The World's Most Superhydrophobic Surfaces

Nanotechnology: New Solutions to Old Problems

Sponsors: ORNL Laboratory Directed Reserch and Development and Maturation Funds

Features:

- Uniform array of micro-cones having nano-sharpness.
- Most water-repellent surface ever fabricated (contact angle >179 degrees).
- Arrays can be fabricated to have virtually any size, aspect ratio, or spacing.

Contact Information:
Panos G. Datskos
Group Leader
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831-6054
Phone: 865-574-6205
Fax: 865-574-9407
(datskospg@ornl.gov)

MSSE

OAK RIDGE National Laboratory

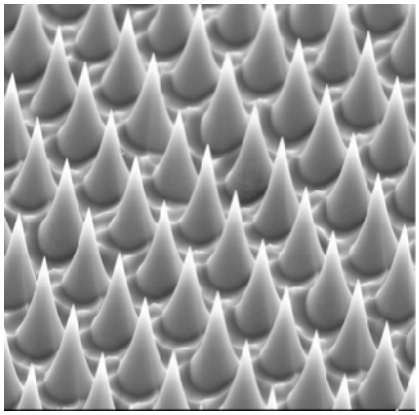
www.ornl.gov

Researchers at the Department of Energy's Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, have developed the world's most water-repellent surfaces. Known as "super-hydrophobic," these surfaces emulate the water-repellent properties of some plants found in nature. For example the lotus plant, native to Asia and Australia, grows in muddy ponds and marshes, but the leaves emerge above water clean and dry due to their superhydrophobic surfaces. On the lotus leaf, the natural water repellence of its waxy surface is greatly enhanced by the rough microstructure of the leaf's surface.

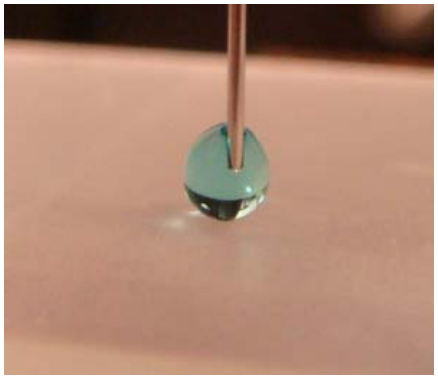
ORNL researchers have learned how to create surfaces with exceedingly uniform arrays of micro-cones and nano-cones that, when properly treated, produce unprecedented water-repellent behavior that is very close to the theoretically most water-repellent behavior possible. Contact angles in excess of 179 degrees have been observed on these surfaces (the theoretical limit is 180 degrees).

These cone arrays not only far outperform the water-repellent properties of the lotus leaf, they also far outperform any other known superhydrophobic material. Researchers achieved this by creating tiny glass "nano-cones" of uniform height and spacing with extremely sharp tips. The closer and smaller the cones, the more pressure tolerant the surface is. Water droplets actually bounce off the surface of these man-made materials.

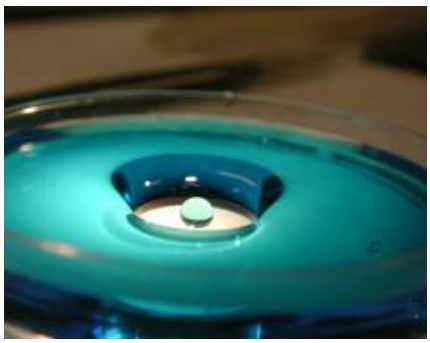
The cone array structures that create this amazing water repellency can be designed and fabricated to have any number of cone sizes, cone spacing, and cone aspect ratios (cone height/cone base).



Superhydrophobic glass cone array.



Water drop sitting on cone array surface.



"Moses effect": superhydrophobic area (middle) prevents water accumulation.