

Physics Colloquium

Effect of Partial Substitution of In with Mn on the Structural, Magnetic, and Magnetocaloric Properties of $\text{Ni}_2\text{Mn}_{1+x}\text{In}_{1-x}$ Heusler Alloys

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November 13, 2019

4:00 p.m.

114 Begeman Hall

The magnetocaloric effect (MCE), thermal response to changing magnetic field, is an intrinsic property of all magnetic materials. The practical application of MCE in magnetic cooling is expected to replace the existing vapor-compression-based cooling technology with energy efficient and environment friendly solid-state cooling technology. The main challenge is to find a cost effective magnetic material that can be used as a magnetic refrigerant. We have investigated the structural, magnetic and magnetocaloric properties of a prospective magnetocaloric material $\text{Ni}_2\text{Mn}_{1+x}\text{In}_{1-x}$, prepared using an arc-melting and annealing. The room-temperature x-ray diffraction shows that the $\text{Ni}_2\text{Mn}_{1+x}\text{In}_{1-x}$ alloys with $0 \leq x \leq 0.34$ exhibit austenite cubic phase, whereas the alloys with $x > 0.34$ have mixed tetragonal martensite and cubic austenite phases. The $\text{Ni}_2\text{Mn}_{1.34}\text{In}_{0.66}$ alloy shows a clear second-order phase transition with a Curie temperature of 305 K but its elemental composition is very close to the critical composition between first and second-order phase transitions. The calculated magnetic entropy change and relative cooling power of the $\text{Ni}_2\text{Mn}_{1.34}\text{In}_{0.66}$ alloy measured at 3 T field are $4.5 \text{ Jkg}^{-1}\text{K}^{-1}$ and 201 Jkg^{-1} , respectively. The temperature dependent resistivity of $\text{Ni}_2\text{Mn}_{1.34}\text{In}_{0.66}$ alloy measured at $H = 0 \text{ Oe}$ shows that the sample has a room temperature resistivity of $\rho = 7 \times 10^{-7} \Omega\text{m}$. In this presentation, I will discuss the synthesis and characterization of $\text{Ni}_2\text{Mn}_{1+x}\text{In}_{1-x}$ ($x = 0, 0.15, 0.20, 0.25, 0.30, 0.34, 0.35,$ and 0.40) alloys, and the prospect of these materials for magnetic cooling technology.

Everyone Welcome! Refreshments Provided.