Adiabatic polaron transport in $La_{0.9}Pb_{0.1}MnO_3$ manganites

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Electron paramagnetic resonance (EPR) is a useful tool to study an internal dynamic of material showing a colossal magnetoresistance effect. An internal dynamic of lanthanum manganites is determined by spin-spin interaction and by spin-lattice interaction according to works [1,2] and [3], respectively. To clarify the situation we carried out the EPR and resistance measurement of $La_{0.9}Pb_{0.1}MnO_3$ composition. EPR study was performed at 9.2 GHz with a Jeol JES-TE300 ESR Spectrometer. In the paramagnetic region EPR spectra showed a single Lorentzian line with g $\approx$2 and that value was temperature independent. Resistance measurements were performed using the four-probe technique. Curie temperatures, T_c, of sample was determined by an extrapolation of magnetization to zero value on its temperature dependence. The EPR line intensity, I(T), can be fitted by the exponential decay, $I(T) \propto \exp(E_a/k_BT)$, in more wide temperature range, than that described by the Curie-Weiss law (E_a and k_B are the activation energy and Boltzmann constant, respectively). The E_a value deduced from the I(T) dependence equals to 0.11 eV. This is in agreement with the value of E_a=0.16 eV, deduced from the temperature dependence of resistivity, ρ, using the adiabatic polaron hopping model, $\rho(T) \propto T\exp(E_a/k_BT)$. The lower E_a value, deduced from the I(T) dependence, than from the temperature dependence of resistance can be caused by the decrease of activation energy in magnetic field, where the EPR resonance was observed. Analysis of temperature dependencies of EPR line intensity showed that spin-lattice interaction becomes weaker with increasing temperature from T_c to higher temperatures where the spin-spin interaction is dominant.

References

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