Structural and magnetic properties of Gd_5Sb_3

S. Shanmukharao Samatham[1], Akhilesh Kr. Patel[1], K. G. Suresh[1]

[1]Magnetic Materials Laboratory, Department of Physics, Indian Institute of Technology Bombay, Mumbai 400076, Maharashtra, India

It is always a challenging task to understand the competing interactions manifested magnetic ground states. In recent years, the renewed interest in R_5M_3 (R = rare-earth and M = Ge, Sb, Ga, Sn etc.) compounds is due to their variety of ground states and magnetic field manifested magnetic interactions. Most of these compounds are found to crystallize in Mn_5Si_3-type hexagonal structure with P 63/m c m space group [1]. The unit cell consists of 5 layers of atoms in c-axis direction. In this R atom is located in two non-equivalent positions 4d (1/3, 2/3, 0) and 6g (x_R, 0, 0.25) whereas M atom is situated in 6g (x_M, 0, 0.25) position in which x_R and x_M are element specific.

We report on the structural and magnetic properties of Gd_5Sb_3. Figure 1(a) shows the Rietveld refined room temperature X-ray diffraction pattern. The lattice parameters are found to be a (= b) ~ 9.019 Å and c ~ 6.323 Å. The nearest neighbor 4d-4d interatomic distance is 3.16 Å while the inter-layer 4d-6g atomic distance is 3.80 Å. Temperature dependent magnetization measured in 100 Oe is shown in Figure 1(b). The compound is found to exhibit multiple temperature-driven transitions below 400 K. Paramagnetic to ferromagnetic (FM) transition is identified as T_C ~ 265 K, FM to antiferromagnetic (AFM) transition at T_N ~ 95 K and a low temperature transition at T_t ~ 62 K is noticed, as indicated by the arrows. T_C and T_N are in agreement with those reported values [2]. Shown in Figure 1(c) is the five-quadrant magnetization isotherm at 2 K. Field-induced AFM to FM-like transition is inferred from the sizeable hysteresis above a certain critical field. However, the magnetization is far from saturation. The compound shows zero coercivity and remanent magnetization.

In the full paper, we will present an in-detail analysis of structural and magnetic properties of Gd_5Sb_3. The magnetic phenomena and the occurrence of field-induced FM state will be discussed by comparing with its germanide counterpart Gd_5Ge_3.

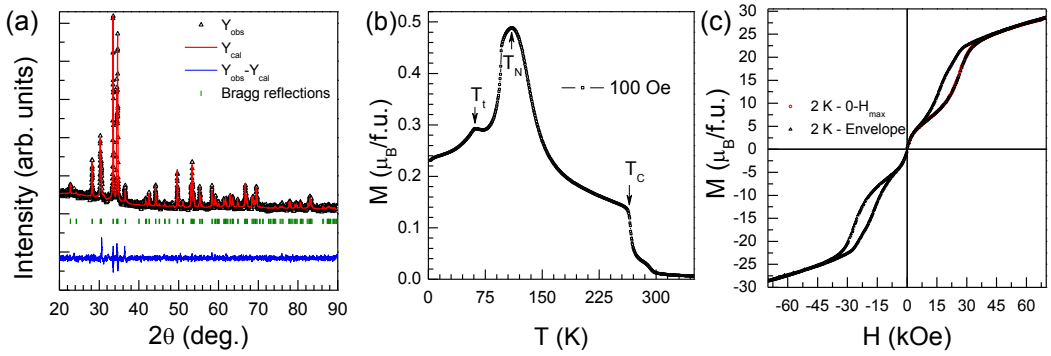

Figure 1. (a) Rietveld refined room temperature X-ray diffraction pattern, (b) M(T) in 100 Oe and (c) Magnetization isotherm M(H) at 2 K.

[1] W. Reiger et al., Acta Crystallogr. **24**, 456 (1968)

[2] J. K. Yakinthos et al., J. Magn. Magn. Mater. **36**, 136 (1983)