Summary

Two main topics were discussed in this Phd thesis. a) An experimental part concerning the characterization of soft magnetic thin films by ferromagnetic resonance (FMR) and b) a theoretical part, where numerical simulations of the magnetization inversion of thin films by a spin polarized current were performed.

a) In the case of ultra thin films (a few nanometers) the broadband ferromagnetic resonance experiment has a limited sensitivity, since the absorption is only a small part of measured signal, and depends directly on the volume of the sample. An interferometer setup was implemented, in order to circumvent this problem. The FMR interferometer with two identical diode detectors and a lock-in amplifier was implemented. The experimental signal-to-noise ratio was improved two to three times in comparison to standard state-of-the-art vector network analyzer based experiments. The experiment worked for thicknesses down to 3 nm of Py with in plane anisotropy, but was not able to successfully identify absorptions in ultra thin films (2 nm) with perpendicular anisotropy.

Amorphous FeSiB thin films presenting magnetostriction have been investigated for decades for energy and sensors applications. They are very soft magnetic films, with high magnetization saturation. The magnetic properties of those films can be tuned by thermal annealing, releasing the quenched-in stresses. There have been just a few reports in the literature about the microwave dynamic magnetic properties on these films. $Fe_{78}Si_9B_{13}$ thin films with 80 to 300 nm thickness progressively annealed from 200ºC to 325ºC were characterized by FMR. These materials possess a notable state exhibiting stripe domains regime, where several absorption modes were found, and this peculiar domain configuration was investigated in detail with experiments and micromagnetic simulations to evaluate the possibility of using these films for magnonic applications. The Magnetization saturation obtained was M_s=1.65 T and the magneto-elastic energy could not be exactly quantified due to accuracy issues, but was in close to already published results by our group. The Gilbert damping was found between 1.5 and 2.7 x 10^{-3}, which is surprisingly low for amorphous thin films. The microwave oscillation modes observed in a specific magnetic configuration exhibiting stripe domains were identified by micromagnetic simulations.

b) Recently Field free switching of magnetic nano elements by spin polarized current have been achieved experimentally . The spin current is generated due to an electric current passing through a heavy metal underlayer by spin Hall effect. This is very promising for spintronic applications, such as magnetic random access memories. In order to obtain the switching in perpendicular anisotropy films, the energy symmetry of the system needs to be broken spatially. The symmetry of the system can be broken mainly in two ways: either by introducing a tilt in the anisotropy axis or by applying an external bias field using a heavy metal antiferromagnet such as IrMn or PtMn. In this thesis a comparison is presented between the two methods, done both analytically and by macrospin simulations. We have shown that the energy barrier is degraded by the use of a bias field, and thus the tilt method has more potential for minimization and faster operation speed.