65mm Disk Patterning at 500 Gb/in^2 with Full Surface Area Coverage from Diblock Copolymer Templates

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Patterning of magnetic areas on hard disk medium is commonly suggested as a method to increase the disk storage density. In the case of fabricating Bit Patterned Media [BPM], large areas of closely packed bits will need to be fabricated in the disk substrate or into the magnetic media itself. Given the nanometer-scale dimensions and strict positioning requirements of BPM, self assembled block copolymers are an excellent candidate to produce uniform templates with sub-lithographic resolution. After patterning a master template with block copolymers, nano-imprinting can be used for high throughput stamping of BPM structures. Presented here is an approach to pattern the full surface of a 65mm disk substrate with 500 Gb/in^2 BPM patterns (39nm period hexagonal close pack [HCP]). Poly(styrene-b-methyl methacrylate) [PS-b-PMMA] diblock copolymer films (volume ratio~70:30) are spun on 125mm fused silica wafers, then annealed and developed to create a sacrificial mask with HCP patterns. Reactive ion etching is used to transfer the pattern into the wafer. The result is a series of holes in quartz that are 25nm in diameter and 25nm deep. AFM images of the wafer, Fig. 1, show that the HCP patterns uniformly cover the entire surface area of the 125mm fused silica wafer. The pattern assembles in randomly oriented grains (<1um^2) because no guiding was imparted to the self-assembly. Nonetheless disks with full surface area BPM patterns are important for understanding imprint resist flow issues, as well as for evaluating planarization and magnetic layer deposition techniques. Optical and e-beam lithography are then used to define a 65mm disk mesa pattern and alignment gratings for use in an MII Iprio 1100 imprint tool. After imprinting 65mm disks with the full coverage BPM template, AFM images show the resist pillar height is ~25nm, Fig. 2. This imprint resist pattern can then be used as an etch mask for pattern transfer into the disk surface.

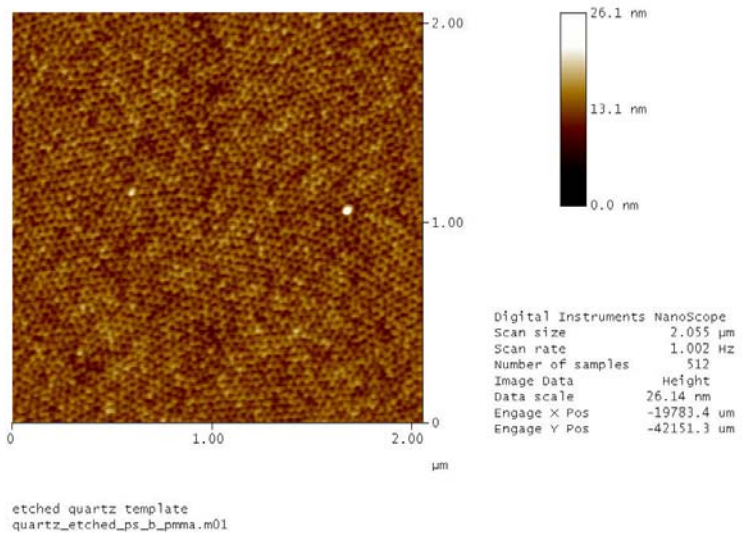

Fig. 1: An AFM image of 500Gb/in^2 holes etched into a fused silica nano-imprinting template

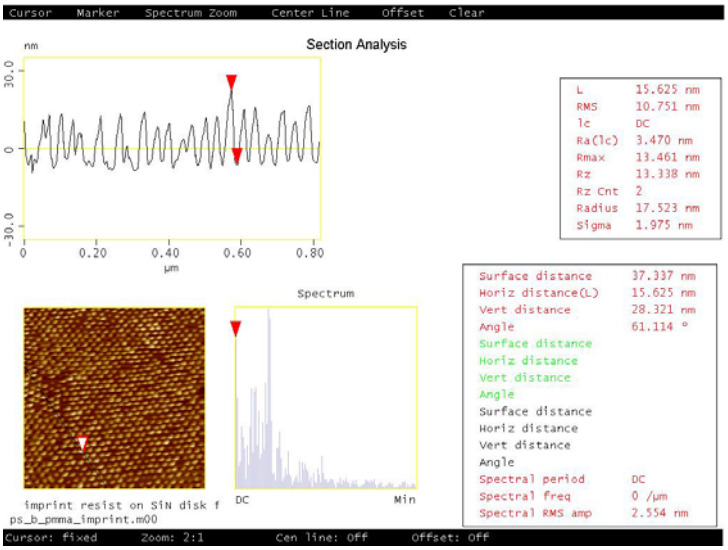

Fig. 2: An AFM image of imprint resist with features at 500GB/in^2 on a 65mm disk