Characterization and conduction mechanism of La5/8Sr3/8MnO3 thin films prepared by pulsed laser deposition on different substrates

ABSTRACT

The La5/8Sr3/8MnO3 (LSMO) thin films were directly grown on MgO and Si wafer substrates by Pulsed Laser Deposition (PLD) technique. The films were characterized using X-ray diffraction (XRD), field emission-scanning electron microscope (FE-SEM). The electrical and magnetic properties of films are studied. From the XRD patterns, the films are found polycrystalline single-phases. The highest magnetoresistance (MR) value obtained was −17.21% for LSMO/MgO film followed by −15.65% for LSMO/Si film at 80K in a 1T magnetic field. Transition temperature (TP) is 224K for LSMO/MgO and 200K for LSMO/Si film. The films exhibit a ferromagnetic transition at temperature (TC) around 363K for LSMO/MgO and 307K for LSMO/Si film. For LSMO/MgO, the high Curie temperature such as 363K is one of the high TC in all LSMO thin films and as our knowledge, is the highest value that is reported in literature for MgO substrates with high lattice mismatch parameter. The conduction mechanisms for both films have been extensively investigated. In the metallic regime, resistivity seems to emanate from the electron–electron (major) and electron-magnon (phonon) scattering processes. For both films in the range of T >TP, the resistivity data were well fitted by both variable range hopping (VRH) and small polaron hopping (SPH) models giving higher density state, and lower activation energy and Mott temperature T0 for LSMO/Si film than those for LSMO/MgO film. The high TC such as 363K makes these LSMO/MgO films very useful for room temperature magnetic devices.

Keyword: Crystal structure; Thin film; Polycrystalline; Pulse laser deposition.