Ni-Mn-In Heusler alloys showing both direct and inverse magnetocaloric effect for room temperature magnetic refrigeration

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Room temperature magnetic refrigeration requires materials with large isothermal entropy and adiabatic temperature (ΔT_{ad}) changes at T≈293 K and negligible thermo-magnetic hysteresis when cycled in magnetic fields below 2 T.

Ni-Mn based Heuslers hold a great promise thanks to their huge inverse magnetocaloric effect (MCE) at the martensitic transformation, yet fall short in applicability due to the associated hysteresis, which hampers cyclability.

In this contribution we will explore two strategies to overcome irreversibility: (i) samples with second order transitions close to room temperature and (ii) samples with converging magnetostructural and Curie transitions, which display a quasi-superposition of direct and inverse MCEs. The chosen system is Ni_2MnIn based Heusler alloys, gifted with promising values of ΔT_{ad} at the second order Curie transition. The starting composition, $Ni_{48}Mn_{36}In_{16}$, is optimized by substituting Fe and Cu at Mn sites, to enhance magnetization and tailor the Curie point, or by varying the Mn-In ratio to tune the distance between the magnetic and structural transitions. In-field calorimetry and ΔT_{ad} measurements are performed to reveal the reversible and irreversible contributions to the MCE. By studying the ΔT_{ad} curves we consider the possibility to exploit the concurrent direct and inverse MCEs in alternative refrigeration cycles