Fabrication of 5 Tb/in^2 Bit Patterned Media with Servo Pattern using Directed Self-Assembly

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Bit patterned media (BPM) for magnetic recording has emerged as a promising technology for delivering thermally stable magnetic storage at densities beyond 1 Tb/in^2. We recently reported the first successful track-following test in a prototype drive of 2.5 Tb/in^2 BPM.[1] The prepared 2.5 Tb/in^2 BPM was equipped with circular tracks and arbitrary servo marks fabricated using the graphoepitaxy directed self-assembly method. Polystyrene-polydimethylsiloxane (PS-PDMS) was applied because of its high segment-segment (Flory-Huggins) interaction parameter (χ= 0.26). For fabrication of 2.5Tb/in^2 BPM, PS-PDMS of Mn: 14600 (PS: 11700, PDMS: 2900) was utilized. The volume fragment of the PDMS of the applied polymer is 0.21, which shows spherical microphase separation structure. To order the PS-PDMS pattern, graphoepitaxy guide pattern was formed on a magnetic substrate. Figure 1 (A) shows an SEM image of the prepared 2.5 Tb/in^2 BPM. As shown in the figure, hexagonally aligned PDMS dots are observed. Figure 1 (B) shows an SEM image of the prepared BPM pattern with PS-PDMS of Mn: 8500 (PS: 7000, PDMS: 1500) prepared in the same manner. The ordering of PDMS dots in the address pattern is inferior to that of Fig.1 (A).

In this paper, we report the fabrication method of 5 Tb/in^2 BPM template using small-molecular-weight PS-PDMS. To improve the ordering of the PS-PDMS of Mn: 8500 on a substrate, the annealing process was investigated.

Figure 2 shows the AFM images of the self-organized PS-PDMS films. The films were formed by spin-coating on a self-assembled monolayer (SAM) which was equipped with phenyl structure. Then, the films were treated thermally or with solvent atmosphere. AFM images were observed after etching with CF_4 gas and subsequently O_2 gas. As shown in Fig. 2, both AFM images show spherical phase-separation structure. The remarkable point is that the solvent-annealed film in NMP atmosphere shows finer ordering than that of thermally treated film. The lattice spacing of the hexagonal pattern is 11 nm.

Applying the low-molecular-weight PS-PDMS with solvent annealing, the dots-array template for 5 Tb/in^2 was formed.

Acknowledgement

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[1] Y. Kamata, A. Kikitsu, N. Kihara, S. Morita, K. Kimura, H. Izumi: IEEE Trans. Magn., **47**, 51 (2011).

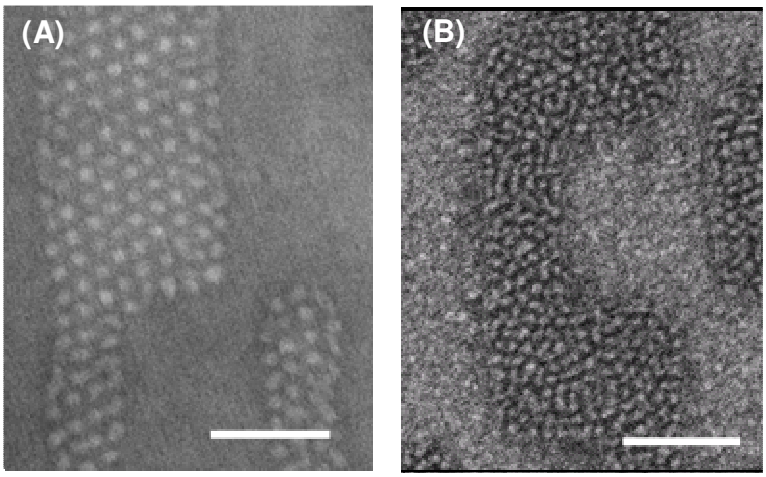

Figure 1: SEM image of servo pattern consisting of PDMS dot array:
(A): PS-PDMS of Mn: 14600 (PS: 11700, PDMS: 2900), (B): PS-PDMS of Mn: 8500 (PS: 7000, PDMS: 1500).
Scale bars are 100 nm.

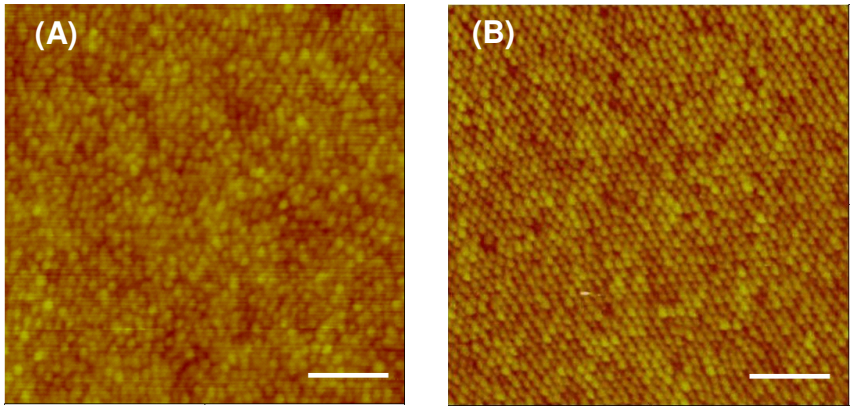

Figure 2: AFM images of PS-PDMS of Mn= 8500 self-organized pattern:
(A): annealed at 100 °C in vacuum, (B): solvent-annealed in NMP atmosphere.
Scale bars are 100 nm.