

Large area optical lithography using cylindrical masks

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We report on our progress in developing a new patterning technique based on near-field optical lithography (NFOL). NFOL implemented using soft masks has proved to be an effective and inexpensive way to pattern substrates with high resolution, down to 50 nm, over small areas. We have extended this method to continuously pattern much larger areas by fabricating photomask in the shape of cylinder (“Rolling Mask”), which is rolled across a photoresist-coated substrate during exposure process.

“Rolling Mask” optical lithography has capability to surpass other available methods (for example, Roll-to-Roll Nanoimprint lithography - R2R NIL) in throughput, cost and quality. Width of cylindrical phase mask can be scaled up without compromising process uniformity. Pattern quality and mask lifetime are much better in the absence of the typical feature filling and demolding problems of NIL.

The current prototype of “Rolling Mask” Lithography system allows patterning areas up to 300 mm x 300 mm. Using off-the-shelf photoresist materials we were able to demonstrate nanopatterning with resolution down to 100 nm. The process can be fine tuned to get different pattern types from the same phase-relief of the photomask (positive or negative).

Obviously, one of the most demanding tasks is to develop fabrication technology of soft cylindrical masks. We report on the latest attempts in manufacturing seamless 300 mm wide mask and first printing results.

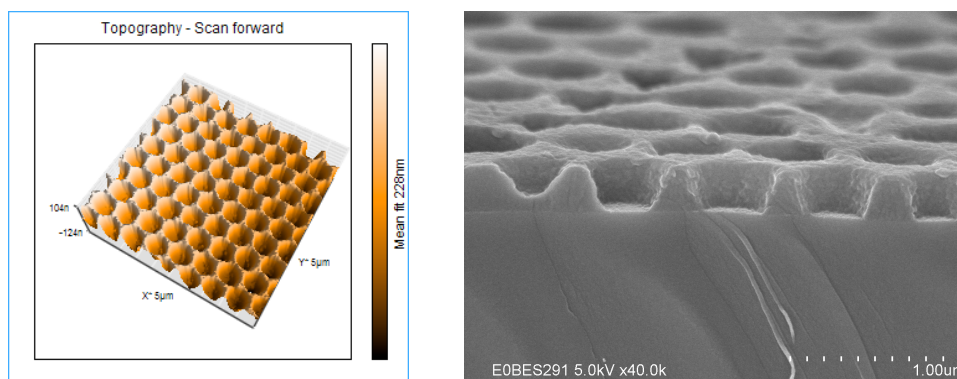


Figure 1: Nanostructures printed using “Rolling Mask” lithography system: Left – AFM scan; right – SEM cross-section of the printed photoresist structure on glass substrate.