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CS-03. Domain wall dynamics controlled through magnetoelastic interaction. *K. Chichay*[1,2], V.V. Rodionova[1,2], V. Zhukova[3], N.S. Perov[1,4] and A. Zhukov[3,5] *1. Science and Technology Park "Fabrika", Immanuel Kant Baltic Federal University, Kaliningrad, Russian Federation; 2. Center for Functionalized Magnetic Materials, Immanuel Kant Baltic Federal University, Kaliningrad, Russian Federation; 3. Dpto. Fisica de Materiales, Fac. Quimicas, UPV/EHU, San Sebastian, Spain; 4. Faculty of Physics, Lomonosov Moscow State University, Moscow, Russian Federation; 5. Ikerbasque, Basque Foundation for Science, San Sebastian, Spain*

CS-04. Magnetic characterization of α-Iron/Iron oxide core/shell nanoparticles synthesized by pulsed wire evaporation method. *D. Kim*[1], S. An[2], J. Kim[2], S. Lee[1], K. Hyun Sung[1], J. Yeo[1,2], C. Liu[1] and B. Lee[1] *1. Department of Physics and Oxide Research Center, Hankuk University of Foreign Studies, Yongin-si, Gyeonggi-do, The Republic of Korea; 2. Corporate R&D Institute, Samsung Electro-Mechanics, Suwon-si, The Republic of Korea*

CS-05. Flexible Magnetic Tape with High Permeability. *Y. Yen*[1], C. Lee[1] and P. Lin[1] *1. Material Science and Engineering, National Tsing Hua University, Taichung City, Taiwan*

CS-06. Site preference and hyperfine structure in doped Z-type hexaferrite $Ba_{1.5}Sr_{1.5}Co_2(Fe_{1-x}Al_x)_{24}O_{41}$ investigated by Mössbauer spectroscopy. *J. Lim*[1], T. Kouh[1] and C. Kim[1] *1. Kookmin University, Seoul, The Republic of Korea*

CS-07. Magnetostriction Behaviors of $Ni_{100-x}Fe_x$ and $Ni_{100-y}Co_y$ (001) Single-Crystal Films with fcc Structure under Rotating Magnetic Fields. *K. Serizawa*[1], T. Kawai[1], M. Ohtake[2,1], M. Futamoto[1], F. Kirino[3] and N. Inaba[4] *1. Faculty of Science and Engineering, Chuo University, Koganei, Japan; 2. Faculty of Engineering, Kogakuin University, Hachioji, Japan; 3. Graduate School of Fine Arts, Tokyo University of the Arts, Taito-ku, Japan; 4. Faculty of Engineering, Yamagata University, Yonezawa, Japan*

CS-08. Gd_5Si_4-PVDF nanocomposites-films for triboelectric energy harvesting. *S.M. Harstad*[1], N. Soin[2], A. El-Gendy[1,3], P. Zhao[2], S. Gupta[4], V. Pecharsky[4,5], J. Luo[2], E. Siores[2] and R. Hadimani[1] *1. Mechanical and Nuclear Engineering, Virginia Commonwealth University, Richmond, VA; 2. Institute of Renewable Energy and Environment Technology, University of Bolton, Bolton, United Kingdom; 3. Nanotechnology and Nanometrology Laboratory, National Institute for Standards, Giza, Egypt; 4. Division of Materials Science and Engineering, Ames Laboratory, US Dept. of Energy, Ames, IA; 5. Department of Materials Science and Engineering, Iowa State University, Ames, IA*

CS-09. $Lu_2Ni_{21-x}Co_xB_6$: From Pauli Paramagnetism to Weak Ferromagnetism. *A. Leithe-Jasper*[1], R. Gumeniuk[2], W. Schnelle[1], H. Rosner[1] and S. Wirth[1] *1. MPI-CPfS, Dresden, Germany; 2. TU Bergakademie, Freiberg, Freiberg, Germany*

CS-10. Tunable permeability and permittivity of low loss NiZnCo ferrite by sintering temperature for VHF-UHF applications. *Z. Zheng*[1] and Q. Feng[1] *1. School of Information Science and Technology, Southwest Jiaotong University, Chengdu, China*

CS-11. Improvement of Power Inductor Performance by Adding Fe Nanoparticle to Fe-Si Soft Magnetic Composite. *S. Lee*[1], D. Kim[1], J. Yeo[1,2], S. An[2], J. Kim[2] and B. Lee[1] *1. Department of Physics and Oxide Research Center, Hankuk University of Foreign Studies, Yongin-si, The Republic of Korea; 2. Corporate R&D Institute, Samsung Electro-Mechanics, Suwon-si, Gyeonggi-do, The Republic of Korea*

CS-12. Crystallographic orientation and microstructure dependent magnetic behaviors of arrays of Ni nanowires. *M. Ko*[1], S. Kim[1] and Y.K. Kim[1] *1. Materials Science and Engineering, Korea University, Seoul, The Republic of Korea*

CS-13. Characterization of Soft Ferromagnetic Materials in AC Magnetic Fields with Regard to Magnetic Losses. *R. Hiergeist*[1], K. Wagner[1] and G. Ross[1] *1. Magnet-Physik Dr. Steingroever GmbH, Köln, Germany*

CS-14. Modelling of temperature dependence of saturation magnetisation of silicon-iron steels. *G. Shirkoohi*[1] *1. Engineering, London South Bank University, London, United Kingdom*

WEDNESDAY MORNING 8:30 — THE FORUM

Session CT
MOTORS, GENERATORS AND ACTUATORS III (Poster Session)

Antonino Laudani, Chair
Universitá degli Studi Roma Tre, Roma, Italy

CT-01. Proposal and Design of Transverse-Flux Flux-Reversal Linear Motor with Consequent-Pole Structure. *J. Luo*[1], B. Kou[1], L. Zhang[1] and X. Yang[1] *1. Electrical Engineering, Harbin Institute of Technology, Harbin, China*

CT-02. A Novel Consequent-Pole Hybrid Excited Vernier Permanent-Magnet Machine for EV/HEV Applications. H. Wang[1], S. Fang[1], H. Yang[1], H. Lin[1], Y. Li[1] and *J. Jiang*[1] *1. Southeast University, Nanjing, China*

CT-03. 2D Finite Element Analysis of Hybrid Excitation Synchronous Machines with Radial/Axial Flux Paths via Magnetic Equivalent Circuit. *Y. Liu*[1], Z. Zhang[1], W. Geng[1] and J. Li[1] *1. Nanjing University of Aeronautics and Astronautics, Nanjing, China*

CT-04. Investigation of Stator Flux Density and Iron Loss in 3rd Order Harmonic Shaped Surface-Mounted Permanent Magnet Machines. *X. Chen*[1] and K. Wang[1] *1. Nanjing University of Aeronautics and Astronautics, Nanjing, China*

CS-06. Site preference and hyperfine structure in doped Z-type hexaferrite $Ba_{1.5}Sr_{1.5}Co_2(Fe_{1-x}Al_x)_{24}O_{41}$ investigated by Mössbauer spectroscopy.

J. Lim[1], T. Kouh[1] and C. Kim[1]
1. Kookmin University, Seoul, The Republic of Korea

INTRODUCTION Recently, hexagonal ferrites such as $Sr_{3-x}Ba_{x-}Co_2Fe_{24}O_{41}$ and $BaSrCo_2Fe_{11}AlO_{22}$ have been reported to show the magnetoelectric (ME) effect around room temperature under low magnetic field. With Sr ion substitution, Z-type hexaferrite can lead to the modification of spin structure due to the high planar anisotropy of Sr ions. In addition, it is known that adding Al ions into Z-type hexaferrite can improve the multiferroic properties due to the reduction of the in-plane orbital moment via lowering magnetic anisotropy[1-2]. Here, we investigate Z-type hexaferrite $Ba_{1.5}Sr_{1.5}Co_2(Fe_{1-x}Al_x)_{24}O_{41}$ (x = 0.00, 0.01, 0.03, and 0.05). This compound has not been studied in detail because single-phase is difficult to synthesize due to the narrow temperature range for the formation of Z-type hexaferrite by Sr and Al ions substitution. In this study, $Ba_{1.5}Sr_{1.5}Co_2(Fe_{1-x}Al_x)_{24}O_{41}$ (x = 0.00, 0.01, 0.03, and 0.05) samples were synthesized by polymerizable complex method and the magnetic properties, site preference and hyperfine structure were investigated by using x-ray diffractometer (XRD), vibrating sample magnetometer (VSM) and Mössbauer spectrometer. **EXPERIMENT PROCEDURES** The polycrystalline samples of $Ba_{1.5}Sr_{1.5}Co_2(Fe_{1-x}Al_x)_{24}O_{41}$ (x = 0.00, 0.01, 0.03, and 0.05) were prepared by polymerizable complex method. Staring materials of high purity $BaCO_3$ (99.98%), $SrCO_3$ (99.995%), $Co(NO_3)_26H_2O$ (98%), $Fe(NO_3)_39H_2O$ (98%), and $Al(NO_3)_39H_2O$ (98%) were used and dissolved in distilled water with citric acid at 70 °C for 1 h. The molar ratio of citric acid was 1: 2.5 (total metal : citric acid). Then, a proper amount of ethylene glycol was added into metal-citrate solution and stirred at 80 °C for 1 h. The solution was dried at 120 °C for polymerization between metal-citrate complexes, and the gel metal-organic complexes were heated at 320 °C for 3 h in air. The calcined powder was pressed into a cylindrical pellet, and sintered at 1190 °C for 10 h in air. The crystal and magnetic properties of samples were characterized by using x-ray diffractometer (XRD) using Cu-Kα radiation(λ = 1.5406 Å) and vibrating sample magnetometer (VSM). The site preference and hyperfine structure were investigated with Mössbauer spectrometer. In order to separate the sub-lattice lines, Mössbauer spectra were obtained under the external magnetic fields range from 0 to 50 kOe at 4.2 K. **III. RESULTS AND DISCUSSION** From the refined XRD pattern of $Ba_{1.5}Sr_{1.5}Co_2(Fe_{1-x}Al_x)_{24}O_{41}$ (x = 0.00, 0.01, 0.03, and 0.05) at 295 K, the crystal structure was found to be a single-phased hexagonal structure with the space group $P6_3/mmc$. With increasing Al concentration, the lattice constants a_0, c_0, unit cell volume (V_u) of samples decrease, because the ionic radius of Fe^{3+} ions (r = 0.645 Å) is larger than that of Al^{3+} ions (r = 0.535 Å) is, as expected from Vegard's law. From the applied-field dependent hysteresis curves under 15 kOe at 295 K, the magnetization at 15 kOe (M_{15kOe}) of $Ba_{1.5}Sr_{1.5}Co_2(Fe_{1-x}Al_x)_{24}O_{41}$ (x = 0.00, 0.01, 0.03, and 0.05) decreases from M_{15kOe} = 55.47 for x = 0.00 to M_{15kOe} = 39.90 emu/g for x = 0.05 due to the preferential occupation of non-magnetic Al ions in down-spin site, while the coercivity (H_c) of samples increases from H_c = 80.56 for x = 0.00 to H_c = 214.75 Oe for x = 0.05 due to the reduction of magnetic anisotropy. Also, the samples are not saturated with increasing Al ion contents because spin structure is modified due to the reduction of magnetic anisotropy at 295 K. The zero-field Mössbauer spectra of the samples were taken at various temperatures ranging from 4.2 to 750 K and analyzed as six distinguishable sextets (A : $4f_{IV}$, B : $4f_{IV}$*, C : $12k_{VI}$*, D : ($4f_{VI}$* and $4e_{IV}$), E : $12k_{VI}$, and F : ($2d_V$, $2a_{VI}$, $4f_{VI}$ and $4e_{VI}$)) below T_C due to superposition of ten-sextets for Fe sites corresponding to the Z-type hexagonal ferrite. In addition, all samples have shown abrupt changes in the hyperfine field (H_{hf}) and electric quadrupole shift (E_Q) around T_s. Also, we have taken the Mössbauer spectra of all samples at 4.2 K with applied field between 0 to 50 kOe, parallel to the direction of γ-ray emission. The Mössbauer spectra under zero external magnetic field show overlapped absorption lines, while Mössbauer spectra with increasing external magnetic field show well-distinguished 2-site absorption lines.

[1] T. Nakajima, Y. Tokumaga, M. Matsuda, S. Dissanayake, J. Fernandez-Baca, K. Kakurai, Y. Taguchi, Y. Tokura, and T. Arima, Phys. Rev. B **94**, 195154 (2016). [2] M. Soda, T. Ishikura, H. Nakamura, Y. Wakabayashi, and T. Kimura, Phys. Rev. Lett **106**, 087201 (2011).