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Reversible magnetocaloric effect and Critical exponent analysis in Mn-Fe-Ni-Sn Heusler alloys

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Abstract

We report the magnetic and magnetocaloric properties of $\text{Mn}_{48-x}\text{Fe}_x\text{Ni}_{41}\text{Sn}_{11}$ ($x = 8.5, 10.5$) Heusler alloys. The temperature dependent magnetization curve (M vs T curve) reveals that these alloys show only second order ferromagnetic (FM) to paramagnetic (PM) transition at their Curie temperature (T_C) and no structural transformation is observed. A large value of saturation magnetization (M_S) $\sim 72.76 \text{ Am}^2/\text{kg}$ is observed at 80 K for $x = 8.5$ alloy as the alloy becomes purely austenite for this composition. A reversible magnetic entropy change of $1.02 \text{ JKg}^{-1}\text{K}^{-1}$ with moderate refrigerant capacity (RC) $\sim 40.2 \text{ J/kg}$ are obtained near room temperature ($\sim 305 \text{ K}$) for $x = 8.5$, across its T_C due to a field change of 14 kOe only. The critical exponents are calculated for both the samples and found to exhibit long range ferromagnetic ordering in their austenite phase.

Keywords: Heusler alloy; Magnetocaloric effect; Magnetic entropy change; Magnetic refrigeration; Refrigeration capacity; Saturation magnetization.

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