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Pinning Mechanisms for Vortices in Ferromagnetic Films TE-YU CHEN, MICHAEL ERICKSON, CHRIS LEIGHTON, PAUL CROWELL, University of Minnesota — In ferromagnetic materials, domain wall motion is generally discontinuous and stochastic in the presence of pinning sites. The pinning energy is typically quantified via a single experimental parameter - the coercivity of the hysteresis loop. We show here that in magnetic structures supporting a vortex, the vortex dynamics provide quantitative information about both the strength and range of the interaction between the vortex and individual pinning sites. Using time-resolved Kerr microscopy, we have measured the defect-induced pinning energy and length scales for magnetic vortices in micron-sized NiFe disks. We find that the pinning length scale matches the size of vortex core, and is insensitive to film thickness and growth conditions. This suggests that the dominant mechanism of vortex pinning is directly associated with the core region. The pinning energy however, is strongly dependent on microstructure. Specifically, we observe large pinning energies in NiFe films that have large roughness on lateral length scales commensurate with the core size (10 nm). The dependence of pinning energy on thickness provides further insight into the relative role of surface roughness versus bulk disorder. The strength as well as the spatial distribution of pinning sites suggest that roughness at this length scale is the dominant source of pinning in these films.

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