Probing Magnetic Configurations in Artificially Structured Nanomagnets

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Last year's Nobel Prize in Physics has showcased the vibrant research on magnetic nanostructures. Such artificially structured materials often exhibit novel and tunable properties as their physical dimensions become comparable to certain characteristic length scales. In this talk I will illustrate a variety of custom-designed magnetic nanostructures and highlight our recent studies of the magnetization reversal mechanisms using a first order reversal curve (FORC) method [1]. 1). In arrays of Fe nanodots, we have examined a single domain to vortex state transition as the dot size increases from 52 to 67 nm [2]. Despite subtle changes in the major hysteresis loops, striking differences are seen in the FORC diagrams. The FORC method also gives quantitative measures of the magnetic phase fractions and vortex nucleation and annihilation fields. 2) In electrodeposited Co/Cu multilayered nanowires, we have captured magnetic and magnetoresistance ÒfingerprintsÓ of Co nanodiscs. In 200 nm diameter nanowires, the magnetic configurations can be tuned by adjusting the Co nanodisc aspect ratio. The thinnest nanodiscs exhibit single domain behavior while the thicker ones exhibit vortex states. The magnetoresistance effect shows different characteristics, which correspond to the different magnetic configurations of the Co nanodiscs. These studies illustrate a new capability in qualitatively and quantitatively ÒfingerprintingÓ magnetic nanostructures.

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2. R. K. Dumas et al, Phys. Rev. B 75, 134405 (2007); Appl. Phys. Lett. 91, 202501 (2007).