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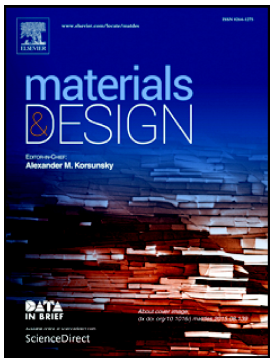

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Enhanced magnetic refrigeration capacity in Ni-Mn-Ga micro-particles

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Abstract Bulk magnetic refrigerant materials with first-order character usually possess hysteresis losses and concentrated refrigeration working temperature interval (δT_{FWHM}), which are detrimental for magnetic refrigeration applications. Here, we report on Ni-Mn-Ga micro-particles with size ~38.5-45 μm fabricated by grinding and subsequent stress relief annealing (SRA). The microstructure, martensite transformation (MT), hysteresis loss and magnetocaloric effect (MCE) of the SRA particles were studied in comparison with the bulk alloy counterpart. The thermal and magnetic hysteresis losses in SRA particles ~1.3 K and ~1.9 J/kg were significantly reduced compared to those in the bulk alloy ~5.5 K and ~9.7 J/kg, respectively, which is related to the reduction of neighboring grain constraints on martensite/austenite phase boundary motion. The MT transformation temperature range of the SRA particles ~26.5 K was higher than that of the bulk alloy ~5.5 K because of the high specific surface area of the particles and the residual internal stress after SRA. A magneto-structural partly-coupled state was attained in the SRA particles, which is responsible for the wide δT_{FWHM} ~25 K and the high refrigeration capacity (RC_{net}) ~117 J/kg. Based on these results, a possible approach for the high magnetic refrigeration efficiency is expected and discussed.

Keywords: magnetocaloric effect (MCE); refrigeration capacity (*RC*); particle; martensite transformation; hysteresis loss; Ni-Mn-Ga alloy