Microwave oscillations induced by spin polrized currents

Contact: Ursula EBELS DSM/INAC/SPINTEC ursula.ebels@cea.fr 0438785344

PhD may follow: Yes

Summary :

One of the basic concepts of spintronics is the spin momentum transfer where spin polarized conduction electrons can transfer a magnetic moment to the local magnetization of a thin ferromagnetic film. This magnetic momentum transfer is responsible for the excitation of high frequency (Gigahertz range) magnetization oscillations and opens new possibilities for the development of integrated microwave components. SPINTEC studies the autonomous and non-autonomous operation of such spintronics oscillators (STOs) from a fundamental point of view but also in context of possible applications. A current important question considers how the spin momtnum transfer driven dynamics interacts with other excitations of the spintronics nanodevice that can influence for instance the frequency characteristics and overall RF performances.

THREE M1 or M2 MASTER PROJECTS are currently available within a group of 7 people to study spin torque driven magnetization dynamics in innovative spintronics oscillator configurations.

Full description :

SUBJECT 1 FOR M2 - SELF POLARISING MAGNETIC MULITLAYERS: While standard spintronics oscillators are made of a polariser (to spin polarise the current) and a free layer (in which the dynamics is excited by spin momentum transfer), novel structures consider magnetic multilayers made of several (more than two) magnetic thin layers, separated by a non-magnetic layer. Here each layer is supposed to spin polarise the current and to be excited at the same time. The objective is to study the non-linear collective excitations coupled via spin momentum transfer, dipolar field and exchange interaction.

Contacts: ursula.ebels@cea.fr (+33 4 38 78 53 44) and bernard.dieny@cea.fr (+33 4 38 78 38 70) ____

SUBJECT 2 FOR M1 OR M2 - FERROMAGNETIC RESONANCE STUDIES OF THE DAMPING PARAMETER IN SPINTRONIC DEVICES :

The damping parameter plays a central rÃ´le for spintronic devices defining for instance the critical current above which the magnetization switches or above which steady state excitations are excited.

This parameter is quite often characterized for isolated magnetic layers, while it is well known, that it is modified in presence of other layers inside the functionl stack, for instance via the spin pumping effect. The aim of this internship is to characterize the damping parameter via ferromagnetic resonance for real stacks that are used for magnetic memomry and for oscillator devices that are realized and studied in our laboratory.

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SUBJECT 3 FOR M1 - CHARACTERIZATION OF THE STABILITY OF MAGNETIC TUNNEL JUNCTION SPIN TORQUE OSCILLATORS:

Spintorque oscillators are based on magnetic tunnel junctions in order to reach the required output voltage level. However, the thin MgO barrier is very fragile under continuous DC current operation. This intership aims at a characterization of the static and dynamic properties of tunnel junction spin torque oscillators in order to determine their stability limit. This will be an important feedback for materials optimisation and nanofabrication.

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Requested skills :

Motivated student with a sound background in solid state physics and/or nanosciences and keen to explore new concepts and ideas that are at the interface between physics (spintronics) and applications (microwave oscillators).