad magnetic circular dichroism(MCD) signals with similar shapes indicate magneto-optical effects of different crystal sizes.

[1] Van Stapele R P 1982 Ferromagnetic Materials vol 3, ed E P Wohlfarth (Amsterdam: North - Holland) p 603 [2] Bettinger J S et al 2007 J. Magn. Magn. Mater. 318 65 [3] Oda K, Yoshii S, Yasui Y, Ito M, Ido T, Ohno Y, Kobayashi Y and Sato M 2001 J. Phys. Soc. Japan 70 2999 [4] Li S, Bi H, Cui B, Zhang F, Du Y, Jiang X, Yang C, Yu Q and Zhu Y 2004 J. Appl. Phys. 95 7420