MA 6: Spin Pumping/ Spin Hall Effects - Invited Talk

Time: Monday 14:00–14:30 Location: TRE Ma

Invited Talk MA 6.1 Mon 14:00 TRE Ma

Quantifying Spin Hall Effects in Nonmagnetic Metals — •Axel Hoffmann — Materials Sceince Division, Argonne National Laboratory, Argonne, IL 60439, U.S.A.

Spin Hall effects intermix spin and charge currents even in nonmagnetic materials and, therefore, offer the possibility to generate and detect spin currents without the need for ferromagnets. In order to gain insight into the underlying physical mechanism it is important to quantify the spin Hall angle γ, which is a direct measure of the charge-to-spin conversion efficiency. Towards this end we utilized non-local transport measurements with double Hall bars fabricated from gold and copper. We observe an unusual non-local resistivity that changes sign as a function of temperature. However, this results is quantitatively similar in gold and cooper, indicating that the non-local signals are not due to spin transport, suggesting an upper limit of $\gamma < 0.027$ for gold at room temperature. Therefore we developed an approach based on spin pumping, which enables us to quantify spin Hall angles with high accuracy. Spin pumping utilizes microwave excitation of a ferromagnet adjacent to a normal metal to generate a dc spin current, which can be quantified from the line-width of the ferromagnetic resonance. In this geometry voltages from spin Hall effects scale with the device dimension and therefore good signal-to-noise can be obtained even for small spin Hall angles. Using this approach we determined the spin Hall angle for a variety of non-magnetic materials (Pt, Pd, Au, and Mo) at room temperature. Financial support was through U.S. Department of Energy under Contract no. DE-AC02-06CH11357.