INVESTIGATION OF MAGNETORESISTIVE PROPERTIES OF La-Sr-Mn-Co-O FILMS AT CRYOGENIC TEMPERATURES IN HIGH PULSED MAGNETIC FIELDS

Vakaris Rudokas, Nerija Žurauskienė

Center for Physical Sciences and Technology, Department of Material Science and Electrical Engineering, Vilnius, Lithuania
vakaris.rudokas@gmail.com

The renewed interest in thin manganite films of the type $La_{1-x}A_xBO_3$ (where A is a divalent alkaline-earth element like Ca, Sr, B-site element Mn) during last two decades has been motivated by fundamental understanding of colossal magnetoresistance phenomenon (CMR) as well as potential device applications [1]. It has been demonstrated that the CMR phenomenon in nanostructured (polycrystalline with nanosize grains) manganite films can be successfully used for the development of CMR-B-scalar sensors, which can measure the magnitude of pulsed magnetic fields in very small volumes independently on magnetic field orientation [2]. Such sensors based on La-Sr-Mn-O films have been successfully used at room temperatures to measure the distribution of magnetic fields in electromagnetic launchers and non-destructive pulsed-field magnets [3,4]. However, for specific applications in condensed matter physics or plasma science, sensors operating at cryogenic temperatures and measuring high magnetic field magnitude are required. It was found that substitution of Co for Mn in La-Sr-Mn-O films decreases the paramagnetic-ferromagnetic phase transition temperature and increases the resistivity of the material [5]. This is mostly related with Co which replacing Mn in the lattice destroys the long-range ferromagnetic ordering of the Mn network, resulting in changes of magnetic and electrical properties of the films. Therefore, the doping of manganite films with higher Co concentration could result in increase of low temperature magnetoresistance and can increase the sensitivity of manganite films to magnetic field at cryogenic temperatures.

The magnetoresistance (*MR*) of nanostructured $La_{1-x}Sr_x(Mn_{1-y}Co_y)_zO_{3\pm\delta}$ (La-Sr-Mn-Co-O) films with substitution of Co for Mn with amount of Co/(La+Sr)=0.12 and 0.14 was investigated at temperatures 4-150 K in pulsed magnetic fields up to 20 T. It was found that manganite-cobaltite films exhibit larger magnetoresistance in comparison with manganite films without Co doping. The manganite-cobaltite films with different Mn concentration Mn/(La+Sr)=1.05, 1.07, 1.11 were investigated. The magnetoresistance of the films with 0.12 and 0.14 amount of Co were found similar, however, the Mn excess slightly decreased the *MR* values. The largest magnetoresistance values and sensitivity to magnetic field were obtained for La-Sr-Mn-Co-O films having Mn content close to the stoichiometric ratio for manganites: Mn/(La+Sr)=1.05. It was found that magnetoresistance at high fields (20 T) has a minimum at (50-80 K) and increases with decrease of temperature. The possibility to use these films for the development of magnetic field sensors operating at cryogenic temperatures is demonstrated.

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