

# Superhydrophobic surface helps researchers develop optical displays from water and air (w/ Video)

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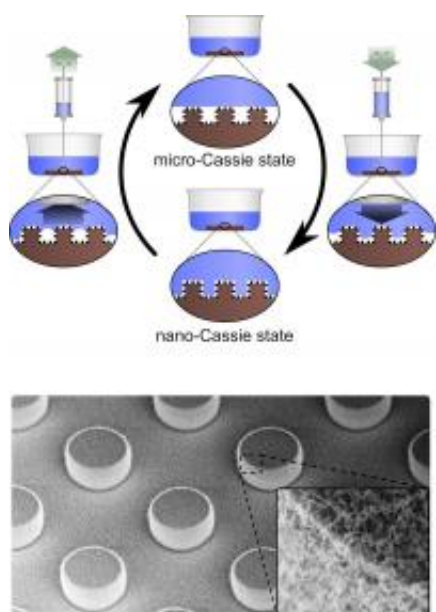


Image: Aalto University

(Phys.org) -- For many years, scientists have been pursuing ways to mimic the perplexing capability of the lotus leaf to repel water. Lotus leaves hate water so much that droplets effortlessly roll off the surface, keeping it clean from dirt. Now an international team of researchers led by Aalto University have come up with an entirely new concept of writing and displaying information on surfaces using simply water. They exploit the unique way a trapped layer of air behaves on a lotus-inspired

dual-structured water-repelling surface immersed under water.

To achieve the extreme [water-repellency](#) of the [lotus leaf](#), a surface needs to be superhydrophobic: it must have microscopic [surface structures](#) that prevent [water](#) from wetting the surface completely, leaving a [thin layer](#) of air between water and the surface. When such a surface is immersed in water, a trapped air layer covers the entire surface.

The researchers lead by Dr. Robin Ras at Aalto University in Finland, University of Cambridge and Nokia Research Center Cambridge fabricated a surface with structures in two size scales: microposts that have a size of ten micrometers and tiny nanofilaments that are grown on the posts. On such a two-level surface the air layer can exist in two different shapes (wetting states) that correspond to the two size scales. The researchers found that one can easily switch between the two states locally using a nozzle to create over- or underpressure in the water, in order to change the air layer to either state.

“The minimal energy needed to switch between the states means the system is bistable, which is the essential property of memory devices, for example”, Academy Research Fellow Dr. Robin Ras points out. However, there is a feature that makes it all the more interesting: there is a striking optical contrast between the states due to a change in the roughness of the water-air interface. “Combined with the optical effect, the surface is also a bistable reflective display.”

The switching only involves a change in the shape of the air layer – nothing happens to the solid surface itself. This is demonstrated by writing shapes on the surface underwater (making use of the contrast between the states) and taking the sample out of water: the surface emerges completely dry, and no traces of the writing remain.

The method for manipulating the air layer with the [nozzle](#) was developed by Tuukka Verho, graduate student in Aalto University. He was able to show that the reversible switching can be done with precision in a pixel-by-pixel fashion.

“This result represents the first step in making non-wettable surfaces a platform for storing or even processing information”, says Academy professor Olli Ikkala. Until now, lotus-inspired surfaces have been mainly developed for applications like self-cleaning, anti-icing or flow drag reduction. This research is a landmark example how the Nature teaches materials scientists towards functional materials.

An article entitled “Reversible switching between superhydrophobic states on a hierarchically structured [surface](#)” is published in *PNAS*, *Proceedings of the National Academy of Sciences*, and provides more in depth information about this project.

**More information:** [www.pnas.org/cgi/doi/10.1073/pnas.1204328109](http://www.pnas.org/cgi/doi/10.1073/pnas.1204328109)

Provided by Aalto University

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