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Temperature Dependent Cation Distribution in $Tb_2Bi_1Ga_1Fe_4O_{12}$

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In this study, heavy rare earth garnet $Tb_2Bi_1Ga_1Fe_4O_{12}$ powders were fabricated by a sol-gel and vacuum annealing process. The crystal structure was found to be single-phase garnet with a space group of *Ia3d*. The lattice constant a_0 was determined to be 12.465 Å. From the analysis of the vibrating sample magnetometer (VSM) hysteresis loop at room temperature, the saturation magnetization and coercivity of the sample are 7.64 emu/g and 229 Oe, respectively. The Néel temperature (T_N) was determined to be 525 K. The Mössbauer spectrum of $Tb_2Bi_1Ga_1Fe_4O_{12}$ at room temperature consists of 2 sets of 6 Lorentzians, which is the pattern of single-phase garnet. From the results of the Mössbauer spectrum at room temperature, the absorption area ratios of Fe ions on 24*d* and 16*a* sites are 74.7 % and 25.3 % (approximately 3:1), respectively. These results show that all of the non-magnetic Ga atoms occupy the 16*a* site by a vacuum annealing process. Absorption area ratios of Fe ions are dependent not only on a sintering condition but also on the temperature of the sample. It can then be interpreted that the Ga ion distribution is dependent on the temperature of the sample. The Mössbauer measurement was carried out in order to investigate the atomic migration in $Tb_2Bi_1Ga_1Fe_4O_{12}$.

Keywords : vacuum annealing process, $Tb_{3-x}Bi_xFe_5O_{12}$, cation distribution, Mössbauer spectroscopy