Supporting Information

DNA Nanostructures-Mediated Molecular Imprinting Lithography

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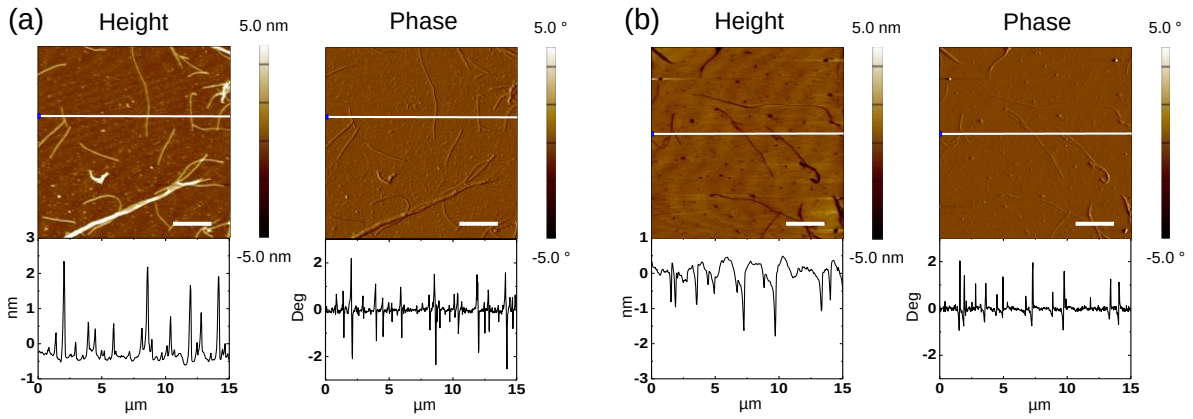


Figure S1. Additional AFM images of fabrication of PMMA stamps by replication over DNA nanotubes. AFM height (left) and phase (right) images of (a) DNA nanotubes deposited on the silicon wafer and (b) replica of nanotube patterns on PMMA stamps (top). Corresponding cross-sections are shown at the bottom. Scale bars represent 3 µm.

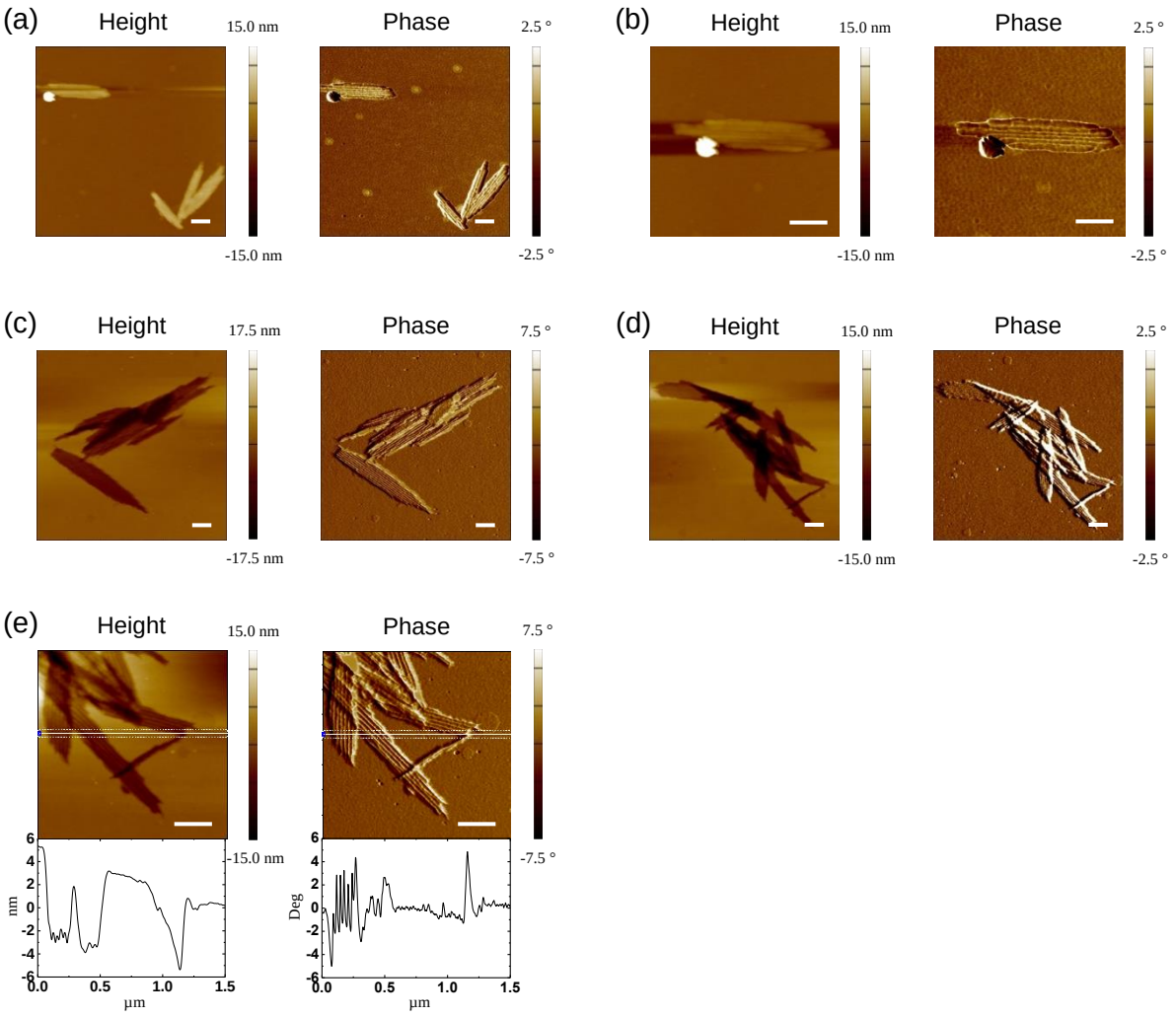


Figure S2. Additional AFM images of fabrication of PMMA stamps by replication over 2D DNA brick crystals. AFM height (left) and phase (right) images of (a, b) 2D DNA brick crystals deposited on the silicon wafer and (c-e) replica of 2D DNA brick crystals on PMMA stamps (top). Corresponding cross-section is shown at the bottom of e. Scale bars represent 300 nm.

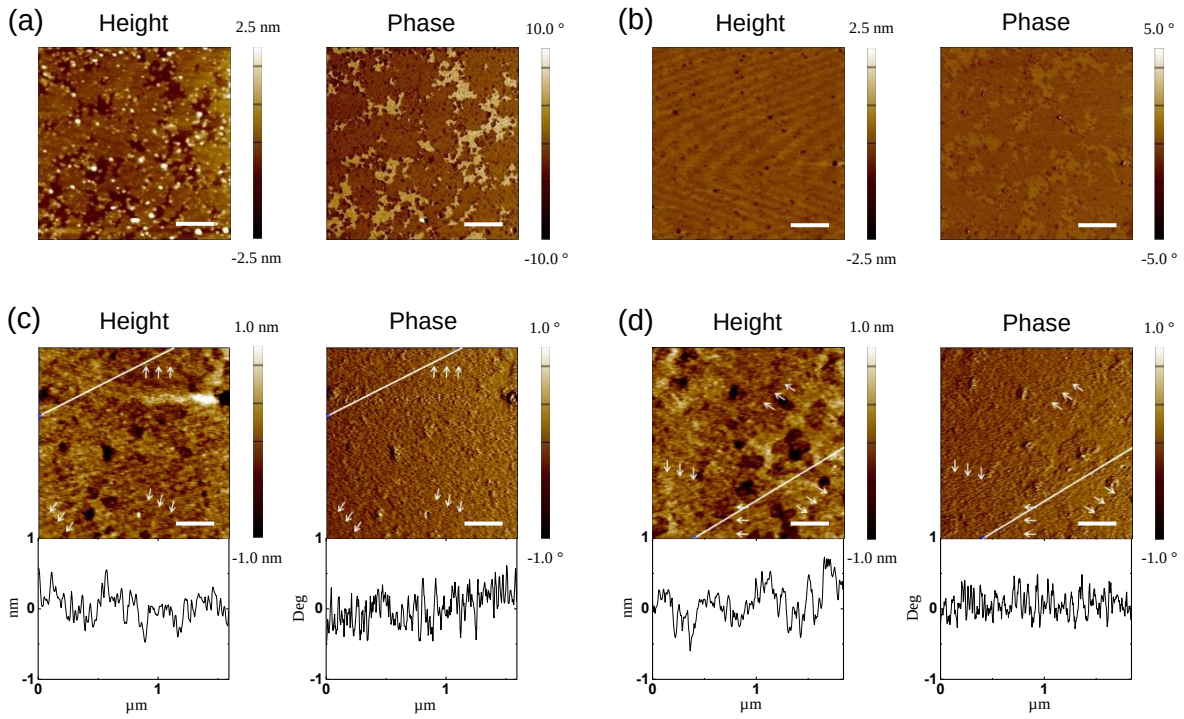


Figure S3. Additional AFM images of fabrication of PMMA stamps by replication over hexagonal DNA 2D arrays. AFM height (left) and phase (right) images of (a) DNA 2D arrays assembled on the silicon wafer and (b-d) negative patterns of DNA 2D arrays on PMMA stamps (top). Corresponding cross-sections are shown at the bottom of c and d. White arrows indicate the locations of negative patterns of single layer DNA 2D arrays on PMMA stamps. Scale bars in a and b represent 2 µm and scale bars in c and d represent 400 nm.

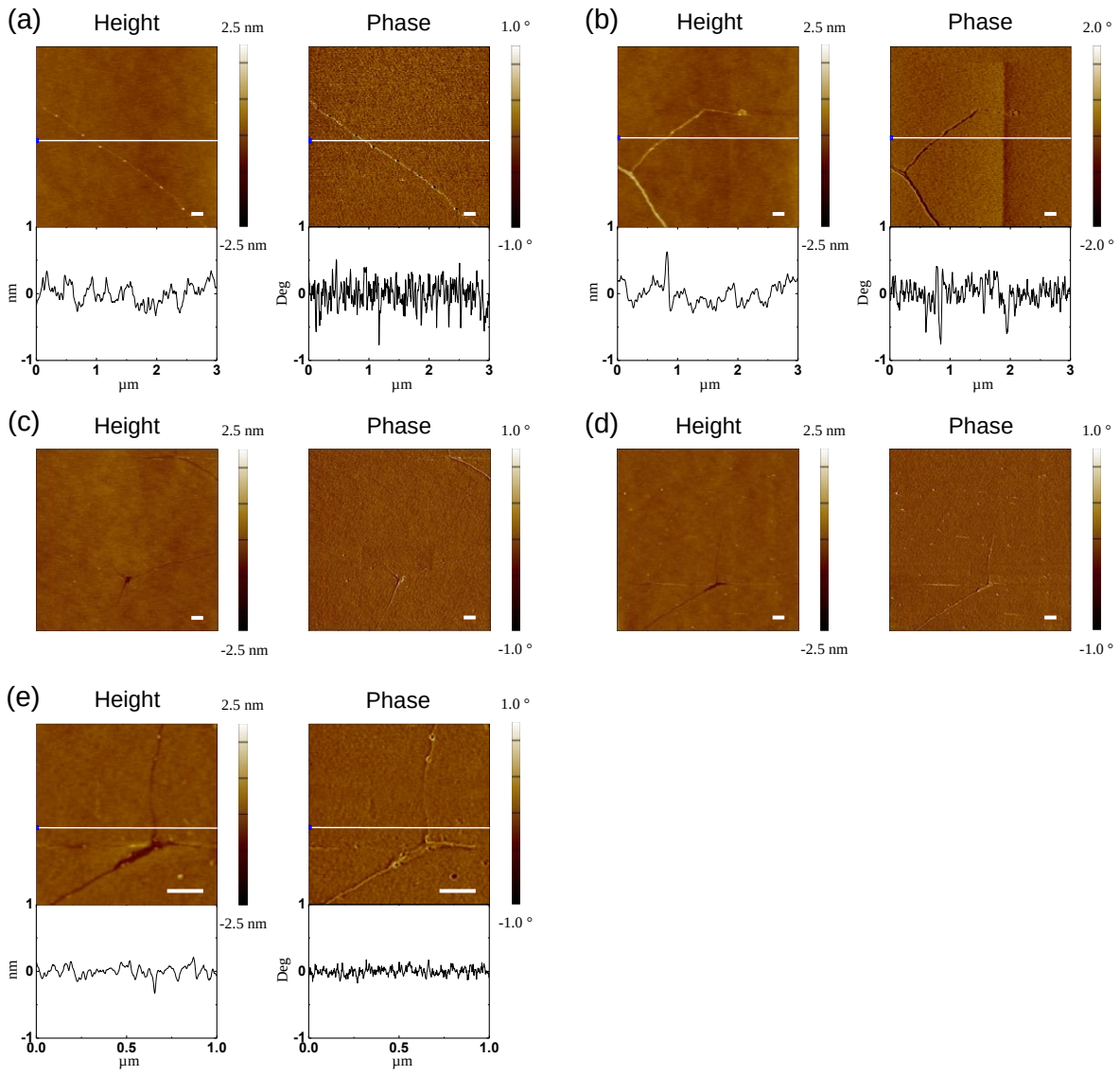


Figure S4. Additional AFM images of fabrication of PMMA stamps by replication over the λ-DNA. AFM height (left) and phase (right) images of (a,b) the λ-DNA deposited on the silicon wafer and (c-e) replica of λ-DNA patterns on PMMA stamps (top). Corresponding cross-sections are shown at the bottom of a, b and e. Scale bars represent 200 nm.

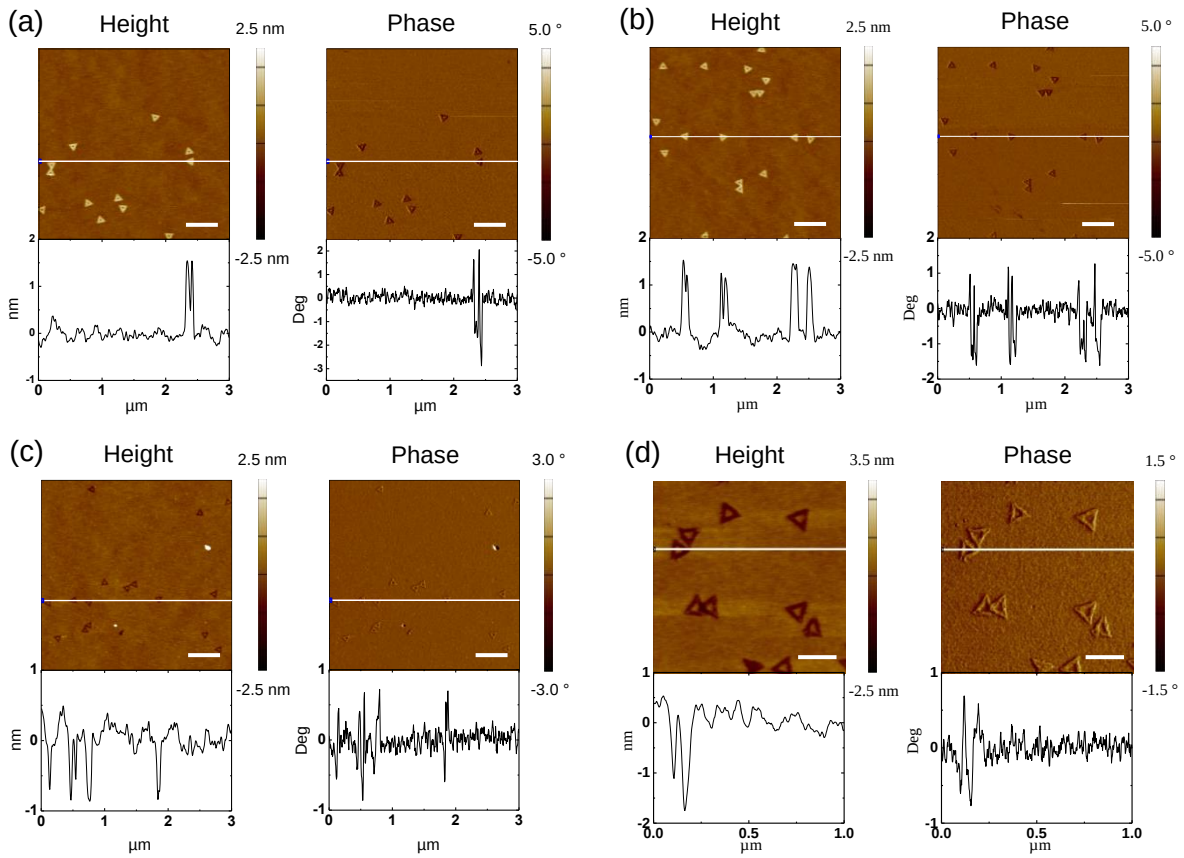


Figure S5. Additional AFM images of fabrication of PMMA stamps by replication over the triangular DNA origami. AFM height (left) and phase (right) images of (a, b) DNA triangles deposited on the silicon wafer and (c, d) triangular patterns on PMMA stamps (top). Corresponding cross-sections are shown at the bottom. Scale bars in a-c represent 500 nm and scale bars in d represent 200 nm.

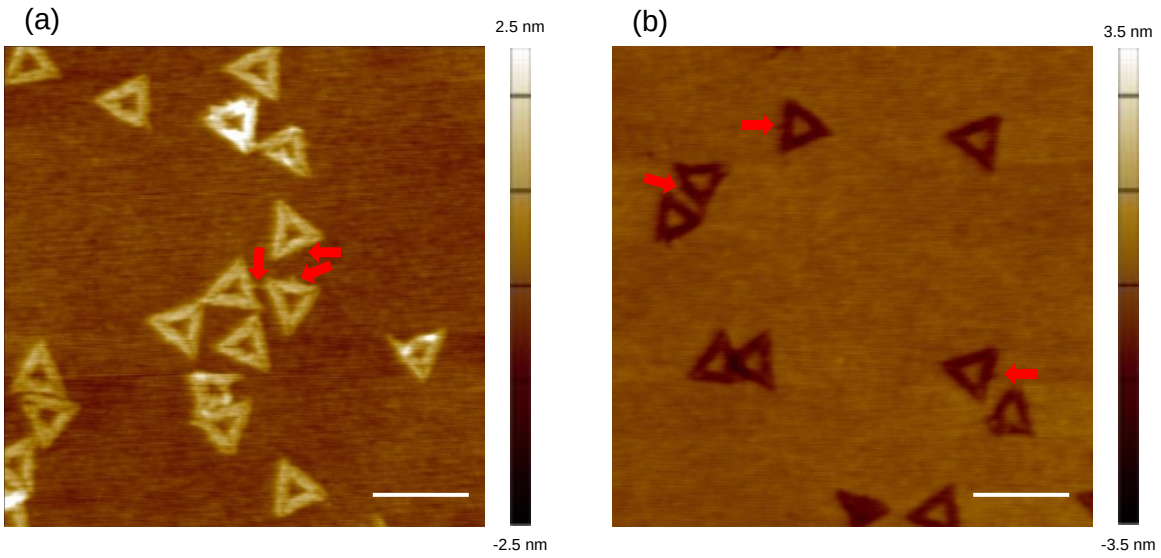
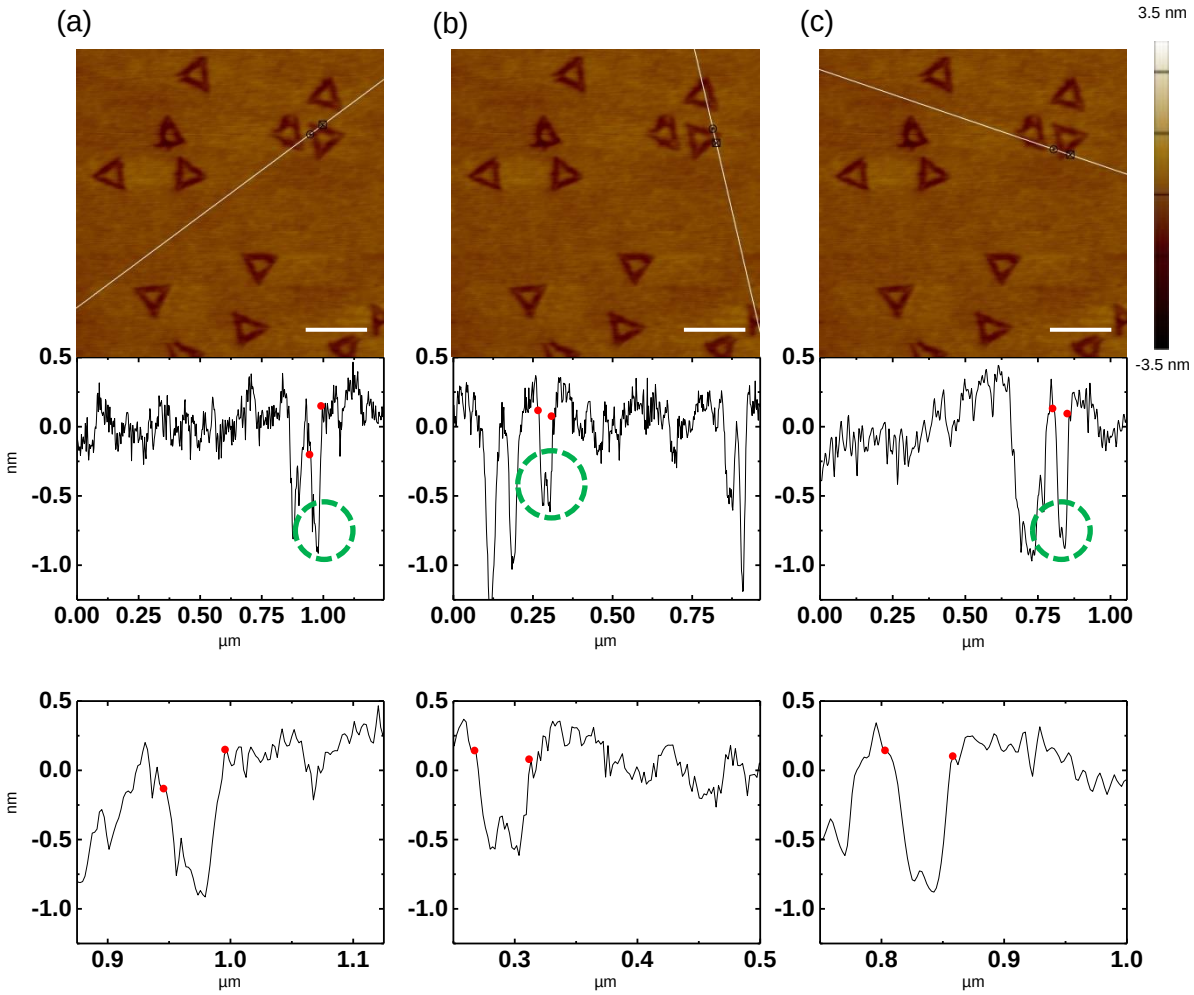


Figure S6. AFM images of fabrication of PMMA stamps by replication over the triangular DNA origami. AFM height images of (a) DNA triangles deposited on the silicon wafer and (b) triangular patterns on PMMA stamps. The dangling loops of the DNA triangles and the corresponding patterns on the triangular trenches are indicated by the red arrows. Scale bars represent 200 nm.


(a)
(b)
(c)
3.5 nm
-3.5 nm
nm
µm
0.5
0.0
-0.5
-1.0
0.00 0.25 0.50 0.75 1.00
0.00 0.25 0.50 0.75
0.9 1.0 1.1
0.3 0.4 0.5
0.8 0.9 1.0

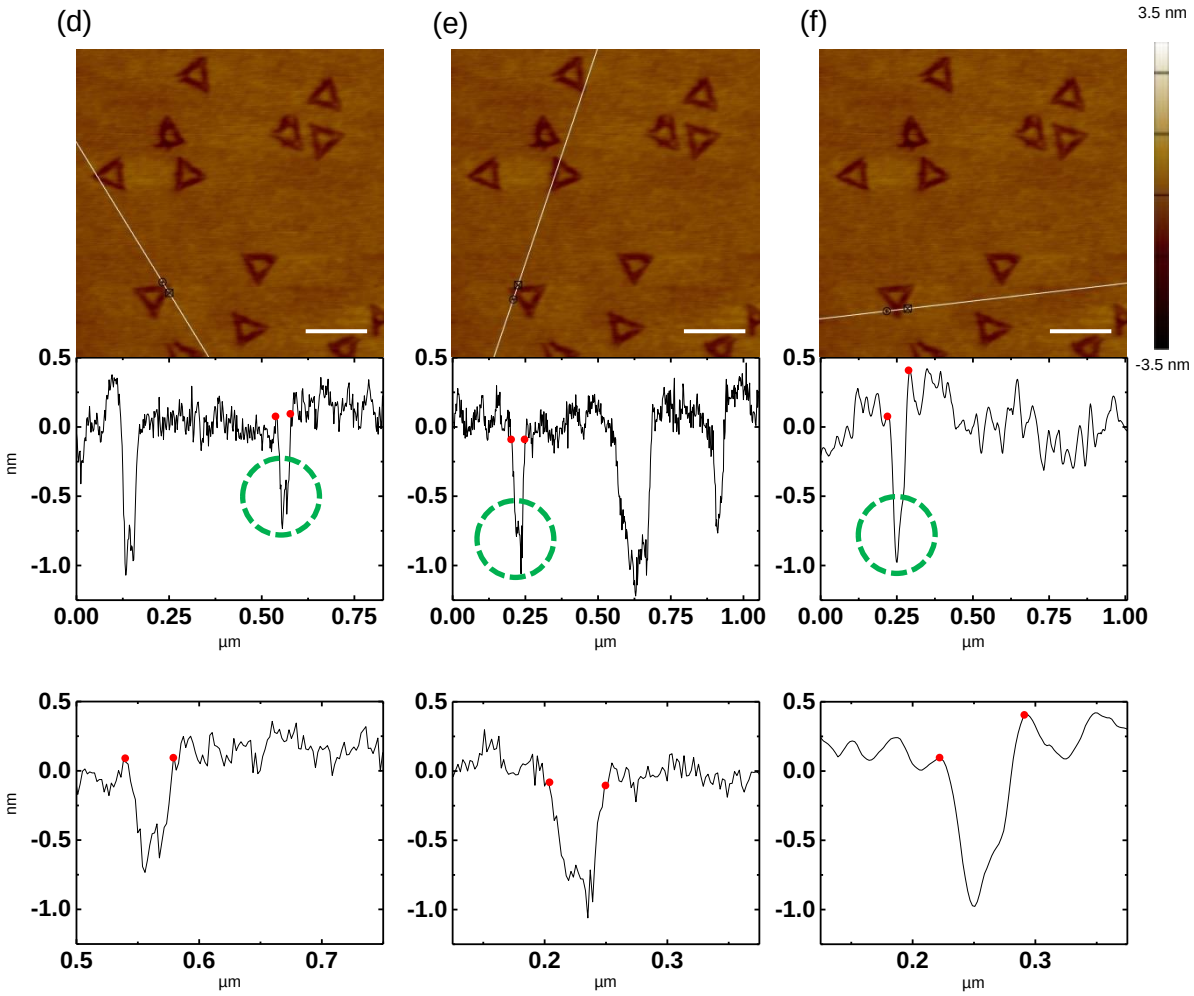


Figure S7. AFM height images (top) and cross-section analysis (middle and bottom) of the bumps at the vertices of triangular trenches on the PMMA stamps. Cursors in the AFM height images define the outer edges of the vertices that are measured. Red dots in the cross-section (middle) correspond to the cursors in the AFM images. Dashed green circle (middle) highlights the curve valley that corresponds to the trench at the vertex. The zoomed-in view of the corresponding curve valley is shown at the bottom. In a-e, the jump in the zoomed-in curve valley of the cross-section confirms the appearance of the bump. In f, there is no jump at the curve valley, indicating that no bump exists at this vertex. Scale bars represent 200 nm.

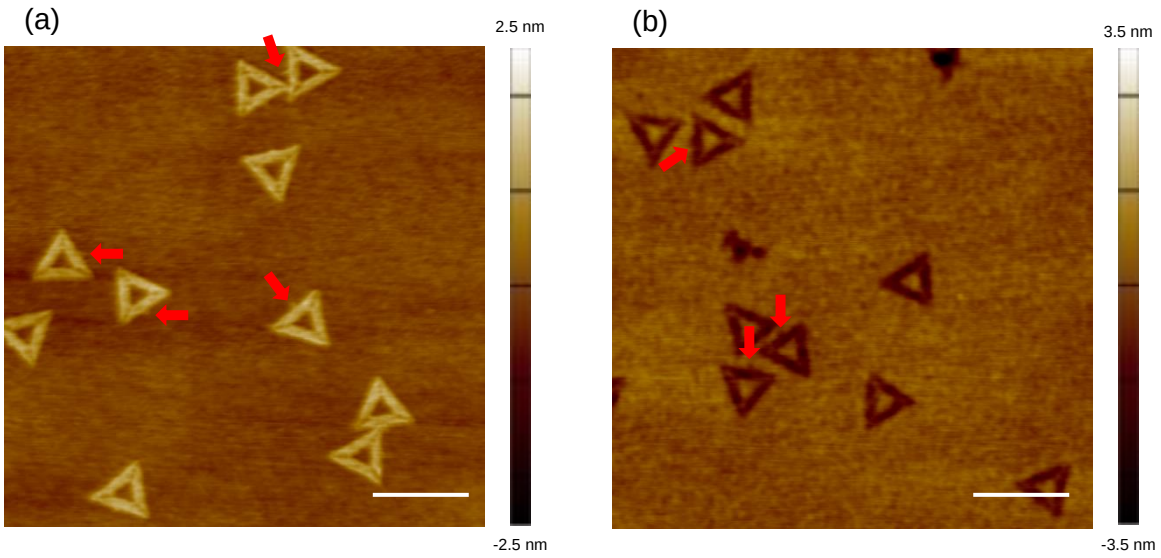


Figure S8. AFM images of fabrication of PLLA stamps by replication over the triangular DNA origami. AFM height images of (a) DNA triangles deposited on the silicon wafer and (b) triangular patterns on PLLA stamps. The dangling loops of the DNA triangles and the corresponding patterns on the triangular trenches are indicated by the red arrows. Scale bars represent 200 nm.

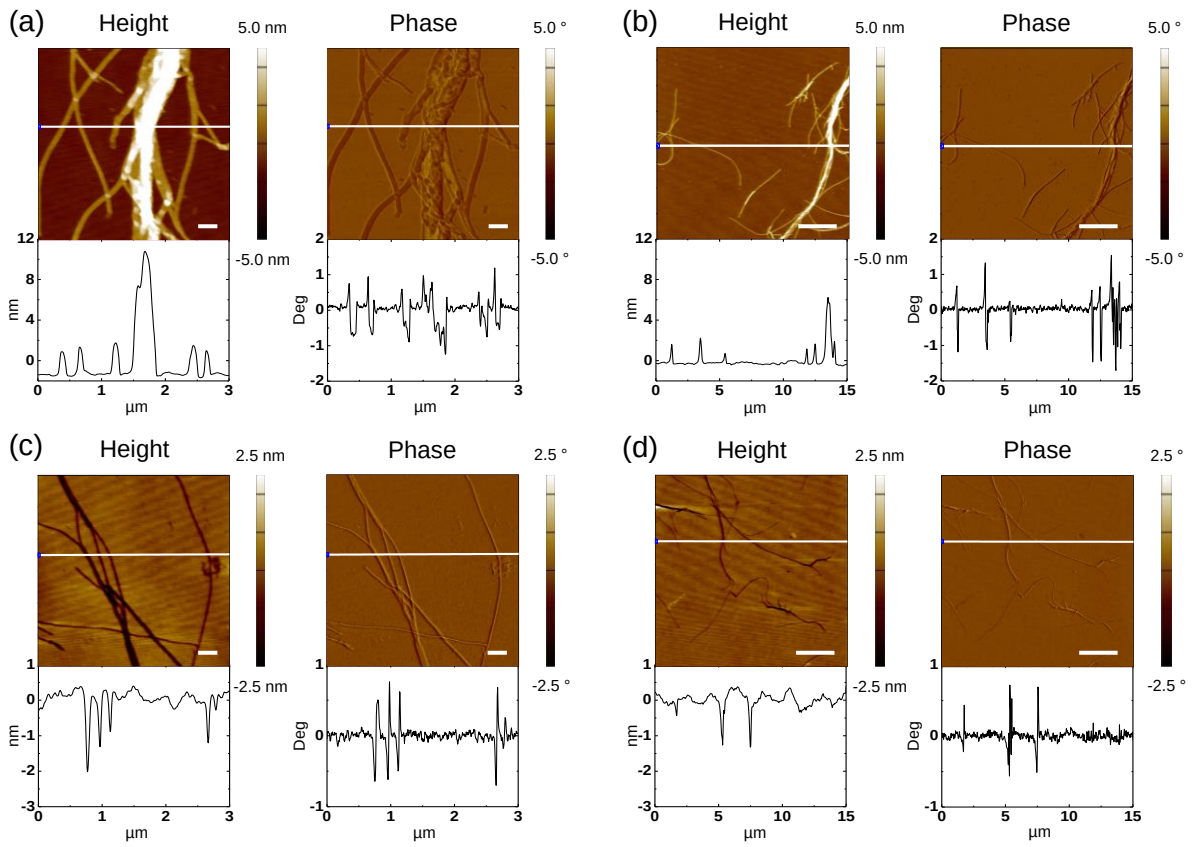


Figure S9. Fabrication of PLLA stamps by replication over DNA nanotubes. (a, b) AFM height (left) and phase (right) images of DNA nanotubes deposited on the silicon wafer (top) and the corresponding cross-sections (bottom). (c, d) AFM height (left) and phase (right) images of nanotube patterns on PLLA stamps (top) and the corresponding cross-sections (bottom). Scale bars in a and c represent 300 nm; scale bars in b and d represent 3 µm.

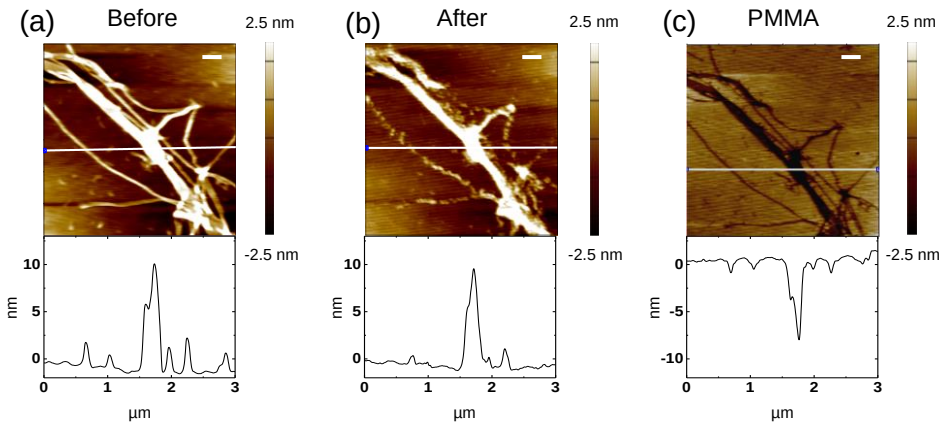


Figure S10. Additional AFM height images (top) and cross-sections (bottom) of DNA nanotubes deposited on the silicon wafer (a) before and (b) after the replication to PMMA stamps, and (c) PMMA replica of the same area. Note: image (c) is flipped horizontally to match the orientation of the DNA master template.

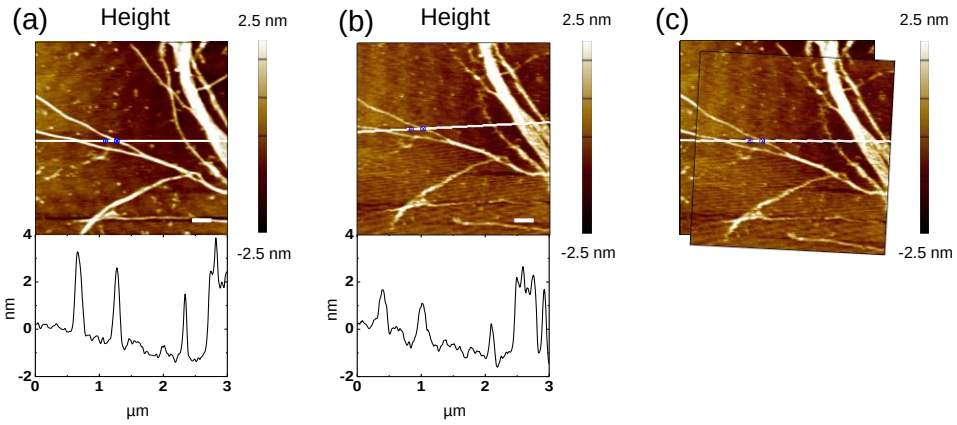


Figure S11. AFM height images of DNA nanotubes in the same location of silicon wafer (a) before and (b) after the replication to PMMA stamps (top). Corresponding cross-section is shown at the bottom. Scale bars represent 300 nm. (c) Overlap of (a) and (b) in the same location. Compared to the results shown in Figure 8, this experiment used less water and decreased the incubation time (*i.e.*, the time between adding water to the Si wafer and peeling off the polymer stamp).

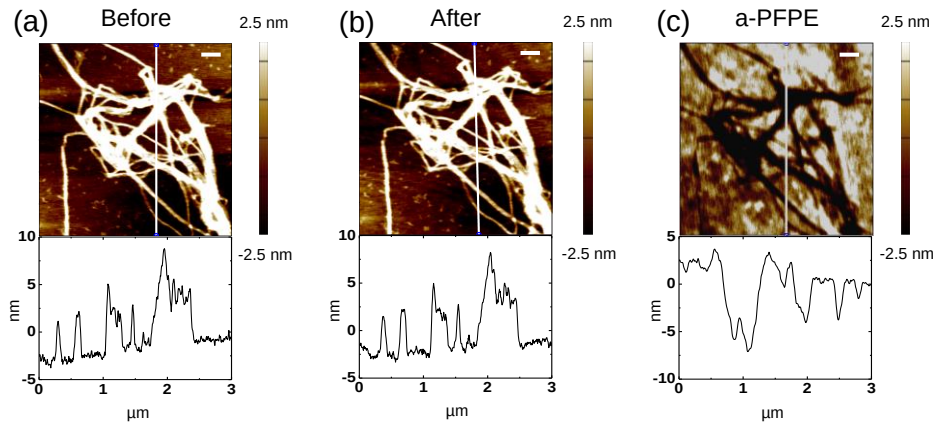


Figure S12. Fabrication of the a-PFPE stamp by replication over DNA nanotubes. AFM height images of DNA nanotubes deposited on the silicon wafer (a) before and (b) after the replication to a-PFPE stamps, and (c) replica of corresponding nanotube patterns on the a-PFPE stamp (top). Corresponding cross-section is shown at the bottom. Scale bars represent 300 nm. Note: image (c) is flipped horizontally to match the orientation of the DNA master template.

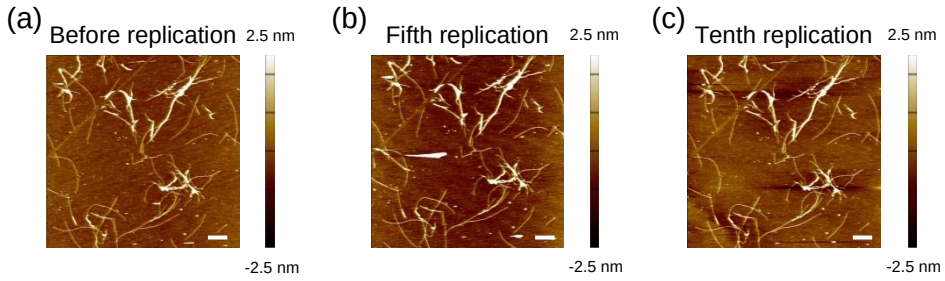


Figure S13. Additional AFM height images of DNA nanotubes in the same location (a) before the pattern transfer and after the (b) fifth and (c) tenth pattern transfer to the a-PFPE stamp. Scale bars represent 1.5 µm.

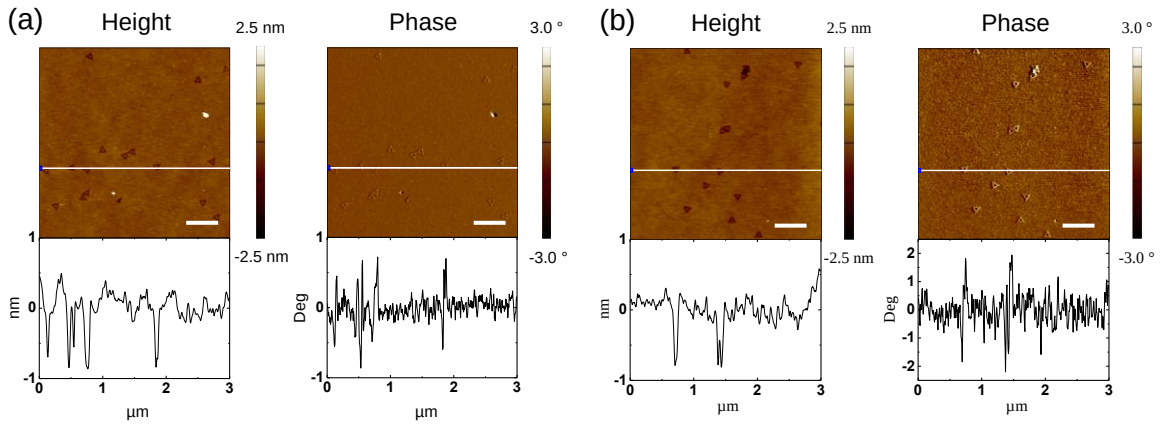


Figure S14. Stability of nanoscale features on PMMA stamps. AFM height (left) and phase (right) images of the PMMA stamp (a) immediately after being peeled off and (b) again after 10 days of aging in the air (top). Corresponding cross-sections are shown at the bottom. Scale bars represent 500 nm. Note: (a) is also shown in Figure S5c.

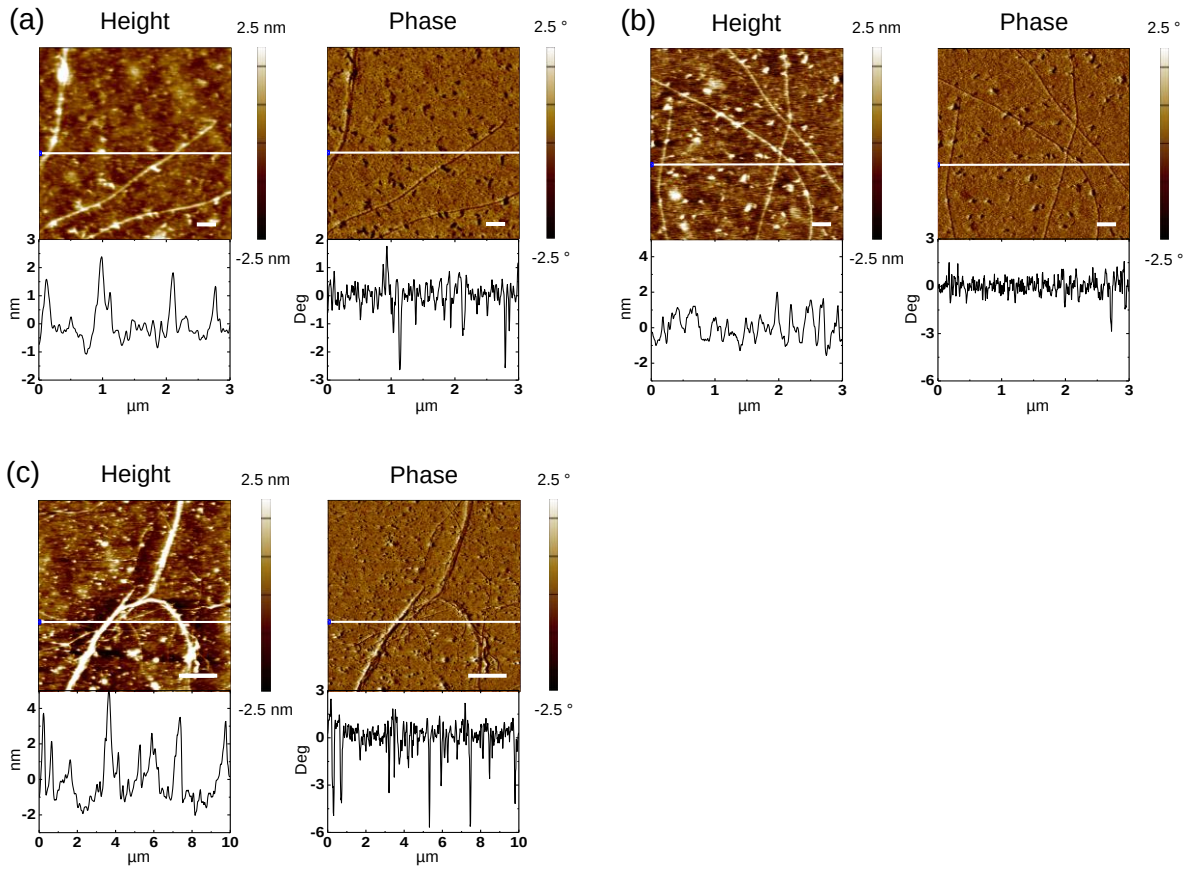


Figure S15. Additional AFM height (left) and phase (right) images of DNA nanotubes patterns on an a-PFPE substrate transferred from PMMA stamps by replica molding (top). Corresponding cross-sections are shown at the bottom. Scale bars in a and b represent 300 nm and scale bars in c represent 2 µm.

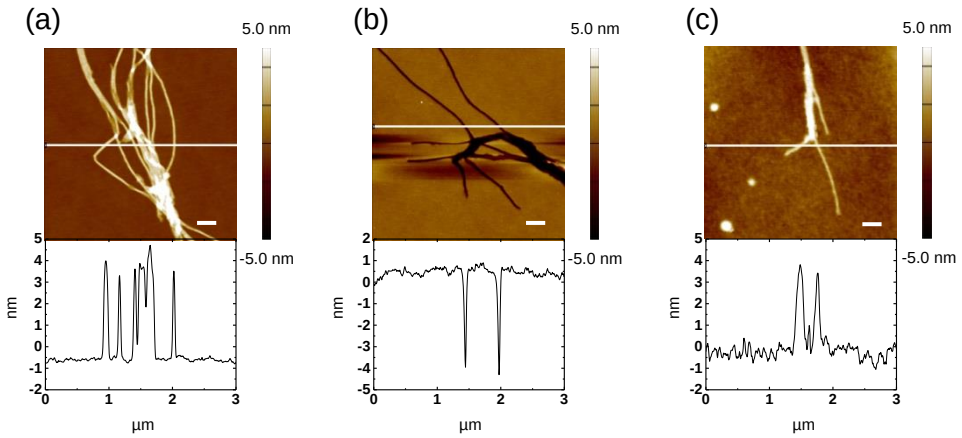


Figure S16. AFM height images of (a) DNA nanotubes on the silicon wafer, (b) DNA nanotube patterns on the PLLA stamp, and (c) DNA nanotube pattern on an a-PFPE substrate transferred from PLLA stamps by replica molding (top). Corresponding cross-sections are shown at the bottom. Scale bars represent 300 nm.

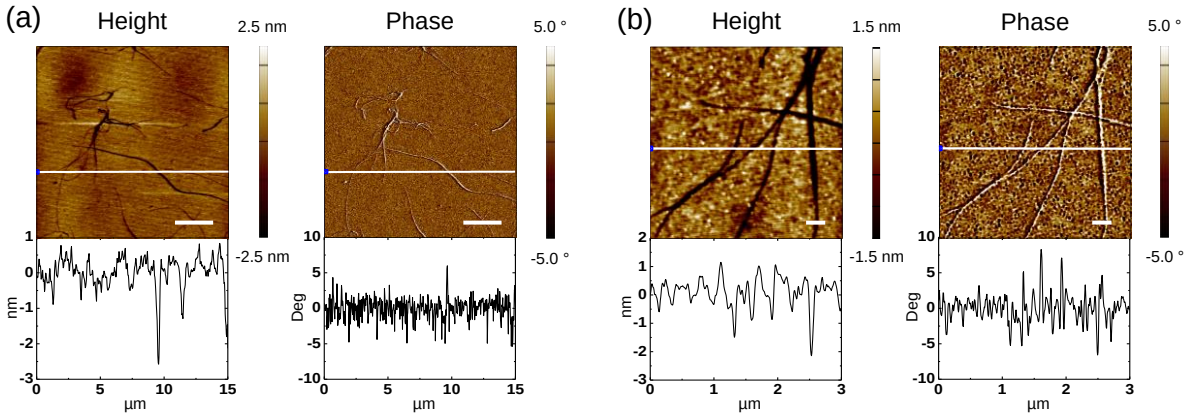


Figure S17. Stability of nanoscale features on PMMA stamps during the replica molding. AFM height (left) and phase (right) images of PMMA stamps after transfer of the pattern to a-PFPE (top). Corresponding cross-sections are shown at the bottom. Scale bars in a represent 3 µm and scale bars in b represent 300 nm.