Temperature-Dependent Magnetic Properties of Bismuth Substituted Terbium–Iron Garnets

Il Jin Park, Kun Uk Kang, and Chul Sung Kim

Departments of Physics, Kookmin University, Seoul 136-702, Korea

The crystallographic structure and magnetic properties of bismuth substituted terbium–iron garnets have been studied using X-ray diffraction (XRD), vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. The crystal structures were found to be a cubic garnet structure with space group *Ia3d*. The lattice constants increase linearly with increasing bismuth concentration. The field-cooled magnetization curves measured at various external fields. The compensation temperature(T_{comp}) were determined at 260, 170, and 120 K, for $x = 0.0$, 0.5, and 1.0, respectively. Bisubstituted samples have the negative value with large coercivity below T_{comp}. In order to study the change of the detailed local structure on bismuth substituted samples, Mössbauer spectra were measured at various temperatures from 4.2 K to Néel temperature. Above T_{comp}, the spectra for the samples consist of two sextets, and the isomer shifts at room temperature of (16a) and (24d) sites are 0.26 and 0.04 mm/s. Below T_{comp}, the spectra for the samples consist of three sublattice structures (16a), (16a'), and (24d). In octahedral (16a') site, electric quadrupole splitting decreases up to -0.2 mm/s with decreasing temperature from T_N to 4.2 K. Therefore, we insist that the negative magnetization is related to the local anisotropy of 16a' site by the strong covalent interaction between bismuth and iron.

***Index Terms*—Garnet, Mössbauer spectroscopy, negative magnetization, sol-gel method.**