Magnetocaloric and Critical Properties in $Ni_{0.5}Mn_{0.35}Sn_{0.15}$ Alloys

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Magnetic refrigeration based on the magneto-caloric effect (MCE) is considered as a promising technique applicable to cooling systems. Comparing with conventional gas-compression refrigeration, the magnetic refrigeration shows up many advantages, such as low energy loss and friendly environment. Notable magneto-caloric materials being considered for magnetic refrigeration applications are Gd-based alloys, $MnFeP_xAs_{1-x}$, $Gd_5Si_2Ge_2$, $La(Fe,Co,Si)_{13}$, Ni-Mn-Ga, etc. Among these, an interesting material system has attracted much attention is ferromagnetic Ni-Mn-based Heusler alloys in which Ni and Mn are both inexpensive elements. An additional doping of Sn, Ga or In enhances strongly ΔS_M values, and also leads to many interesting physical phenomena, particularly the inverse MCE. This makes $Ni_{0.5}Mn_{0.5}$-based materials become promising candidates for magnetic refrigeration applications. To gain more insight into this material system, we have prepared $Ni_{0.5}Mn_{0.35}Sn_{0.15}$ alloy to study the MCE and critical properties.

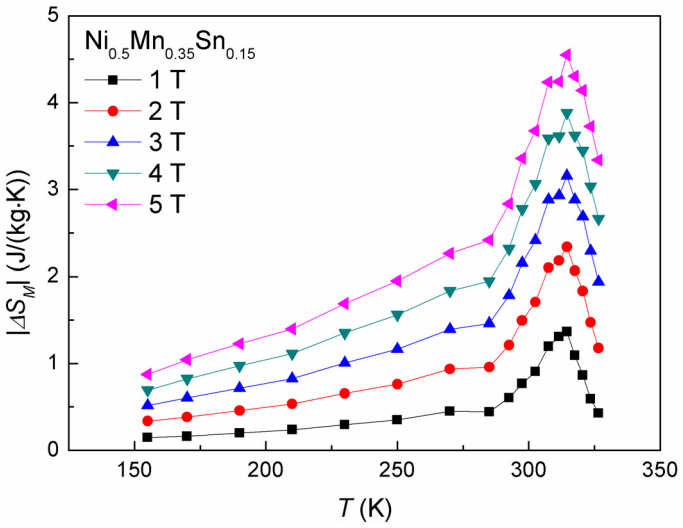

Figure1: Magnetic entropy change of $Ni_{0.5}Mn_{0.35}Sn_{0.15}$ alloys

The isothermal magnetization curves close to Curie temperature (T_c) and magnetocaloric effect (MCE) in $Ni_{0.5}Mn_{0.35}Sn_{0.15}$ alloy has been investigated, which is prepared by arc-melting method. The magnetic measurements were performed on SQUID magnetometer with the applied field in the range of 1-5 T. The TC of $Ni_{0.5}Mn_{0.35}Sn_{0.15}$ alloy measured is 313 K. Figure 1 gives the magnetic entropy change DSM curves, which are calculated from isothermal M-H curves for our sample undergoes the second-order phase transition according to arrott plot (not shown). With a maximum field of 5 T, the maximum magnetic entropy change observed are 4.6 $J \cdot kg^{-1}K^{-1}$. The magnetic entropy change keeps negative from 150 K to 325 K, different with reported

$Ni_{0.5}Mn_{0.5-x}Sn_x$ (x=0.13, x=0.15) alloy which exhibits so called inverse-MCE [1]. The critical behavior analyzed using Arrott-Noakes method (known as modified Arrott plots) turns out to be accordance with mean-field model, reveals a long-range order ferromagnetic interaction are dominant in this kind of Heusler alloy.

References

[1] Thorsten Krenke, et al. Nature Materials, 4 (2005), 450-454.