Magnetic Refrigeration Properties of $La_{0.8}Ca_{0.2}Mn_{0.99}{}^{57}Fe_{0.01}O_3$

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The $La_{0.8}Ca_{0.2}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ sample was prepared by sol-gel method. The crystallographic and magnetic properties of $La_{0.8}Ca_{0.2}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ have been studied using x-ray diffraction (XRD), vibrating sample magnetometer (VSM) and Mössbauer spectroscopy measurements. The crystal structure of $La_{0.8}Ca_{0.2}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ was found to be orthorhombic $(Pnma)$ structure with lattice constants $a_o = 5.486$ Å, $b_o = 7.761$ Å, and $c_o = 5.510$ Å at room temperature. The Curie temperature (T_c) is determined to be 160 K by zero field coolded (ZFC) magnetization curve under 5 kOe applied field. The maximum value of magnetic entropy changes, $|\Delta S_M|$ is 1.25 J/kg • K at 157 K under 13 kOe applied field. Mössbauer spectrum at 4.2 K was fitted with two independent magnetic components of the magnetic hyperfine fields $H_{f,1} = 526$ kOe and $H_{f,2} = 501$ kOe. Mössbauer spectra show that the two well-resolved sextets show nearly equal intensities between them without any external fields. This unusual phenomenon provides direct evidence of the two-phase character of the metallic state in the mixed valence state of $La_{0.8}Ca_{0.2}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ powder.

***Index Terms*—$La_{0.8}Ca_{0.2}Mn_{0.99}{}^{57}Fe_{0.01}O_3$, magnetic refrigeration, magnetocaloric effect, Mössbauer spectra, sol-gel method.**