Large multi-directional spin-to-charge conversion in low symmetry semimetal $MoTe_2$ at room temperature

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Efficient and versatile spin-to-charge current conversion is crucial for the development of spintronic applications, which strongly rely on the ability to electrically generate and detect spin currents. In this context, the spin Hall effect has been widely studied in heavy metals with strong spin-orbit coupling. While the high crystal symmetry in these materials limits the conversion to the orthogonal configuration [1], unusual configurations are expected in low symmetry transition metal dichalcogenide semimetals [2], which could add flexibility to the electrical injection and detection of pure spin currents. Here, we report the observation of spin-to-charge conversion in $MoTe_2$ flakes, which are stacked in graphene lateral spin valves [3]. We detect two distinct contributions arising from the conversion of two different spin orientations. In addition to the conventional conversion where the spin polarization is orthogonal to the charge current, we also detect a conversion where the spin polarization and the charge current are parallel. Both contributions, which could arise either from bulk spin Hall effect or surface Edelstein effect, show large efficiencies comparable to the best spin Hall metals and topological insulators. Our finding enables the simultaneous conversion of spin currents with any in-plane spin polarization in one single experimental configuration [3].

References

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Figures

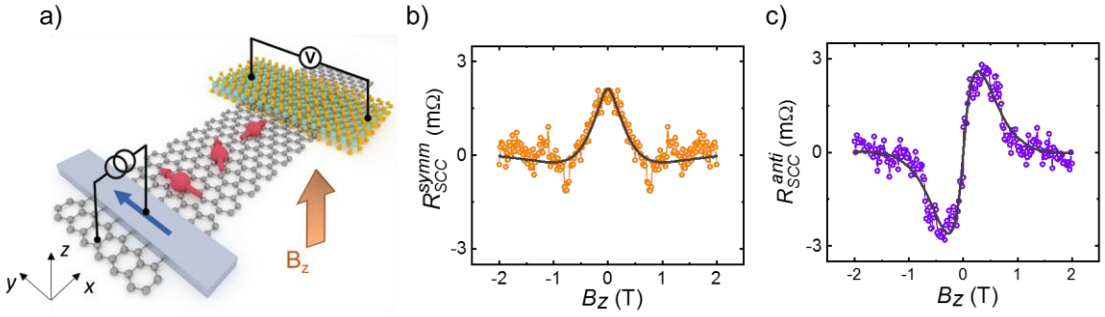

Figure 1: (a) Schematic of the measurement configuration showing the spin precession by applying an out-of-plane magnetic field. (b-c) Symmetric and antisymmetric components of the spin-to-charge conversion signal fitted to the Bloch equation (solid black line) corresponding to the spin to charge conversion of the spin component along y and x directions respectively.