

Magnetostructural coupling and giant magnetocaloric effect in MnCoGe-based compounds

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Serious environmental consequences of the traditional vapor-compression cooling techniques have turned the research efforts towards the development of alternative cooling techniques, and the search for materials showing large caloric effect. Magnetic cooling technology is a rapidly growing technology with a potential of becoming more economical, energy efficient and environmentally friendly cooling technology. The search of new or improving the existing magnetic materials exhibiting large magnetocaloric effect near room temperature but with the use of none or negligibly small number of critical/toxic elements is a field of intense research for magnetic cooling technology. The magnetocaloric effect of a material can be significantly improved by combining the lattice degree of freedom with the magnetic one. This produces a first-order magnetostructural transition which in turn leads to a gigantic magnetocaloric effect. Intermetallic alloy MnCoGe is an interesting compound

which experiences a martensitic structural transformation and a magnetic transition separated by around 100 K. Both of the transitions can be tuned via physical and/or chemical pressure which can lead to a magnetostructural coupling resulting in a first-order transition and thus a giant magnetocaloric effect. In this presentation, magnetostructural coupling and giant magnetocaloric effect via tuning of the structural and magnetic transitions of MnCoGe compound through partial substitution of Co and Mn by Cu will be discussed. A giant maximum isothermal entropy change of $\sim 40 \text{ JKg}^{-1}\text{K}^{-1}$ (for $\Delta H = 5 \text{ T}$) has been obtained for 10 at %Mn substitution by Cu. The Mn-substituted samples show a normal paramagnetic to ferromagnetic transitions. Interestingly, in addition to paramagnetic to ferromagnetic transitions, the Co-substituted samples show ferromagnetic to antiferromagnetic (FM to AFM) and then AFM to FM transitions with decreasing the temperature. The presence of antiferromagnetic phase and complex magnetic transitions can be possible due to the varying Mn-Mn distances during the martensitic transition. A comparative study of the Mn- and Co-substituted samples and a correlation of the magnetic and structural properties will be presented and discussed.

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