

Supplementary information

1. Experimental method for yield analysis

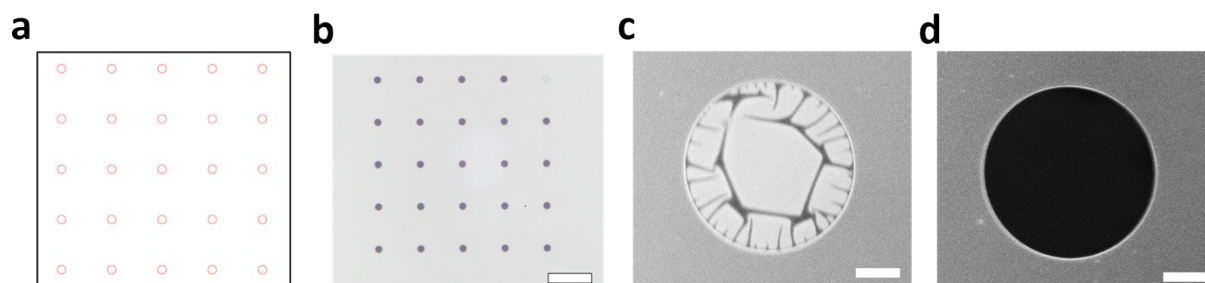


Figure S1: Experimental method of the yield analysis of the PFEBL. (a) Layout design for the EBL writing. (b) Optical microscope image of the test result for a given parameter set. (c) SEM image of an “incomplete” patterning with the broken membrane. (d) SEM image of a “complete” patterning with the unbroken membrane. Scale bar: (b) 100 μm ; (c-d) 5 μm .

2. Zoom-in of the residue and profiler measurement

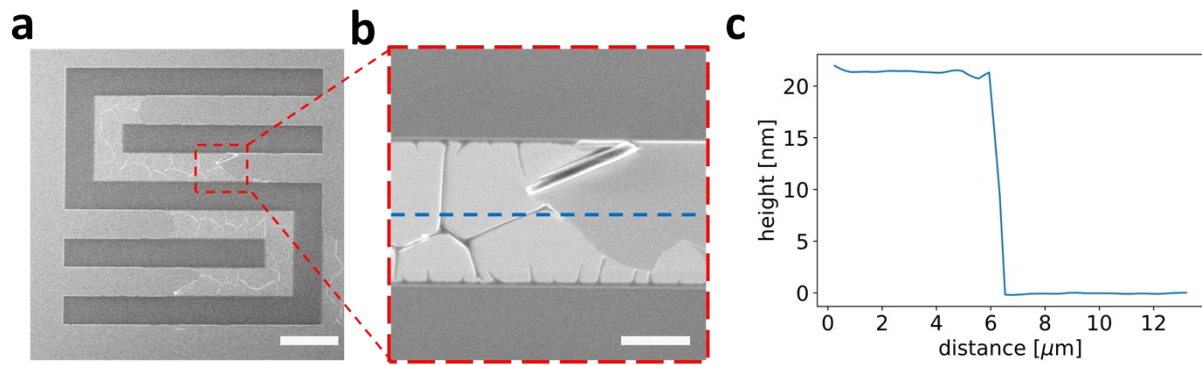


Figure S2: SEM image and thickness measurement of the residual layer. (a) SEM image of the “S” letter after development. (b) Enlarged SEM image the residual layer. (c) Surface profiler measurement of the thickness of the residual layer residual layer along the cyan line specified at (b). Scale bar: (a) 20 μm ; (b) 3 μm .

3. Comparison between measured thickness of the HSQ film and HSQ membrane before and after etching

Table 1. Comparison between measured thickness of the HSQ film and HSQ membrane before and after etching

	Before RIE etching	After RIE etching
Thickness of HSQ film (nm)	(96.7 ± 1.2)	(77.7 ± 2.1)
Thickness of HSQ membrane (nm)	(21.7 ± 0.5)	0

4. Strategy used for thickness measurement

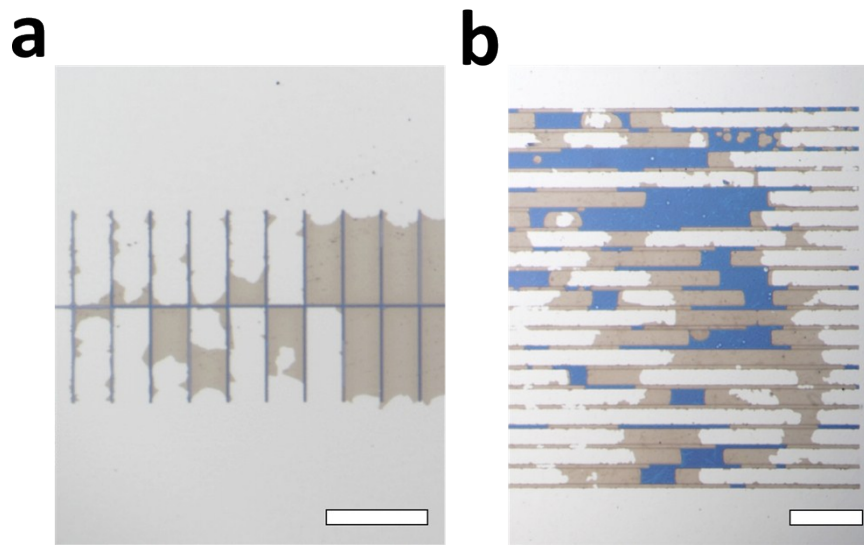


Figure S3: Strategy used for thickness measurement of the membrane formed during plasma treatment process. Optical microscope images of fabricated geometry using PFEBL process with a boundary width of 200 nm. (a) Fish-skeleton-like geometry with 2 μm width fin and 2 mm spine (b) Grating geometry with the width/pitch ratio of 1/6. Scale bar: (a) 50 μm ; (b) 250 μm .