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# First-order magneto-structural transition and magnetocaloric effect in $Mn(Co_{0.96}Fe_{0.04})Ge$

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## ABSTRACT:

The magnetic properties and magnetic structure of an as-prepared $Mn(Co_{0.96}Fe_{0.04})Ge$ sample has been investigated by powder neutron diffraction as well as X-ray diffraction and magnetisation measurements. The sample has a ferromagnetic structure in the low-temperature orthorhombic phase and a magneto-structural transition at 299(1) K to the high-temperature paramagnetic hexagonal phase. This transition occurs at a higher temperature than for as-prepared $(Mn_{0.96}Fe_{0.04})CoGe$ ($T_M$ = 239(1) K). Increased occupancy by Fe of the Co (4c) site rather than the Mn (4c) site results in this smaller suppression of the structural transition temperature away from that of undoped MnCoGe. It was found that chemical pressure increased the Curie temperature $T_C^{orth}$ in the orthorhombic phase from 355(5) K in $Mn(Co_{0.96}Fe_{0.04})Ge$ to 379(6) K in MnCoGe. $Mn(Co_{0.96}Fe_{0.04})Ge$ exhibits a large magnetocaloric effect around the magneto-structural transition, $-\Delta S_m^{peak}$ = 11(2) J kg$^{-1}$ K$^{-1}$ and $RC$ = 187(30) J kg$^{-1}$ with $\mu_0\Delta H$ = 5 T. The magneto-structural transition is a first order transition as demonstrated by master curve analysis.

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