Abstract

The growth of composite multiferroic films and study of their properties has been an active area of research in the present decade for their potential applications in Si based multi-level memory devices. The present research study is concerned with the growth, structural and electrical characterization of 0-3 composite films of strontium bismuth tantalate (SBT) and lanthanum strontium manganese oxide (LSMO) thin films on Si-based substrates for device applications.

Nano-crystalline LSMO powders were prepared by using solution combustion synthesis. Calcined powders pressed into pellets were sintered in air to produce PLD targets. Density, structural, and composition analyses carried out using XRD, SEM and XPS showed the targets to be highly dense, polycrystalline and phase pure. Magnetic measurement using SQUID showed the nano-crystalline powders to be magnetic.

The structural characteristics of pulsed laser deposited LSMO films on Si substrate under various process parameters were investigated using X-ray diffraction, atomic force microscopy and electrical measurements. The crystallite size and oxygen content of ablated LSMO films increased with increasing substrate temperature. The microstructure and oxygen content of the films were found to be largely influenced by the oxygen partial pressure during deposition. Electrical properties of the LSMO films were evaluated using standard four probe technique. The overall resistivity and peak position in the resistance (R)-temperature (T) plot of the films were found to be affected by the process parameters. The changes in the R-T plot have been explained in the light of the oxygen content, crystallinity and surface roughness of the films.

Structural and electrical characteristics of pseudo co-ablated 0-3 $SBT_{(1-x)}$-$LSMO_{(x)}$ composite films deposited on $Si/SiO_2/Ti/Pt$ substrate have been investigated. Complex impedance and modulus spectroscopy of the composite films were found to be significantly affected by the incorporation of LSMO as a second phase in the SBT matrix. Overall dielectric and conductive property of the films were found to initially increase with doping concentration x.

The physical and magneto-electrical properties of pulsed laser deposited LSMO-SBT composite thin films on Si substrate have been studied. Magneto-resistance and four probe ρ-T characteristics were measured for LSMO rich films at broad range of

magnetic field and temperature. Capacitance-voltage measurements indicated the ferroelectric nature of the composite films.

Keywords: Multiferroic films, Lanthanum strontium manganese oxide, Strontium bismuth tantalate, Impedance spectroscopy and PLD