Centre de Nanosciences et de Nanotechnologies

Séminaire

Mardi 08 janvier 2019
14h00

"Injection locking and spin transfer torque efficiency in three-terminal spin-torque oscillators"

Emilie JUE

National Institute of Standards and Technology, Boulder, COLORADO

Beyond their nanoscale size and their tunability in frequency, spin-torque oscillators are of interest for their ability to lock to an external microwave signal or to mutually synchronize. In this work, we measure the injection locking of a three-terminal STO excited by spin-orbit torque. The three-terminal device consists of a magnetic tunnel junction (MTJ) on a Pt wire. A DC and microwave (MW) current are applied through the Pt wire to induce the oscillations and injection lock the device, respectively, and the precessional signal is measured via a spectrum analyzer through the MTJ. We study the injection locking at fMW≈f0 and at fMW≈2f0, where f0 is the free running frequency of the STO and fMW is the MW frequency. Interestingly, we observe a frequency response that is different from the injection locking of STO generally reported in the literature. Whereas typical phase locking behavior is observed at fMW≈2f0, the injection locking at fMW≈f0 exhibits a strong asymmetry. In this presentation, we give a qualitative and quantitative description of the injection locking in the three-terminal STO.

In the second part of this presentation, I use the three-terminal spin-torque oscillator to compare the spin-transfer efficiency of two mechanisms: the spin orbit torque and the spin filtering torque (i.e. spin transfer torque obtain via a spin polarized current through a spin valve (SV) or a MTJ). For this study, the device consists of a SV on top of a Pt wire. The devices can be excited either by the spin filtering torque (SFT) or by the spin orbit torque (SOT) depending on whether the current is applied through the SV or through the Pt wire. By varying the Pt width and the dimensions of the SV, we tune the SOT and STT and compare their efficiencies. We show that, for the device that we study, the SFT is more efficient in terms of current density, whereas the SOT can be more efficient than the SFT in terms of current when the Pt wire is narrower than 700 nm. Finally, we use three control samples (where the Pt wire is replaced by a Cu wire or where the SV is replaced by an MTJ) to discuss the limits of the method.

[1] Jué, Pufall, and Rippard, *Appl. Phys. Lett.* 112 (2018)

IMPORTANT***

Participants external to C2N should register below prior to the seminar:

https://framaforms.org/registration-c2n-seminar-dr-emilie-jue-1545050748