Observation of spin polarization of Weyl semimetal, WTe_2, at room temperature

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A type-II Weyl semimetal, WTe_2 is receiving great attention in spin physics because of the generation of spin polarization due to fictitious Weyl monopoles. In a previous study, in-plane spin polarization (S_y, parallel to the *b*-axis of WTe_2) originating from the Weyl node was reported by introducing an electrical method even though detection is limited at very low temperature [1]. Meanwhile, the existence of spin polarization along the *c*-axis (S_z, perpendicular to the plane) in WTe_2 due to local symmetry breaking was suggested by using angle-resolved photoemission spectroscopy (ARPES) [2], and S_z spin polarization can affect the spin-torque ferromagnetic resonance (ST-FMR) of adjacent ferromagnets [3]. However, the S_z spin generation using an electrical method and more precise origin of S_z spin polarization have not been explored.

In this study, we successfully detected the S_z spin polarization of WTe_2 using an all-electric method up to room temperature. Perpendicular magnetic anisotropy (PMA) electrodes made of $[Pt/Co]_{10}$ (“10” denotes a stacking number) and nonmagnetic Pt electrodes were deposited on the mechanically exfoliated WTe_2, and the out-of-plane magnetic field dependence of spin voltages was measured from 5 K to 300 K (see Fig.1). Figure 2 shows the result at 5 K and 300 K, and the hysteresis attributed to spin accumulation beneath the PMA electrode was observed up to 300 K [4]. In addition, the polarity of spin voltage hysteresis was reversed by switching the electric current direction, and this evidences that the hysteresis was originating from the local symmetry breaking of WTe_2. Other supporting evidence and detailed discussion will be given in the presentation.

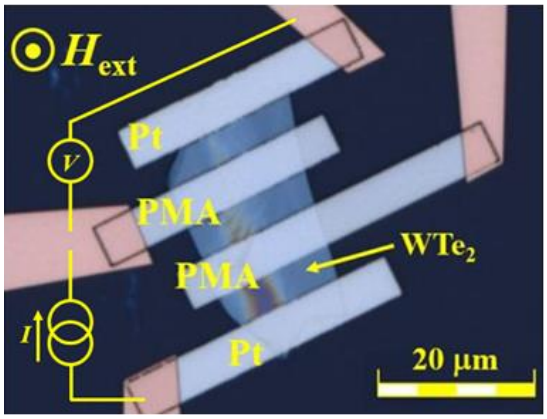

Fig. 1: Optical microscopic image of the device and measurement setup

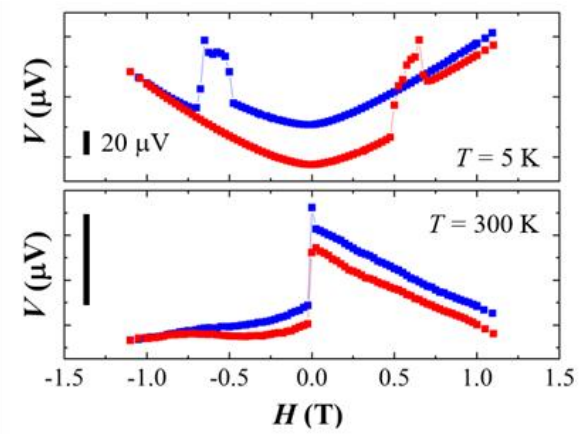

Fig. 2: Magnetic field dependence of the spin voltage at 5 K and 300 K

[1] Li, P. *et al*., Nat. Commun. **9**, 3990 (2018). [2] Das, P.K. *et al.*, Nat. Commun. **7**, 10847 (2016). [3] MacNeil, D. *et al*., Nat. Phys. **13**, 300-306 (2017). [4] K. Ohnishi *et al*., under review.