Magnetic properties and conduction mechanism in $La_{0.7}Sr_{0.25}Na_{0.05}Mn_{0.8}Al_{0.2}O_3$ manganites

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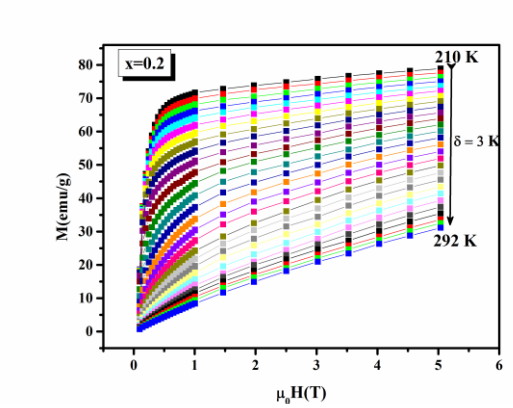
Abstract



The Al-substitution influence on the magnetic and dielectric properties of the electron-doped manganese oxides $La_{0.7}Sr_{0.25}Na_{0.05}Mn_{0.8}Al_{0.2}O_3$ was investigated. Based on Banerjee's criteria and Franco's universal curves, we proved the existence of a second-order magnetic phase transition in the samples. the value of the critical exponents of the magnetic phase transitions suggest that the magnetic phase transition of the samples falls into the three-dimensional (3D) Heisenberg universality classes, corresponding to short-range ferromagnetic (FM) order due to FM clusters in a wide temperature range even above T_C. Impedance measurements were made on the prepared sample over a wide range of temperatures (150-300 K) and frequencies (40Hz-1MHz), which show the presence of both bulk and grain boundary effects in the material. An equivalent circuit model is applied to explore the physical parameters associated with grains and grain boundaries. Detailed study of impedance parameters shows the non-Debye temperature of relaxation phenomena in the system. The dc conductivity depicted a semiconductor to metal type transition and the variation of ac conductivity with frequency at different temperatures obeys the universal Jonscher's power law.