Session S14 - Focus Session: Force Microscopy and Probes II.
FOCUS session, Wednesday afternoon, March 24
511C, Palais des Congres

[S14.009] External field effects on resonant modes of double-torsional single-crystal silicon oscillators with individual thin-film micromagnets

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We measured the effects of an external magnetic field on double torsional oscillators with 7x7~\mum^2 and 15x15~\mum^2 square magnets at the edge of the head, and different aspect-ratio rectangular magnets on the oscillator. All the magnets are approximately 30-nm-thick permalloy films. This work is the first attempt to analyze the behavior of the lower and upper cantilever modes along with the lower and upper torsional modes of double-torsional oscillators as a function of the external field. We found that resonant frequencies for all modes initially decrease by up to 3% (softening of oscillators) with increasing external magnetic field until some threshold field. Each mode has a different value for the threshold field (0.5--1.5 tesla). For fields above the threshold the resonant frequency starts increasing (stiffening of the oscillators). The resonant frequency saturates at high fields. We will also discuss the damping effects of the external field on double-torsional oscillators. A simple single-domain magnetostatic model well describes most of the data. Understanding the behavior of the micro-oscillators with permanent magnets is essential for many applications such as nuclear magnetic resonance force microscopy (NMRFM) and cantilever magnetometry