

View Abstract

FINAL ID: NPB-04

TITLE: Magnetostructural transition and magnetocaloric effect in thermally annealed $\text{Mn}_{0.5}\text{Fe}_{0.5}\text{NiSi}_{1-x}\text{Al}_x$ melt-spun ribbons ($x = 0.055$ and 0.060)

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KEYWORDS: Mn-Fe-Ni-Si-Al alloys, Melt spun ribbons, Giant Magnetocaloric effect materials .

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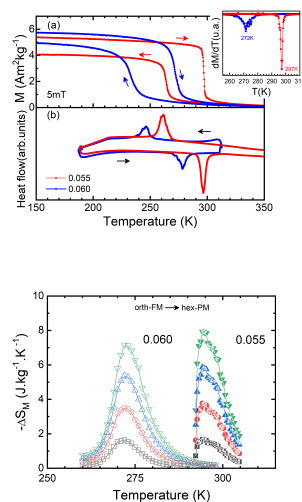
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ABSTRACT BODY:

Abstract Body: The giant magnetocaloric (MC) effect measured in $\text{Mn}_{0.5}\text{Fe}_{0.5}\text{NiSi}_{1-x}\text{Al}_x$ alloys ($0.05 \leq x \leq 0.07$) for a low magnetic field change ($|\Delta S_M|^{\text{max}} \sim 16\text{-}24 \text{ J kg}^{-1}\text{K}^{-1}$ at 2 T) [1], and the fact that they are based on cheap and abundant elements motivated the interest on their study. The effect is linked to their first-order martensitic-like magnetostructural transformation (MST) from a high-temperature hexagonal Ni_2In -type paramagnetic (PM) phase to a low-temperature orthorhombic TiNiSi -type ferromagnetic (FM) phase which is tunable over wide temperature range by changing the Al content [1,2]. As melt spinning is a rapid solidification technique able to produce alloy ribbon samples with a high chemical homogeneity and may result very appropriate to fabricate these five-elements alloys, we produced $\text{Mn}_{0.5}\text{Fe}_{0.5}\text{NiSi}_{1-x}\text{Al}_x$ melt-spun ribbons with $x=0.055$ and 0.060 that were thermally annealed at 1123 K for 4 h; their MST and MC characteristics were studied. RT XRD patterns show that samples are nearly single phase with a major Ni_2In -type phase coexisting with a minor amount of the TiNiSi -type one. DSC, $M(T)^{5\text{mT}}$ and $M(T)^{2\text{T}}$ curves, shown in Fig. 1, denote the occurrence of the MST with a large thermal hysteresis ($\sim 32 \text{ K}$), the substantial effect of Al-content on the tuning of the MST temperature without a significant change in the magnetization change across the MST which led to similar $\frac{1}{2}\Delta S_M(T)^{\frac{1}{2}\text{max}}$ values (as Fig. 2 shows). The results are discussed and compared with previous data reported in literature for bulk alloys.

References: [1] A. Biswas et al., Acta Mater. 180, 341–348 (2019).

[2] C.L. Zhang et al., Appl. Phys. Lett. 105, 242403 (2014).



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Product version number 4.17.4 (Build 149). Build date Mon Jul 18 14:32:33 EDT 2022. Server ip-10-236-27-228