C27

Energy Landscape Analysis of Switching in Perpendicular Thin Film Elements

Pieter B. Visscher and Jyun-Sheng Guo
Center for Materials for Information Technology (MINT)
Department of Physics and Astronomy
University of Alabama
Tuscaloosa, AL, U.S.A.
and National Chung Hsing University, Taiwan

We have studied the nucleation of switching in short cylindrical (coin-shaped) magnetic elements, with perpendicular anisotropy (easy axis along the symmetry axis). We find that the switching mechanism depends on the element size (relative to the exchange length). The square of this ratio is the dimensionless quantity $x = A / \mu_0 M_s^2 a^2$. When the exchange is large (x is large) the element switches coherently, whereas if exchange is small, a curling mechanism (Fig. 1) is seen. To determine the crossover between these two behaviors quantitatively, we gradually increased the switching field applied to the disk, and determined the field at which each perturbation (uniform tilting or curling) starts to grow. The results (Fig. 2) show that the crossover between coherent switching and curling occurs at about $x \sim 0.025$.

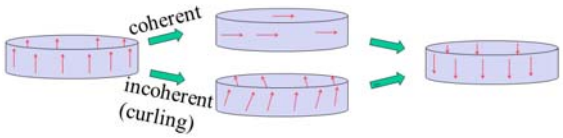

Fig. 1. The two competing nucleation mechanisms for the switching of a perpendicularly magnetized disk.

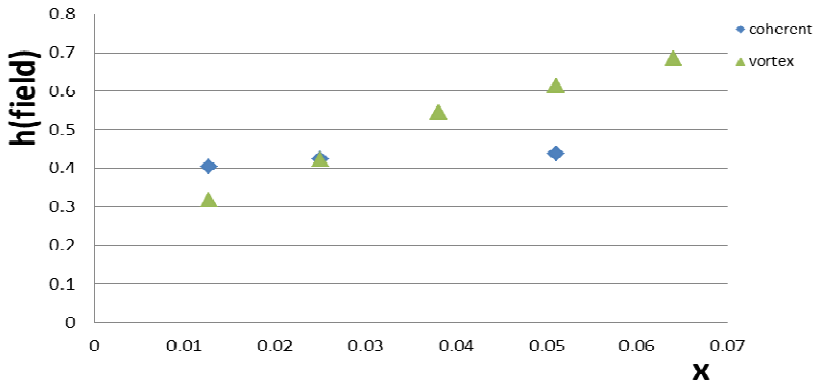

Figure 2. Nucleation field for coherent switching (triangles) and curling ("vortex") switching (squares). Physical switching mechanism is the lower one, that occurs first as we increase the switching field.