Magnetic and transport properties of Mn_3Sn and Fe doped Mn_3Sn Weyl semimetal

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In the past few years, Mn_3Sn has attracted extensive attention due to its remarkable magnetic and electro-transport properties [1]. A large Anomalous Hall Effect (AHE) has been found in Mn_3Sn. AHE arises in Mn_3Sn due to the non-vanishing Berry flux emerging from the Weyl points. This compound draws enormous interest due to the complicated magnetic structure and its correlation with the transport properties. In general, Mn_3Sn with a hexagonal crystal structure is only stable in the presence of excess Mn atoms partially occupying Sn sites ($Mn_{3+\delta}Sn_{1-\delta}$, δ = 0.005 to 0.07) [2]. The macroscopic topological properties strongly depend on the sample composition, *i.e.*, the amount of excess Mn. Magnetic and transport properties of different compositions of polycrystalline samples will provide an understanding of the composition dependence on the AHE. We have measured the magnetic and transport properties of different compositions of polycrystalline samples Mn_xSn (x = chemical wt. ratio of Mn and Sn). We observed AHE from 420 K (T_N = 420 K) down to 282 K for the less Mn concentration samples (x = 2.94 to 3.09, δ = -0.015 to 0.022). However, AHE is present from 420 K to 5 K for excess Mn concentration samples (x = 3.16 to 3.29, δ = 0.04 to 0.068).

Fe doping influences the nearest-neighbor exchange energy, changing the magnetic and transport properties [3]. From magnetization measurement, the Néel temperature of $(Mn_{1.01}Fe_{0.025})_3Sn$ was observed at 405 K, slightly lower than the parent compound. Neutron powder diffraction results confirm that the magnetic structure is commensurate between 210 K < T < 405 K and incommensurate below 210 K. AHE exists only in the commensurate phase. Comparison with the parent compound concludes that a tiny amount of Fe doping significantly modifies the magnetic structure and transport properties.

References:

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