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ABSTRACT

Structural and magnetic properties of the compositions $(La_{0.7}Pr_{0.3})_{0.8}Sr_{0.2}Mn_{0.9}Ti_{0.1}O_{3\pm\delta}$ prepared at different oxygen partial pressures were investigated over a wide temperature range. The temperatures of phase structural transitions were found; their values varied significantly depending on the oxygen index δ. The first structural transition was due to the cooperative Jahn-Teller effect occurred within the orthorhombic system. The second transition occurs at a higher temperature at which the orthorhombic phase transformed into a rhombohedral phase. The temperature of this transition increased with increasingδ and was equal to ~323 K (δ=+0.03), 353 K (δ=+0.02)and 623 K (δ=-0.03).The temperature dependence of the magnetization evidenced that all compositions exhibited a ferromagnetic to paramagnetic transition at T_C=132-149 K. The transition temperature was found to increase with increasing oxygen content. It was shown that the phase transition from ferromagnetic to paramagnetic state was of the second order. The magnetic entropy change was calculated from the isothermal magnetization curves obtained at different temperatures. A magnetocaloric effect over a wide temperature range in the vicinity of T_C with a maximum magnetic entropy change of ~1 J/kg K and the relative cooling power of 120 J/kg under the applied field of 2 T was found.The relatively large value and broad temperature interval of the magnetocaloric effect make $(La_{0.7}Pr_{0.3})_{0.8}Sr_{0.2}Mn_{0.9}Ti_{0.1}O_{3}$compound a promising candidate for magnetic refrigerant.

Keywords: oxide materials; sintering; phase transitions; magnetocaloric effect; X-ray diffraction; magnetic measurements.

1. INTRODUCTION

Rare earth manganites $(R,A)MnO_3$ (R - rare earth ion, A - alkaline earth ion) with a perovskite-like structure are known as highly correlated systems in which the anomalies of structural, magnetic and electrical properties are interrelated [1]. In the last two decades, they have been a special object of research due to the discovery of the effect of a colossal magnetoresistance in them [2]. Chemical substitution was widely used as a convenient method for studying the physics of the phenomenon and searching for compounds with new properties. The results of substitution of R and Mn were described in detail in the literature [3].

The interest has resumed in recent years in connection with the discovery of the magnetocaloric effect (MCE) in these compounds [4-6]. MCE-materials are successfully used to produce ultra-low temperatures, and also have good prospects in the heat engines and refrigeration units production. The development of MCE materials can lead to the creation of commercially viable magnetic refrigerants and environmentally friendly refrigeration technologies without the use of refrigerant gases, the application of which is associated with global warming. The most effective magnetocaloric materials are gadolinium and Gd-containing alloys [7,8]. But because of its high cost and limited resources, in recent years, the exploration of other, more cheap and affordable materials have been accelerated [9-11]. These are rare earth manganites represented by a wide variety of structures and chemical composition - from simple substituted perovskite-like manganites to double perovskites. The advantages of manganites are

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