NANO-POINT CONTACTS PROCESSING FOR SPIN TORQUE OSCILLATORS

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Spin torque oscillators are devices in which a DC electrical current induces high frequency steady-state oscillations in the free layer magnetization of a GMR multilayer[1], extending the magneto-electronics field with promising GHz radio-frequency (RF) generators for wireless communication. In order to manifest the spin-transfer torque effect[2,3], high electrical current density must be achieved and the geometries mostly used are nano-pillars and nano-point contacts.

Here we focus on the fabrication of nano-point contacts devices. The basic process flow starts with a [$Co_{90}Fe_{10}$/Cu/$Co_{90}Fe_{10}$ and $Ni_{80}Fe_{20}$] spin valve stack that is sputter deposited on a Cu bottom electrode and passivated with a 50 nm SiO_2 layer. The 80 nm point-contacts are patterned using electron beam lithography (e-beam) and covered with a thick layer of gold in order to define the top electrodes by optical lithography.

The etching technique used to transfer the point contacts from the e-beam resist into the SiO_2 insulator is a key point in controlling the final dimension of the point contacts. Wet chemical etching using buffered HF is isotropic and results in an increase of the point contact diameter to ± 180 nm. To aim at smaller sizes, we are exploring dry etching techniques such as vapor HF and reactive ion etching using CF_4 and C_4F_8 gases to selectively etch the SiO_2 passivation layer with well defined and vertical sidewalls, in contrast to the sloped sides obtained by the wet chemical etch.

Additional concerns arise when optical access is required, e.g. to perform Brillouin Light Scattering (BLS) studies of the spin waves excited by the spin transfer torque. In this case the dimension of the top electrode (width ≈ 200 nm) has to be minimized as much as possible for maximum optical access. This condition limits the maximum DC current that can be injected into the device (< 40 mA) without damaging it. Although initial devices showed the emission of spin waves excited by an RF current[4], they broke down before the onset of DC-current induced spin-torque oscillations. During the workshop, we will demonstrate our latest improvements to address these issues.

[1] J.A. Katine, F.J. Albert *et al.*, Phys. Rev. Lett. **84**, 3149-3152 (2000).
[2] J.C. Slonczewski, J. Magn. Magn Mater. **159**, L1-L7 (1996).
[3] L. Berger, Phys. Rev. B. **54**, 9353-9358 (1996).
[4] Refer to the talk of A. Laraoui and the poster of F. Ciubotaru during the workshop. Further investigations on spin waves radiation, nonlinear phenomena and DC current distribution simulations in nano-point contacts will be presented.