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Investigation of Mg doped Y-type Barium hexaferrite using Mössbauer spectroscopy

Jae Sung Baik, In-Bo Shim and Chul Sung Kim*

Department of Physics, Kookmin University, Seoul 02707, Korea

Y-type barium hexaferrite $Ba_2Co_2xMgxFe_{12}O_{22}$ (x = 0, 0.1, 0.3, 0.5) was prepared by conventional solid-state reaction method. The samples were sintered first at 1100 °C and then at 1150 °C to obtain the single phase $Ba_2Co_{2-x}Mg_xFe_{12}O_{22}$ samples. To observe the crystal structure of the prepared sample, X-ray diffraction (XRD) with Cu-Kα (λ = 1.5406 Å) was used. The analysis of the XRD patterns showed that the $Ba_2Co_2xMgxFe_{12}O_{22}$ is hexagonal in the R-3m space group. To investigate the magnetic properties, a vibrating sample magnetometer (VSM) and Mössbauer spectroscopy were utilized. The hysteresis loops and the zero field cooled-field cooled (ZFC-FC) curves of the samples were obtained via VSM. The results of the M-H experiment showed that, the saturation magnetization (M_s) and the coercivity (H_c) decreased with increasing Mg^{2+} concentration. The spin reorientation temperature (T_s) was observed in the ZFC-FC curves obtained through temperature dependent magnetization experiments. The T_s was decreased from 215 to 202 K as the substitution of Mg^{2+} ions increased. The Mössbauer spectra were obtained using Mössbauer spectroscopy. The Mössbauer experiments were conducted from 4.2 to 295 K. The results of the Mössbauer experiments at various temperatures showed that the magnetic hyperfine fields (H_{hf}) decreased with an increase in temperature. The isomer shift (δ) values maintained at approximately 0.1 ~ 0.4 mm/s. The ion state of the iron at all temperatures was Fe^{3+}. The quadrupole splitting (ΔE_Q) values were stably maintained; however, they changed abruptly at T_s.

***Index Terms*—Hexaferrite, Mössbauer spectroscopy, Magnetic properties, Mg ion substitution.**