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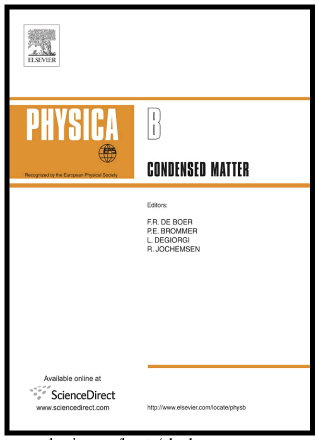

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Characterization of magnetic phase in yttrium-doped polycrystalline $La_{1-x-y}Y_yCa_xMnO_3$ with $x = 0.05,\ 0.33$ and $y = 0.07$ using dielectric and optical parameters

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Abstract

The dielectric permittivity of yttrium-doped polycrystalline samples $La_{1-x-y}Y_yCa_xMnO_3$ with $x = 0.05,\ 0.33$ and $y = 0.07$ has been measured at frequencies f from 20 Hz to 2 MHz and at temperatures T from 80 K to 350 K. These samples were prepared in the form of bulk polycrystals(ceramics) by solid state reaction method and characterized by X-ray diffraction technique. With the decrease in temperature, this system exhibits a phase transition from paramagnetic insulating to ferromagnetic metallic at a temperature $T_{MI} = 225$ K for $x = 0.05$ and at 170 K for $x = 0.33$. In this report, it is shown that such phase transition can be characterized by the exponents obtained from the scaling analysis of the variation of the real and the imaginary part of the dielectric permittivity ϵ_1 and ϵ_2 and the loss factor $tan\delta$ as a function of frequency and temperature. Results are analyzed systematically from the existing theoretical models and the scaling formalism.

Keywords

Polycrystalline system, Dielectric properties, Scaling, Master curve, Exponent, Magnetic phase transition

PACS:75.47.Lx, 51.50.+v, 77.22.Gm

1. Introduction

Divalent cation doped polycrystalline $La_{1-x}Ca_xMnO_3$ shows a strong correlation between metallicity and ferromagnetism and a metal-insulator transition (MIT) at a temperature T_{MI} with a ferromagnetic metallic(FMM) ground state at lower temperature and paramagnetic insulating(PMI) state at high temperature [1]. The existence of FMM state is explained by double-exchange (DE) mechanism based on the strong Hund coupling between t_{2g} and e_g electrons [2]. This transition temperature T_{MI} depends on the fraction of divalent cation x and the magneto-transport in such polycrystalline systems is mostly determined by the bond lengths and the bond angles of $Mn^{3+}-O-Mn^{4+}$. The substitution of smaller trivalent ion Y^{3+} (ionic radius=1.018A)