Service de Physique de l'Etat Condensé

Thèses ou HDR SPEC

Vendredi 17/10/2014, 14h00-17h00

Amphi. Service Astrophysique, Bât. 713C, Salle Galilée

Christian Hahn

SPEC - Laboratoire Nano-Magnétisme et Oxydes

Magnetization Dynamics and Pure Spin Currents in YIG/normal-metal Systems

Spintronics aims at designing electronic devices which capitalize on the spin degree of freedom to transport information using spin currents. In order to incorporate spin currents into electronic devices, it is particularly interesting to study the interconversion from a spin current, the motion of spin angular momentum, to a charge current (Spin Hall Effect) as well as the transfer of spin angular momentum between the conduction electrons of a normal metal (NM) and the magnetization of a ferromagnet (FM) (Spin Transfer Torque/Spin Pumping). To investigate the interplay of those effects this thesis studies hybrid systems of the ferrimagnetic insulator Yttrium Iron Garnet and normal metals with large spin-orbit coupling, a prerequisite for spin Hall effect.

We study spin pumping and spin hall magnetoresistance in YIG|Pt and YIG|Ta bi-layers using extended films of 200 nm thick YIG, grown by liquid phase epitaxy. The inverse spin Hall voltages in Pt and Ta confirm the opposite signs of spin Hall angles in these two materials. Moreover, from the dependence of the inverse spin Hall voltage on the Ta thickness, we constrain the spin diffusion length in Ta. Both the YIG|Pt and YIG|Ta systems display a similar variation of resistance upon magnetic field orientation, the spin Hall magnetoresistance. To study the influence of interfacial spin pumping and a possible reverse effect, it is desirable to work with thin film thicknesses. A high quality 20 nm thick YIG film was grown by pulsed laser deposition, showing a damping similar to that of bulk YIG. We use nano-lithography to pattern series of YIG(20nm) and YIG(20nm)|Pt(13nm) discs with diameters between 300 and 700 nm. The ferromagnetic resonance (FMR) spectra of the individual sub-micron sized samples are recorded through magnetic resonance force microscopy. Passing dc-current through micron sized YIG|Pt disks reveal a variation of the FMR linewidth consistent with the geometry and amplitude of the expected SHE transfer torque. In the absence of exciting microwave fields, a variation in the magnetization is detected when the dc-current reaches the expected threshold for auto oscillations.

Contact : christian.hahn@cea.fr - +33 1 69 08 11 46