Resolving spin currents and spin densities generated by charge-spin interconversion in systems with reduced crystal symmetry

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Abstract

Charge-spin interconversion (CSI) phenomena in systems with spin-orbit coupling allow us to generate and detect spin information [1]. Crystal symmetries impose constrains on the CSI components and, in high-symmetry materials, the spin polarisation and the charge and spin currents are mutually perpendicular. Conversely, low-symmetry materials enable unconventional CSI components [2] which are potentially relevant for a new generation of efficient spintronic devices, such as spin orbit torque non-volatile memories [1,2,3]. The WTe_2 crystal is an example of a material with reduced symmetry that can exhibit unconventional CSI components. By performing multi-terminal nonlocal spin precession experiments, we investigate CSI phenomena in WTe_2-graphene heterostructure and discuss their origin by considering the symmetries of the WTe_2 bulk and of its interface with the proximitized graphene [4]. We acknowledge support from H2020 FET-PROACTIVE project TOCHA under Grant No. 824140. J S acknowledges funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 754558.

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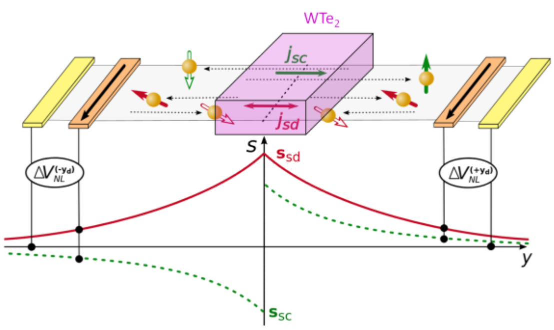

Figure 1: Sketch of the device geometry and generated spin currents (top) and spin electrochemical potential ***S*** (bottom). Spins generated in the CSI region diffuse in the spin channel towards ±y and are detected remotely in the FM electrodes (orange) by measuring the nonlocal voltage ΔV_{NL}. The spin currents J_{sc} and spin densities J_{sd} originate from the spin Hall current and the uniform spin accumulation in the CSI region associated to inverse spin galvanic effect, respectively.