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Spin-reorientation and Mössbauer studies of orthoferrites $TbFe_{0.75}Mn_{0.25}O_3$

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The rare earth orthoferrites (RFeO$_3$ where, R = rare earth) have attracted interest because of their potential magnetic and electrical application [1,2]. The distorted perovskites $TbFe_{1-x}Mn_xO_3$ with a variable Mn concentrations are interesting substance for studying the influence of the Jahn-Teller ions Mn^{3+} on the magnetic properties and spin-reorientation transitions [3]. Mn^{3+} substituted orthoferrites $TbFe_{0.75}Mn_{0.25}O_3$ were prepared by the sol-gel method. The crystallographic and magnetic properties of powders were characterized by X-ray diffraction (XRD), Mössbauer spectroscopy, and vibrating sample magnetometry (VSM). The crystal structure was found to be single phase of orthorhombic structure (space group *Pbnm*) by the Rietveld refinement method. It is found that the resulting lattice constants are a_0 = 5.317 Å, b_0 = 5.604 Å, and c_0 = 7.598 Å, respectively. Mössbauer spectra of $TbFe_{0.75}Mn_{0.25}O_3$ have been taken at various temperatures ranging from 4.2 to 550 K. For Mössbauer spectra, we have fitted the spectra to a model based on a random distribution of Fe and Mn ions on the octahedral sites. The magnetic hyperfine fields of the four pattern (B_0, B_1, B_2, B_3) at 4.2 K are found to be H_{hf} = 553, 544, 535, and 527 kOe, respectively. Isomer shift at room temperature is 0.37-0.38 mm/s, which mean that the valence state of Fe ions is ferric (Fe^{3+}). The Néel temperature was determined to be T_N = 550 ± 5 K by the Mössbauer thermal scan method and VSM. The magnetic moment rapidely decreases with increasing temperature from 50 K and then it jump near 180 K, and again it decrease gently up to near 500 K, finally it fall suddenly at about 500 K. This inflection points in the *M-T* curve can arise from a spin-reorientation in the antiferromagnetically ordered state of the slightly distorted perovskite structure. Its spin-reorientation transition is 70 K lower than the value of 250 K for pure $TbFeO_3$.

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