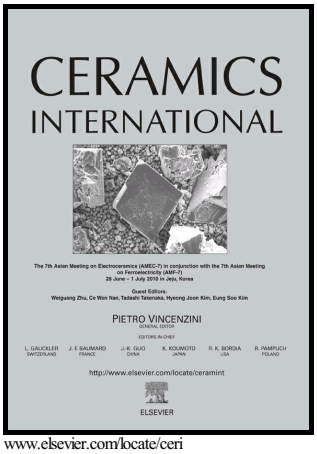

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Magnetic Ordering in Manganites Doped by Ti and Al

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Abstract

Neutron powder diffraction (NPD) and magnetization measurements have been performed for the $La_{0.7}Sr_{0.3}Mn_{0.7}Ti_{0.3-x}Al_xO_3$ ($0 \le x \le 0.15$) stoichiometric compounds. Increase of the Al^{3+} content enlarges the fraction of Mn^{4+} ions from 0% for the sample with x=0 up to around 20% for x=0.15 one. The compound without Al content undergoes a structural transition from rhombohedral phase to orbitally disordered orthorhombic one below room temperature whereas crystal structure of the compounds with x=0.1 and 0.15 remain to have rhombohedral one down to 2 K. The structural transition occurs well above the magnetic transition temperature. The substitution of Ti^{4+} by Al^{3+} ions is accompanied by a gradual increase in the bond angle Mn – O – Mn and Mn – O bond length thus strengthening the covalent component of the related chemical bonds. All these compounds are insulators and have ferromagnetic components. Magnetic moments calculated per manganese ion based on NPD data obtained at 2 K are found to change from 1.3 μ_B for x=0 compound up to 1.7 μ_B for x=0.1 and 0.15 ones. It is suggested that ferromagnetism is predominantly caused by superexchange interactions Mn^{3+} – O – Mn^{3+} and Mn^{3+} – O – Mn^{4+} whereas fluctuations in the bond angles and distances frustrate magnetic interactions. It is assumed that increase of covalency within the chemical bonds Mn – O slightly enforces ferromagnetic interactions.

1. Introduction

Mixed-valence manganites and cobaltites with perovskite-like structure as $La_{1-x}Sr_xMn(Co)O_3$, having charge, orbital, spin and lattice degrees of freedom attract great attention of the researchers during last decades [1]. The interplay between ferromagnetism and electroconductivity in these compounds has been explained in frames of the double exchange model