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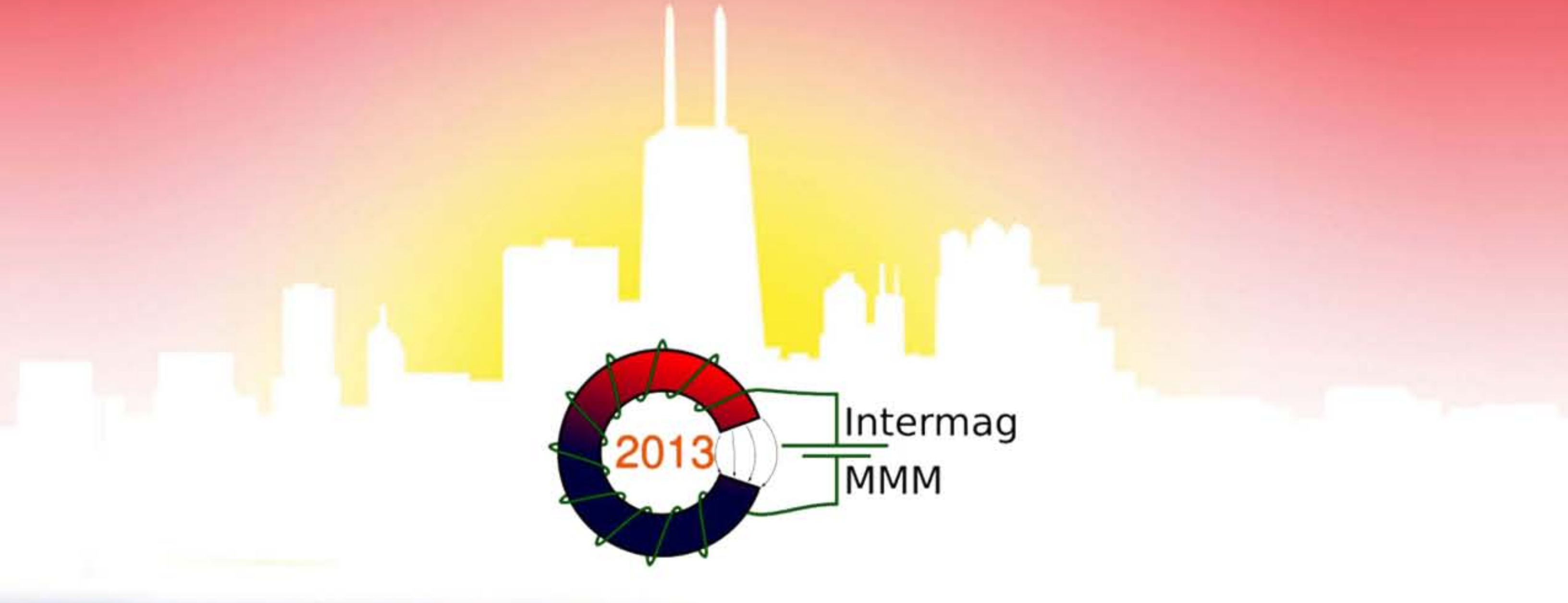

ABSTRACTS

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an excellent temperature stability of μ_i in the range of 70 ~230°C. The $\Delta T(T_2 - T_1)$ has a great influence on μ_i, and the larger ΔT is required for improving magnetic softness of the bulk samples. In addition, the mechanism of improved magnetic softness for the two-step sintering method was proposed.

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BV-06. Structural and magnetic properties study of ZnO-doped cobalt ferrite nanoparticles.T.J. Castro[1], S.W. Da Silva[1], F. Nakagomi[1], N.S. Moura[2,3], *A. Franco Jr*[3], V.K. Garg[1], A.C. Oliveira[1] and P.C. Morais[1] *1. Instituto de Física, Universidade de Brasilia, Brasilia, DF, Brazil; 2. Instituto de Física, Universidade Federal deGoiás, Goiânia, GO, Brazil; 3. Instituto de Química, Universidade Federal de Goiás, Goiânia, GO, Brazil*

Hybrid semiconducting and magnetic nanostructures are currently a research focus owing to their potential in optoelectronic, spintronic, and biomedicine applications. Zinc oxide ZnO is a semiconductor of wide band gap energy (E_g = 3.37 eV) with applications in many optical, electronic and acoustic devices. On the other hand, spinel ferrites have remarkable properties like high electrical resistivity, mechanical hardness, chemical stability, etc. Therefore, the combination of cobalt ferrite and zinc oxide to form a composite will make them having multiple properties. Thus, in this work, the composites of $x(CoFe_2O_4)+(1-x)ZnO$ for x = 0.5 - 40% were prepared by heating each composition at 1100°C for 2h in ar atmosphere. Initially, zinc oxide and cobalt ferrite nanoparticles were prepared by the combustion reaction method. The Rietveld method was employed to quantify the lattice parameters, particle size, strain, and phase fractions. The lattice parameter *a* of the ferrite phase decreases when the $CoFe_2O_4$-content increasing from x = 0.5 to x = 40%. This behavior indicates an exchange of zinc atoms between the wurtzite and spinel phases, giving rise the $Zn(CoFe_2)_{1-x}O_4$ ferrite. It was also found that the lattice parameters *a* and *c* ZnO phase exhibit the opposite behaviors. The exchange of zinc atoms between the wurtzite and spinel phases was also demonstrated by Raman and Mossbauer spectroscopy. The Mossbauer spectra, at room temperature, of the samples with x = 20 and 40% showed the presence a strong paramagnetic doubletin, indicating the presence of the $Zn(CoFe_2)_{1-x}O_4$ phase. Room temperature Raman spectra features in the 200-1000 cm^{-1} spectral range are assigned to vibrational modes associated to the wurtzite and $Zn(CoFe_2)_{1-x}O_4$ phases. The magnetic properties were carried out by a vibrating sample magnetometer (VSM) in applied magnetic field up to 2.0 kOe at room temperature; varies significantly with chemical composition. For instance, with the addition of 20% of cobalt ferrite, the compound exhibits ferrimagnetism typical of soft ferrite materials. A discussion on the implications of this behavior in the magnetic properties in these composites will also be presented.

BV-07. Design of SPM BLDC motor with ferrite PM as the substitution of the rare-earth PM for water pump.*H. Kim*[1], G. Lee[1] and T. Jung[1] *1. KyungNam Univ., Changwong-Si, Republic of Korea*

Recently, the application of permanent magnet brushless DC motors has been remarkably expanded because of the performance improvements by the application of rare-earth permanent magnets. However, the material cost of Nd-Fe-B magnet is abnormally rising because of the shortage of supply, and it is due to the export control policies of China which is the biggest supplier of the world. It causes the mismatch between the supply and demand and the big cost increase of Nd-Fe-B magnets. Therefore, many companies are seriously researching about the design change of BLDC motor to use ferrite magnet instead of the currently using Nd-Fe-B magnet. This paper presents the design comparisons of BLDC motor for the water pump for washer. Before the study, the Nd-Fe-B magnet was applied in the conventional water pump motor. This water pump BLDC motor should have waterproofing property, so the IPM rotor using Nd-Fe-B magnet is encapsulated by synthetic resin plastic. We studied about the rotor design change using ferrite ring magnet to reduce material cost in the condition of the same stator core design. But, this design direction has many weak points such as the decreasing of BEMF, the lowered maximum output, the irreversible demagnetization characteristics of PM and so on. In the proposed water pump SPM BLDC motor using ferrite PM, the outer and inner diameter and stack length of stator is fixed to the value of the conventional IPM BLDC motor using Nd-Fe-B magnet. The design specification requirements are having the same output power and efficiency characteristics in the same dimension volume. Firstly, the air gap length reduction design is studied to cover the decrease of magnet flux. In the use of ferrite ring magnet, it is possible to have waterproof characteristics without plastic capsulation. Secondly, the design optimization of stator teeth, turns, air gap length and magnet overhang is accomplished to acquire the same output power and efficiency characteristics. As a result of this study, the design comparison results concerning about driving performances and material cost are represented. And the design results are verified by the experiment result of the prototype motors.

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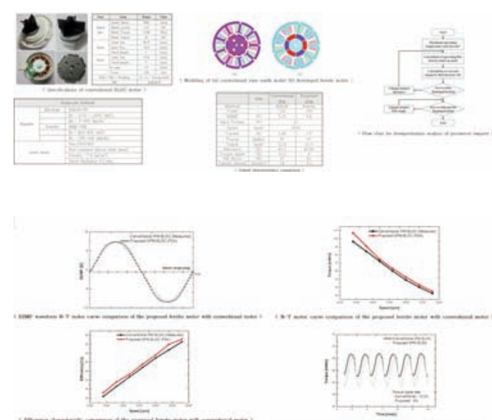

BV-08. Investigation of magnetic properties of Zn doped Y-type Barium ferrite.*J. Lim*[1], B. Lee[2] and C. Kim[1] *1. Department of Physics, Kookmin University, Seoul, Republic of Korea; 2. Department of Physics, Hankuk University of Foreign studies, Yongin, Kyungki, Republic of Korea*

The $Ba_2Co_{2-x}Zn_xFe_{12}O_{22}$ (x = 0, 0.5, 1, 1.5, 2) polycrystalline samples were synthesized by the solid-state reaction method. Based on the Rietveld refinement, the crystal structures of samples were found to be single-phased with the Bragg factor (R_B) and structure factor (R_F) less than 5 %, and determined to be rhombohedral with space group of *R-3m*. The unit cell volume (V_u) of $Ba_2Co_{2-x}Zn_xFe_{12}O_{22}$ were V_u = 1296.60, 1298.65, 1300.26, 1302.13, and 1303.74 Å^3, respectively. The V_u of the samples increased linearly with increasing Zn ion concentration, since the Zn ion has the larger ionic radius than the Co ion does. From the temperature-dependent magnetization curves under 100 Oe between 4.2 and 740 K, the Curie temperature (T_C) of the samples were found to be decreasing with increasing Zn concentration. The decrease of T_C is due to the decreasing in the super-exchange interaction by non-magnetic Zn substitution. Fig. 1 shows the ZFC curves under 100 Oe between 4.2 and 300 K. With increasing Zn substitution, we observed the disappearance of the spin transition from helicalmagnetic to collinear ferrimagnetic. Fig. 2 shows the saturation magnetization (M_s) of samples with concentration under 10 kOe at various temperatures. The non-magnetic Zn ions preferentially occupy the tetrahedral sublattices of $6c_{IV}$, and $6c_{IV}^*$ with down-spin site. Therefore, one might expect that M_s of samples increases with Zn ion doping. However, the experimentally measured M_s at 295 K shows slightly decrease around $x = 1.5$. Also, from the Mö ssbauer spectra of 295 K, we observed the line-width broadening with increasing Zn concentration, because of thermal agitation effect in the samples with lower T_C. In addition, we have measured Mö ssbauer spectra of samples at various temperatures ranging from 4.2 to 750 K and the spectra below T_C were analyzed with six-sextet for Fe site. From theses, we have observed the abruptly changes in hyperfine field at spin transition.

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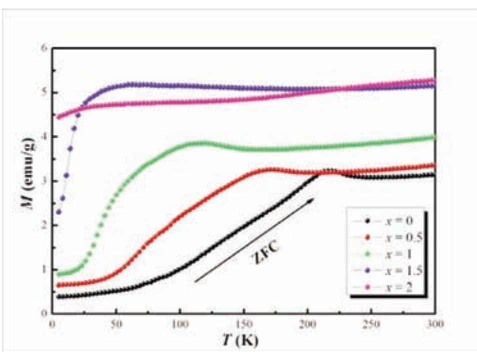

Fig. 1. The temperature dependence of ZFC curves under 100 Oe between 4.2 and 300 K.

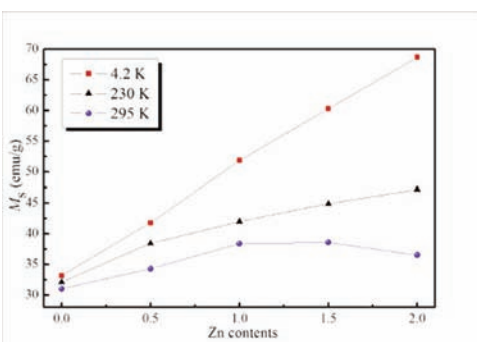

Fig. 2. Saturation magnetization of $Ba_2Co_{2-x}Zn_xFe_{12}O_{22}$ samples under 10 kOe at various temperatures.

BV-09. Effect of VC nano - inhibitors and dynamic continuous annealing on the magnetic properties of GO steels.

F. Kovac[1], I. Petryshynets[1], J. Marcin[2] and I. Skorvanek[2] *1. Microstructural Engineering of Steels, Institute of Materials Research, Slovak Academy of Science, Košice, Slovakia; 2. Laboratory of Nanomaterials and Applied Magnetism, Institute of Experimental Physic, Slovak Academy of Sciences, Košice, Slovakia*

The grain oriented (GO) steels with 3% Si and strong crystallographic orientation {110}<001> in the sheet plane (Goss texture) are characterized by low power losses and high permeability in the rolling direction. These steels are predominantly employed for the transformers with high efficiency. In order to achieve the {100}<001> texture development during the secondary recrystallization, which is realized by means of the long time box annealing, it is necessary to provide: (i) the inhibitors of the normal grain growth by a dispersion of small (50-100nm in size) second phase particles such as MnS, AlN and MnS+AlN, (ii) the presence of {100}<001> oriented grains in the primary recrystallized fine grained matrix. In the present work we have used the novel approach for the abnormal growth of Goss grains. This approach employs the system of VC nano-precipitates in the combination with a phenomenon of deformation induced grain growth. The laboratory slab of grain oriented steel was subjected to hot rolling with reduction of the thickness of sheet to 2.2 mm, and subsequently, the influence of coiling temperatures on the distribution of VC particles was analyzed by TEM. The obtained results have confirmed the presence of VC nanoparticles with a typical size of 20 – 80 nm located preferentially in the vicinity of grain boundaries. Later, the hot rolled strips were subjected to the cold rolling with the reduction ε~84%, followed by primary recrystallization, temper rolling and final annealing in dynamic conditions in the temperature range 850°C - 1150°C. This procedure led to evolution of the sufficiently strong {110}<001> Goss texture, which is comparable to that obtained in the conventionally treated GO steels. Moreover, the steels treated by this new method showed the comparable magnetic properties as the materials passed the conventional long – time heat treatment (e.g. the coercivity of our steels reached ~ 11 A/m). The proposed approach allowed to reach the equal material's quality at significantly shortened time in comparison to the conventional process of GO steel fabrication.

BV-10. Magnetic and FMR study on CoFe2O4/ ZnFe2O4 bilayers.

B. Sahu[1], S.C. Sahoo[2], N. Venkataramani[3], S. Prasad[1], R. Krishnan[4], M. Kostylev[5] and R.L. Stamps[5,6] *1. Physics, IIT Bombay, Mumbai, Maharastra, India; 2. Physics, Central University of Kerala Riverside Transit Campus, Kerala, Kerala, India; 3. Metallurgical Engineering & Materials Science, IIT Bombay, Mumbai, Maharastra, India; 4. CNRS, CNRS/Universite de Versailles-St-Quentin, Versailles Cedex, France; 5. Physics, University of Western Australia, Crawley, Perth, WA, Australia; 6. Physics and Astronomy, University of Glasgow, Glasgow, United Kingdom*

Bilayer of Zn ferrite (ZnFe2O4) and Co ferrite (CoFe2O4) are interesting as they show novel magnetic properties requiring low deposition/annealing temperature1. ZnFe2O4 also shows low ferromagnetic resonance (FMR) line width2. In the present work we present magnetic and FMR study on (CoFe2O4 /ZnFe2O4) bilayers. The bilayers were deposited on fused quartz substrate by pulse laser deposition at different substrate temperatures (Ts). They were also annealed in air for two hours at varying temperatures (Ta). Magnetic measurements were carried out at 300 and 10K. In-plane FMR was measured at frequencies between 8GHz to 20GHz. Perpendicular and parallel FMR were measured using standard cavity at 9.524GHz. The samples with Ts= 350 and 450oC showed two-step M-H loop at 10K even after annealing at 350oC. These loops arise from a combination of high coercivity Co ferrite and low coercivity Zn ferrite. Fig1 shows one such loop obtained for Ts=350oC bilayer. For other bilayers, a single loop is seen. The value of room temperature magnetization (4πMs) as high as 6500G with a coercivity of around 170 Oe could be obtained for one of our samples. Fig.2 shows the perpendicular and parallel FMR spectra of sample with Ts= 350oC. The perpendicular spectrum shows two modes. These modes appear to arise from separate resonances in Co- and Zn ferrite layers. The value of magnetization obtained from these peaks, assuming uniform precession is 1530 Oe and 1800 Oe. Thickness weighted average magnetization obtained from FMR was close to the one measured for the film. For Ta=350oC, the bimodal structure in still seen, but the weighted value of magnetization differed from the measured one. This may be due to increased exchange coupling between the two layers. For Ta=650oC sample, we obtained a single broad resonance peak. The FMR study leads to the inference that the CoFe2O4 /ZnFe2O4 bilayers are exchange coupled up to annealing temperature of 350oC and tend to mix up thereafter. Financial support by the Australian-Indian Research Fund is acknowledged.