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Magnetic structure, magneto-caloric properties and magnetic critical behaviours of LaMn_2Ge_2 compounds



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ABSTRACT

The structural and magnetic properties of LaMn_2Ge_2 compound in both the as-cast bulk and melt-spun ribbon forms have been investigated by a comprehensive set of x-ray/neutron powder diffraction, magnetic and heat capacity measurements as well as corresponding sets of data analyses. Our neutron diffraction study reveals that with decreasing temperature the magnetic state of bulk LaMn_2Ge_2 changes first from paramagnetic to incommensurate antiferromagnetism Af_1 s at $T_N = 430$ K, and then gives way to incommensurate canted ferromagnetism Fm_1 below $T_C \sim 320$ K. No noticeable magnetoelastic effect was detected in the temperature dependence of lattice parameters derived from the refinement of the neutron diffraction patterns over the temperature range -5 – 460 K. Detailed analyses of the magnetic data indicate that the magnetic phase transition around the ferromagnetic transition ($T_C \sim 320$ K) is second order. Under field changes of 2 T and 5 T, the maximum values of magnetic entropy change around the ferromagnetic transition respectively reach $-\Delta S_{\text{max}} = 1.65$ J/kg K and $-\Delta S_{\text{max}} = 3.26$ J/kg K for the bulk sample, compared with $-\Delta S_{\text{max}} = 1.21$ J/kg K and $-\Delta S_{\text{max}} = 2.60$ J/kg K, for the ribbon sample. The magnetic phase transition around T_C has been investigated by Kouvel-Fisher analysis and the Modified Arrott Plot method with the critical exponent values indicating that the magnetic interactions in LaMn_2Ge_2 are long range. Moreover, it was found that the field- and temperature- magnetisation data around T_C collapse onto two curves obeying