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Ferromagnetic resonance force spectroscopy of individual submicron-size samples

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Abstract

We review how a magnetic-resonance force microscope (MRFM) can be applied to perform ferromagnetic resonance spectroscopy of individual submicron-size samples. We restrict our attention to a thorough study of the spin-wave eigenmodes excited in Permalloy (Py) disks patterned out of the same 43.3-nm-thin film. The disks have a diameter of either 1.0 or 0.5 μm and are quasisaturated by a perpendicularly applied magnetic field. It is shown that quantitative spectroscopic information can be extracted from the MRFM measurements. In particular, the data are extensively compared with complementary approximate models of the dynamical susceptibility: (i) a two-dimensional analytical model, which assumes a homogeneous magnetization dynamics along the thickness, and ii) a full three-dimensional micromagnetic simulation, which assumes a homogeneous magnetization dynamics below a characteristic length scale c and approximates the cylindrical sample volume by a discretized representation with regular cubic mesh of lateral size c=3.9 nm. In our analysis, the distortions due to a breaking of the axial symmetry are taken into account; both models incorporating the possibility of a small misalignment between the applied field and the normal of the disks.

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