Electrical and magnetic properties of semi-metallic WTe_2

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Spintronics device is one of alternative ways to realize next generation electric device beyond modern electronic device. The generation, manipulation and detection of spins in materials are an important issue for the development of spin-based electronics. In an aspect of overcoming these challenges, refers to ohmic junction and suitable spin trnasport channel with long spin relaxation time in terms of propagating spin polarized current injected from source to drain without spin dephasing. Recent studies have shown generation of pure spin current, efficient propagation, spin manipulation in low-dimensional materials. Among them, Van der Waals materials representing atomic ultra-thin layers isolated from layered single crystals have been researched. Transition-metal dichalcogenide (TMD), which is one of Van der Waals materials have been known for large spin—orbit interaction (SOI) and object of opto-valleytronics research, thus TMD has recently attracted attention.

In this research, we introduce 1T'-WTe_2 crystals as a material for spintronic device. We fabricated Hall bar structure using an exfoliated WTe_2 layers. This device is used for electrical and magnetic measurement. We obtained ohmic contacts between metal electrodes and WTe_2 by chemical and physical surface treatment, and then observed the extremely large magnetoresistance (XMR), transverse resistivity contributed by both electron and hole transport, and the quantum oscillation by the Shubnikov–de Haas effect at low temperature. In a transport measurement, we observed non-saturating magnetoresistance (MR) which illustrates a high-mobility and semi-metallic property of 1T'-WTe_2 crystal. Therefore, these study imply that WTe_2 is one of the excellent candidates for spin transport devices.