

Structural, magnetic and electrical properties of $\text{La}_{1-x}\text{Bi}_x\text{MnO}_{3+\delta}$ ($\delta=0.09$) perovskite compounds

N. Biniskos, M. Calamiotou, E. Syskakis*

Section of Solid State Physics, Department of Physics, University of Athens, Panepistimiopolis, Gr-15784 Zografos, Athens.

*email: esysk@phys.uoa.gr

LaMnO_3 is an antiferromagnetic insulator with orthorhombic symmetry, while BiMnO_3 is a ferromagnetic insulator with monoclinic symmetry. These remarkably different properties are unambiguously established despite the fact that the A-site in both compounds is occupied only by trivalent cations with similar ionic radii. The polarizability of the $6s^2$ lone pair of Bi [1,2] seems to be responsible not only for the above mentioned differences, but also for the multiferroic properties of BiMnO_3 . In the present work phase and magnetic transitions of $\text{La}_{1-x}\text{Bi}_x\text{MnO}_{3+\delta}$ ($0.00 < x < 0.30$) with high O_2 excess ($\delta=0.09$) have been investigated by electrical resistance ($R(T)$), ac susceptibility (χ_{ac}) and low field magnetoresistance (LFMR) in the region $80 < T < 300\text{K}$. The phase composition and structural properties were also investigated by X-ray diffraction (XRD) at $T=300\text{K}$. The compounds were synthesized by solid state reaction at $T=1030^\circ\text{C}$ in air, using high purity La_2O_3 , MnO_2 and Bi_2O_3 .

According to X-ray powder diffractometry the samples are single phase perovskites crystallizing with rhombohedral symmetry (R3c) (see Fig.1a). The electrical conductivity, $\sigma(T)$, can be described by the small polaron model and is strongly correlated with the observed long range FM order at $T < 150\text{K}$ in the frame of the double exchange (DE) mechanism. Bi doping in the specimen causes an increase of the unit cell volume. With the assumption that δ is independent of Bi content this can only be understood if the $6s^2$ lone pair of Bi is active. The observed decrease of the Curie temperature, T_C , and the accompanied weakening of the LFMR (see Fig.1b) might be explained as a consequence of structural deformation caused by the $6s^2$ lone pair too.

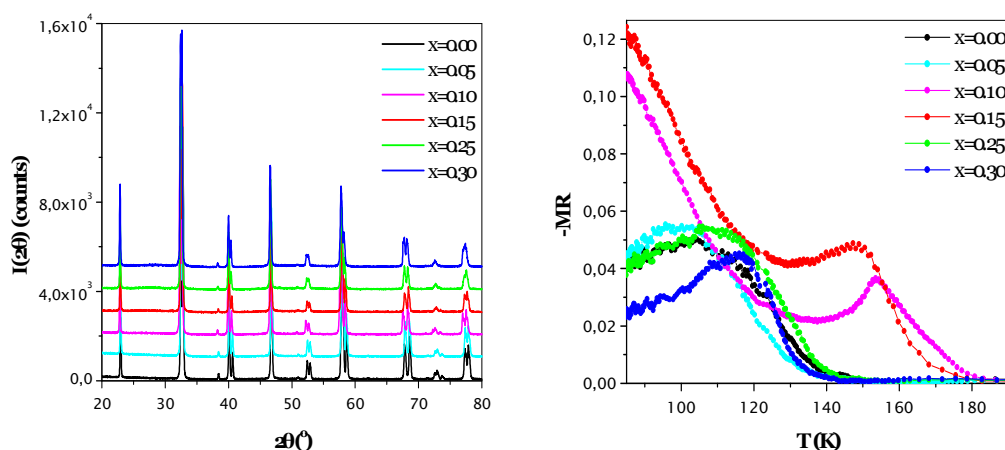


Fig 1: (a) X-Ray Diffractograms, (b): MR(T) measurements of Bi-doped specimen treated in O_2 at $T=1030^\circ\text{C}$ for 100h.

[1]: Nicola A. Hill, J. Phys. Chem. B, 104, 6694-6709 (2000)

[2]: T. Kimura et al, Nature 426, 55 (2003)