

Magnetic properties of Mn-doped Bi_2Te_3 and Sb_2Te_3

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Diluted magnetic semiconductors (DMS), which magnetic ions are substituted for the host lattices of semiconductors, have attracted the worldwide scientific interests because of their spintronic applications. Group V_2 - VI_3 compounds are known as good materials for thermoelectric and thermomagnetic refrigerators operating at room temperature. Among them, Bi_2Te_3 and Sb_2Te_3 are narrow-bandgap semiconductors with layered structures. The sequence is Te-Bi(Sb)-Te-Bi(Sb)-Te, and three such sequences combine to make a unit cell. $\text{Bi}(\text{Sb})_2\text{Te}_3$ can be easily cleaved along the planes perpendicular to trigonal axis because of the weaker van der waals bonding between Te layers over the covalent ionic bonding between Bi and Te layers. [1].

Recently, ferromagnetism was reported in Fe-doped Bi_2Te_3 with $T_C = 12$ K [2]. Here we present the transport and magnetic properties of Mn-doped Bi_2Te_3 and Sb_2Te_3 crystals. We have fabricated Mn-doped Bi_2Te_3 and Sb_2Te_3 single crystals by the vertical gradient solidification method. The compositions and crystal structures of $\text{Bi}_{2-x}\text{Mn}_x\text{Te}_3$ and $\text{Sb}_{2-x}\text{Mn}_x\text{Te}_3$ were determined using EPMA and powder XRD patterns. The crystal structure was rhombohedral with smaller lattice constants because of smaller atomic radius of Mn than those of Sb(Bi). Magnetic and transport properties of Mn-doped Bi_2Te_3 and Sb_2Te_3 were investigated using SQUID and PPMS (Quantum Design, Inc). Figure 1 shows temperature dependent magnetizations, indicating transitions at low temperatures. Based on the transport and magnetization measurements, we may conclude that Mn-doped Bi_2Te_3 and Sb_2Te_3 compounds are spin-glass.

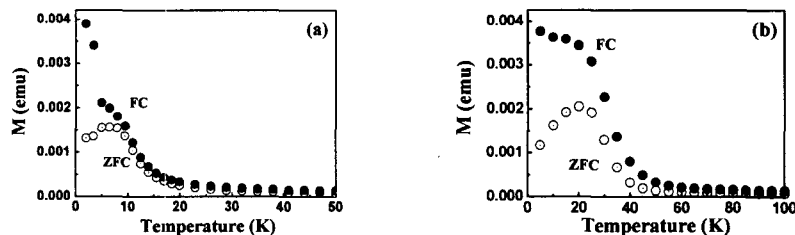


Fig.1. Temperature dependent magnetization of (a) $\text{Bi}_{2-x}\text{Mn}_x\text{Te}_3$ and (b) $\text{Sb}_{2-x}\text{Mn}_x\text{Te}_3$.

References

- [1] David M. Rowe *et al.*, CRC Handbook of Thermoelectrics, CRC press, 1995
- [2] V. A. Kulbachinskii, A. Yu. Kaminskii, K. Kindo, Y. Marumi, K. Suga, P. Lostak, P. Svanda, *Physica B*, 311 (2002)