Fabrication of CoCrPt Alloy Bit Patterned Media at 1 Td/in^2 for Recording Measurement

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Bit patterned media (BPM) is a solution to data thermal instability in future generation hard disk drives (HDDs). Although the plan of record for patterning bit patterned media in manufacturing is through high speed nanoimprint lithography, the fabrication of high quality master templates and replicas is labor intensive. Small area, direct write e-beam patterning has more flexibility to rapidly modify bit pattern geometries as media fabrication and/or recording performance issues are discovered. Recording performance is measured with a static tester using HDD product heads. In addition, media patterns filling an area of ≥ 200 um x 200 um allow magnetic measurement with micro-Kerr on the same patterns that recording performance was measured. The results give valuable feedback on media fabrication, magnetic media development, head performance, recording strategy, and tribology.

Magnetic Disks were coated with an etch stop layer and 20 nm of Carbon. XR1541-001 from Dow Chemical was diluted with MIBK at the spinner and immediately spun on the disk. The resolution, adhesion and scumming of the HSQ dots were found to be very dependent on preprocessing of the disk and the thickness of the HSQ. The CoCrPt alloy magnetic media etched half as fast as previously reported Co-Pd multilayers and the alloy samples placed more stringent requirements maintaining the full integrity of the carbon hard mask during the hard mask etching step. Shown in Fig. 1 is an AFM image of a 6 nm HSQ pattern. The resist height of the dots varied too greatly to be sufficiently robust to the hard mask etching process. The resist thickness was optimized to 8.5 nm for 1 Tb/in2 patterns and an additional low bias reactive ion resist hardening step was required prior to etching the carbon hard mask. In order to improve the tribology for the static tester, an additional hard mask patterning step was employed to mask the unpatterned full film of the disk so that the surrounding disk was at the same height as the patterned media pillars. Following the hardmask etching, the media was ion milled with 200 eV Ar. The mask was immediately stripped. During all phases of fabrication, extreme care was taken to avoid damage to the media as well as to avoid particles that would result in very high hard mask bumps, which would destroy the tribology of the disks.

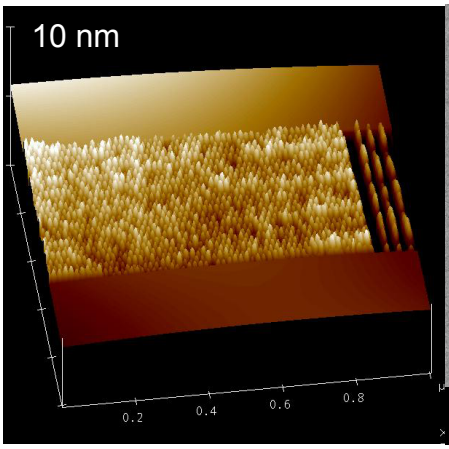

Figure 1. AFM Image of 1030 Gb/in2 pattern in HSQ resist

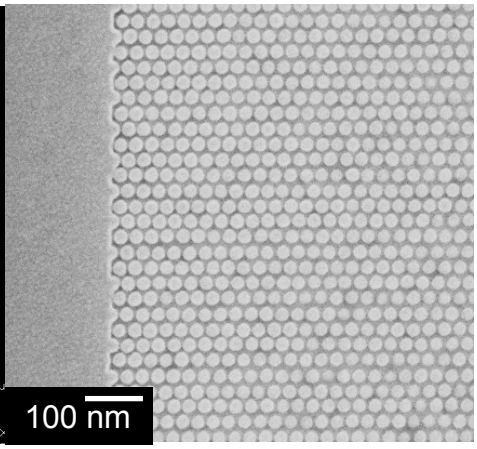

Figure 2. SEM of finished patterned media at 950Gd/in^2 with window to assist in tribology

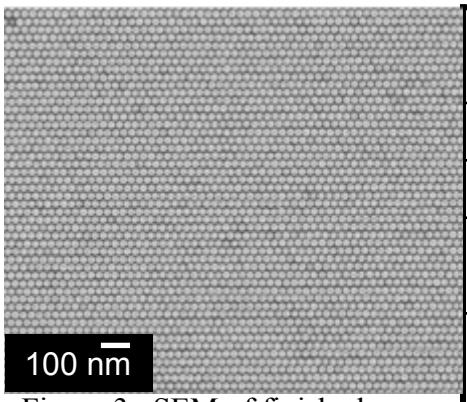

Figure 3. SEM of finished patterned media 950 Gb/in2 with pattern analysis in Table on right

Parameter	nm	s(nm)
Track Pitch	25.88	0.71
Bit Pitch	26.46	0.74
Cross Track Jitter		0.54
Down Track Jitter		0.91
Dot Width	23.57	1.23
Dot Height	22.98	1.08
Dot Area	421.36 nm^2	35.43 nm^2

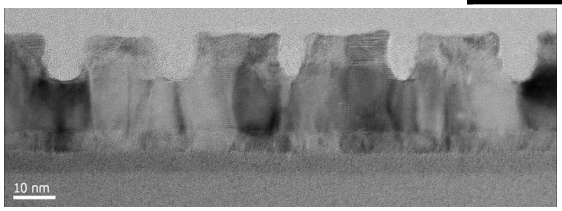

Figure 4. TEM of patterned magnetic media of density 1 Td/in2