Poster Presentation

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Resonant X-ray magnetic scattering study of Ti-Mn-doped Ba ferrites

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BaFe12O19 has M-type hexaferrite structure, giving strong uniaxial anisotropy of the magnetization along c axis. In doped BaTixMnxFe12-2xO19, the substitution of Fe3+ by a pair of Ti4+ and Mn2+ results in a weakening of the magnetic interactions due to the canting of magnetic moments. The crystal structure has a sequence of (Fe6O8) spinel and (BaFe6O11) hcp blocks, associated with five independent Fe sites: tetrahedral 4f1, bipyramidal 2b, and octahedral 2a, 4f2 and 12k sites. Single crystals synthesized by a flux method have cell dimensions of a = 5.8953(2) and c = 23.1887(8) Å and a = 5.9039(2) and c = 23.2047(8) Å for samples of x = 0.5 and 1.0, respectively. Each crystal was mounted with short glass fiber on rare-earth magnet and goniometer head. Conventional intensity measurements were made using a Rigaku AFC7 four-circle diffractometer with a graphite (002) monochromator for Mo Kα radiation. Site-occupancy experiments were performed by using a vertical-type four-circle diffractometer at PF-BL-10A. In this study the magnetic structure has been examined to use resonant X-ray magnetic scattering (RXMS) at the Fe K absorption edge in PF-BL-6C. Circularly polarized X rays produced by a diamond phase retarder were switched between right-handed (helicity=+1) and left-handed polarizations. An AFC-5u four-circle diffractometer was used in the geometry of horizontal scattering plane. Intensity measurements were made to collect as many as possible of Bragg reflections. Based on an asymmetrical ratio of the intensities between right- and left- handed circular polarizations, the intensity difference in the RXMS was estimated for each of reflections. A set of observed asymmetrical ratios was fitted to a model of spin orientation in crystal-structure calculations with the resonant magnetic scattering factors. A residual function in the least-squares fitting is useful to evaluate magnetic moments for individual sites, which is a multiplicity parameter refined in terms of atomic scattering factor. It gives a minimum in plot between site-multiplicity and residual function, assigning the multiplicity related to the canting of magnetic moment in the Fe sites. The magnetic structure obtained in this study is compared with those of M-type BaFe12O19 and BaTiCoFe10O19.

Keywords: Ba ferrite, ferrimagnetic structure, resonant X-ray magnetic scattering