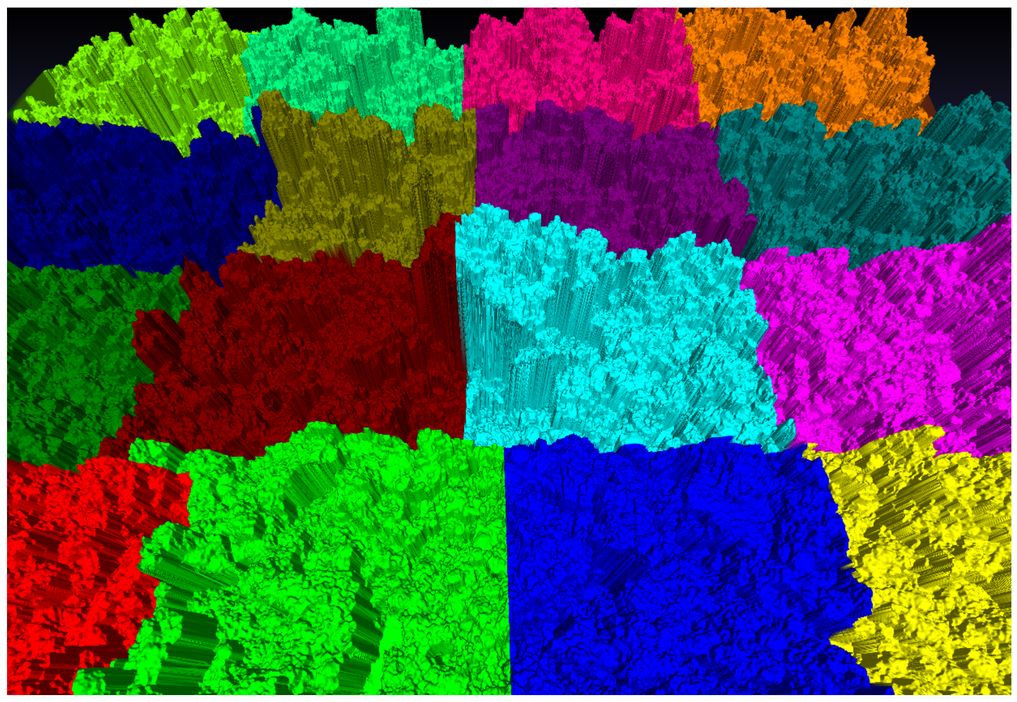
3D printing for surface wettability research

Jose David Fernández Rodríguez (1)
Joël de Coninck (2)

(1) Laboratory for Physics of Surfaces and Interfaces, University of Mons, Av. Victor Maistriau, 19, 7000 MONS, Belgium. Email: yosoyjd@gmail.com
(2) Laboratory for Physics of Surfaces and Interfaces, University of Mons, Av. Victor Maistriau, 19, 7000 MONS, Belgium. Email: joel.deconinck@umons.ac.be

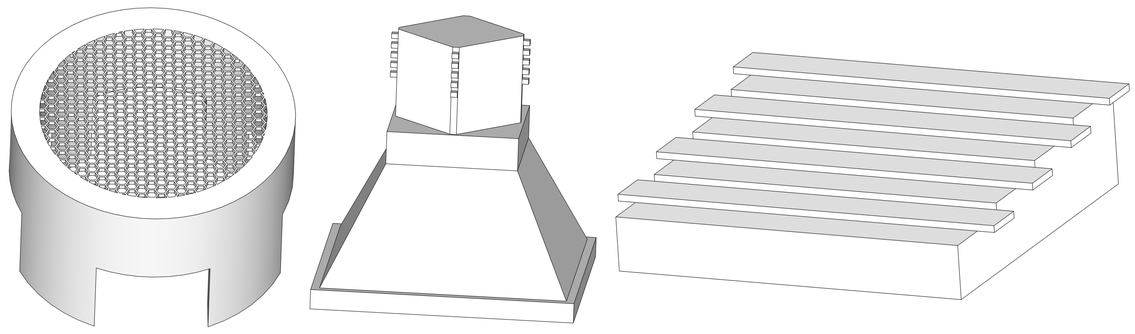
Towards using 3D printing to pattern surfaces for wettability research

- Problem: very large, very high-resolution 3D models of objects cannot be effectively processed by currently existing software
- Solution: develop a new 3D printing software pipeline designed to work with very large models

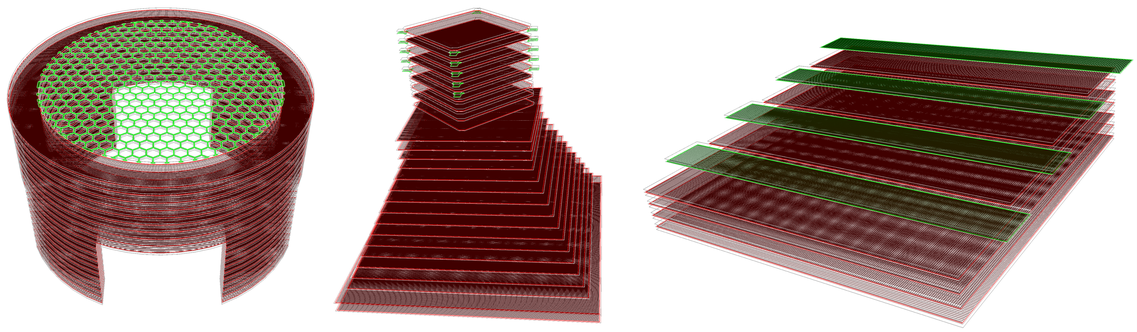


3D model of hydrophobic surface from confocal topographies, sub-micrometer resolution, area ~4mm^2, file size ~650Mb

- Problems with TPP stereolitography:
  - It is **very slow at very high resolution** (sub-micrometer)
  - Printing at very high resolution often results in **large deformations** (severe shrinkage)
- Solution: **automatically** print at several resolutions
  - **The bulk** of the structure can be printed **at low resolution** (faster, little shrinkage)
  - **Only small features** have to be printed **at high resolution** (slower, large shrinkage)
  - **Actual speed-up depends on the geometry** of the object to print
  - **Up to ~2X speed-up** with our current experimental setup (voxel heights ranging from **0.75µm** to **1.5µm**)
  - **Up to ~25X speed-up** with even larger voxel ranges, as reported in some studies (voxel heights ranging from **0.6µm** to **15µm**)



CAD models, from left to right: a filter with hexagonal holes with a diameter of 2µm, a tower with cubical overhangs, each one with a side of 1µm, and a staircase with overhangs 2µm long and 5µm wide.

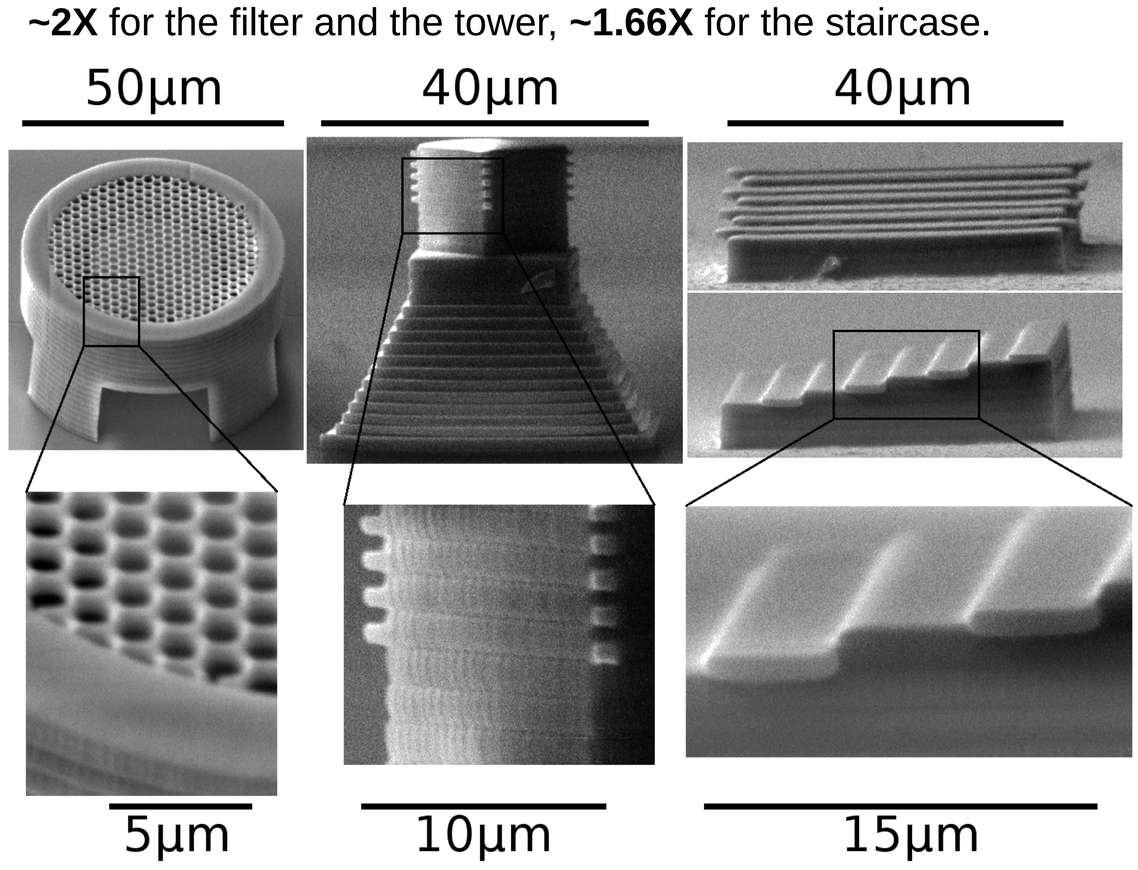


Toolpaths generated by our slicer for our experimental setup.

Voxel for red toolpaths: ~1.50µm height, ~0.75µm width

Voxel for green toolpaths: ~0.75µm height, ~0.50µm width

Actual speed-ups (compared to prints only at high resolution): **~2X** for the filter and the tower, **~1.66X** for the staircase.



Structures after being printed in a **Nanoscribe Photonics GT 3D printer** with a 63X, 1.4NA objective. All toolpaths were printed with the same exposure time. Different voxel sizes were achieved by modulating the laser power output.

Credits

- Research: Université de Mons, LPSI research group
- 3D printer: Université Libre de Bruxelles, BEAMS department