Selective Patterning of Fluorinated Self-assembled Monolayer by UV Nanoimprinting for Directed Self-Assembly

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Block copolymer (BCP) self-assembly create periodical pattern with the potential to reach feature sizes below 10nm. To regularly align the BCP, the substrate surface is usually modified by lithographically pre-defined templates, such as chemical pattern[1] and guide pattern[2], which is called, directed self-assembly (DSA). Nanoimprint lithography (NIL) has an advantage that patterns less than 5 nm in size can be realized over a large area at a high throughput. So NIL is the useful technique to fabricate topographically and chemically pre-patterned template for DSA. In this study, we proposed the new fabrication method of chemically pre-patterned fluorinated self-assembled monolayer (F-SAM) by lift-off process using UV nanoimprint.

We used NIAC705 (Daicel Co.) as UV nanoimprint resin because it can be easily removed by organic solvent (tetrahydrofuran) after UV curing[3, 4]. (Tridecafluoro-1, 1, 2, 2-tetrahydrooctyl) trimethoxysilane (FAS-13) was used to form F-SAM. Fig. 1 shows a schematic diagram of fabrication process of FAS-13 pattern. (1) NIAC705 was spin-coated on Si substrate and prebaked at 90˚ for 1 min. (2) We carried out UV nanoimprint using a mold with 2 μm-line and space patterns. The pattern was clearly imprinted on NIAC705, as shown in Fig. 2. (3)Then, the residual layer was etched away by reactive ion etching (RIE) using O_2 gas. (4)Following, FAS-13 was coated by dip-coating process. (5), (6) Finally, the substrate was soaked in the organic solvent to remove NIAC705. Figures 3(a) and 3(b) show topographic and friction images of FAS-13 pattern. It is difficult to recognize the FAS-13 line in the top-view of topographic image (Fig. 3(a)) because F-SAM was very thin-film. However, in the cross-sectional topographic image which was measured along the sold line shown in top view image of Fig. 3(a), we could confirm the difference in height. The height of FAS-13 line was about 0.43 nm. On the other hand, FAS-13 line was clearly observed in friction image (Fig. 3(b)) because the friction was different between the FAS-13 and Si surfaces. This result indicates that the selective patterning of F-SAM by UV nanoimprinting was succeeded. In the presentation, we discuss the BCP align on the F-SAM selective patterns.

References

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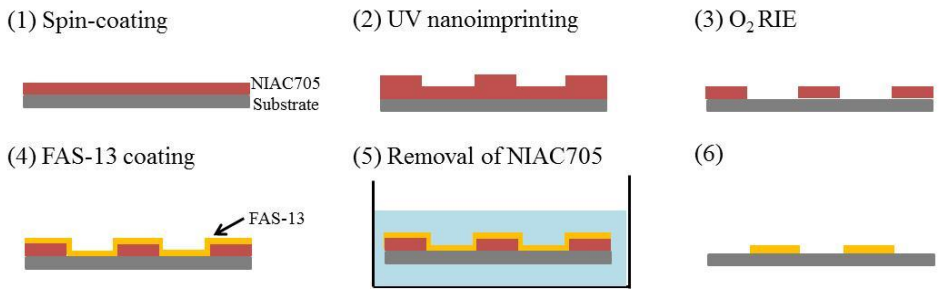

Fig. 1 Schematic diagram of FAS-13 selective patterning.

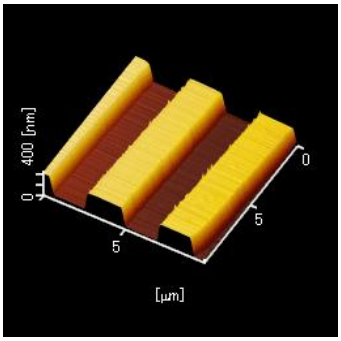

Fig. 2 AFM image of NIAC705 pattern fabricated by UV nanoimprinting.

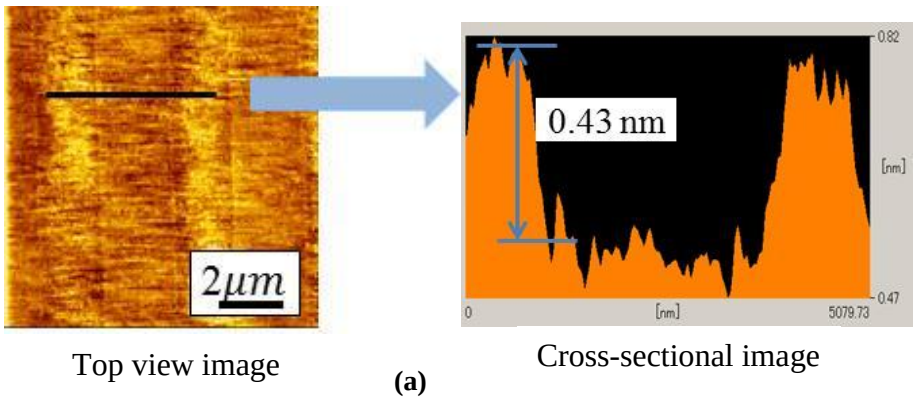

Fig. 3 (a) Topographic and (b) friction images of FAS-13 pattern.