Spin transfer torque oscillators for Phase locked loop operation

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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 when a DC current is injected into a magneto-resistive device.

This concept opens novel possibilities for the development of integrated microwave components. SPINTEC studies these effects of spin momentum transfer from a fundamental point of view to better understand the non-linear magnetization dynamics of nansocale devices, but also in context of potential applications. In particular, the generation of microwave signals will be the object of the study of this internship, followed by a thesis.

Full description :

The non-linear dynamics of a spin transfer torque oscillator and its microwave signal generation have been studied in the past by our group as well as by numerous others. Good results in terms of output power and spectral purity have been obtained for oscillators emitting in the 0.2-1GHz range. Operation at higher frequency ranges (1-10GHz) of interest for applications, still suffers from too high a phase noise, making implementation for instance into a phase locked loop (PLL) difficult. The aim of the present internship project, followed by a PhD, is to explore different magnetic stack configurations (magnetization in-plane and/or out of plane for polarizer and/or free layer), allowing for more stable and robust oscillations. The final aim is the operation and characterization of a PLL for the frequency range of 1-10GHz.

As a first task, the student will evaluate the dynamic response of different magnetic stack configurations by numerical simulations. Subsequently the student will realize the device (materials and nanofabrication) and characterize the high frequency emission properties. Successful devices will be tested within PLL operation. This work will be realized in collaboration with other group members of the microwave component group of Spintec, as well as in collaboration with TU Dresden (for PLL testing) and in collaboration (or joint supervision) with a group of the Â« International Iberian Nanotechnology Â» center in Portugal for materials development 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).