The impact of reversible spin texture in ferroelectric GeTe

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Spin-orbit coupling effects in materials with broken inversion symmetry are responsible for peculiar spin textures. Among them, ferroelectric materials allow for non-volatile control of the spin degree of freedom through the electrical inversion of the spin texture, thanks to their reversible spontaneous polarization. Such functionality holds potential for technological applications exploiting spin effects controlled by electric fields.
Germanium Telluride stands out as material for spin-orbitronics being a FErroelectric Rashba SemiConductor (FERSC) [1]. Its *ferroelectricity* provides a non-volatile state variable able to generate and drive a giant *bulk Rashba-type spin-splitting* of the electronic bands. Finally, its *semiconductivity* allows for the realization of spin-based transistors.
Here, the ferroelectric control of the Rashba spin texture in GeTe is experimentally proved by combining Piezoresponse Force Microscopy and Spin and Angular Resolved PhotoEmission Spectroscopy (ref. [2] and advances). *Charge-to-spin conversion phenomena in GeTe* are investigated by unidirectional spin Hall magnetoresistance [3] in Fe/GeTe heterostructures [4], as shown in Figure 1. Finally, the concept and the realization of Rashba barriers semiconductor-based tunable spin filters is shown.
The work looks toward the non-volatile electric control of spin transport in semiconductors.

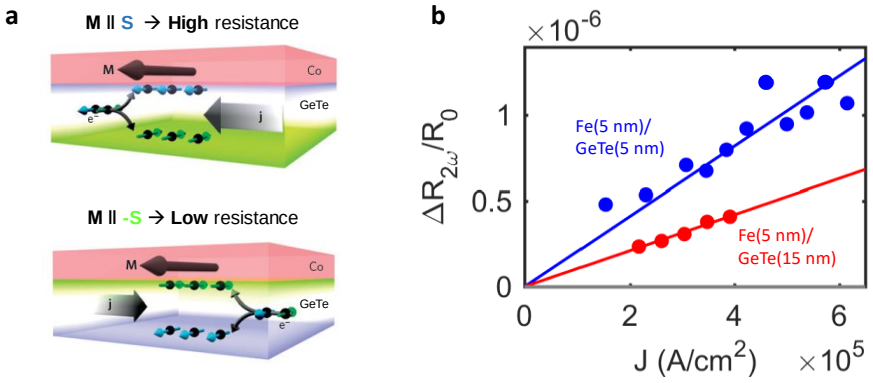

Figure 1. (a) Sketch of the unidirectional Spin Hall Magnetoresistance concept (adapted from [3]). The longitudinal resistance in Fe/GeTe bilayers depends on the relative orientation of Fe magnetization and spins generated by Spin Hall Effect in GeTe. (b) Relative change of the longitudinal resistance (second harmonic signal) versus current density. The magnitude and the linear behavior confirm the presence of sizable charge-to-spin interconversion in GeTe.

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