

Neutron Diffraction and Permeability Studies of Co_zZ-type Hexaferrite



Takashi Nakagawa*¹, Yukio Takada², Masatoshi Tokunaga², Takao A. Yamamoto², Yoshinobu Ishii³, Naoki Igawa³, Masaru Tada⁴, and Masanori Abe¹

¹Department of Physical Electronics, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro, Tokyo 152-8552, Japan
²Department of Management of Industry and Technology, Osaka University, 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan
³Quantum Beam Science Directorate, Japan Atomic Energy Agency, 2-4 Shirane Shirakata, Tokai-mura, Naka-gun, Ibaraki 319-1195, Japan

*Corresponding author: nakagawa@uabe.pe.titech.ac.jp, Phone: +81 3 5734 2394, Fax: +81 3 57 34 2906

Co_zZ-type hexagonal ferrite, Ba_{1-x}Sr_xCo₂Fe₂O₄, is one of candidate materials for electromagnetic noise absorbers used in gigahertz region. We previously reported the effect of substitution of Sr for Ba of Ba_{1-x}Sr_xCo₂Fe₂O₄ (x = 0, 1.5 and 3.0) on permeability and magnetic structure^[1]. In this paper, we report results of neutron diffraction and permeability measurement of Ba_{1-x}Sr_xCo₂Fe₂O₄ samples with x = 2.0 and 2.5 together with those with x = 0, 1.5 and 3.0 prepared in our previous study.

We have prepared the samples in conventional ceramic method. Figure 1 shows temperature dependences of canting angles from c-axis in Ba_{1-x}Sr_xCo₂Fe₂O₄ which are determined from the Rietveld analyses of the neutron diffraction patterns obtained at different temperatures. The angle of each sample decreases with increasing temperature. As for the sample with x = 2.0, the magnetic moment lies in c plane (canting angle: 90°) at room temperature.

Figure 2 shows the temperature dependence of magnetic moments of iron and cobalt ions in Ba_{1-x}Sr_xCo₂Fe₂O₄. Both the moment sizes decrease with increasing temperature. The moment of cobalt ion disappears at 523 K, where canting angle rapidly decreases as

shown in Fig. 1. This suggests that canting of magnetization in Co_zZ-type hexaferrite arises from magnetic anisotropy of cobalt ion.

Figure 3 shows the frequency dependence of the real part of permeability for Ba_{1-x}Sr_xCo₂Fe₂O₄. The static permeability, μ' , reaches 22 when x = 2.0. This is higher than the highest value ($\mu' = 21$) reported for the Z-type ferrites^[2]. Also x = 2.0 sample gives at 550 MHz to 3 GHz higher imaginary permeability, μ'' , than other samples.

Therefore, Ba_{1-x}Sr_xCo₂Fe₂O₄ is expected to be used as materials for gigahertz noise absorbers.

REFERENCES

[1] Y. Takada, et al., *J. Appl. Phys.*, **100**, 043904 (2006).
 [2] T. Tachibana, et al., *J. Magn. Magn. Mater.*, **284**, 369 (2004).

High Frequency Magneto-electric Properties of Composite Material Made of Soft Magnetic Ferrites and Hard Magnetic NdFeB

Chao-Ming Fu^{1,*}, Ming-Feng Kuo², Chao-Wen Cheng², Pao-Hua Chou³, and Menq-Jun Wu³

¹Physics department, National Taiwan University, Taiwan
²Physics department, National Kaohsiung Normal University, Taiwan
³Department of Mechatronics Engineering, National Changhua University of Education, Taiwan
 * Corresponding author, email: chaomingfu@physics.ntu.edu.tw, Phone: +886 2 3366 5175

The magneto-electric dynamics of composite material made of soft magnetic ferrites and hard magnetic NdFeB are studied. In this work, the nano-sized ferrites were synthesized by combustion method, and then were mixed with various amount (1, 3, 5%) of micro-sized NdFeB. The M-H behavior of the ferrites/NdFeB composites has displayed specific features of wasp-waisted hysteresis loops, correlated to the superposition of magnetization of hard and soft magnetic phases. The variation of magneto-impedance of composites has demonstrated that small amount of NdFeB additive into ferrites can significantly effect the behavior of spectra. Mechanism of hard and soft magnetic interaction underlying for the magneto-electric dynamics is investigated. The results imply for high frequency device applications utilizing ferrites/NdFeB nano-composites.

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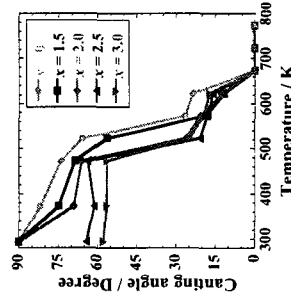


Fig. 1. Temperature dependence of canting angle of magnetic moment from c-axis for Ba_{1-x}Sr_xCo₂Fe₂O₄.

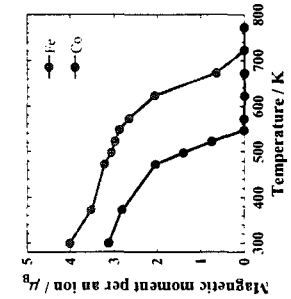


Fig. 2. Temperature dependence of magnetic moment sizes of iron and cobalt ions in Ba_{1-x}Sr_xCo₂Fe₂O₄.

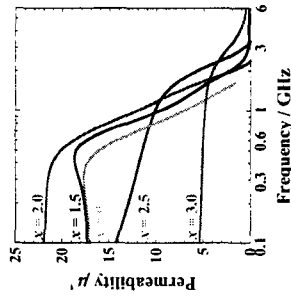


Fig. 3. Frequency dependence of the real part of permeability for Ba_{1-x}Sr_xCo₂Fe₂O₄.