

# Digest Book



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For what's next

- EP-02. Intrinsic and induced magnetic anisotropies in NiZn and NiZnCo spinel ferrites: a determination of their respective contributions by using either microwave (FMR) or static (Single Point Detection) measuring methods.** J. Mattei<sup>1</sup>, A. Maalouf<sup>1</sup>, V. Laur<sup>1</sup> and A. Chevalier<sup>1</sup> *1. Functional Materials, Lab-STICC, Brest, France*
- EP-03. A double-negative waveguide metacomposite enabled by ferromagnetic microwires.** Y. Luo<sup>1</sup>, F. Qin<sup>1</sup>, F. Scarpa<sup>2</sup>, M. Ipatov<sup>3</sup>, A. Zhukov<sup>3</sup> and H. Peng<sup>1</sup> *1. Zhejiang University, Hangzhou, China; 2. University of Bristol, Bristol, United Kingdom; 3. Universidad del Pais Vasco, San Sebastian, Spain*
- EP-04. Altering Magnetic Properties in Nickel Ferrite Through Patterning and pH.** A. Cruz<sup>1</sup> *1. Material Science, North Carolina State University, Raleigh, NC*
- EP-05. Topological Phase Transitions in Iron Garnets Crystals with a Magnetic Compensation Temperature.** L.A. Pamyatnykh<sup>1</sup>, L.Y. Agafonov<sup>1</sup> and I.E. Belskiy<sup>1</sup> *1. Institute of Natural Sciences and Mathematics, Ural Federal University (named after the first President of Russia B.N.Yeltsin), Ekaterinburg, Russian Federation*
- EP-06. Effect of Zn doping on the magnetic and dielectric properties of nanocrystalline GaFeO<sub>3</sub>.** T. Han<sup>1</sup>, C. Yen<sup>1</sup>, Y. Chung<sup>1</sup> and Y. Lee<sup>1</sup> *1. Department of Applied Physics, National University of Kaohsiung, Kaohsiung, Taiwan*
- EP-07. Synthesis and magnetic properties of FeCo/edge-oxidized graphene nanocomposites.** K. Kim<sup>1</sup>, J. Kim<sup>1</sup> and J. Lee<sup>1</sup> *1. Physics, Yeungnam University, Gyeongsan, The Republic of Korea*
- EP-08. Time evolution of magnetic properties of MgFe<sub>2</sub>O<sub>4</sub>: role of cation distribution.** S. Raghuvanshi<sup>1</sup>, F. Mazaleyrat<sup>2</sup>, A. Pasko<sup>2</sup> and S. Kane<sup>1</sup> *1. School of Physics, Devi Ahilya University, Indore, India; 2. SATIE, ENS Cachan, CNRS, Université Paris-Saclay, Cachan, France*
- EP-09. Enhanced photocatalytic activity of core-shell ZnFe<sub>2</sub>O<sub>4</sub>@ZnO nanoparticles for visible light photodegradation.** S. Lee<sup>1</sup>, K. Seo<sup>1</sup>, K. Choi<sup>2</sup>, B. Park<sup>2</sup> and J. Jung<sup>1</sup> *1. Chemistry, Gangneung-Wonju National University, Gangneung, The Republic of Korea; 2. Department of Electrical and Biological Physics, Kwangju University, Seoul, The Republic of Korea*
- EP-10. Hyperthermic effects of FeCoNi coated glass fibers in alternating magnetic field.** J. Kim<sup>1</sup>, B. Jung<sup>2</sup>, S. Lee<sup>2</sup> and K. Kim<sup>1</sup> *1. Physics, Yeungnam University, Gyeongsan, The Republic of Korea; 2. Composites Research Division, Korea Institute of Materials Science, Changwon, The Republic of Korea*
- EP-11. Magnetic properties of pure iron soft magnetic composites coated by manganese phosphates.** S. Lee<sup>1</sup>, M. Choi<sup>1</sup> and J. Kim<sup>1</sup> *1. Hamyang University, Ansan-si, The Republic of Korea*
- EP-12. Structural characterization and magnetic properties of Zn-doped Fe<sub>3</sub>O<sub>4</sub> nanoparticles for biomedical applications.** H. Choi<sup>1</sup>, S. Kim<sup>1</sup>, E. Hahn<sup>2</sup> and C. Kim<sup>1</sup> *1. Department of Physics, Kookmin University, Seoul, The Republic of Korea; 2. Department of Physics, Suwon University, Suwon, The Republic of Korea*
- EP-13. Uncharacteristic magnetic moment in nanocrystalline Co<sub>0.3</sub>Zn<sub>0.7</sub>Fe<sub>2</sub>O<sub>4</sub> thin films.** P. Rajagiri<sup>1</sup>, B. Sahu<sup>1</sup>, V. Narayanan<sup>2</sup>, S. Prasad<sup>1</sup> and R. Krishnan<sup>3</sup> *1. Physics, Indian Institute of Technology Bombay, Mumbai, India; 2. Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, Mumbai, India; 3. CNRS/ Université de Versailles-St-Quentin, Versailles Cedex, France*
- EP-14. Hyperfine structure and magnetic properties of BaSrCo<sub>2</sub>(Fe<sub>1-x</sub>Al<sub>x</sub>)<sub>2</sub>O<sub>7</sub> synthesized by polymerizable complex method.** J. Lim<sup>1</sup>, I. Shim<sup>1</sup>, B. Lee<sup>2</sup> and C. Kim<sup>1</sup> *1. Kookmin University, Seoul, The Republic of Korea; 2. Hankuk University of Foreign Studies, Yongin, The Republic of Korea*
- EP-15. Effect of deposition rate on morphology and magnetic properties of cobalt ferrite films grown by pulsed laser deposition.** F. Eskandari<sup>1,2</sup>, P. Kameli<sup>1</sup>, M. Venkatesan<sup>2</sup>, M. Coey<sup>2</sup> and H. Salamat<sup>1</sup> *1. Department of Physics, Isfahan University of Technology, Isfahan, The Islamic Republic of Iran; 2. School of Physics and CRANN, Trinity College Dublin, Dublin, Ireland*
- EP-16. Evaluation of Exchange Stiffness from Temperature Dependent Magnetization in ZnFe<sub>2</sub>O<sub>4</sub> Thin Films.** B. Sahu<sup>1</sup>, P. Rajagiri<sup>1</sup>, V. Narayanan<sup>2</sup>, S. Prasad<sup>1</sup> and R. Krishnan<sup>3</sup> *1. Physics, Indian Institute of Technology Bombay, Mumbai, India; 2. Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, Mumbai, India; 3. CNRS/Université de Versailles-St-Quentin, Versailles, France*
- EP-17. Effects of Mixed Solvents on Morphologies, Cation Distribution and Magnetic Properties of ZnFe<sub>2</sub>O<sub>4</sub> Nanoparticle by the Hydrothermal Method.** K. Hyun Sung<sup>1</sup>, D. Kim<sup>1</sup>, C. Liu<sup>1</sup> and B. Lee<sup>1</sup> *1. Department of Physics and Oxide Research Center, Hankuk University of Foreign Studies, Yongin-si, The Republic of Korea*
- EP-18. Comparison of Limiting Loop Model and Elemental Operator Model for Magnetic Hysteresis of Ferromagnetic Material.** W. Xu<sup>1</sup>, N. Duan<sup>1</sup>, Y. Li<sup>2</sup>, S. Wang<sup>1</sup>, Y. Guo<sup>3</sup> and J. Zhu<sup>3</sup> *1. Xi'an Jiaotong University, Xi'an, China; 2. Hebei University of Technology, Tianjin, China; 3. University of Technology Sydney, Sydney, NSW, Australia*

# EP-14. Hyperfine structure and magnetic properties of BaSr-Co<sub>2</sub>(Fe<sub>1-x</sub>Al<sub>x</sub>)<sub>12</sub>O<sub>22</sub> synthesized by polymerizable complex method.

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**INTRODUCTION** Y-type hexagonal ferrite family has been studied for magnetoelectric (ME) effect based on spin-current model due to the conical spin order depending on the external magnetic field, temperature and crystal structure. Especially, Aluminum doped Y-type hexaferrite has been extensively studied[1-2]. However, Al-doped Y-type hexaferrite is difficult to prepare as a single-phase because the temperature range for the formation of Y-type ferrite is narrow and hyperfine structure has not been studied fully. In this study, BaSrCo<sub>2</sub>(Fe<sub>1-x</sub>Al<sub>x</sub>)<sub>12</sub>O<sub>22</sub> (x = 0.00, 0.01, 0.05, and 0.10) samples were synthesized by polymerizable complex method and the crystalline, magnetic properties and hyperfine structure were investigated by using x-ray diffractometer (XRD), vibrating sample magnetometer (VSM) and Mössbauer spectrometer. **EXPERIMENT PROCEDURES** The BaSrCo<sub>2</sub>(Fe<sub>1-x</sub>Al<sub>x</sub>)<sub>12</sub>O<sub>22</sub> (x = 0.00, 0.01, 0.05, and 0.10) polycrystalline samples were synthesized by using polymerizable complex method with the starting materials of high purity BaCO<sub>3</sub> (99.98%), SrCO<sub>3</sub> (99.995%), Co(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O (98%), Fe(NO<sub>3</sub>)<sub>3</sub>·9H<sub>2</sub>O (98%), and Al(NO<sub>3</sub>)<sub>3</sub>·9H<sub>2</sub>O (98%). These were dissolved with appropriate stoichiometric ratio for Y-type hexaferrite in distilled water and citric acid was dissolved in the nitrate solution. The molar ratio of citric acid was 1: 2.5 and the solution was stirred on a hot-plate at 70 °C for 1 h. Then, a proper amount of ethylene glycol (1: 5 of citric acid : ethylene glycol) was added and stirred at 80 °C for 1 h. The solution was heated at 120 °C for dehydration and polymerization, and the polymerized samples were calcined at 320 °C for 3 h. The calcined powder was pressed into a cylindrical pellet, and sintered at 1000 °C for 10 h in air. The crystallographic and magnetic properties of BaSrCo<sub>2</sub>(Fe<sub>1-x</sub>Al<sub>x</sub>)<sub>12</sub>O<sub>22</sub> (x = 0.00, 0.01, 0.05, and 0.10) samples were investigated by using x-ray diffractometer (XRD) with Cu-Kα (λ = 1.5406 Å) radiation, vibrating sample magnetometer (VSM), and Mössbauer spectrometer. **III. RESULTS AND DISCUSSION** From the XRD patterns analyzed by Rietveld refinement of BaSrCo<sub>2</sub>(Fe<sub>1-x</sub>Al<sub>x</sub>)<sub>12</sub>O<sub>22</sub> (x = 0.00, 0.01, 0.05, and 0.10) at 295 K, all samples were determined to be single-phased and crystalline structure was confirmed to be rhombohedral structure with the space group *R-3m*. The lattice constants *a*<sub>0</sub>, *c*<sub>0</sub>, unit cell volume (*V*<sub>u</sub>), and bulk density (ρ) of samples decrease from *a*<sub>0</sub> = 5.85, *c*<sub>0</sub> = 43.39 Å, *V*<sub>u</sub> = 1284.62 Å<sup>3</sup>, ρ = 5.29 g/cm<sup>3</sup> for x = 0.00 to *a*<sub>0</sub> = 5.83, *c*<sub>0</sub> = 43.21 Å, *V*<sub>u</sub> = 1272.70 Å<sup>3</sup>, ρ = 5.21 g/cm<sup>3</sup> for x = 0.10 because the Al<sup>3+</sup> ions (r = 0.535 Å) has smaller ionic radius than the Fe<sup>3+</sup> ions (r = 0.645 Å) does, as expected from the Vegard's law. The hysteresis curves of these samples were measured under 15 kOe at various temperatures ranging from 4.2 and 295 K, showing they were not saturated with increasing Al ion contents due to the reduction of magnetic anisotropy. At 295 K, the magnetization at 15 kOe (*M*<sub>15kOe</sub>) and coercivity (*H*<sub>c</sub>) of BaSrCo<sub>2</sub>(Fe<sub>1-x</sub>Al<sub>x</sub>)<sub>12</sub>O<sub>22</sub> (x = 0.00, 0.01, 0.05, and 0.10) samples were found to be *M*<sub>15kOe</sub> = 32.46, 29.66, 25.76, 22.06 emu/g and *H*<sub>c</sub> = 247.33, 218.90, 217.45, 438.59 Oe, respectively. We expect that non-magnetic Al ions preferentially occupy the up-spin site of 18*h*<sub>VI</sub>, 3*b*<sub>VI</sub>, and 3*a*<sub>VI</sub>. From the zero-field-cooled (ZFC) and field-cooled (FC) magnetization curves under 100 Oe between 4.2 and 750 K, all samples showed spin transition. With increasing Al ion contents, the spin transition temperature *T*<sub>s</sub> increases while Curie temperature (*T*<sub>C</sub>) decreases. The Mössbauer spectra of the samples were obtained at various temperatures ranging from 4.2 to 750 K, and analyzed with six-sites for Fe sites corresponding to the Y-type hexaferrite crystallography sites. Also, in order to separate the sub-lattice lines, Mössbauer spectra were obtained in the external magnetic fields range from 0 to 50 kOe at 4.2 K.

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