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Effects of the Tb-Ion Concentration in Multiferroic $Tb_xY_{1-x}Mn_{1.99}{}^{57}Fe_{0.01}O_5$ (x = 0.0, 1.0) Materials

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Multiferroic $Tb_xY_{1-x}Mn_{1.99}{}^{57}Fe_{0.01}O_5$ (x = 0.0, 1.0) was synthesized by using a sol-gel method. The lattice constants of $Tb_xY_{1-x}Mn_{1.99}{}^{57}Fe_{0.01}O_5$ with Tb substitution of x = 0.0 and x = 1.0 were determined to be a_0 = 7.275 Å, b_0 = 8.487 Å, c_0 = 5.674 Å and a_0 = 7.334 Å, b_0 = 8.523 Å, c_0 = 5.679 Å, respectively. The magnetic moment of $YMn_{1.99}Fe_{0.01}O_5$ decreased sharply with temperature down to a temperature of 25 K due to the canted magnetic moment. However, a large increase in the magnetic moment was observed in $TbMn_{1.99}Fe_{0.01}O_5$. The Mössbauer spectra of $Tb_xY_{1-x}Mn_{1.99}{}^{57}Fe_{0.01}O_5$ (x = 0.0, 1.0) exhibited two-sextet patterns at 4.2 K. There was a noticeable difference in magnetic hyperfine fields at the tetrahedral site ($^{Y}H^{A}_{hf}$, $^{Tb}H^{A}_{hf}$). We also observed similar behaviours in the electric quadrupole splitting values at pyramidal site ($\Delta^{Y}E^{A}_{Q}$, $\Delta^{Tb}E^{A}_{Q}$). Furthermore, the electric quadrupole splitting of $Tb_xY_{1-x}Mn_{1.99}{}^{57}Fe_{0.01}O_5$ (x = 0.0, 1.0) showed discontinuous jump below 30 K. These suggest that the multiferroic properties of $Tb_xY_{1-x}Mn_{1.99}{}^{57}Fe_{0.01}O_5$ are greatly affected by the magnetic ordering.

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