High tuning of spin-orbit coupling and crossover between weak localization and weak antilocalization in ionic-gated tellurium

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Abstract

Controlling charge carrier density within solids via electrostatic gating has shown diverse phase transitions in two-dimensional materials, such as insulator-metal transition and superconductivity [1]. Furthermore, the gate voltage or electric field control of electron spin in materials with high spin-orbit coupling (SOC) is a key factor in the field of spintronics. Here, I will first provide a brief overview of electric double-layer transistors (EDLTs) and highlight the advantages of utilizing ionic liquids as the dielectric medium over conventional solid dielectrics; then, I will present our experimental results of ionic liquid gated *p*-type tellurium (Te) [2]. Our results show the possibility of gate tuning insulator-metal transition and a crossover from weak localization (WL) to weak antilocalization (WAL) into the sample, implying an increased Rashba-like SOC in the material created by a strong electric field restricted to the solid/electrolyte interface in EDLTs. Moreover, temperature-dependence of WAL showed an e-e interaction to be the main scattering mechanism of quantum decoherence in the material. More interestingly, we have demonstrated the ability to control the electron spin and amplify the Rashba parameter by a factor of 4 through ionic gating *p*-type Te, which could have potential applications in the field of spintronics.

References

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