Fabrication of UV-NIL Polymer Stamp using Step and Stamp Imprint Lithography

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Imprint lithography is a molding process in which the topography of the master is transferred into substrate. Molding can be done by hot embossing or by UV-imprinting. In hot embossing such as step and stamp imprint lithography (SSIL) [1,2] a patterned master is pressed into thermoplastic polymer using temperature elevated above glass transition point of the polymer. In UV-nanoimprinting (UV-NIL) a mold is pressed into a low viscosity polymer which is cured by UV light [3]. The UV-NIL stamp has to be transparent for UV-light, since the UV light exposure is carried out through the stamp.

We report the fabrication of a UV stamp using SSIL to pattern a fluoro-resin coated quartz support. The 50x50 mm quartz template is patterned by SSIL using small silicon stamps with feature size ranging from submicron to micron scale features (Fig. 1a) The quartz substrate was coated by a fluorinated resin (Asahi Glass Co.), which has a low surface energy assuring a good mold release, a high UV transparency and a high chemical and decay durability. These attributes make the patterned resin template a suitable UV-stamp without any subsequent treatments (Fig 1b).

The work was carried out by Nano imPrinting Stepper NPS300 (SUSS MicroTec) capable for both hot embossing and cold embossing in the same platform. The SSIL imprinted resin template consisted features ranging from sub 100 nm to several microns (Fig 2) and it was tested successfully for UV-NIL. The features in the resin template were transferred into a silicon substrate by molding and curing a dispensed UV resist. No sticking nor distortion was observed in the UV-cured features.

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1 T. Haatainen, J. Ahopelto, G. Gruetzner, M. Fink and K. Pfeiffer, Emerging Lithographic Technologies IV, Proceedings of SPIE. Dobisz, Elizabeth. Vol. 3997. SPIE-The International Society for Optical Engineering, 874 (2000)
2 T. Haatainen and J. Ahopelto, Physica Scripta. Vol. 67, No: 4, 357 (2003)
3 J. Haisma, M. Verheijein, K. van den Heuvel and J. van den Berg, J. Vac. Sci. Technol. B 14 (1996) 4124.

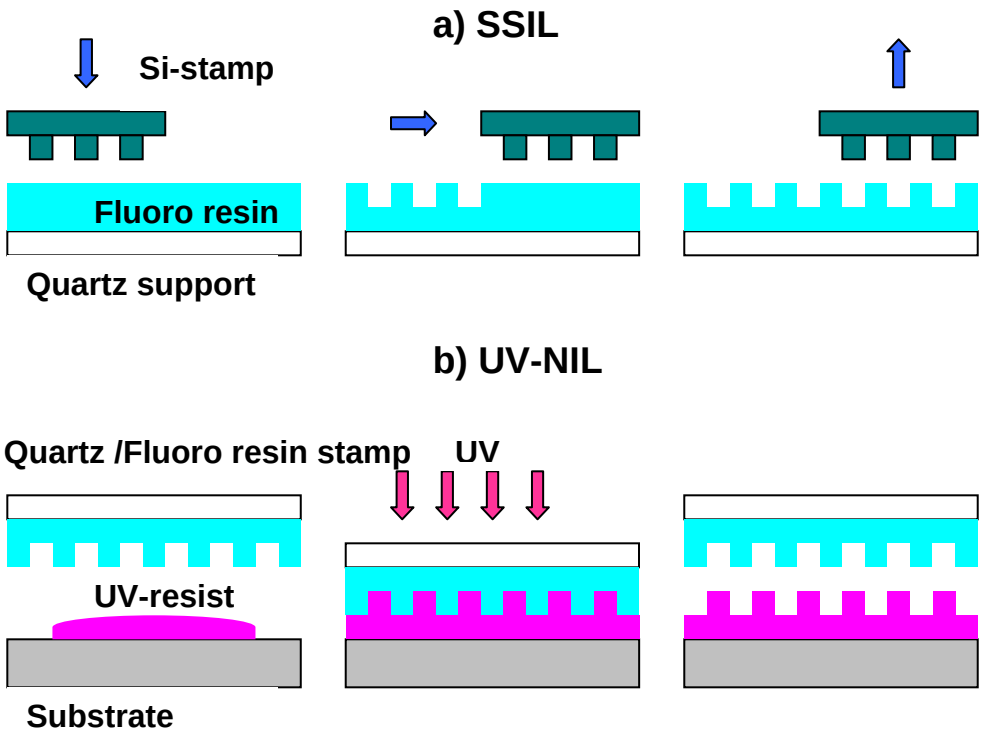

Fig 1a: The UV-NIL stamp is fabricated by patterning a quartz plate supported resin layer by SSIL and a small silicon stamp. b: The resin template is used as a stamp in UV-NIL for patterning UV-curable resist.

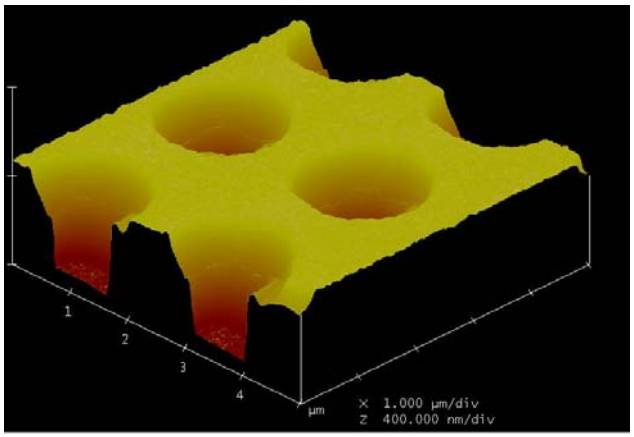

Fig 2: An AFM image of imprinted 390 nm deep 1 µm diameter holes in the fluoro-resin template.