CQ11

Magneto-transport Properties of $La_{0.7}Ca_{0.3-x}Sr_xMnO_3$ thin Films Deposited by Pulsed Electron Deposition (PED)

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We report the magneto-transport properties of $La_{0.7}Ca_{0.3-x}Sr_xMnO_3$ (x = 0, 0.075, 0.1, 0.125, 0.15, 0.3) thin films obtained by pulsed electron beam deposition (PED) on (100) $LaAlO_3$ substrate. Microstructure analysis by SEM and AFM revealed that all film surfaces were composed of dense outgrowths ranging from a few nano to micron size. The properties of the films are presented in Table 1. With increasing x from 0 to 0.3, Curie temperature (T_C) of the films was increased from 202 to 339 K. The resistivity of film was decreased with increasing x while both T_{MI} and T_{max} were increased. The resistivity decrease with increasing x may be attributed to a tendency of the charge carrier delocalization when larger Sr^{2+} cations substitute Ca^{2+} ions. High MR ratios of 13 ~ 17% around room temperature were obtained for the films of x = 0.10, 0.125, 0.15. These results are promising for the application of these films as room temperature MR sensors.

Table 1. Curie temperature (T_C), metal-insulator transition temperature(T_{MI}), temperature of maximum magnetoresistance (T_{max}), and Magnetoresistance (MR = [R(0T)-R(1T)]/R(0)×100%) of $La_{0.7}Ca_{0.3-x}Sr_xMnO_3$ films.

x	T_C (K)	T_{MI} (K)	T_{max} (K)	MR (%)
0	202	212	197	70.8
0.075	272	290	263	29.5
0.10	300	312	285	17.7
0.125	318	340	306	15.9
0.15	328	342	306	13.7
0.30	339	366	338	6.4

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Hopping in Uranium Doped One-Dimensional Antiferromagnet Ca_2CuO_3

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Recently, the uranium doping in piezoelectric ceramics and oxide based optical materials showed the significant improvements in the desired properties of these materials [1]. The doping of a small amount of the oxygen-rich uranium oxide U_3O_7 in the strongly anisotropic, S=1/2 one-dimensional (1D) antiferromagnet system Ca_2CuO_3 induced a large change in resistance while preserving its covalent insulator state. Besides the clear changes in magnetic properties and optical transitions (where a new peak was seen in visible region) the strong correlation between doping content and resistance appeared as an additional important aspect of this doping.

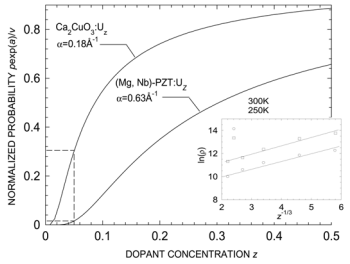

Fig. 1. The normalized hopping probability and the dependence of resistivity on doping uranium content (the inset).

Unlike in the undoped system where the conduction mechanism seems to couple with the 1D character of the spin transport along Cu-O chains in a similar variable range hopping regime as observed in a quasi 1D spin-ladder $CaCu_2O_3$ [2], the conduction mechanism here followed mainly from the three-dimensional (3D) hopping among the uranium dopant sites. All doped compounds demonstrated the continuous semiconductor-like behavior with preserving covalent insulator state from room temperature down to low temperature region. Their conduction mechanism was identified as the thermally activated phonon-assisted hopping regime and the parameter α, which is characteristic for the hopping probability, was determined to be 0.18Å-1. This value manifests the relatively stronger hopping probability for Ca_2CuO_3 in comparison with other uranium doped ceramics [1].

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