Giant Magnetcaloric Effect in Perovskite Manganites of $La_{0.7}Ca_{0.3}MnO_3$ Doping with the Ni

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Magnetic refrigeration based on the magnetocaloric effect (MCE)[1] is currently a promising technology that can replace the conventional gas-compression / expansion technique. Major advantages of the magnetic refrigeration comparing to compressor-based refrigeration are environmental friendly technology and low running cost. To realize this technology, however, the important task for us is the searching of magnetic materials having large magnetic entropy change. It has been seen that perovskite manganites exhibit the colossal magneto-resistance (CMR) at the ferromagnetic-paramagnetic phase transition temperature (TC). In this phase transition, large magnetic entropy change is also observed and is comparable to that of Gd (a conventional magnetocaloric material)[2]. For the application aspect, it is necessary to find the manganites with large magnetic entropy change around room temperature. Such the requirement can be achieved basing on some typical manganites of La0.7M0.3MnO (M = Sr, Pb, or Ba) with TC > 300 K.

In this work, we have studied the magnetic entropy change of $La_{0.7}Ca_{0.3}Mn_{1-x}Ni_xO_3$ (x=0.00, 0.01, 0.02, 0.03, 0.05) compound. Our sample was made by the reactive milling method, used initially high-purity powders of La_2O_3, $CaCO_3$, NiO, and $MnCO_3$. The powders combined with stoichiometric quantitieswere ground and mixed well, and then calcinated in air at 1000℃ for 24 hrs. This process was repeated twice. The mixtures obtained were pressed into pellets, and sintered at 1300℃ for 24 hrs in air. This process was also repeated twice. X-ray diffraction measurement on the $La_{0.7}Ca_{0.3}Mn_{1-x}Ni_xO_3$ compound was performed by using Cu Kα radiation. X-ray diffraction patterns indicate all the samples to be single phase in the orthorhombic structure. The magnetization measurements as a function of temperature and field were carried out by using a VSM with a maximum applied field of 1.5T at different temperature from 100K to 300K.

X-ray diffraction patterns indicate all the samples to be single phase in the orthorhombic structure. As Ni content is increased from x=0.00 to 0.03, the lattice parameters and cell volume was increased. When the Ni content was x=0.05 the lattice parameters and cell volume was decreased. The Curie temperature is decreased, when the Ni content from x=0.00 to 0.02. The maximum $|\Delta S|$ was increased from 1.52 J/kgK to 1.73 for the Ni content x=0.00 to 0.03. We have get the maximum entropy change ($|\Delta S|$) was 1.73 J/kgK at TC = 186K for the x=0.03. Hence, we believe that the structural change significantly contributed to the enhancement in magnetic entropy.

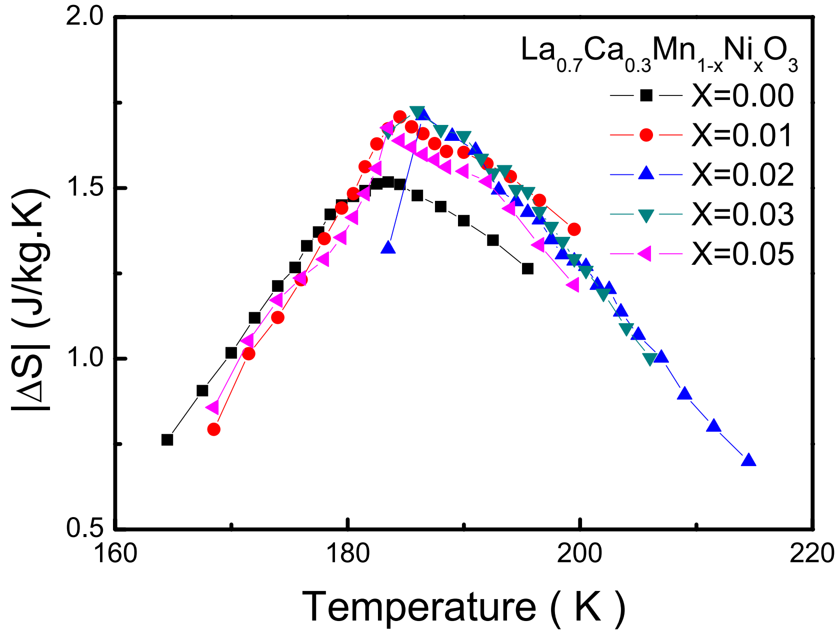

Fig. 1. Temperature dependences of |ΔS| under an external field interval of 15 kOe for $La_{0.7}Ca_{0.3}Mn_{1-x}Ni_xO_3$ (x= 0.00, 0.01, 0.02, 0.03, 0.05).

참고문헌

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[2] A. M. Tishin, and Y. I. Spichkin, *The magnetocaloric effect and its applications*, IOP Publishing Ltd, 2003.