Thermal Diffusivity of $La_{1-X}Ca_XMnO_3$ up to 1200 K.

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The $La_{1-X}Ca_XMnO_3$ (LCMO) system is a typical colossal magnetoresistance (CMR) material and exhibits a paramagnetic (PM) to ferromagnetic (FM) transition upon cooling for the Ca concentration regime $0.2<X<0.5$. The FM transition is accompanied with the metal-insulator transition in this range of X and the electrical resistivity shows a large CMR effect. For the higher doping range $X\geq0.5$, the ground state is an antiferromagnetic (AFM) insulator with the charge ordering (CO) and a canted AFM order also takes place at $0.82<X<1.0$. From the measurement below 300 K,[(1)] we have noticed that the thermal diffusivity α of the X=0.25 sample abruptly increases just below the FM transition temperature T_c=232 K and then continues to increase gradually with decreasing temperature. In the PM insulating state (T>232 K), α(T) slightly increases with increasing temperature. Because the thermal transport is estimated to be overwhelmingly due to phonons, the positive gradient, $d\alpha/dT$ for $T>T_c$, suggests that the phonon scattering increases on approaching to T_c from high temperatures. Thus, it is interesting to measure the thermal diffusivity α above room temperature and to discuss the origin of the anomalous temperature dependence of α(T).

In this study, we report the thermal diffuisivity α(T) of $La_{1-X}Ca_XMnO_3$ system ($0<X<1.0$) at the temperature range from 10 K to 1200 K. For the measurements, the arbitrary heating method[(2)] and the laser flush method are used below and above 300 K, respectively. At high temperatures above 300 K, the positive gradient $d\alpha/dT$ decreases gradually with increasing Ca concentration X. For X=0.67, α(T) becomes nearly independent of temperature and for the X>0.75, the sign of $d\alpha/dT$ changes to negative and α decreases with increasing temperature, making a marked contrast with the $X\leq0.5$ samples. Usually it is expected that the phonon scattering decreases with decreasing temperature. The systematic change of $d\alpha/dT$ suggests that lattice dynamics of LCMO system become rather normal with the decrease of the Jahn-Teller ions (Mn^{3+}) in the samples with large X. We also report the α(T) anomalies related to the structural transition from orthorhombic to rhombohedral phase at high temperatures.

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