Strain-tunable anomalous Hall effect in hexagonal MnTe

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The ability to control and manipulate time-reversal (T) symmetry-breaking phases with near-zero net magnetization is a sought-after goal in spintronic devices. The recently discovered hexagonal altermagnet manganese telluride (α-MnTe) is a prime example. It has a compensated A-type antiferromagnetic (AFM) ground state where the in-plane ferromagnetic (FM) moments in each layer are stacked antiferromagnetically along the c axis, yet exhibits a spontaneous anomalous Hall effect (AHE) that breaks the T-symmetry with a vanishingly small c-axis FM moment. However, the presence of three 120° separated in-plane magnetic domains presents a challenge in understanding the origin of AHE and the effective control of the altermagnetic state. Here we use neutron scattering to show that a compressive uniaxial strain along the nearest-neighbor Mn–Mn bond direction detwins α-MnTe into a single in-plane magnetic domain, aligning the in-plane moments along the next nearest-neighbor direction. Furthermore, we find that uniaxial strain (−0.2% to 0.1%) significantly sharpens the magnetic hysteresis loop and switches the sign of the AHE near room temperature. Remarkably, this is achieved without altering the AFM phase-transition temperature, which can only be explained by a strain-induced modification of the electronic band structure. Our work not only unambiguously establishes the relationship between the in-plane moment direction and the AHE in α-MnTe but also paves the way for future applications in highly scalable, strain-tunable magnetic sensors and spintronic devices.