

Magnetocaloric effect in polycrystalline Mn_5Si_3

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The interest of researchers in magnetics with phase transitions and with a magnetocaloric effect in the cryogenic temperature range is associated with the possibility of their application in cryocoolers [1]. The single-crystal Mn_5Si_3 sample demonstrates a strong inverse magnetocaloric effect upon the metamagnetic transition at $T_{\text{NI}} = 65$ K [2]. We have investigated the magnetic and magnetocaloric properties of a polycrystalline Mn_5Si_3 sample, which is easier to manufacture. A polycrystalline sample of the nominal composition Mn_5Si_3 was prepared by argon-arc melting with three remelts. The sample sealed in a vacuum quartz ampoule was annealed for 50 hours at a temperature of 1273 K, after which it was quenched in water at room temperature. Measurements of the isofield magnetization of the sample showed that a metamagnetic transition with temperature hysteresis is observed in the temperature range from 5 K to 70 K. With an increase in the magnetic field from 1 T to 10 T, the characteristic temperatures of this metamagnetic transition shift to low temperatures with a coefficient of 4.9 K/T (Fig. 1 left). A sample of the Mn_5Si_3 alloy at a temperature of 50 K demonstrates a sharp change in magnetization of about 20 emu/g in the range of the applied magnetic field from 5.5 T to 6.5 T (Fig. 1 right). In this region, an inverse magnetocaloric effect can be observed at cryogenic temperatures.

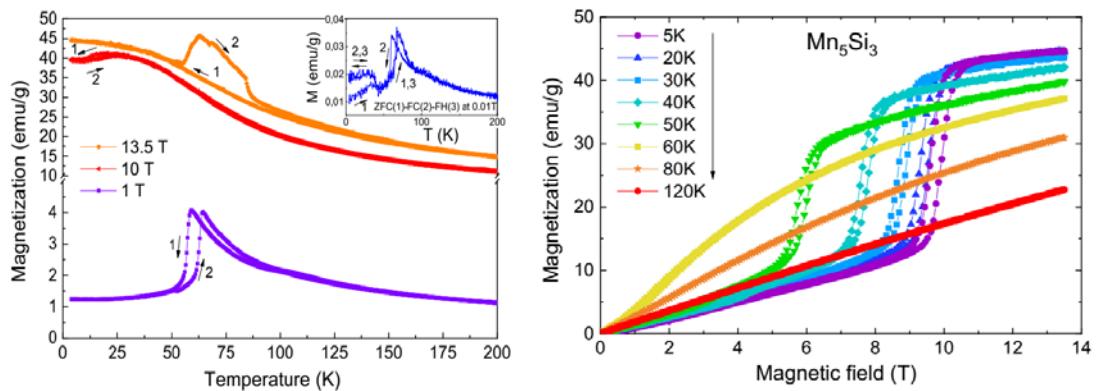


Fig. 1. Left graph: isofield magnetization of the Mn_5Si_3 sample versus temperature in magnetic fields. The inset shows the view isofield magnetization at magnetic field 0.01 T. Right graph: measured isothermal magnetization of Mn_5Si_3 in a magnetic field to 13.5 T.

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References

- [1] I. Park and S. Jeong, Cryogenics 88, (2007) 106.
- [2] R. F. Luccas et al., J. Magn. Magn. Mater. 489, (2019) 165451.