Emerging Magnetoresistance Effects in Spin-Orbitronics

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The main objective of spintronics is currently full electrical control of the spin degree of freedom via electrically-induced spin torques of various origins. In this context, the key role is played by spin-orbit coupling that allows for efficient charge-to-spin interconversion owing to the spin Hall effect (SHE) or current-induced spin polarization (Edelstein effect) [1].

In the past few years, the new concepts for the magnetoresistance phenomena mediated by spin-orbit coupling were reported. One of them explores the processes induced by the spin Hall effect at the interface between ferromagnet (insulating or metallic) and a material with strong spin-orbit coupling (e.g., heavy metal) [2]. Recently, the magnetoresistance which scales linearly with both external electric and magnetic fields has been reported, even in a single uniform layer of material with strong spin-orbit coupling [3]. The bi-linear character of spin-orbital magnetoresistance phenomena makes them undoubtedly attractive for applications.

During the lecture, we will summarize recent magnetoresistance experiments in materials used in spin-orbitronics (topological insulators (α-Sn, Bi_2Se_3), perovskite oxides (LAO/STO based systems, and thin films of Germanium). We will also discuss possible theoretical explanation of the bi-linear behavior of the magnetoresistance signal [3,4].

References:

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