

UV curable nanoimprint lithography for replicating three dimensional structures

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This work investigates the use of ultraviolet nanoimprint lithography (UV-NIL) for patterning three dimensional (3D) structures using quartz molds. Previous work demonstrated that the 3D patterns of the mold structure can be generated by dosage control during the electron beam lithography (EBL) writing exposure¹. Generating the 3D structures is a challenging task especially for insulating substrate such as quartz; thus, in this work, the conductive polymer layer, PEDOT/PSS was used as a top coating to suppress the surface charging effects and enhance the dosage control by using higher voltage acceleration during the EBL exposure. The modified mold fabrication process is shown in Figure 1(a). The 3D mold profiles were created on the negative tone photoresist, Microresist ma-N2403, using the Raith150 EBL tool with variable dose controlled exposure in a single step exposure. The developed 3D pattern profiles were then utilised as the 3D masking layer. The 3D patterns were transferred into the mold substrates by single step reactive ion etching (RIE). The process of 3D mold structure replication using UV-NIL technique is shown in Figure 1(b). The master mold profile was replicated onto Microresist ORMOCOMP resist on the first imprint and became soft mold. This cured mold was then used for replicating the 3D pattern structures on the Microresist mr-UVCur06 resist in the second imprint. This 3D imprinted pattern was utilised as the final 3D masking layer for pattern transfer using RIE. An array of 3D structures with multilevel features was replicated using this technique as shown in Figure 2. This technique has huge potential of patterning other complex 3D structures for lithography applications.

Keywords : UV curable, nanoimprint, three dimensional, multilevel

1 K. Mohamed, M. M. Alkaisi, and R. J. Blaikie, *J. Vac. Sci. Technol. B.*, 25(6), 2357-2360, 2007.

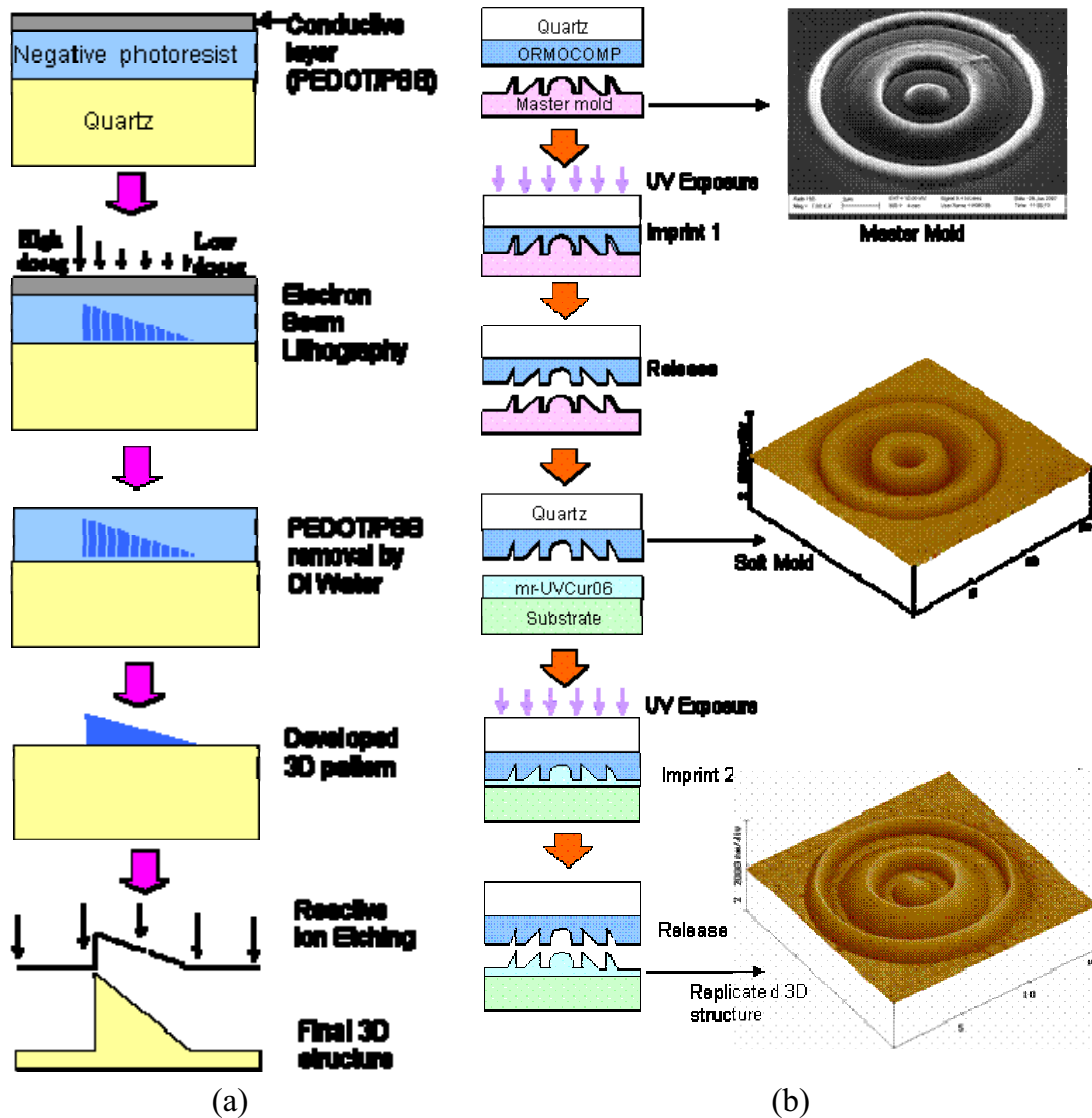


Figure 1 : (a) The fabrication process for 3D mold structure on quartz substrate and (b) the UV curable nanoimprint process in replicating the 3D structure.

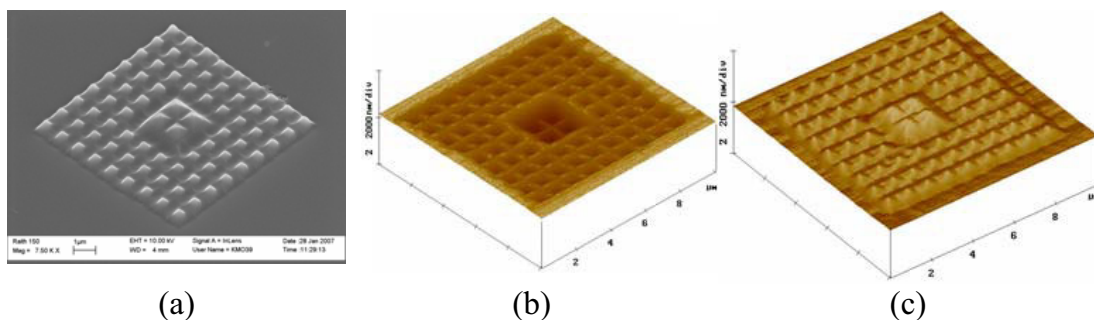


Figure 2 : The replication of 3D structure (pyramid array) with multilevel features, (a) the SEM image of the fabricated 3D mold structure on the quartz substrate, (b) the AFM image of the replicated 3D mold structure on the Microresist ORMOCOMP resist after first imprint step and (c) the AFM image of the replication of the 3D mold structure after the second imprint step.