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Spin-to-charge conversion in copper oxide heterostructures

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A spintronics device must perform three main functions: generate, manipulate, and detect spin currents. A spin current can be created/detected by the spin Hall Effect (SHE) or Rashba-Edelstein Effect (REE), whose principal ingredient is the spin-orbit coupling (SOC) that relates the electron spin with its orbital motion. Based on SOC effects a new technology can be improved to generate/detect a spin current without a ferromagnetic layer. In a spin-orbit torque device (SOT-MRAMs), magnetization switching is generated by a current-induced torque due to SHE in materials with high SOC adjacent to the ferromagnetic (FM) layer. Recently a large spin-to-charge conversion was reported in copper oxide multilayers [1]; however, its origin is still not well understood and further investigations are required. Different approaches have been proposed to understand the physics behind this phenomenon. Copper is a metal with negligible SOC but oxidizing a copper film in contact with a high SOC material makes it possible to get a remarkable efficiency, even higher than employing heavy metals [2]. The mechanism behind this efficient conversion is the Orbital Hall Effect (OHE) altogether with SHE, but up to now, the contribution of each effect to the measured signal remains unclear [3]. In this presentation, we show a remarkable spin-to-charge conversion in CuxO, where the origin of this behavior can be attributed to OHE. In this study, we have deposited a set of CoFeB/CuxO samples as a function of the CuxO thickness using the sputtering technique. We use a CoFeB ferromagnetic layer as a spin current source and CuxO layer as a spin sink. Spin pumping experiments were carried out on a Bruker EPR at room temperature. The debate on the physical process underlying the charge-to-spin conversion in oxides is still open, which demonstrates that this field is in an infancy stage where is very important to understand the physics behind all these new mechanisms to produce large spin-to-charge conversion using light materials such as copper oxide or to explore another metal oxide heterostructures.

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References

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