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Effects of rare earth ions substitution on the magnetocaloric and critical behavior of $La_{0.6}A_{0.2}Sr_{0.2}MnO_3$ (A=Pr, Nd, Ce) manganite

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Abstract

We have studied the influence of Ce, Pr and Nd elements substitution on the magnetic and magnetocaloric properties of $La_{0.6}A_{0.2}Sr_{0.2}MnO_3$ (A=Pr, Nd, Ce) polycrystalline manganites. X-ray diffraction patterns show that the samples crystallize in the rhombohedral structure with R-3C space group. The Pr and Nd doped samples are single phase, while Ce doped sample has a CeO_2 secondary phase. The temperature dependent magnetization exhibits a sharp paramagnetic (PM)–ferromagnetic (FM) transition at 333, 252 and 243 K for Ce, Pr and Nd doped samples, respectively. The results show that the saturation magnetization of the pure and Nd doped samples are higher than Pr doped sample, while the Ce doped sample exhibits lowest magnetization. The magnetic entropy change (ΔS_M) was calculated by applying the Maxwell equation and the estimated values in H=25 kOe were found to be 3.20, 2.63, 3.34 and 3.50 J/kgK for pure, Pr, Nd and Ce doped samples, respectively. Also, improved relative cooling power was observed for the Pr and Nd doped samples. By using three different methods including analyzing magnetization data using Banerjee's criterion, normalizing entropy change versus reduced temperature and using $\Delta S_M(T)$ data which is related to the local exponent (n_L), it is found that all samples display a second-order magnetic phase transition. The critical exponents