and transforms to an anti-ferromagnetically ordered state (θ_P = -18.6(2) K) below 33 K. The magnetic spin structure can be described with k = (0, 0, 0) in space group *Pbca'* and it is similar to the one of the *C*2/*c* phase except that it is non-collinear in nature, i.e. there are components of the magnetic moment along all three crystallographic axes. Small magneto-elastic coupling is observed in the orthorhombic phase. More details are reported in [5].

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Magnetostructural and magnetocaloric properties of $Ni_{50-x}Cu_xMn_{36}Sn_{14}$ by magnetic measurements and neutron diffraction experiments.

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Compared with conventional refrigeration, magnetic refrigeration technology has many advantages, such as the absence of harmful gas, less noise, low cost and high efficiency. Since the discovery of martensitic transformation with both phases magnetically ordered in Heusler alloys Ni-Mn-Z (Z: Ga, In, Sn and Sb) increasing attention has been paid to study the change in magnetic and electrical properties associated to the first-order reversible magnetostructural transition that originates valuable functional properties such as magnetic superelasticity, large inverse magnetocaloric effect, and large magnetoresistance change [1 and the references therein]. The reversibility and irreversibility of the magnetostructural transition is very important for magnetic actuator materials such as magnetic shape memory alloys. The austenite phase induced by the magnetic field is able to transform back to the initial martensite phase when the magnetic field is removed. A complete recovery of the initial martensite state may bring about magnetoelasticity (two-way magnetic shape memory effect), while the irreversible magnetostructural transition would result in magnetoplasticity (one-way magnetic shape memory effect).

We showed that the effects of the irreversibility of the magnetostructural transitions on magnetocaloric effect in the (Ni-Cu)-Mn-Sn compounds was very important by magnetic and resistance measurements under magnetic field [1]. The magnetic entropy change of the $Ni_{50-x}Cu_xMn_{36}Sn_{14}$ (x=2 and 4) compounds are estimated by using Maxwell equation and the M(H) curves obtained from noncontinuous heating method. These compounds show the magnetostructural phase transition from cubic to orthorhombic structure with decreasing temperature at around 218 and 168 K, respectively. To see better the type of the magnetostructural transition, we perform the neutron diffraction experiments for these compounds at the different temperatures and under different magnetic fields. According to the neutron diffraction experiment near A_S (A_S: Austenite start temperature), the Martensite phase of these compounds transforms to Austenite phase with increasing the magnetic field from 0 to 5 T, while these compounds remains in the Austenite phase with decreasing the magnetic field to zero Tesla. This is the evidence of the irreversible magnetostructural transition occurred in these compounds. Because of that, the determination of the magnetic entropy change in alloys which show the irreversible magnetostructural transition has carefully been studied [2].

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Structural, magnetic and magnetocaloric effect in the off-stoichimetric $Gd_5Ge_{2.05-x}Si_{1.95-x}Mn_{2x}$ alloys

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Magnetic refrigeration based on MCE of solid-state working substances have attracted tremendous attention in recent years due to its energy efficient and environment friendly properties as compared with the gas compression refrigeration technology that is used currently. Practical applications of the MCE, therefore, have the potential to reduce the global energy consumption and eliminate or minimize the use of ozone-depleting alloys, greenhouse gases, and precarious. After the discovery of the giant magnetocaloric effect in the $Gd_5Si_2Ge_2$ alloy, there has been much interest in the $Gd_5(Si_xGe_{1-x})_4$ family alloys [1]. As seen in earlier studies, the stoichiometric $Gd_5Si_2Ge_2$ with doping alloys have not won with the appropriate of magnetocaloric features. For this reason, we attempt to improve the magnetocaloric properties of the off-stoichiometric $Gd_5Ge_{2.05}Si_{1.95}$ alloy by replacing non-magnetic Ge/Si atoms by a small amount of magnetic Mn atom. We have investigated the structural, magnetic and magnetocaloric properties of the $Gd_5Ge_{2.05-x}Si_{1.95-x}Mn_{2x}$ (2x=0.02, 0.06) alloys using scanning electron microscopy, x-ray powder diffraction, DSC and magnetic measurements. According to DSC and magnetic measurements, the both alloys exhibit a structural phase transition (the first order phase transition) around room temperature. The Curie temperatures of these alloys are around 295 K. We determine the magnetic entropy changes near the transition temperatures using Maxwell relation and magnetization data. The maximum values of isothermal magnetic entropy change of the $Gd_5Ge_{2.05-x}Si_{1.95-x}Mn_{2x}$ alloy with 2x = 0.02 that occurred is found to be -12.1 $J.kg^{-1}.K^{-1}$ and -19.8 $J.kg^{-1}.K^{-1}$ around 268 K in an applied field of 2 T and 5 T, respectively. The magnetic entropy changes are also estimated from DSC analysis for each alloy. The values of the magnetic entropy change of the $Gd_5Si_{2.05-x}Ge_{1.95-x}Mn_{2x}$ (2x=