Ferromagnetic resonance study on Y-type hexaferrite Ba$_{0.5}$Sr$_{1.5}$Zn$_2$Fe$_{12}$O$_{22}$

Osaka Univ., Japan$^1$, Inha Univ., Korea$^2$, KBSI, Korea$^3$, Sogang Univ., Korea$^4$

$^1$Jaehun Cho$^{1,2}$, Nam-Hui Kim$^2$, Jungbum Yoon$^2$, Kimyung Song$^2$, Namjung Hur$^2$, Chun-Yeol You$^2$, Seung-Young Park$^3$, Myung-Hwa Jung$^4$, Yuji Hiraoka$^1$, Tsuyoshi Kimura$^1$, Kohei Nawaoka$^1$, Shinji Miwa$^1$, and Yoshishige Suzuki$^1$

E-mail: cho@spin.mp.es.osaka-u.ac.jp

Hexaferrites have attracted considerable interests as the variety of structural and chemical variations which enable a large degree of flexibility in their magnetic phases. It has been reported Ba$_{0.5}$Sr$_{1.5}$Zn$_2$Fe$_{12}$O$_{22}$ shows magnetically induced ferroelectricity and a magnetoelectric effect related to modifications of a spiral magnetic structure by applying a magnetic field. The magnetic structure in the ferroelectric phase is stabilized only in the intermediate magnetic field regime (intermediate-III phase) and does not seem to essentially differ from the nonpolar phase in the lower magnetic field (intermediate-II phase). Observation of any subtle difference in the intermediate magnetic phases can be invaluable in understanding microscopic mechanism of the magnetically induced ferroelectricity in Ba$_{0.5}$Sr$_{1.5}$Zn$_2$Fe$_{12}$O$_{22}$.

In this study, single crystals of Ba$_{0.5}$Sr$_{1.5}$Zn$_2$Fe$_{12}$O$_{22}$ are grown from Na$_2$O-Fe$_2$O$_3$ flux and we employed vector network analyzer ferromagnetic resonance (VNA-FMR) to investigate the magnetic phase diagram of Ba$_{0.5}$Sr$_{1.5}$Zn$_2$Fe$_{12}$O$_{22}$. Fig. 1(a) shows FMR spectra with increasing field at 100K. By employing the VNA-FMR analysis, we found new magnetic dynamic phases within the intermediate-II state. (We refer to the phases as intermediate-IIA and -IIB phases.) In the two phases, distinguishable VNA-FMR spectra were obtained, as shown in Fig. 1(b).

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Fig. 1 (a) FMR spectra at 100K
(b) Magnetic Phase diagram