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Physical properties of modified $BaTiO_3$ thin films

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Recently, materials with multifunctional character have attracted the attention as the cross-coupling between the sub-lattices facilitates the design of variety of applications include multistate memories and logic devices, tunable filters, sensors etc. Electric field control of ferromagnetism in multiferroics through the magnetoelectric coupling has been reported in several single phase and composite materials. In single phase materials this effect arises due to the sub-lattice interaction while the product property between magnetostrictive and piezoelectric phases gives rise to the ME interaction. The present work is aimed to study ME properties of B-site modified $BaTiO_3$ thin films.

$BaTiO_3$ (BTO) was chosen for the present study due to its simple crystal structure and relatively low Curie temperature (120 ^oC). Since the B-site of the lattice allows large number of dopants, we chose Fe^{3+} for some Ti^{4+} ions. Earlier reports on Fe-doped BTO have shown that the doping induces ferromagnetism and increased optical absorption. Hence, we studied this material to observe multiferroic physical properties by fabricating heterostructures using pulsed-laser deposition (PLD). High density ceramic target with composition $BaTi_{0.6}Fe_{0.4}O_3$ (BTFO) was synthesized by the conventional ceramic route. Thin films were deposited on STO (001) using an excimer laser of 248-nm (KrF) wavelength with a repetition rate of 2 Hz at several temperatures in the range 600-800 ^oC under oxygen partial pressure of 10mTorr. The quality and structure of the films was characterized by means of High Resolution-X-ray diffraction, high-resolution transmission electron microscopy and Atomic force microscope. Fig.1 presents the XRD data of BTFO thin films grown at 1 and 10mTorr oxygen pressures. Dielectric, ferroelectric and magnetic characterization of the films was carried out. The obtained results are explained based on the growth conditions and epitaxial constraints.

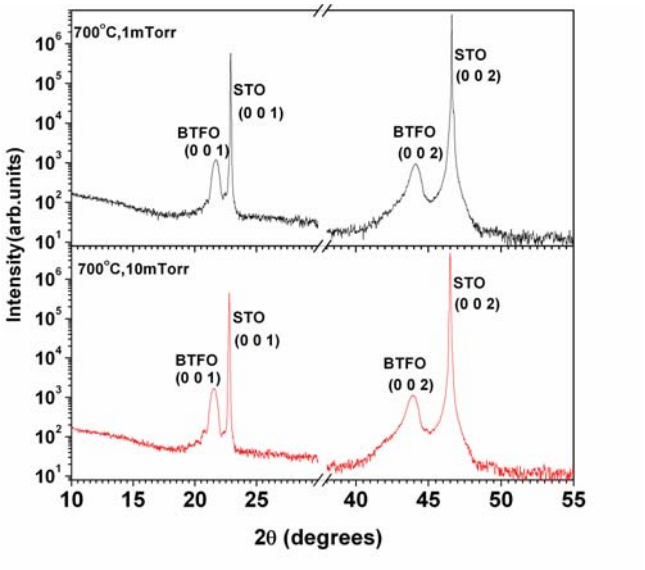

Fig.1 XRD patterns of BTO thin films grown on STO(001).

References

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