Superhydrophobicity:
An Interaction of Two Forces

Hydrophobic/Hydrophilic/Super hydrophobic

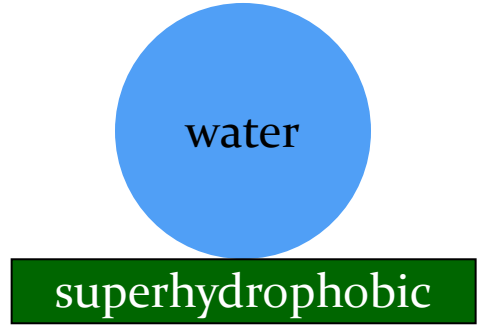
Hydrophobic Surfaces: “Water-fearing surface” Water tries to minimize contact with surface.

Examples: Teflon, oily surfaces

Hydrophilic Surfaces: “Water-loving surface” Water tries to maximize contact with surface.

Examples: Glass, rusted metal surfaces

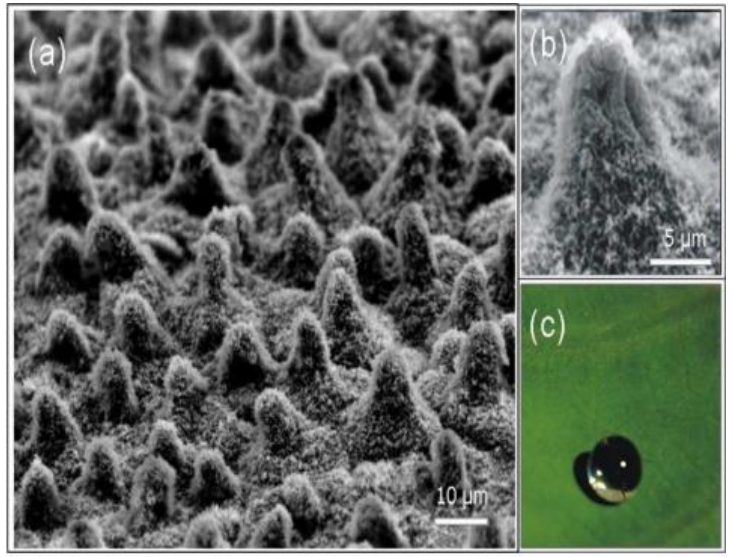
Superhydrophobic Surfaces: Hydrophobic surface having nano-scale roughness.

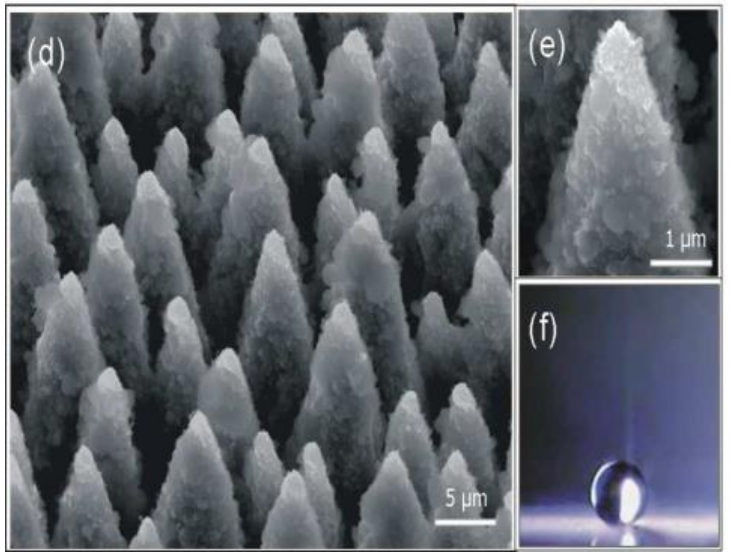


Natures use of Superhydrophobicity: Lotus Leaf

(a) SEM image of a lotus leaf at 10 um

(d) SEM image of a Man made superhydrophobic surface at 5 um





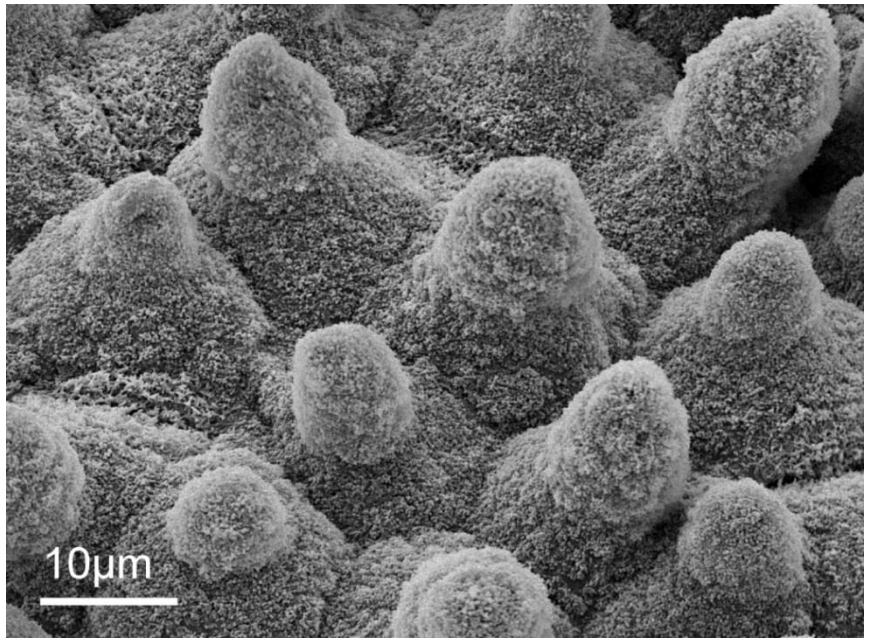
We can observe some natural materials that seem to be even better than wax paper at making water drops ‘bead up.’

Some examples include:

Lotus leaves
Rose petals
Rice leaves
Insect wings and shells

Examination of these diverse materials at the nanometer scale reveals a common structural feature: Micrometer scale bumps with nanoscale surface features

Lotus leaf

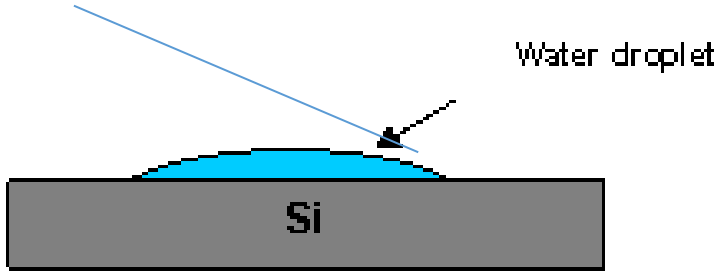


http://www.beilstein-institut.de/Bozen2010/Proceedings/Koch/Koch.html

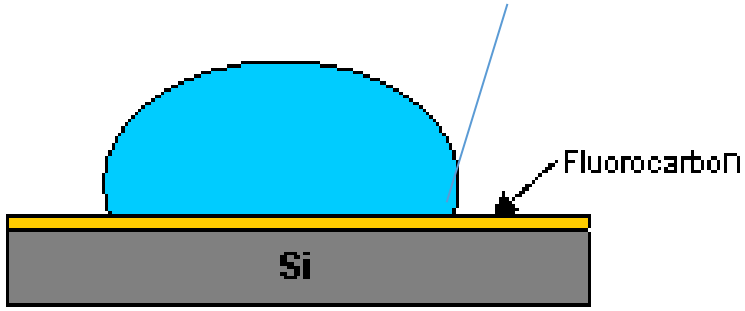
Termite wing

http://cen.acs.org/articles/88/i5/Tiny-Features-Keep-Termite-Wings.html

The formal definition of a superhydrophobic surface is one where the contact angle between the surface and the droplet is greater than 150 degrees

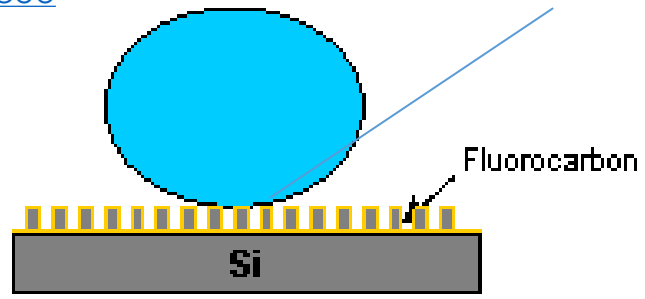


Hydrophilic<90

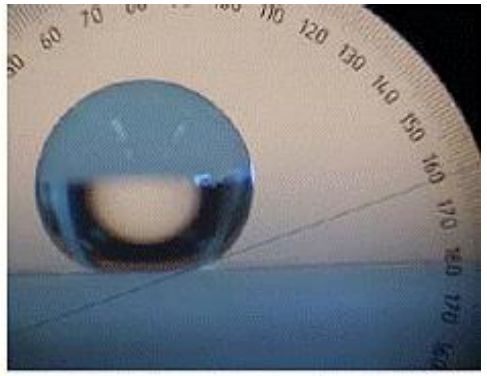


Hydrophobic>90

http://web.tyndall.ie/mai/microcool.htm

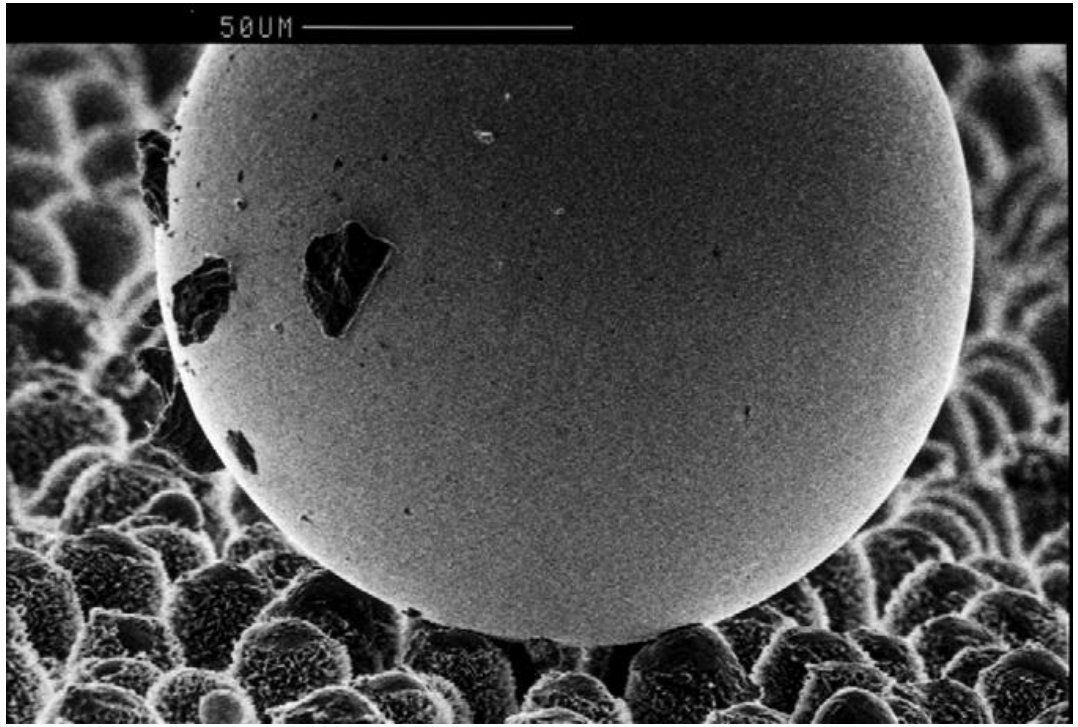


Superhydrophobic>150



http://superhydrophobiccoating.com/

Although the superhydrophobic surface does not interact with water, anything attached to the surface, like dirt, will still interact with water and will be pulled away from the superhydrophobic surface. This means that these surfaces tend to be **self-cleaning**. The lotus leaf is well known to stay remarkably clean in its environment. Below is an image of dirt clinging to a bead of water on a lotus leaf.



https://s10.lite.msu.edu/res/msu/botonl/b_online/lotus/planta.htm

The Namib desert beetle (*Stenocera gracilipes*) has evolved a patterned superhydrophobic surface on its back that allows it to collect water from the desert air in the morning. The beetle spends the night under the sand so that when it climbs to the back of the dune in the morning, it is slightly cooler than its surroundings and water can collect on its back and be channeled to its mouth. The Namib desert is one of the driest places on earth, and this is the only water source this beetle has to survive.

The Namib desert beetle stands this way so the tiny drops of water will roll into its mouth as they form.

A proposed application for collecting water in dry environments using the Namib beetle's example

http://www.yankodesign.com/2010/07/05/beetle-juice-inspired/

Write inequality equations for different situations

- Room temp
- Hi/low temp
- Different fluids