



**Film structure and characterizations.** (a) Schematic layer structure of  $(\text{MnSb}_2\text{Te}_4)_x(\text{Sb}_2\text{Te}_3)_{1-x}$  film and substrate layers. The thin twin-free  $\text{In}_2\text{Se}_3$  layer is formed by Se-passivation on an  $\text{InP}(111):\text{B}$  substrate, and twin defects are suppressed, too, in the following  $\text{Bi}_2\text{Se}_3$  and  $(\text{MnSb}_2\text{Te}_4)_x(\text{Sb}_2\text{Te}_3)_{1-x}$  layers. (b) X-ray diffraction (XRD)  $2\theta - \omega$  scan of the entire film of  $(\text{MnSb}_2\text{Te}_4)_x(\text{Sb}_2\text{Te}_3)_{1-x} - \text{Bi}_2\text{Se}_3 - \text{In}_2\text{Se}_3 - \text{InP}(111):\text{B}$ . The location of  $\text{Sb}_2\text{Te}_3(0015)/\text{MnSb}_2\text{Te}_4(0021)$  peak indicates the  $\text{MnSb}_2\text{Te}_4$  concentration,  $x$ . (c) XRD  $\phi$ -scan of (015) - plane. Three-fold symmetry verifies the absence of twin defects. (d) Hall measurement at 2 K. The lack of hysteretic behavior implies a weakened ferromagnetic ground state.