

MS13-2-18 Complex Magnetic Behaviour in Rare Earth Rich Magnetocaloric Materials - R₃T
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Abstract

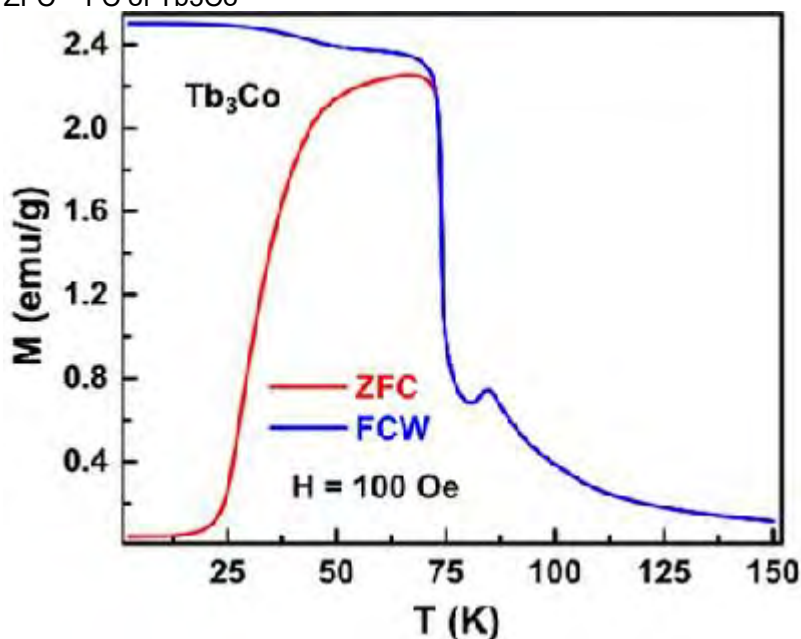
Rare earth rich intermetallic compounds of the type R₃T (R = rare earth, T = transition metal) are found to be very interesting class of materials as far as their complex magnetic structure is concerned. Tb₃Co is one such compound that orders antiferromagnetically below T_N = 84 K (Fig. 1) and goes through a first order transition below ~72 K (T_{FO}). In spite of the several studies attempted on this compound a sharp phase transition like feature (seen in ZFC magnetization) around 30 K was never got any proper explanation. From our temperature dependent neutron diffraction data (Fig. 2) it was found that the magnetic structure of this compound below 70 K remains unchanged. Rietveld refinement analysis confirmed that the phase transition like feature is mainly associated with the change in strength of spin-lattice coupling from weaker to stronger with decrease in temperature and it was never a real phase transition. [1] Besides, the analyses of the frequency dispersed linear and non-linear ac -susceptibility data confirms that the magnetic state below T_{FO} is coexisting with a spin-glass like phase and the glass temperature was found to coincide with T_{FO}. [1]

Further, this spin glass like behaviour in Tb₃Co persists even in the presence of external pressure up to P ~ 1 GPa although the glassiness was found to be weakened enough at P = 0.69 Gpa. Any further increase in pressure has negligible effect on the glassiness. [2] However, application of pressure shifts the magnetic transitions to lower temperature (T_N by 6 K, T_{FO} by 15 K, low temperature transition like feature by 3 K) and modulates the magnetic structure as well. In addition, the magnetocaloric effect (MCE) of Tb₃Co was improved by 37% in presence of pressure. [3]

Interestingly, other R₃T compounds (Ho₃Co, Dy₃Co, Dy₃Ni) was also examined and it was observed that R₃T compounds exhibit highly complex magnetic structure. The degree of complexity also varies with different R atom. The spin glass like state is found to be present in all these compositions, coexisting with long range magnetic order. This feature sustains even in presence of external pressure up to 1 Gpa. Low symmetry crystalline electric field plays a crucial role in magnetism of these materials. R₃T compounds can be used as potential magnetocaloric material at lower temperature and the enhancement in MCE in Tb₃Co with pressure can be realized in practice by some suitable chemical substitution.

References

- [1] S. Goswami, P. D. Babu, R. Rawat, J. Phys. Condens. matter 2019. 31, 445801.
 [2] S. Goswami, P. D. Babu, R. Rawat, J. Phys. Condens. matter 2019, 31, 505802.
 [3] S. Goswami, P. D. Babu, R. Rawat, J. Phys. Condens. matter 2020, 32, 365803.

ZFC – FC of Tb₃Co

Temperature dependent ND pattern of Tb₃Co

