

Fabrication of Adhesion-free Transparent Roll Stamp for Large Area Patterning using UV-typed Roller Nanoimprint Lithography

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To fabricate some flexible electronic devices on large area and to improve the throughput and productivity, a roll-to-roll nanoimprint lithography became hot issue in the recently. The roll-to-roll nanoimprint technology has many advantages to fabricate some functional structures with continuous and fast pattern transfer process on large area. Also, it can be adapt to fabricate the functional nano-patterned film, the optical film for display such as wire grid polarizer, the flexible electronic devices and photovoltaic devices. However, the nano-patterned roll stamps with hydrophobic surface are inevitably necessary in order to realize these devices without any defects which are generate during demold process. A ployvinylsilazane (PVSZ, PVSZ, Kion-Ceraset HTT1800, Kion Corp. USA) material is used for a top layer for the quartz roll stamp. The cured PVSZ material has good characteristics such as UV curable resist under room temperature, high optical transparency, non-sticky silicate with high mechanical properties (hardness of 416 GPa and Young's modulus of ~3.27 GPa) and excellent releasing properties after hydrolysis process. Also, the cured PVSZ layer after hydrolysis process does not require extra surface modification and could be used as an ideal mold with low adhesion force for roll nanoimprint lithographic applications. To fabricate adhesion-free transparent stamp, the roll-typed bare material and the replicated h-PDMS mold with width of 300 nm and height of 300 nm are set-up in the roller and mold chucks on the UV-typed roller nanoimprint lithography systems, respectively. The h-PDMS mold is fabricated from Si master stamp which has width of 300 nm and height of 300 nm. The PVSZ resist is coated on the h-PDMS surface by means of droplet. To perfectly cure the PVSZ resist without any slip between the bare roller and h-PDMS mold, the linear velocity of the bare roller is kept step with feeding velocity of h-PDMS chuck. The maximum feeding velocity is up to 500 mm/min. Fig.1a shows the UV-typed roller nanoimprint lithography (RNIL) systems. Fig.1b shows the adhesion-free transparent roll stamp with length of 210 mm and diameter of 100mm on the RNIL systems. Fig.2 shows the SEM images for the fabricated roll stamp. In the further work, it will be adapted to transfer patterns plat and roll surfaces for some flexible electronic devices and solar cells.

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Figure 1: Experimental systems (a) UV-typed roller nanoimprint lithography (RNIL) systems. (b) the adhesion-free transparent roll stamp with length of 210 mm and diameter of 100mm on the RNIL systems. The roll-typed bare material and the replicated h-PDMS mold with width of 300 nm and height of 300 nm are set-up in the roller and mold chucks on the RNIL systems

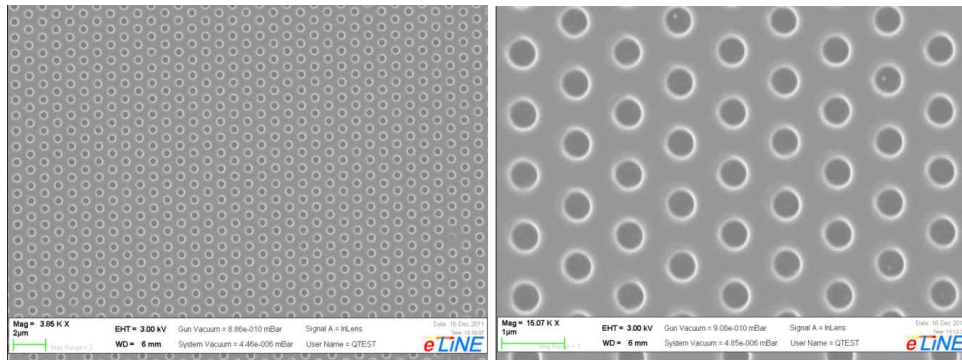


Figure 2: SEM images for the fabricated transparent roller surface covered by PVSZ.