IEEE International Magnetics Conference

PROGRAM

China National Convention Center
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BR-13. Electromagnetic nondestructive evaluation of mechanical strength in flake and spheroidal graphite cast irons. Y. Kamada¹, S. Masuda¹, T. Kowata¹, S. Hiratsuka¹ and H. Kage² 1. Faculty of Engineering, Iwate University, Morioka, Japan; 2. Kusaka Rare Metal Products Co., Tokyo, Japan

BR-14. Investigation of magnetic properties of Sr doped Ba₃₋ₓSrₓCo₂Fe₂₄O₄₁ Z-type hexaferrite by Mössbauer spectroscopy. J. Lim¹ and C. Kim¹ 1. Kookmin University, Seoul, Korea

BR-15. Preparation and Application on Antenna of Soft Ferrite Core for Wireless Sensor Networks. L. Li¹,², Y. Fang¹,² and Y. Liu¹,² 1. State Key Laboratory of Networking and Switching Technology, Beijing University of Posts and Telecommunications, Beijing; 2. Beijing Key Laboratory of Network System Architecture and Convergence, Beijing University of Posts and Telecommunications, Beijing; 3. Research Institute of Functional Materials, China Iron and Steel Research Institute, Beijing; 4. Beijing Engineering Laboratory of Advanced Metallic Magnetic Materials and Preparation Techniques, Beijing

TUESDAY PLENARY HALL B
AFTERNOON 1:30

Session BS MAGNETOCALORIC MATERIALS II (Poster Session)
Julia Lyubina, Co-Chair Evonik Industries AG Fengxia Hu, Co-Chair Institute of Physics, Chinese Academy of Sciences

BS-01. Tailoring of magnetic properties in Heusler-type NiMnGa glass-coated microwires. V. Zhukova¹,³, V. Chernenko², M. Ipatov¹,³ and A. Zhukov¹,² 1. Department of Material Physics, Basque Country University, San Sebastian, Spain; 2. IKERBASQUE, Basque Foundation for Science, Bilbao, Spain; 3. Dpto. de Física Aplicada, EUPDS, University of Basque Country (UPV/EHU), San Sebastian, Spain; 4. BCMaterials & University of Basque Country (UPV/EHU), Bilbao, Spain
Investigation of magnetic properties of Sr doped \( \text{Ba}_{3-x}\text{Sr}_x\text{Co}_2\text{Fe}_{24}\text{O}_{41} \) Z-type hexaferrite by Mössbauer spectroscopy

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INTRODUCTION

Recently, the magnetoelectric (ME) effect observed in some of spiral magnets has been extensively studied. Especially, Z-type hexagonal \( \text{Ba}_{3-x}\text{Sr}_x\text{Co}_2\text{Fe}_{12}\text{O}_{22} \) show ME effect via a complex helical spin structures such as heliconical magnet and transverse conical magnet [1,2]. Also, Z-type hexaferrite has been considered for microwave application due to high cut-off frequency and high permeability at GHz [3]. Their properties are strongly affected by the hyperfine distribution in hexagonal structure.

EXPERIMENT PROCEDURES

The samples of polycrystalline \( \text{Ba}_{3-x}\text{Sr}_x\text{Co}_2\text{Fe}_{24}\text{O}_{41} \) \( (x = 0.0, 0.5, 1.0, 1.5) \) were synthesized by the solid-state reaction method. The high purity \( \text{BaCO}_3 \) (99.98%), \( \text{SrCO}_3 \) (99.995%), \( \text{CoO} \) (99.99%), and \( \text{Fe}_2\text{O}_3 \) (99.995%) powders were used as the starting materials, and were mixed with the appropriate stoichiometric ratio for Z-type hexaferrite. The mixture was ground, and calcined at 1000 °C. The calcined samples were pressed into a cylindrical pellet, and sintered at 1200 °C. Finally, the samples were slowly heated at a rate of 2 °C/min to 1200 °C, and sintered again at 1250 °C.

The crystallographic and magnetic properties of \( \text{Ba}_{3-x}\text{Sr}_x\text{Co}_2\text{Fe}_{24}\text{O}_{41} \) \( (x = 0.0, 0.5, 1.0, 1.5) \) samples were investigated by using x-ray diffractometer (XRD) with Cu-K\( \alpha \) \( (\lambda = 1.5406 \text{ Å}) \) radiation, vibrating sample magnetometer (VSM), and Mössbauer spectrometer. In order to separate the sub-lattice lines, Mössbauer spectra were obtained in the external magnetic fields range from 0 to 50 kOe.

III. RESULTS AND DISCUSSION

The results of XRD patterns analyzed by Rietveld refinement of \( \text{Ba}_{3-x}\text{Sr}_x\text{Co}_2\text{Fe}_{24}\text{O}_{41} \) \( (x = 0.0, 0.5, 1.0, 1.5) \) at 295 K, samples were found to be single-phased with the Bragg factor \( (R_B) \) and structure factor \( (R_F) \) less than 5 %. The crystalline structure was confirmed to be hexagonal structure with the space group \( P\overline{6}_3/mmc \). The lattice constants \( (a_0, c_0) \), and unit cell volume \( (V_u) \) of samples decrease with increasing Sr ions contents, because the ionic radius of \( \text{Ba}^{2+} \) ions \( (r = 1.49 \text{ Å}) \) are larger than the ionic radius \( \text{Sr}^{2+} \) ions \( (r = 1.32 \text{ Å}) \) does.

From the applied-field dependent hysteresis curves under 10 kOe at 295 K, the saturation magnetization \( (M_s) \) and coercivity \( (H_c) \) of \( \text{Ba}_{3-x}\text{Sr}_x\text{Co}_2\text{Fe}_{24}\text{O}_{41} \) \( (x = 0.0, 0.5, 1.0, 1.5) \) samples were found to be \( M_s = 50.90, 45.59, 44.98, 44.83 \text{ emu/g} \) and \( H_c = 37.10, 40.24, 40.41, 40.67 \text{ Oe} \), respectively.

Base on the zero-field-cooled (ZFC) magnetization curves under 100 Oe between 4.2 and 300 K, all samples showed spin transition \( (T_s) \). The \( T_s \) decrease from 230 for \( x = 0.0 \) to 135 K for \( x = 1.5 \) with increasing Sr ion contents due to the reduction of planar anisotropy with the difference in ionic radius of \( \text{Ba}^{2+} \) and \( \text{Sr}^{2+} \) ions.
The zero-field Mössbauer spectra of the samples were taken at various temperatures ranging from 4.2 to 750 K and analyzed the spectra below $T_C$ as six distinguishable sextets due to superposition of ten-sextets for Fe sites corresponding to the Z-type hexagonal ferrite. Isomer shift values of all samples show that the charge states are Fe$^{3+}$ high spin. In addition, all samples has shown abrupt changes in the hyperfine field ($H_{hf}$) and electric quadrupole shift ($E_Q$) around $T_s$. Also, From the Mössbauer spectra of all samples taken at 4.2 K with applied field parallel to the direction of $\gamma$-ray emission ranging from 0 to 50 kOe, Mössbauer spectra under zero external magnetic field show overlapped absorption lines, while Mössbauer spectra show well-distinguished 2-site absorption lines with increasing external magnetic field.

Reference