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Shape Asymmetry Effect on Vortex Annihilation in Submicro-scaled Magnetic Disks

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Shape asymmetry in a magnetic dot achieves the control over the chirality of vortex with an in-plane external field [1]. The behaviors of vortex nucleation in submicro-scaled disks with different asymmetry level were studied in our earlier reports [2, 3]. In this study, series of $Ni_{80}Fe_{20}$ (Py) disk arrays with a diameter of 200 nm, a thickness of 35 nm, and different excised angles were prepared by combining electron beam lithography and lift-off technique to investigate the effect of shape asymmetry on the vortex annihilation. The level of asymmetry in the one-side-flat disk is quantified by an excised angle (θ), which is one half central angle corresponding to the excised arc of the disk, as shown in Fig. 1(a). The magnetic properties are characterized by focused magneto-optical Kerr effect magnetometry and micromagnetism simulation. Due to the introduced asymmetry, the vortex annihilation field, which originally is the same in a circular disk, is not degenerate any more for vortex with different chirality in the asymmetric disks, as shown in Fig. 1(b). The difference between the annihilation fields for a clockwise vortex and a counterclockwise vortex is observed as a function of the excised angle. This relation indicates that the vortex annihilation is controlled by the vortex chirality, the shape anisotropy of disk, and the boundary effect. These results are discussed and compared with the numerical simulations.

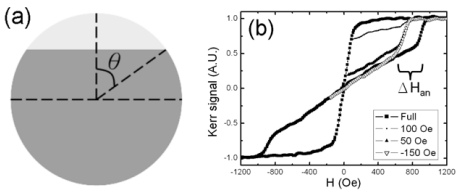

Fig. 1. (a) Schematic illustration of excised angle. (b) Hysteresis loops of vortex with different chirality in θ = 60 deg. asymmetric disk array.

This work is supported by National Science Council of the Republic of China under Grant No. NSC 96-2112- M-018-004.

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Magnetic Properties of Nanocrystalline Barium Hexaferrite Thin Films Prepared by Sol-Gel Method

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Thin films of barium ferrite have been recognized as one of the appealing candidates and widely used in the fabrication of low-noise high-density recording media. Some investigations have been carried out to decrease the calcination temperature for achieving the finer crystalline size of barium hexaferrite thin films synthesized by sol-gel method [1, 2].

In this work nanocrystalline $BaFe_{12}O_{19}$ thin films have been prepared on Si(100) substrates by sol-gel method. Precursor solutions were primed with various Fe/Ba ratios and two kinds of alkaline agent. Then the coated films were heat treated at different temperatures. The effects of calcination temperature, molar ratio of Fe/Ba and alkaline agent on phase composition, crystallites size, morphology and magnetic properties were investigated using X-ray diffraction (XRD), scanning electron microscopy (SEM), atomic force microscopy (AFM) and vibrating sample magnetometer (VSM) techniques. The results showed that the lowest calcination temperature for production of the single phase barium hexaferrite thin film by sol-gel method was 700ºC which has not been reported so far. The SEM micrograph of this sample is also exhibited in the figure 1 showing the ferrite discs with average grain size of less than 30 nm.

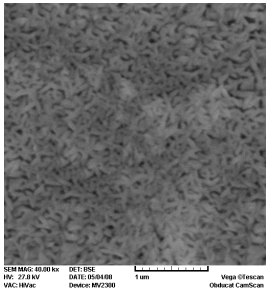

Fig. 1. SEM micrograph of Ba-hexaferrite thin film calcined at 700ºC.

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