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Critical behavior near the ferromagnetic-paramagnetic transformation in the austenite phase of $\text{Ni}_{43}\text{Mn}_{46}\text{Sn}_8\text{X}_3$ (X = In and Cr) Heusler alloys

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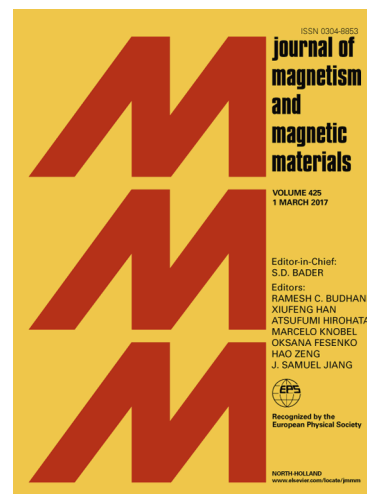
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Critical behavior near the ferromagnetic-paramagnetic transformation in the austenite phase of $\text{Ni}_{43}\text{Mn}_{46}\text{Sn}_8\text{X}_3$ ($\text{X} = \text{In}$ and Cr) Heusler alloys

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In this work, we present a detailed study on the magnetic property and critical behavior in the austenitic phase of $\text{Ni}_{43}\text{Mn}_{46}\text{Sn}_8\text{X}_3$ alloys with $\text{X} = \text{Cr}$ and In , which were prepared by an arc-melting method in an argon ambience. The $M(T)$ curve of the Cr sample ($\text{X} = \text{Cr}$) exhibits a single magnetic phase transition at the Curie temperature of the ferromagnetic (FM) austenitic phase with $T_C^A = 303$ K. In contrast, the In sample ($\text{X} = \text{In}$) exhibits multiple magnetic phase transitions, including a magnetic phase transition from a FM state to weakly magnetic state at $T_C^M = 165$ K of the martensitic phase, a martensitic transition from the weakly magnetic to the FM austenite phase at $T^{M-A} = 259$ K, and a magnetic phase transition from the FM to paramagnetic (PM) at $T_C^A = 297$ K of the austenite phase. Based on the Landau theory and $M(H)$ data measured at different temperatures, we pointed that the FM-PM phase transitions around T_C^A in both samples were the second-order phase transition. Our results suggest an existence of the long-range FM interactions in the austenite phase. A small deviation from the mean-field theory of the critical exponents has been also observed pointing out an existence of the inhomogeneous magnetism that could be associated with the presence of the anti-FM interactions in these samples. Besides, their effective exponents $\beta_{\text{eff}}(\varepsilon)$ and $\gamma_{\text{eff}}(\varepsilon)$ have been also calculated.

Keywords: Critical behavior; Ni-Mn-Sn; Heusler alloys; Mean-field theory; Austenite phase.

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