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Magnetic properties and colossal magnetoresistance of $La_{0.67}Ca_{0.33}Mn_{0.99}Fe_{0.01}O_3$ materials

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Polycrystalline perovskite with composition $La_{0.67}Ca_{0.33}Mn_{0.99}Fe_{0.01}O_3$ has been produced by a metal-salt routed sol-gel processing method. Colossal magnetoresistance of $La_{0.67}Ca_{0.33}Mn_{0.99}Fe_{0.01}O_3$ has been studied with x-ray diffraction, Rutherford back-scattering spectroscopy, Mössbauer spectroscopy and vibrating sample magnetometer. Crystalline $La_{0.67}Ca_{0.33}Mn_{0.99}Fe_{0.01}O_3$ was perovskite cubic structure with a lattice parameter a_0=3.868 Å. Mössbauer spectra of $La_{0.67}Ca_{0.33}Mn_{0.99}Fe_{0.01}O_3$ have been at various temperature ranging from 4.2 K to room temperature. Analysis of ^{57}Fe Mössbauer data in terms of the local configurations of Mn atoms has permitted the influence of the magnetic hyperfine interactions to be monitored. The values of the isomer shifts show that all iron ions are in the Fe^{3+} state. For magnetic fields > 8 kOe and T < 100 K the magnetic moment is saturated at the value is 85 emu/g. The Curie temperature, T_C, is determined to be 270 K. The doping of ^{57}Fe reduces Curie temperature and saturation magnetization. The temperature dependence of the resistance for $La_{0.67}Ca_{0.33}Mn_{0.99}Fe_{0.01}O_3$ under zero and 10 kOe applied field is shown that a semiconductor-metal transition, T_{SC-M}, occurs at 250 K. The relative magnetoresistance, MR, defined as : [R(0) - R(H)] / R(H), is about 33 %.

Key words : CMR, Sol-gel, VSM, Mössbauer