Capillary Force Lithography for Ferromagnetic Nanoring Array Fabrication

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Ferromagnetic ring structures have attracted wide attention because they enable the investigation of fundamental physical properties such as vortex chirality and domain wall pinning, and have important applications in novel magnetic memory and spintronic sensor devices. However, the reliable and cost-effective fabrication of nanoring structures with variable thickness or small notches for memory and sensor applications remains a technological challenge; better fabrication techniques than time-consuming and expensive e-beam lithography are required. In this study, we demonstrated that capillary force lithography (CFL) using PDMS stamp with either elliptic hole or antihole arrays and subsequent RIE could produce polymeric elliptic ring arrays with distinctively different geometric features.[1] For elliptic hole arrays, the resulting polymer rings had local minima in the ring width, forming pinching zones near the minor axes because the Laplace pressure had local minimum there. However, for elliptic antihole arrays, the trend of Laplace pressure was reversed completely and pinching zones appeared near the major axes. We transferred the polystyrene (PS) ring patterns to array of elliptical NiFe rings by Ar milling and characterized magnetic properties in terms of non-uniform ring width as shown in Fig. 1. The result showed that the magnetic domain walls were strongly pinned at the narrowest width of elliptical NiFe ring elements.

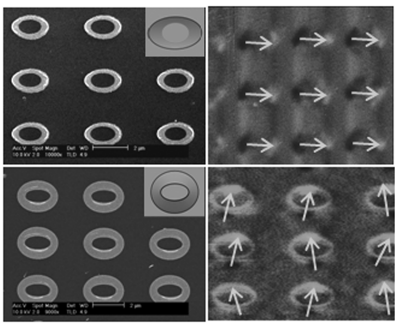

Fig. 1. Two different types of ferromagnetic nanoring arrays with variable thickness prepared by CFL and corresponding MFM images.

[1] S.Y. Lee *et al.*, *Langmuir* **25**, 12535 (2009).