QA09

Room-temperature Magnetic Entropy Change in $La_{0.7}Sr_{0.3}Mn_{1-x}M_xO_3$ (M = Al, Ti)

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Magnetic entropy changes in and above the room-temperature region has been measured for $La_{0.7}Sr_{0.3}Mn_{1-x}MxO_3$ (M = Al, Ti) by means of magnetization measurements in magnetic fields up to 6 T. The magnetocaloric effect (MCE) becomes strongest at the Curie temperature T_c that is tuned to ~300K by the substitution of Al or Ti for Mn. While the substitution of Al for Mn drastically reduces the entropy change, it extends considerably the working temperature span and improves the relative cooling power (RCP). The MCE and RCP seem to be only lightly affected by Ti substitution. Although manganites are considered potential for magnetic refrigerants, the limitations for achieving strong MCE is in the materials are also discussed.

Author Keywords: Magnetocaloric effect; Entropy; Refrigeration; Perovskite manganite

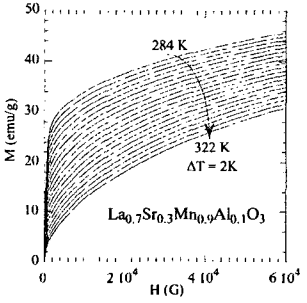

Fig. 1. The M(H) curves of $La_{0.7}Sr_{0.3}Mn_{0.9}Al_{0.1}O_3$ measured at various temperature

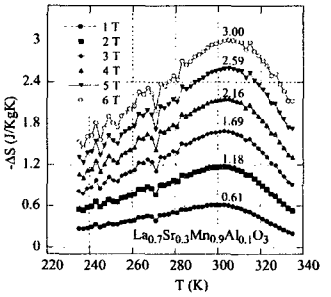

Fig. 2. Magnetic entropy changes as a function of temperature for $La_{0.7}Sr_{0.3}Mn_{0.9}Al_{0.1}O_3$ sample in various

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QA10

NMR study on the A-type Antiferromagnetic and Metallic Properties in $La_{1-x}Sr_xMnO_3$ ($0.5 \leq x \leq 0.6$)

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Heavily doped manganites R1-xAxMnO$_3$ (R = La, Pr, Nd, A = Ca, Sr) with x 0.5 have displayed unique magnetic properties such as charge ordered CE-type antiferromagnetic(AFM) state, orbital ordered A-type AFM state, and a magnetic phase coexistance state. Such various magnetic properties are presumally due to the competition between the FM double exchange and the AFM superexchange interactions. The A-type AFM spin structure with the in-plane FM and out-of-plane AFM orderings has been observed only in the heavily Sr-doped system such as $Pr_{0.5}Ca_{0.5}MnO_3$, $Nd_{0.45}Sr_{0.55}MnO_3$, and $La_{0.46}Sr_{0.54}MnO_3$[1,2]. In these manganites, interestingly, the pseudo-2D metallic state is induced by the unique A-type AFM spin structure accompanying with the $d_{x^2-y^2}$ orbital ordering. Therefore, the resistivity within the FM layers is typically two orders of magnitude smaller than that between the FM layers.

In order to understand such pseudo-2D metallicand A-type antiferromagnetic state, we have investigated the microscopic magnetic properties of La1-xSrxMnO$_3$ ($0.5 \leq x \leq 0.6$) using ^{55}Mn nuclear magnetic resonance. ^{55}Mn NMR spectra showed a variation with the Sr doping ratio x and revealed a magnetic phase coexistance state of AFM and FM which was not observed by the magnetization measurement. Remarkably, the spin-spin relaxation time of the metallic AFM state was longer than those of the insulating AFM state and the metallic FM state. Below the AFM transition temperature, the Shul-Nakamura process related to the electronic spin-wave excitation was a dominant mechanision of nuclear spin-spin relaxation of the FM phase, but not of AFM phase. Conclusively, we found that the A-type AFM state has unique microscopic magnetic properties different from the insulating AFM state and the metallic FM state.

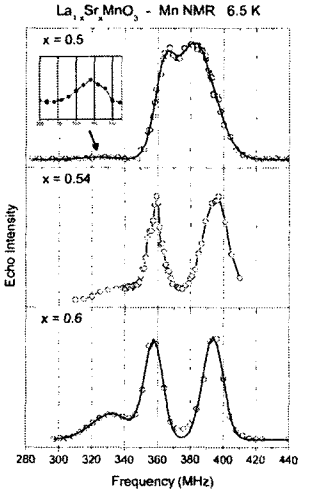

Fig.1. ^{55}Mn NMR spectrum of $La_{1-x}Sr_xMnO_3$($0.5 \leq x \leq 0.6$)

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