Electrical properties and conduction mechanisms in La2/3Ca1/3MnO3 thin films prepared by pulsed laser deposition on different substrates

ABSTRACT

Perovskite manganite La2/3Ca1/3MnO3 thin films were directly grown on MgO(100), Si(100) and glass substrates by pulsed laser deposition. From the XRD patterns, the films are found to be polycrystalline, single-phase orthorhombic. The metal-insulator transition temperature is 209 K for LCMO/MgO, 266 K for LCMO/Si and 231 K for film deposited on the glass substrate. The conduction mechanism in these films is investigated in different temperature regimes. Low-temperature resistivity data below the phase transition temperature (T P) have been fitted with the relation ɟ = ɟ0 + ɟ 2T2 + ɟ 4.5T4.5, indicating that the electron-electron scattering affects the conduction of these materials. The high-temperature resistivity data (T > T P) were explained using variable-range hopping (VRH) and small-polaron hopping (SPH) models. Debye temperature values are 548 K for LCMO/Cg, 568 K for LCMO/Si and 508 K for LCMO/MgO thin films. In all thin films, the best fitting in the range of VRH is found for 3D dimension. The density of states near the Fermi level N (E F) for LCMO/MgO is lower due to the prominent role of the grain boundary in LCMO/MgO and increase in bending of Mn-O-Mn bond angle, which decreases the double exchange coupling of Mn 3+-O2-Mn4+ and in turn makes the LCMO/MgO sample less conducting as compared to the other films.

Keyword: La2/3Ca1/3MnO3 thin films; Pulsed laser deposition; Thin films; Perovskite manganites