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ORIGINAL PAPER

Spin-Reorientation and Mössbauer Study of Orthoferrite $TbFe_{0.75}Mn_{0.25}O_3$

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Abstract The crystallographic and magnetic properties of $TbFe_{0.75}Mn_{0.25}O_3$ powder were characterized by x-ray diffraction (XRD), Mössbauer spectroscopy, and vibrating-sample magnetometry (VSM). The crystal structure was found to be orthorhombic (space group *Pbnm*) with lattice constants $a_0 = 5.317$ 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 0.25–0.26 mm/s, which means that the valence state of Fe ions is ferric (Fe^{3+}). A sudden change in both the magnitude of magnetic hyperfine field and its slope between 150 and 220 K suggests that magnetic phase transition related to the spin ordering takes place abruptly. The Néel temperature was determined to be $T_N = 550 \pm 5$ K. The inflection points arising from a spin reorientation in the temperature dependence of the magnetic moment is observed. Its spin-reorientation transition is 70 K lower than that of 250 K for pure $TbFeO_3$.

Keywords Mössbauer spectroscopy · Orthoferrite · Sol-gel