

Supercritical-point-dry assisted photolithographic fabrication of high aspect-ratio SU-8 pillars



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High-aspect-ratio (HAR) micropillars fabrication is an absorbing research of interest due to the great potentials in varieties of applications, e.g. 2D photonic crystal, sensitive biosensor, superhydrophobic surfaces, bioinspired surfaces such as the fibrillar structures for biomimetic dry adhesive etc. Meanwhile, dense and HAR micropillars array with feature size close to diffraction limit can be readily fabricated on SU-8 by UV photolithography. On one hand, SU-8 proves to be the favourite material with great versatility in micro/nanofabrication due to its excellent chemical, mechanical and thermal stability as well as high optical sensitivity to facilitate efficient polymerization of HAR structures with steep sidewall. On the other hand, SU-8 based UV photolithography is a facile and efficient way for HAR

structures patterning compared to other routes including X-ray, e-beam and laser direct writing lithography. However, except for many factors that still need intensive optimization including non-uniformity caused by spin-coating, low crosslink level by insufficient UV dose and post baking time, internal stress etc., structure collapse or bending during the process of rinsing and drying becomes the most challenging problem especially when structure (pillar) density increases and feature size shrinks. Attempts to overcome this problem include using rinsing liquid with low surface tension and wettability to decrease the capillary effect acting on sidewall of SU-8 pillars as well as the way of freeze drying. However, liquid with low surface tension still exert appreciable capillary force to cause pillars collapse and the freeze drying process is always extremely time-consuming. The supercritical point drying which was typically used for biological tissue dehydration in SEM specimen preparation is employed here to assist the photolithographic process to finally release uprightly standing dense SU-8 pillars with high aspect ratio of above 10:1.

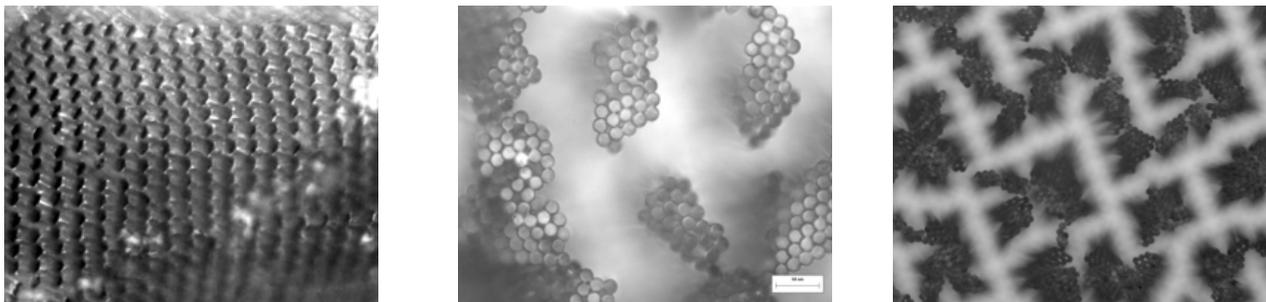


Figure 1 Optical microscopic images of (a) SU-8 pillars collapse after blow-drying by air gun, and (b)-(c)SU-8 pillars bend and stick to each other after drying by natural evaporation

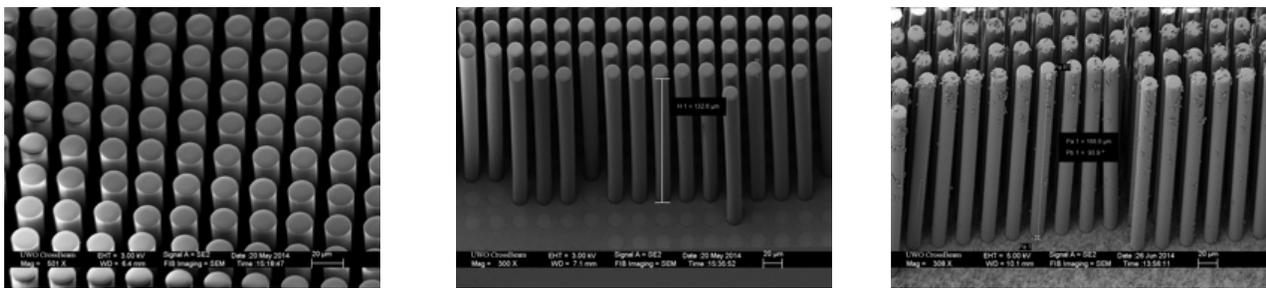


Figure 2 SEM results of high aspect ratio SU-8 pillars fabricated by the supercritical-point-dry assisted photolithographic process. (b) aspect ratio of 9:1 (c) aspect ratio of 11:1

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