Electrical effects in ferromagnetic resonance of nanostructures and atomic contacts

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Thèse SPEC

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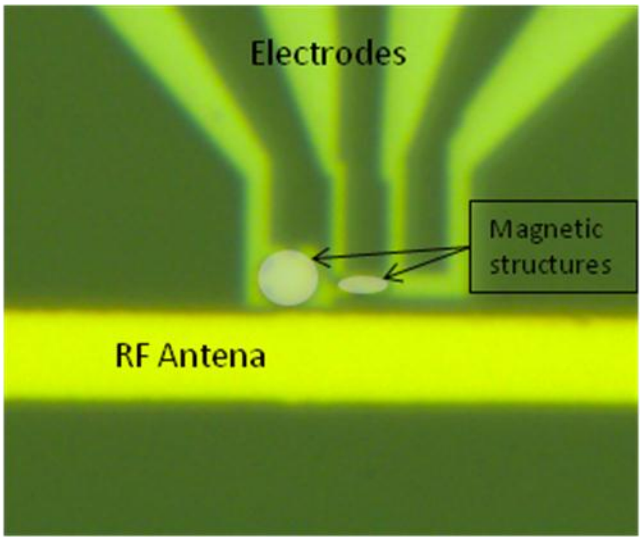

The aim of this thesis is the study of ferromagnetic resonance properties (FMR) of nanostructures and atomic contacts. In order to achieve this, we take advantage of the fact that electrical transport is dominated by the atomic contact, and use an electrical detection technique. We developed a novel experimental setup in which a mechanical break junction is designed in a radio-frequency compatible environment where electrical measurements can be carried out under variable static and dynamical magnetic fields.

Firstly, magnetic nanostructures were measured in order to determine the reliability and the high sensitivity of our system. Then the susceptibility of domain walls in nanostuctures at frequencies higher than those classically used for their displacement, was measured and found to be large and almost independent of the frequency. This susceptibility was roughly 10 times that in saturated domains. The experimental setup also allowed to study the interaction between spin currents and dynamical properties of nanostructures. The spin currents dynamically generated at the ferromagnetic resonance have been measured in Py/Pt nanostructures using the inverse spin Hall effect in platinum. The influence on the FMR of spin current injection using the spin Hall effect in Pt has also been observed.

The FMR of atomic contacts has been studied by a rectified technique. While breaking our nanostructures of cobalt and permalloy, new resonant modes have been shown to appear at fields higher than those of the uniform resonances. This is attributed to the effect of demagnetization fields that are locally modified when reducing the constriction diameter. In the atomic contact regime, we have measured the constrained domain wall resonance. In that case the rectified signal, generated by a few atoms, depends sensitively on the frequency and can reach values 1000 times higher than the FMR signal of saturated domains in the unbroken samples.

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