# *Elastic instabilities yielding super-hydrophobic surfaces*

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The formation of wrinkles is a phenomenon which is found everywhere in nature. Let us consider, for example, wrinkles of the human skin. Basically, human skin is a bilayer with a rigid upper layer (epidermis) and an elastic foundation (dermis).

Various techniques were reported in the literature to reproduce this rigid layer and the most used consists in depositing, by thermal evaporation, a metal forming a homogeneous ultra-thin layer. Another technique much less expensive consists to exposed, under UV/Ozone radiation, the upper surface of an elastomer (Sylgard) in order to creating a micrometric layer of silica. We have used this last method in order to obtain wavelengths and amplitudes being able to vary from a few micrometers to a few millimetres. This irradiation was carried out mainly on elastomer films tended between two jaws in order to create an anisotropic stress field. When constraint is reduced, this led to the appearance of wrinkles perpendicular to the initial stretching. The wavelength and the amplitude are respectively functions of the upper layer thickness and initial lengthening. If the experiment is reiterated on the same substrate but in another direction (for example perpendicular to the first), a network can be created with regularly spaced points.

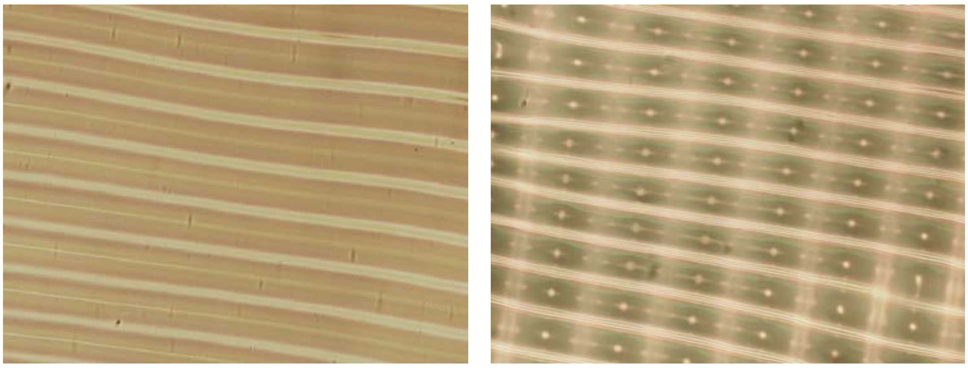

*Figure 1: Anisotropic instabilities after stretching according to Oy (left) then according to Ox (right).*

Initially, we characterized the adhesion of these surfaces with simple fluids such as water by studying the contact angle hysteresis and the slipperiness on the textured Sylgard.

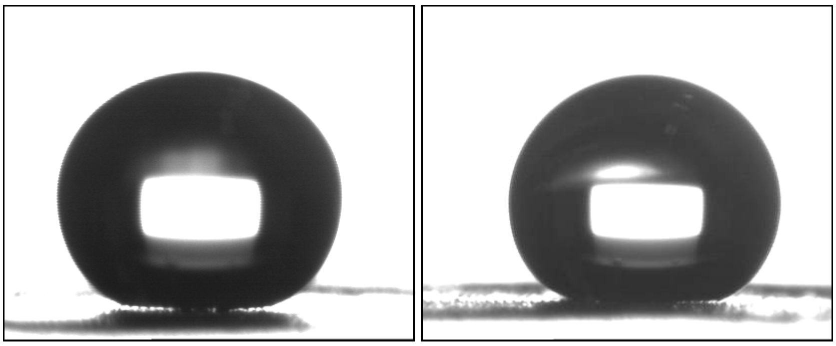

*Figure 2: Visualisation of Fakir and Wenzel states.*

For very high aspect ratio, i.e. for very large roughness, water drop does not penetrate inside the asperities of surface but remains in “levitation” on those. This state, so-called “Fakir” state (or Cassie state), is characterized by an adhesion much weaker than the same liquid in contact with the same surface without structure.
This is due, mainly, to a contact area between the liquid and the solid largely decreased. Without structure, the surface of Sylgard is naturally hydrophobic. The structures reinforce the surface properties which lead to a super-hydrophobic surface.

For low roughness, another state, so-called Wenzel state, take place where drops wet the asperities of the surface. In this case, it is observed that the adhesion of the liquid is more important than on smooth surface. Hysteresis is very important and the slipperiness is null because 90° inclination can be reached.