Spin current source and detector with 2D surface states

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Classical spintronics generally uses magnetic materials to produce a spin current from a spin-polarized charge current, but it now appears that spin-orbit coupling (SOC) provides new directions to generate pure spin currents without associated charge currents. The SOC, this relativistic correction to the equations of quantum mechanics, can be significantly strong in materials containing heavy atoms. Today, it turns out that an efficient conversion can be obtained by exploiting the SOC-induced properties of a two-dimensional electron gas (2DEG) found at some surfaces and interfaces: the so-called Rashba interfaces and the surfaces or interfaces of new materials called topological insulators (TI).

Band gap opening and TI properties at room temperature are induced in α-Sn (0 0 1) layers by strain and quantum-size effects in thin films [1–3]. Indeed, ARPES measurements by Ohtsubo et al. [3] performed on thin α-Sn (0 0 1) films grown *in-situ* by molecular beam epitaxy revealed a Dirac cone (DC) linear dispersion with helical spin polarization around the Γ point of the surface Brillouin zone. We recently reported that a very efficient spin-to-charge conversion (SCC) can be achieved at room temperature by spin pumping into this α-Sn thin films, in clear relation with the Inverse Edelstein Effect induced (IEE) by the counter clock wise helical spin configuration of the Dirac cones that we identified by ARPES [3,4]. I will present the recent research that we are developing to make this surface states an useful tool for spintronics.

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[4] J.-C. Rojas-Sánchez et al. Spin to Charge Conversion at Room Temperature by Spin Pumping into a New Type of Topological Insulator: α-Sn Films Phys. Rev. Lett 116, 096602 (2016)