

Anomalous Hall effect, weak (anti)-localization and magnetic interactions in Ge_{1-x-y}Sn_xMn_yTe epitaxial multiferroics

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We present the structural, magnetic and magnetotransport results of Ge_{1-x-y}Sn_xMn_yTe epitaxial multiferroics with $x = 0.03$ and $y = 0.11$ over a broad range of temperature. The 150 nm thick layer maintains the rhombohedral crystal symmetry of its host lattice, GeTe. The dc susceptibility, $\chi(T)$ manifests double-maxima in the zero-field-cooled curves which might represent paramagnetic to ferromagnetic ($T = 55$ K) and ferromagnetic to an anticipated re-entrant spin-glass ($T = 25$ K) phase transition. Furthermore, a negative to positive crossover in magnetoresistance is observed at $T = 20$ K with a weak (anti)-localization effect below about 50 K that vanishes at higher temperatures. We also present a modified scaling mechanism of anomalous Hall resistivity which displays a large magnitude, $\rho_{AH} = 2.6 \mu\Omega \text{ cm}$ at $T = 4.3$ K. The origin of scattering processes that induce such a large anomalous Hall resistivity is discussed.

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