Progress and Challenges in Fabrication of 1 Terabit/inch^2 Bit Patterned Magnetic Media

X-M. Yang, Z. Yu, M. Feldbaum, Y. Hsu, W. Hu, S. Xiao, H. Yang, R. J. M. Van De Veerdonk, K. Y. Lee, and D. S. Kuo

Seagate Media Research, Seagate Technology, Fremont, CA 94538

There are many technical challenges in bit-patterned media (BPM) fabrication.[1-3] Conventional wisdom envisions a manufacturing process that involves fabricating a "perfect" master template using advanced electron beam lithography from which tens of thousands of disks are replicated by a nanoimprint lithography technology. The imprinted patterns are then transferred into disks by using a RIE or ion milling process, thus forming 25 nm pitch (1 Terabit/in.^{2}) periodic arrays of isolated magnetic islands. Besides the requirements for a very precise nano-patterning process, high throughput and manageable costs are also critical for this technology to be of value to manufacturing.

We will present our recent progress in BPM fabrication. A concentric full track disk template at an areal density of 1 Terabit/in.^{2} will be demonstrated for the first time. This full-track template with pillar-tone dot pattern features was fabricated on a quartz substrate by combining rotating electron beam lithography with directed self-assembly of a cylinder-forming poly(styrene-*b*-methyl methacrylate) (PS-*b*-PMMA) block copolymer. Then a 1 Terabit/in.^{2} hole-tone resist dot pattern was formed on a disk using the full-track template and UV imprint lithography. A reverse-tone process was used to create the thin hard mask layer that is needed in the following dry etch process to form 1 Terabit/in.^{2} magnetic islands. We will present preliminary results on size sigma, positioning accuracy, and switching field distributions of the magnetic dots. Meanwhile, several key challenges in the process will be addressed, such as defect reduction in the template, size sigma control, servo pattern integration, and the improvement of magnetic signal uniformity.

[1] XiaoMin Yang et al., JVST B 26 (6), 2604 (2008).
[2] XiaoMin Yang et al., IEEE, 45 (2), 833 (2009).
[3] XiaoMin Yang et al., ACS Nano, 3 (7), 1844 (2009).

*Email: xiaomin.yang@seagate.com

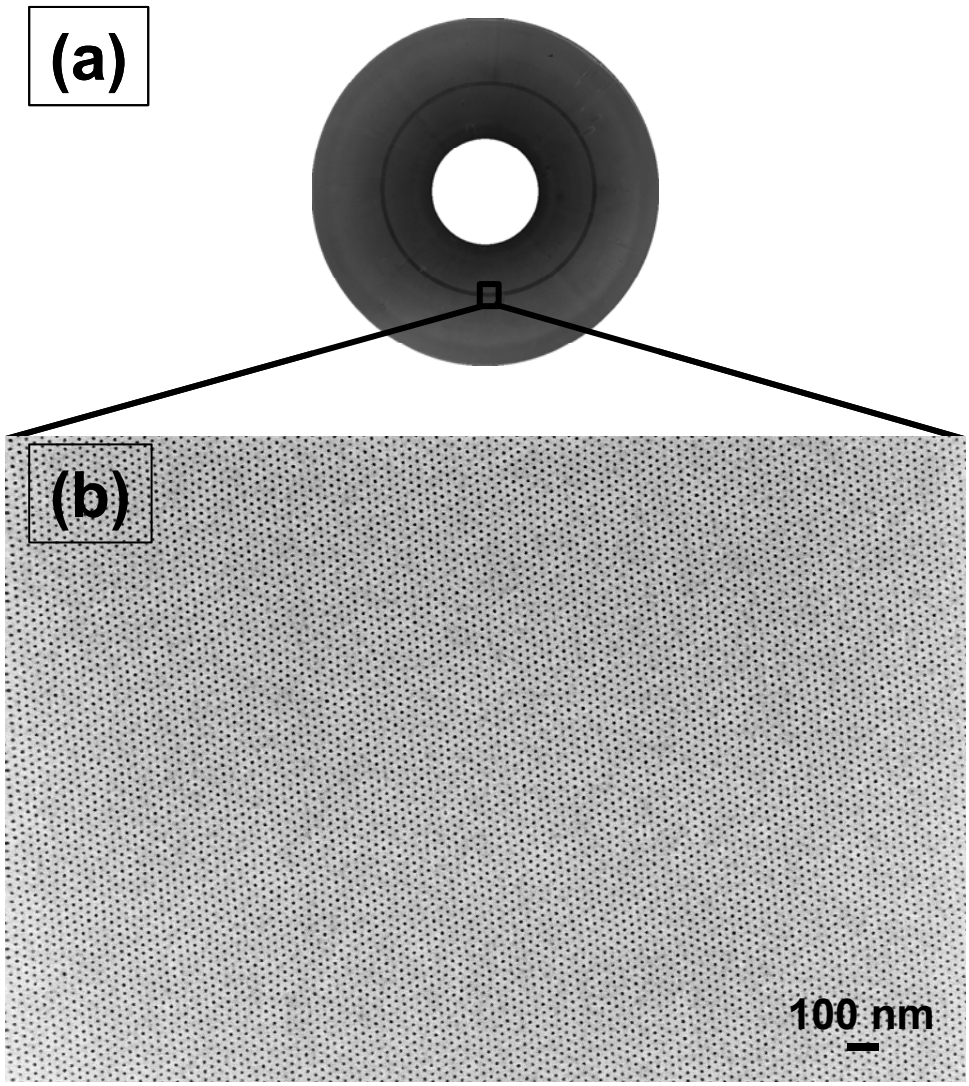

Figure 1. (a) Candela optical image of a 6” quartz template with a 0.8 mm wide concentric full track BCP patterning band. The image is scanned at a disk size (radius= 10 mm to 32.5 mm) only; (b) SEM image of self-assembly of P(S-*b*-MMA) BCP film at 1 Tdpsi within the patterning band.