Low Temperature Study of the Complex Magnetic Order in $Yb_{0.9}Sr_{0.1}MnO_3$ Using Neutron Diffraction

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The present study devoted to investigation of the complex mixed crystal structure of multiferroic materials $Yb_{0.9}Sr_{0.1}MnO_3$. The effect of nano crystalline size on its physical properties was studied. X-ray diffraction, Raman scattering and neutron diffraction of $Yb_{0.9}Sr_{0.1}MnO_3$ confirmed possessing of mixed phases (orthorhombic/hexagonal phase) with space group *Pnma* (62) for orthorhombic phase while a space group $P6_3cm$ (185) for hexagonal phase. The orthorhombic phase decreases with heat treatment of $Yb_{0.9}Sr_{0.1}MnO_3$ from 28 to 1%. Neutron diffraction measurements were carried from 2.6K up to room temperature and antiferromagnetic ordering of $Yb_{0.9}Sr_{0.1}MnO_3$ is appeared near T_N near 87K which is attributed to c-type anti-ferromagnetic ordering and $\Gamma 2$ anti-ferromagnetic ordering. Theoretical model is presented and it is based on the Monte Carlo simulation of the magnetization as a function of crystal and the temperature. Moreover, the internal energy was calculated based on Ising model. Theoretical calculations confirmed the experimental results.

Key words: Neutron; Diffraction; Manganite; Hexagonal; Orthorhombic; Magnetic; Ising model