Magnetic properties of $TbMn_{1-x}Fe_xO_3$ single crystals

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$TbMnO_3$ is a multiferroic compound, exhibiting magnetic ordering of Mn ions, with a sinusoidally modulated collinear magnetic structure along the *a*-axis (*Pnma* space group) below $T_N = 41$ K. This magnetic structure changes to a cycloidal phase below $T_s = 28$ K, which is accompanied by the emergence of a spontaneous electric polarization along the *b*-axis, accordingly to Dzyaloshinskii-Moriya model. On further cooling, Tb^{3+} spins order independently from the Mn^{3+} sublattice at $T_1 = 7$ K [1, 2]. In order to tune the balance between the competitive ferro- and antiferromagnetic interactions leading to frustrated magnetic structures, we have studied the effect of Fe^{3+} substitution for Mn^{3+} on selected physical properties of $TbMn_{1-x}Fe_xO_3$, with $x = 0$ to 0.05 and we presented a detailed characterization of the structural, thermal, magnetic, polar and magnetoelectric properties of the $TbMn_{1-x}Fe_xO_3$ system as well as a lattice dynamical study at low temperatures by Raman spectroscopy [3, 4]. We have found that already at $x = 0.05$ ferroelectricity is lost and below this concentration there is a strong dependence of the magnetoelectric response on Fe concentration.

Our present paper is focused on the study of magneto crystalline anisotropy which we performed on oriented $TbMn_{1-x}Fe_xO_3$ single crystals ($x = 0.0$, 0.02 and 0.04) by magnetization and AC susceptibility measurements. Our measurements revealed huge magneto crystalline anisotropy with respect to main crystallographic axes. The magnetic phase transitions at T_N, T_s and T_1 are connected with anomalies in magnetization and AC susceptibility measurements performed along *b*-axis. On the other hand field induced magnetic transitions we observed below T_1 only on measurements along *a*-axis and *c*-axis.

References:

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The research was supported by VEGA 2/0137/19 project.