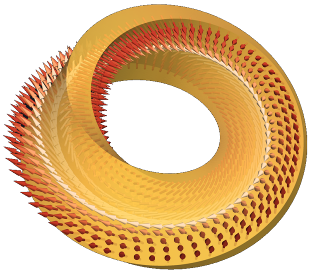

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Arrays of nanostructures on polyimide substrate. Heterogenous strain effect on magnetic properties

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Magnetic nanostructures deposited on flexible substrates are of increasing interest for flexible magnetoelectronic applications. In this context, it is crucial to study the links between strain fields and magnetic behavior. In this study, a large area (5 mm × 5 mm) of ferromagnetic nanostructures (nanowires and antidots) have been deposited on top of a polyimide substrate using interference lithography and sputtering processes [1,2].
In order to characterize the strain effect on magnetic properties, we have developed an in situ technique that combines microtensile tests and ferromagnetic resonance. From the shift of resonance spectra as function of applied strain, it is possible to estimate the magneto-mechanical properties. The magnetic resonance frequencies have been measured as function of macroscopic strain applied to the polyimide substrates. We have shown that the resonance shift due to macroscopic strain depends on the kind of system: the effect is stronger for continuous thin film and lower for nanowires. The nanostructuration (nanowires, nano-antidots) induces strain relaxation whose amplitude depend on nanostructures geometrical features [3].
Modelling combining micromagnetism and solid mechanics, describing the strain heterogeneities in such systems, has explained the experimental results. We show that the nanostructuration affects the strain distribution and its mean value in magnetic nanostructures. Therefore, for a given macroscopic strain applied to the substrate, the strain-induced shift of the magnetic resonance field depends on the nanostructures geometry. Especially, the magnetomechanical response depends on the tensile strain direction as referred to the nanostructure orientation.

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