Supporting Information

A route to engineered high aspect-ratio silicon nanostructures through regenerative secondary mask lithography

Martyna Michalska,†a Sophia K. Laney,†a Tao Li,†a Manish K. Tiwari,b,c Ivan P. Parkin and Ioannis Papakonstantinou* a

a. Photonic Innovations Lab, Department of Electronic & Electrical Engineering, University College London, Torrington Place, London WC1E 7JE, UK. i.papakonstantinou@ucl.ac.uk
b. Nanoengineered Systems Laboratory, Department of Mechanical Engineering, University College London, Torrington Place, London WC1E 7JE, UK.
c. Wellcome/EPSRC Centre for Interventional and Surgical Sciences (WEISS), University College London, London, W1W 7TS, UK.
d. Department of Chemistry, University College London, Torrington Place, London WC1E 7JE, UK.
† These authors contributed equally to this work.
Supporting Figures

Figure S1. AFM images of hexagonally packed PS-b-P2VP micellar bumps generated from direct spin coating onto Si/SiO$_2$. The molecular weight $M_w$ dictates the pitch $p$ of the micelles and varies across (a-c) with $M_w$ (kg mol$^{-1}$) = 57-b-57, 109-b-90, and 440-b-353, giving rise to $p$ = 56, 95, and 257 nm, respectively. Scale bars = 500 nm.

Figure S2. SEM images of the structures generated from a hard mask with $d$ = 112 nm. (a) SEM image of the hard mask, which under coil power 300 W and platen power 40 W yields straight walled nanopillars (b) with mask remaining after 6 min. Etching for a further 3 min under the same condition yields slender high AR nanopillars. Scale bars = 200 nm.

Figure S3. SEM images of sharp nanocones with varying slope angles after HF treatment (inset = before HF treatment, with remaining SiO$_2$ hard mask highlighted in blue). (a) Nanocones with $\beta$ = 58°, generated from a hard mask of $h$ = 70 nm under mixed plasma of Cl$_2$ (18 sccm) and SF$_6$ (2 sccm) at coil power 300 W, and platen power 10 W for 3 min. (b) Nanocones with $\beta$ = 74°, generated from a hard mask of $h$ = 40 nm under Cl$_2$ plasma (20 sccm) at coil power 200 W, and platen power 10 W for 25 min, followed by 1 min etching under mixed plasma: Cl$_2$ (19 sccm) and SF$_6$ (1 sccm). (c) Nanocones with $\beta$ = 80°, generated from a hard mask of $h$ = 100 nm under Cl$_2$ plasma (20 sccm) at coil power 200 W, and platen power 15 W for 15 min. Scale bars = 200 nm.
Supporting Videos

Supporting Video 1 – Slow-motion video of a bouncing droplet upon impacting the nanostructured 6-inch silicon wafer. The video was recorded using a high-speed camera. A water droplet of 8µL was deposited from a height of 1 cm, giving rise to 19 bounces.

Supporting Video 2 – Self-cleaning effect of the superhydrophobic and antireflective 6-inch silicon wafer. The self-cleaning effect enables efficient removal of black pepper powder by a stream of water.