Topological insulators and Rashba interfaces as efficient spin-charge current converters

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New materials with large efficiency of spin-charge current interconversion are highly desirable to study new physical phenomena as well as for spintronics applications. The spin-orbit coupling (SOC) in the 2DEG states at Topological Insulator (TI) or Rashba Interfaces is predicted to be more efficient than their 3D counterparts for such interconversion. We have found the highest efficiency at room temperature using the topological insulator α-Sn [1]. The spin-to-charge current conversion in such 2D systems is called Inverse Edelstein Effect (IEE), also known as spin galvanic effect [2]. We will show results of spin-to-charge conversion by spin pumping experiments and their analysis in term of inverse Edelstein Length [1,3-5]. I will also show additional examples of conversion between spin-to-charge at the following Rashba interfaces: Ag/Bi(111) [3], Fe/Ge(111) [4] and LAO/STO(001) [5].

Experimental results based on ARPES and spin pumping indicate that direct contact of metallic ferromagnetic layer is detrimental for the surfaces states of topological insulators but we can keep the surfaces states of α-Sn using Ag spacer [1]. I will use the conversion parameter obtained at room temperature with α-Sn to demonstrate the very large advantage of the SOC effects in 2D interface states with respect to the Spin Hall Effect (SHE) of 3D metals and the resulting perspective for low power spintronic devices. I will focus especially in the prediction of giant spin Seebeck effect using insulator ferrimagnet $Y_3Fe_5O_{12}$ (YIG) in YIG/α-Sn films structures.

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