# Spin Rotation at Compensation Point Studies of $Tb_3Fe_5O_{12}$ by Mössbauer Spectroscopy

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***Abstract*—The crystallographic and magnetic properties of $Tb_3Fe_5O_{12}$ were studied using X-ray diffraction, vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. The crystal structure were found to have a single phase of garnet cubic structure, and the lattice constants of TbIG was found to be $a_0 = 12.4364$ Å. The Rietveld refinement of X-ray pattern convinced that Tb ions fully occupied into the $24c$ site. The VSM measurements were performed in the temperature range from 30 to 700 K, which covers both the Néel temperature ($T_N = 560 \pm 5$ K) and the compensation temperature ($T_{comp} = 260 \pm 5$ K). In order to elucidate magnetization on this sample, Mössbauer spectra of TbIG were measured at various absorber temperatures from 13 K to Néel temperature. Over the compensation temperature, the Mössbauer spectrum for the sample was considered as a superposition of two sextets. However, below the compensation temperature, the spectrum of the sample showed an additional sharp sextet. Also, the additional set of spectrum persisted up to 260 K, and then disappeared above this temperature. This type of three iron sets in garnet system cannot be explained only by collinear magnetic moment or spin frustration. We suggest that this anomaly originates from the exchange interaction between the octahedral iron moment and the non collinear Tb moments. Temperature dependence of Mössbauer spectra at compensation point is closely related to noncolliner spin rotation.**

***Index Terms*—Compensation temperature, garnet, Mössbauer spectroscopy, sol-gel process.**