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View Abstract

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TITLE: Magnetostructural transition and magnetocaloric effect in thermally annealed $Mn_{0.5}Fe_{0.5}NiSi_{1-x}Al_x$ 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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ABSTRACT BODY:

Abstract Body: The giant magnetocaloric (MC) effect measured in $Mn_{0.5}Fe_{0.5}NiSi_{1-x}Al_x$ alloys (0.05 £ x £ 0.07) for a low magnetic field change ($|\Delta S_M|^{max}$ ~16-24 $Jkg^{-1}K^{-1}$ 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 $Mn_{0.5}Fe_{0.5}NiSi_{1-x}Al_x$ 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 pattens 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, $M(T)^{5mT}$ and $M(T)^{2T}$ curves, shown in Fig. 1, denote the occurrence of the MST with a large thermal hysteresis (~ 32 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 $½DS_M(T)½^{max}$ 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).
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