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Size dependent nonlinear effects of magnetization dynamics in Permalloy disks FENG GUO, HAN-JONG CHIA, National Institute of Standards and Technology, University of Maryland, LYUBA BELOVA, Royal Institute of Technology, ROBERT MCMICHAEL, National Institute of Standards and Technology — We use ferromagnetic resonance force microscopy (FMRFM) to probe nonlinear magnetization dynamics in individual $Ni_{80}Fe_{20}$ disks with diameters ranging from 100 nm to 500 nm. The nonlinear behavior of magnetic nanostructures has important implications for rapid switching of memory devices and for frequency stability of spin torque oscillators. In the studied size range, micromagnetic modeling predicts a transition from complex power dependent behavior in the larger disks to simple behavior in the smallest disks where only a few modes are observed. At low power levels in the measurements, precession produces a force-detected signal that is linear in power and that displays a Lorentzian line shape. At higher powers, we observe nonlinear effects, including asymmetric line shapes and foldover where the resonance shifts with power. In addition, complex, jagged line shapes appear at high powers. We report that the onset power level of the nonlinear regime was found to be size dependent. In smaller disks, higher microwave power is required to drive nonlinear precession, and we see fewer complex peaks. Furthermore, the direction of foldover also depends upon the disk size. We have modeled our results using micromagnetic simulations and they display good correspondence with our experimental data.

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