

Semiconducting and magnetic properties of La_{0.67}Ca_{0.33}Mn_{1-x}Dy_xO₃ ceramics

ABSTRACT

Electrical resistivity measurements of La_{0.67}Ca_{0.33}Mn_{1-x}Dy_xO₃, $x = 0.00$ to 0.12 , ceramics have been studied using a standard four point probe technique, while the magnetic behaviour have been studied using Ac susceptibility technique. The transport properties show the transition of semiconducting to metallic conductivity at TP and Paramagnetic-Ferromagnetic transitions, TC, were observed in the χ -temperature curves for all samples. The existence of metallic conductivity, TP, and ferromagnetism, TC, were found to be linearly correlated. This phenomenon of coexistence are due to the double exchange interaction of two electrons in Mn³⁺-O²⁻-Mn⁴⁺ and Mn⁴⁺-O²⁻-Mn³⁺ configuration which brings the system below T_c into a metallic state. Hence it is observed that the Curie temperature T_c is closely related to the sharp decrease in the electrical resistivity of the samples. However, both transition temperatures shift to lower temperature as dysprosium doping increases indicating the loss of ferromagnetic order and transport properties. As for the transport properties the semiconductor model $\ln(\sigma)$ to approximately $(E_g/2kT)$ was used to explain the conduction mechanism of perovskite manganites above T_p. It was concluded that the total conductivity, σ_{tot} , consists of the intrinsic and the extrinsic components, such that $\sigma_{tot} = \sigma_{int} + \sigma_{ext}$. The energy gap decreases initially from 0.11 eV to a minimum value of 0.06 eV at $x = 0.03$ and increases again to 0.08 eV at the composition of $x = 0.12$ for extrinsic region.

Keyword: Ceramic; Semiconducting; Magnetic behaviour; Transport properties