CORRELATION BETWEEN NÉEL TEMPERATURE AND SUPEREXCHANGE INTERACTION Fe-O-Fe LINKAGE ANGLES IN $\mathbf{TbFe_{1-x}Al_xO_3}$

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In rare earth orthoferrites $REFeO_3$ the Fe^{+3} ions, nearly octahedrally coordinated with oxygen ions, interact through O^{-2} with other Fe^{+3} ions. These superexchange interactions strongly depend on the Fe^{+3}–O^{-2}–Fe^{+3} linkage angle. There are two such linkages: with first and with second neighbours, with corresponding to them θ_I and θ_{II} angles (of $140^o...150^o$ range). The Fe sublattice Néel temperature is proportional to these angles according to phenomenological formula $T_N = -\frac{1}{3}T_N(\theta = 180^o)(\cos\theta_I + 2\cos\theta_{II})$, where $T_N(\theta = 180^o)$ coefficient is Néel temperature of a hypothetical orthoferrite with linkage angle of 180^o. From powder X-ray data, the linkage angles were calculated for the whole $TbFe_{1-x}Al_xO_3$ series. T_N was measured by the differential scanning calorimetry (DSC) for $x \leq 0.4$. Both T_N and $-\frac{1}{3}(\cos\theta_I + 2\cos\theta_{II})$ quantities are linear functions of x. Comparison of them allows to estimate the value of $T_N(\theta = 180^o) \approx 752$ K.

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9.7 cm

13.4 cm

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