

Supporting Information

Robust Superhydrophobic Silicon Without a Low Surface-Energy (hydrophobic) Coating

*Sasha Hoshian^{*1}, Ville Jokinen¹, Villeseveri Somerkivi¹, Arcot R. Lokanathan² and Sami Franssila^{*1}*

1) Department of Materials Science and Engineering, Aalto University School of Chemical Technology, 02150, Finland.

2) Department of pulp and paper technology, Aalto University School of Chemical Technology, Finland

Email: sasha.hoshian@aalto.fi

Typical understanding of superhydrophobicity phenomenon involves two main factors: 1) structuring and 2) chemistry. Structuring typically enhances the intrinsic wetting properties. If the surface is hydrophilic, structuring improves the hydrophilicity and might cause superhydrophilicity. On the other hand, if the surface is hydrophobic, structuring causes more hydrophobicity or might cause superhydrophobicity. For instance silicon is naturally hydrophilic and typical structuring such as parallel micro/nano or hierarchical pillars (figure S1) make silicon surface superhydrophilic.

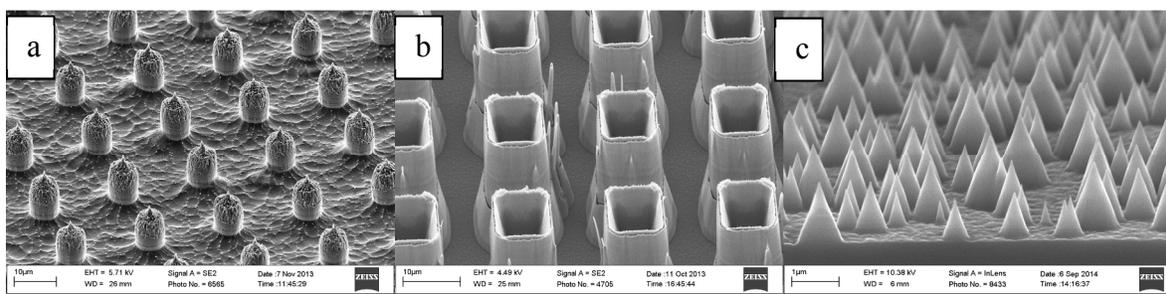


Figure S1. SEM micrograph of superhydrophilic silicon produced by (a) hierarchical micro/nano structures. (b) micro structures. (c) nano structures.

However, in the special case of overhanging structures, silicon which is hydrophilic can turn to be robust low hysteresis superhydrophobic without low surface-energy (hydrophobic) coatings.

The idea is embedding as much as air pockets in between silicon nanostructures. These nanostructures should be designed to be able to capture and keep nanoscale air pockets below themselves. Air pockets could reduce the solid-liquid fraction at the interface and cause superhydrophobicity out of hydrophilic surface. It means there are some structures existed in nature that dominant to chemistry.

Collapsed silicon nanowires into nano-bushes causes superhydrophobicity without silanization or any other low surface-energy coatings. To show a better contrast of re-entrant structure of collapsed silicon nanowires, we did the same MaCE process as explained in manuscript, on a reference sample just using colloidal lithography on flat silicon substrate. Figure S2-a is a SEM micrograph of collapsed silicon nanowires which make bushy like structures using colloidal lithography. Air pockets can be trapped under the bushes in liquid-solid interface and cause superhydrophobicity. 400 nm colloidal polystyrene particles are used to do the MaCE for this sample. Process of MaCE was exactly the same as explained in manuscript. In Figure S2-b and c, schematic of non-collapsed and collapsed silicon nanowires are depicted respectively.

A movie (S3) that shows a hierarchical superhydrophobic sample without low surface-energy coating under tap water attached in supplementary.

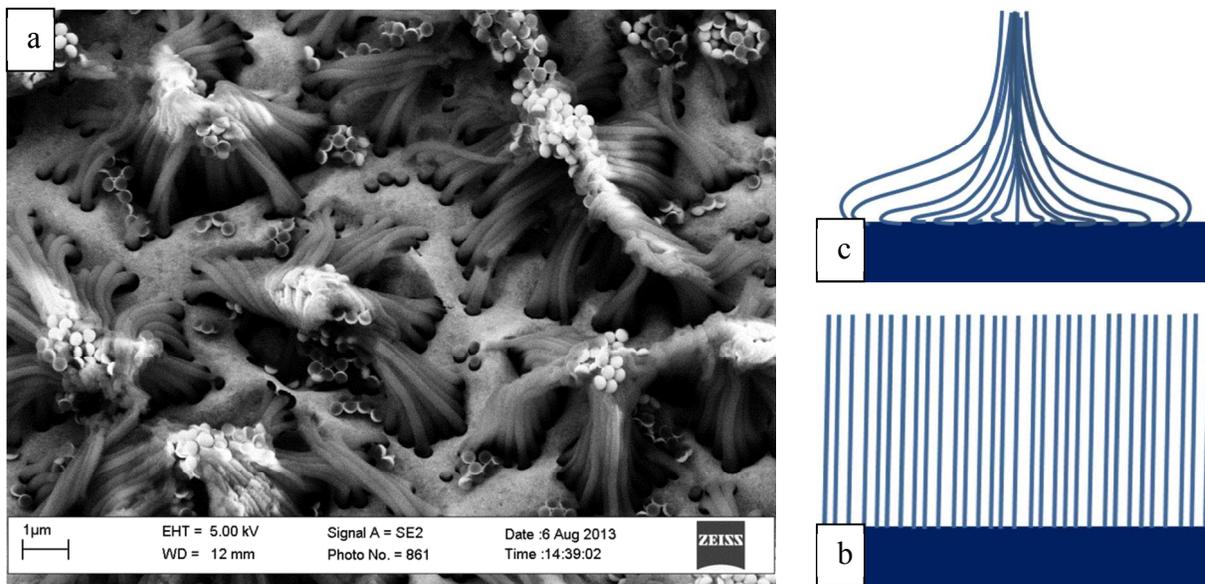


Figure S2 (a) SEM micrograph of collapsed silicon nanowires after MaCE process. Collapsing is caused by high surface tension of water during rinsing the sample after MaCE process. Schematic of silicon nanowires (b) before and (c) after water rinsing.