Evaluation of effect of fluorine additive agent for cationic UV-nanoimprint resin

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UV nanoimprinting has a potential to fabricate the nanostructures with high throughput, low cost, and high accuracy. Generally, an antisticking layer is coated on the nanoimprint mold because the nanoimprint mold is in direct contact with the UV nanoimprint resins. However, it is known that the antisticking layer is deteriorated by repeat UV nanoimprinting.[1)] Therefore, the UV nanoimprint resin with release properties is required to mass-produce the nanostructure devices by UV nanoimprinting. In this study, we evaluated the effect of the fluorine additive agent for cationic-UV nanoimprint resin by X-ray photoelectron spectroscopy (XPS), contact angle measurement, and scanning probe microscopy (SPM).

We used NICT103 and NICT103w (Daicel Chemical Industries.), which are the cationic polymerization type, as a UV nanoimprint resin. Figure 1 shows the monomer structures of the NICT103. NICT103w is the NICT103 with the fluorine additive agent. We analyzed the surface chemical states of the cured NICT103 and NICT103w by XPS. Figure 2 shows the wide-scan spectra of the NICT103 and NICT103w. The C1s and O1s peaks were observed in the spectrum of the NICT103. On the other hand, in the spectrum of the NICT103w, the intense F1s peak was appeared. These results indicate that the fluorine was present on the cured NICT103w surface.

To examine the release properties of the NICT103w, we carried out contact angle and SPM measurements. As the results, the water contact angles on the cured NICT103 and NICT103w were 70° and 104°, respectively. The water contact angle of the NICT103w was about 30° higher than that of NICT103. We then measured frictional force by SPM using a cantilever with SiO_2 particle (diameter was 1 μm). Figures 3(a) and 3(b) show the frictional curves of the NICT103 and NICT103w, respectively. The difference between the upper and lower sides of the frictional curve indicates the frictional force. The frictional force of the NICT103w was half times as low as that of NICT103. We proved from these results that the release properties of the NICT103 were improved by adding the fluorine additive agent.

In the presentation, we will discuss the demolding force in UV nanoimprinting using NICT103 and NICT103w.

1) Y. Tada, H. Yoshida, and A. Miyauchi: J. Photopolym. Sci. Technol., **20** (2007) 545.

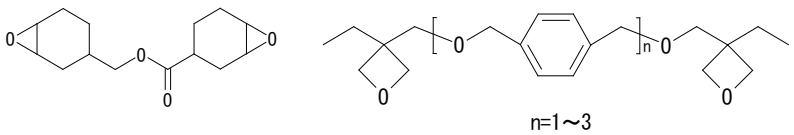

Fig. 1 Monomer structures of NICT103.

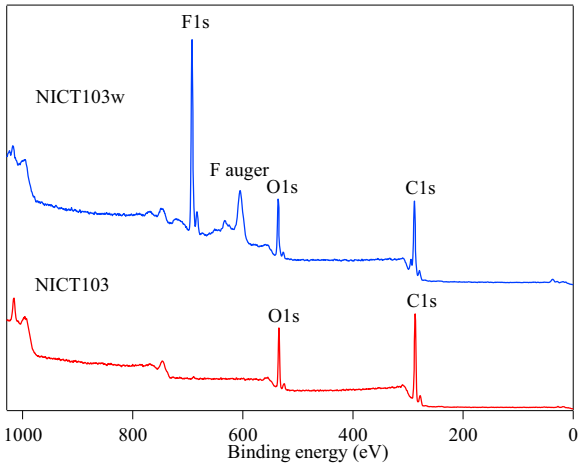

Fig. 2 Wide scan spectra of NICT103 and NICT103w.

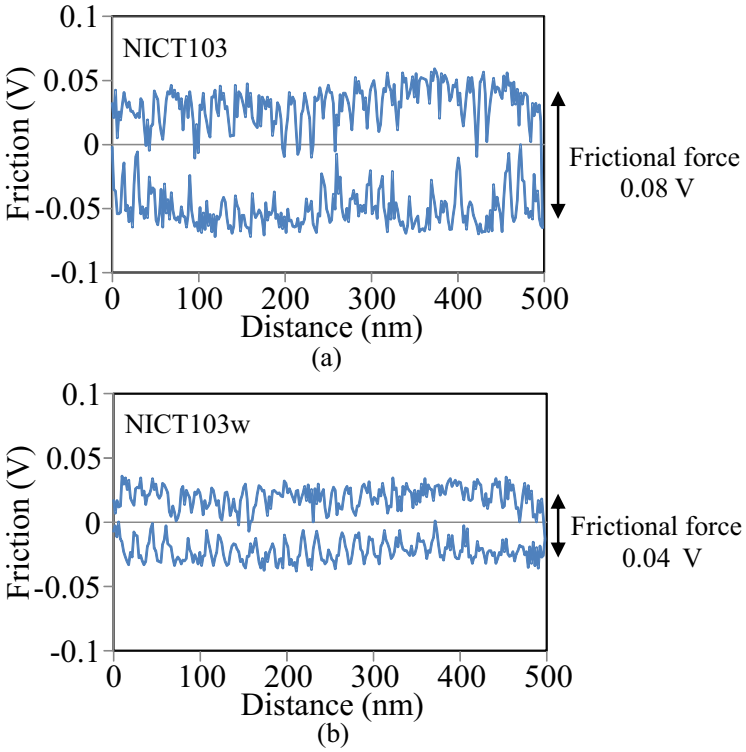

Fig. 3 Frictional curves of (a) NICT103 and (b) NICT103w.