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METAMAGNETIC TRANSITION IN THE SYSTEM $Eu_{1-x}Sr_xMn_{0.5}Co_{0.5}O_3$ ($0 \le x \le 0.75$)

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ABSTRACT

Magnetic properties of orthorhombic (space group *Pnma*) perovskite $EuMn^{4+}_{0.5}Co^{2+}_{0.5}O_3$ synthesized at various temperatures are studied up to 140 kOe. The sample obtained at 1500 °C shows a metamagnetic behavior irreversible below 40 K, whereas the sample obtained at 1200 °C exhibits purely ferromagnetic behavior. Both samples are ordered at Curie temperature T_C = 123 K and reach equal magnetizations at high magnetic fields. The substitution of Eu^{3+} by Sr^{2+} within $Eu_{1-x}Sr_xMn_{0.5}Co_{0.5}O_3$ series of compounds leads to the increase in T_C, but the magnetization of these compositions strongly decreases and the metamagnetic transition disappears at $x > 0.3$. The composition with $x = 0.75$ is a cubic ($Pm\bar{3}m$) antiferromagnet with Neel temperature $T_N \approx 210$ K. It is assumed that the metamagnetic transition is associated with a transition from a noncollinear into a collinear ferromagnetic phase. A noncollinear phase is formed due to the competition between positive $Co^{2+} - Mn^{4+}$ and negative $Mn^{4+} - Mn^{4+}$ and $Co^{2+} - Co^{2+}$ superexchange interactions in the presence of large magnetic anisotropy. It is suggested that Sr^{2+} doping leads to formation of mixed high/low spin state of Co^{3+} ions and enforces antiferromagnetic component.

Keywords: Rare earth alloys and compounds, disordered systems, solid state reactions, exchange and superexchange, phase transitions, magnetic measurements.

INTRODUCTION

The rare-earth manganites $RMnO_3$ are of interest due to the colossal magnetoresistance effect found in derivatives of these compounds [1]. The ground state of these perovskites changes from antiferromagnetic to ferromagnetic one at substitution of either trivalent rare-earth ions R by divalent alkali earth ions Ca, Sr, Ba [2] or manganese ions by other transition metals ions, primarily Co or Ni [3].