Spin-to-charge current conversion in copper oxide heterostructures.

K. Cancino-Alfaro[1,*], G. Rodriguez[1,], E. Burgos-Parra[1], S. Oyarzun[1] , R. Rodriguez[2] , J. Denardin[1].
[1]Universidad de Santiago de Chile – Avenida Libertador Bernardo O'Higgins nº 3363. Estación Central. Santiago. Chile.
[2]Pontificia Universidad Católica de Chile- Vicuña Mackenna 4860, Macul, Región Metropolitana
*khris.cancino@usach.cl,

Abstract

A well-documented method for generating spin currents is known as spin pumping. This method uses ferromagnetic resonance to induce a spin current in a non-magnetic material, usually a heavy metal with high spin orbit coupling. Recently a spin-torque generation in copper oxides comparable to that observed in heavy metals has been reported [1], giving a more affordable alternative to heavy metals such as platinum or palladium. It has been proposed that the mechanism behind this efficient conversion is the Orbital Hall effect (OHE) altogether with Spin Hall Efect (SHE), but up to now, the contribution of each effect to the measured signal remains unclear [2] .

In this study we use a CoFeB ferromagnetic layer as source of the spin current and a second layer of copper oxide, Cu_xO, a light metal with low spin orbital coupling, as a spin sink. we have synthesized CoFeB/Cu_xO bilayer using sputtering method. Spin Pumping experiments were carried out on a Bruker EMX Plus at room temperature.

Using naturally oxided copper as spin sink we have measured a voltage signal of one-fifth of the analogous measurement in platinum. An inverse dependence between the voltage signal and the thickness of the copper oxide layer was also observed. An increase in voltage is observed using a CuO target in the sputtering synthesis of copper oxide, reaching a third of the voltage measured in platinum. These copper oxide thickness dependance studies should help us to elucidate the nature of the spin-to-charge conversion.

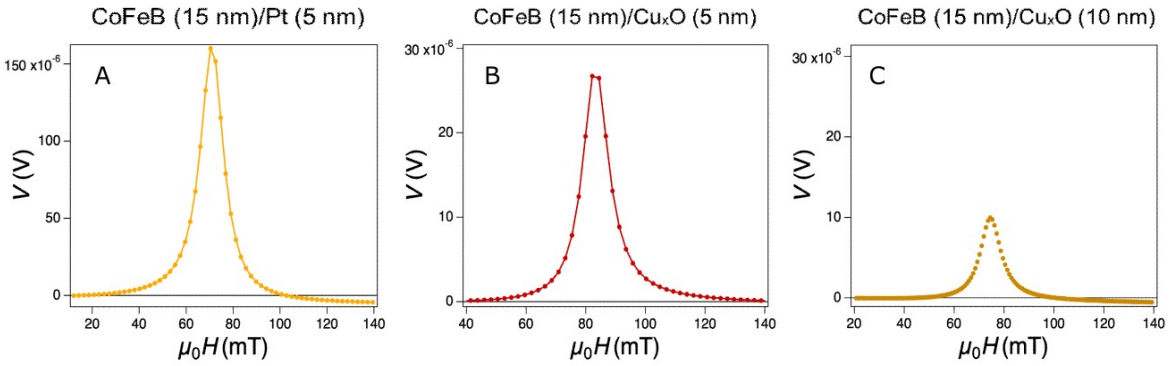

Figure 1: Spin Pumping signal measured in A, CoFeB (15nm)/Pt (5nm), B, CoFeB(15nm)/Cu_xO(5nm) and C, CoFeB(15nm)/Cu_xO(10 nm), at 9 Ghz and 197 mW.

Agradecimientos: Universidad de Santigo de Chile y Proyecto Basal CEDENNA AFB180001.

Referencias

[1] An, H., Kageyama, Y., Kanno, Y., Enishi, N., & Ando, K. (2016). Spin–torque generator engineered by natural oxidation of Cu. Nature Communications, 7(1). https://doi.org/10.1038/ncomms13069

[2] Dongwook Go, Daegeun Jo, et al, (2021).Orbital Rashba effect in a surface-oxidized Cu film. Phys. Rev. B 103. https://doi.org/10.1103/PhysRevB.103.L121113