# Nanocomposites and nanomaterials

## Spin waves in micromagnetic rings

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We present here the experimental measurements and the corresponding calculations of standing spin wave modes in isolated 400 nm-wide circular Ni80Fe20 rings with an outer diameter of 3 μm in the perpendicular geometry (Fig.1). Using the broadband ferromagnetic resonance technique, we observed the important peculiarity of spin waves of the 100 nm thick rings in comparing with the 30 nm thick rings, i.e., the non-monotonic dependence of the absorption amplitudes from the number of modes. To describe such effect, we calculated spin waves dispersion in 100 nm thick rings, taking into account the dependence of mode profile from two spatial variables, radial coordinate ρ and axial coordinate z. In the case of 30 nm thick rings we consider the homogeneous profiles along axial coordinate z, while the dependence from radial coordinate ρ was taken into account. This approach allowed us to achieve a quantitative agreement between experimental data and calculations of spin wave dispersion for rings of both thicknesses (Fig.2).

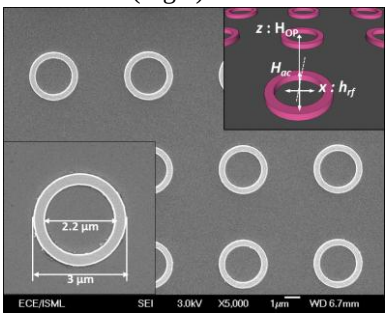


Figure 1. SEM image of the periodic array of $Ni_{80}Fe_{20}$ rings. Bottom left inset: SEM image the isolated ring with indicated dimensions. Top right inset: the geometry of the experiment.

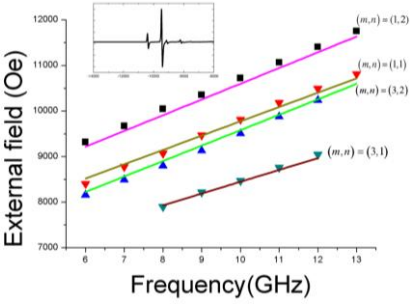


Figure 2. Spin wave dispersion of standing spin waves in 100nm rings as a function of external field (Triangles and squares – experimental results, solid lines – theoretical calculations). In the inset – typical non-monotonic dependence of the absorption amplitudes.