

Investigation of magnetic properties of non-magnetic ion (Al, Ga, In) doped $\text{Ba}_2\text{Mg}_{0.5}\text{Co}_{1.5}\text{Fe}_{12}\text{O}_{22}$

Jung Tae Lim,¹ Chin Mo Kim,¹ Bo Wha Lee,² and Chul Sung Kim^{1,a)}

¹*Department of Physics, Kookmin University, Seoul 136-702, Korea*

²*Department of Physics, Hankuk University of Foreign studies, Yongin, Kyungki, 449-791, Korea*

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$\text{Ba}_2\text{Mg}_{0.5}\text{Co}_{1.5}\text{Fe}_{12}\text{O}_{22}$ (non-doped) and non-magnetic ion (Al, Ga, In) doped $\text{Ba}_2\text{Mg}_{0.5}\text{Co}_{1.5}(\text{Fe}_{0.99}\text{M}_{0.01})_{12}\text{O}_{22}$ (M-doped) polycrystalline samples were prepared by the solid-state reaction method. The crystal structures and magnetic properties of samples were investigated with x-ray diffractometer (XRD), vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. The crystal structures of non-doped and M-doped samples were determined as hexagonal structures with $R\bar{3}m$ space group by the Rietveld refinement. The unit cell volume (V_u) of non-doped sample was $V_u = 1298.0 \text{ \AA}^3$, while those of M-doped samples (M = Al, Ga, In) were $V_u = 1295.7, 1296.7,$ and 1299.9 \AA^3 , respectively. From the magnetic hysteresis curves at room temperature, the saturation magnetization (M_s) and coercivity (H_c) of non-doped sample were found to be $M_s = 28.0 \text{ emu/g}$ and $H_c = 255.4 \text{ Oe}$, but those of M-doped samples (M = Al, Ga, In) were $M_s = 24.7, 28.4, 28.6 \text{ emu/g}$, and $H_c = 222.0, 215.9, 190.7 \text{ Oe}$, respectively. From the temperature dependence of magnetization curves under 100 Oe between 4.2 and 740 K, all samples showed magnetic structure transitions. In addition Mössbauer spectra of all samples were recorded at various temperatures ranging from 4.2 to 750 K. Based on the isomer shift (δ) values of all samples, the charge states were found to be Fe^{3+} state at 295 K. © 2012 American Institute of Physics.

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