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Novel Magnetic Behavior in CDW Compound GdTe₃

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Introduction: Since “layered structure” became one focus in compounds with significant magnetic properties or phenomena, a lot of layered compounds were synthesized and investigated. Rare earth tritellurides ($R\text{Te}_3$) have been added to this list, when the rare-earth metal polytellurides $R\text{Te}_2$ and $R\text{Te}_3$ were reported that they have common basic structure with the alternate layers (Te layer and $R\text{Te}$ layer) [1]. It was reported that Gadolinium tritelluride (GdTe_3) exhibits Charge Density Wave (CDW) transition at 380 K [2]. What’s more, GdTe_3 single crystal exhibits two features in temperature dependence of magnetic susceptibility with only one antiferromagnetic transition at 11.5K and a spin-flop transition around 4K ($H \perp c$) [1]. However, two Neel temperature of GdTe_3 with 11.3 K and 9.7 K were reported by studying specific heat [3]. The specific heat figure also shows another faint anomaly at 7 K, although they have not pointed it out. So we studied magnetic properties of GdTe_3 single crystal again in here.

Experimental results and discussion: Single crystal of GdTe_3 was prepared by a flux method using alkaline metal chlorides. The mixture of the Gd and Te powder with total weight of 1 g was sealed in an evacuated quartz tube together with 2 g of the flux ($\text{LiCl}:\text{RbCl}=1:1$). The quartz tube was kept at 650 °C for two days. Then the temperature was gradually lowered to 540 °C in four days. The structure measurement was made by X-ray diffraction method. The magnetic measurements were performed by MPMS. By X-ray diffraction of surface of flake-shaped GdTe_3 single crystal, we found (001) face of a weakly orthorhombic crystal structure (space group $Cmcm$). **Figure 1** shows temperature dependence of the magnetic susceptibility of GdTe_3 single crystal in 1 T (F.C. / Z.F.C.). It can be seen that there is a broad peak with maximum at 13 K and an inflection point at 9.5 K ($H \perp c$), and that there exists another salient point at 11.5 K for $H // c$. This phenomenon is good enough to support idea of two Neel temperature of GdTe_3 with 11.3 K and 9.7 K. In addition, we also found a small anomaly at 7 K and ZFC-FC effect below 7 K for $H \perp c$ in 1 T. To further study, we measured temperature dependence of the magnetic susceptibility ($H \perp c$) of GdTe_3 single crystal in different magnetic field (0.1, 0.5, 1, 2, 3 and 5 T), shown like **Figure 2**. It shows that a valley appears at 8.8 K and ZFC-FC effect is observed below 8.8 K when the magnetic field turns to 2 T. Then, we consider that the valley is generated from the small anomaly at 7 K. But we don’t know what the phenomena originate from.

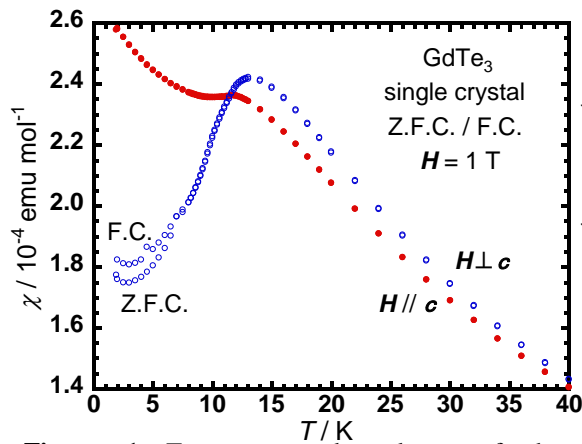


Figure 1 Temperature dependence of the magnetic susceptibility (Z.F.C. / F.C.) of GdTe_3 single crystal measured in the field of 1 T.

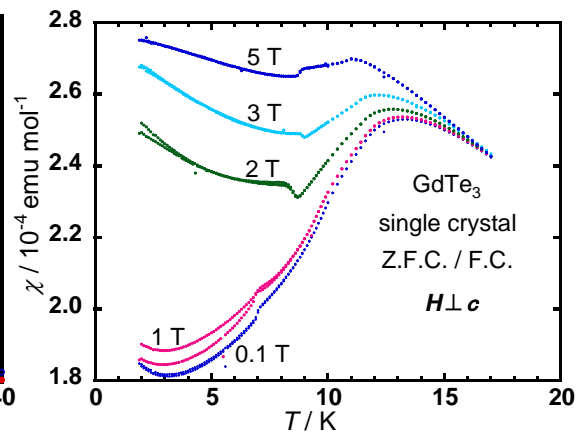


Figure 2 Temperature dependence of the magnetic susceptibility (Z.F.C. / F.C.) of GdTe_3 single crystal measured in 0.5, 1, 2, 3 and 5 T.

Refs: [1] Y. Iyeiri et al. Phys. Rev. B **67**, 144417 (2003). [2] N. Ru et al. Phys. Rev. B **77**, 035114 (2008). [3] N. Ru et al. Phys. Rev. B **78**, 012410 (2008).