Fabrication of Super-Hydorphobic Surfaces via Two-Step Chemical Etching and Plasma Deposition Technique

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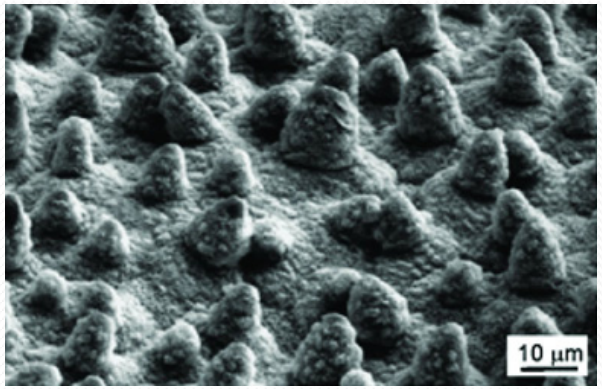
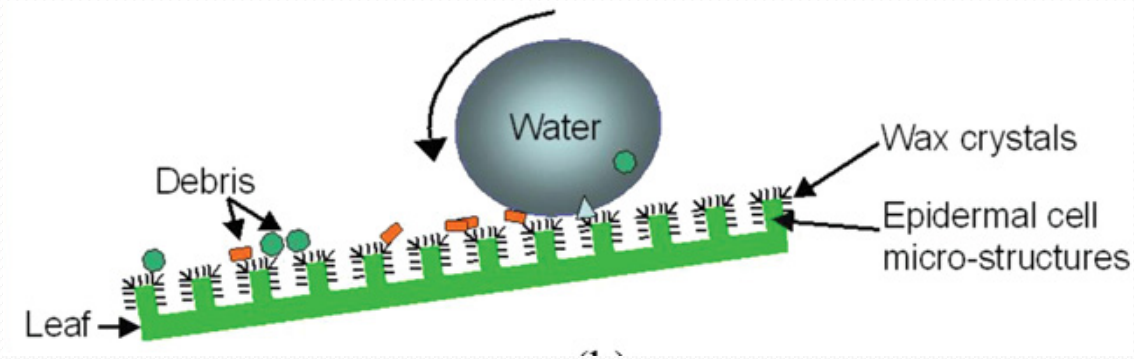
UFRJ, COPPE

Applications of Super Hydrophobic Surfaces(SHS)

1-Lotus leaf





1-Superhydrophobic surfaces: From the lotus leaf to the submarine, C. R. Mecanique 340 (2012) 18–34

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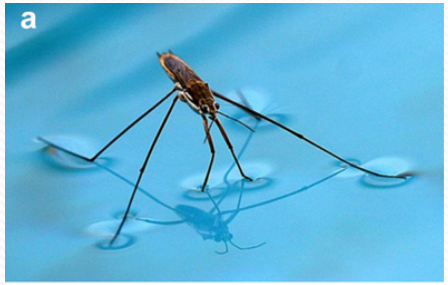
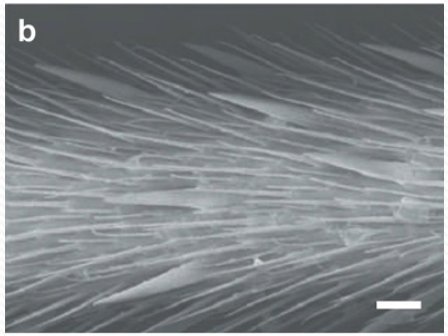
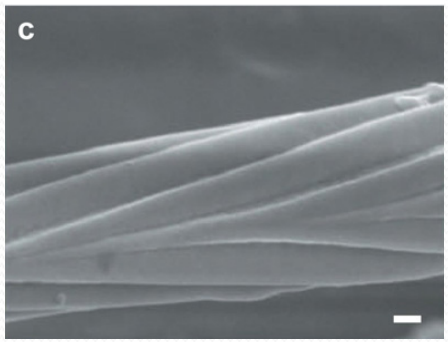
2-Insects walking on water







1-Superhydrophobic surfaces: From the lotus leaf to the submarine, C. R. Mecanique 340 (2012) 18–34
2-Wetting and Roughness, Annu. Rev. Mater. Res. 2008. 38:71–99

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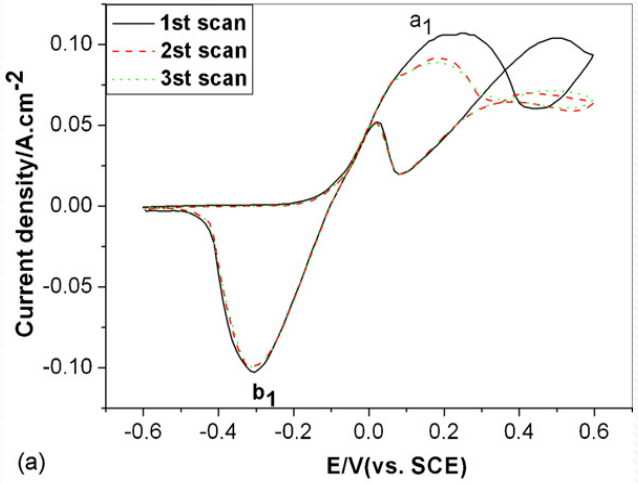
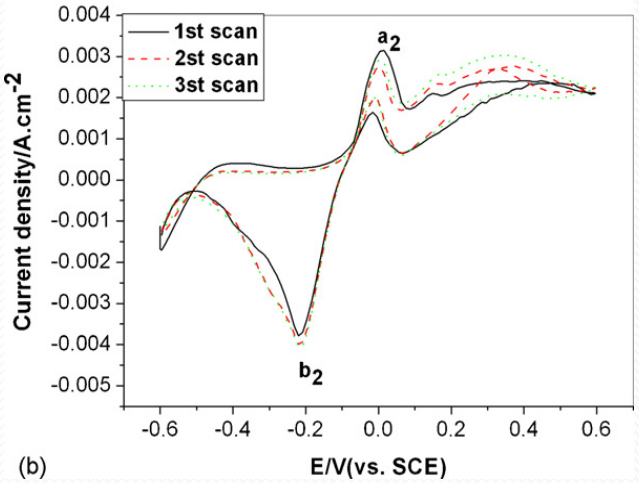
3-Corrosion resistant surfaces



Plane metallic surface



Applied super-hydrophobic surface

3-Super-hydrophobic surfaces improve corrosion resistance of copper in seawater, Electrochimica Acta 52 (2007) 3709–3713

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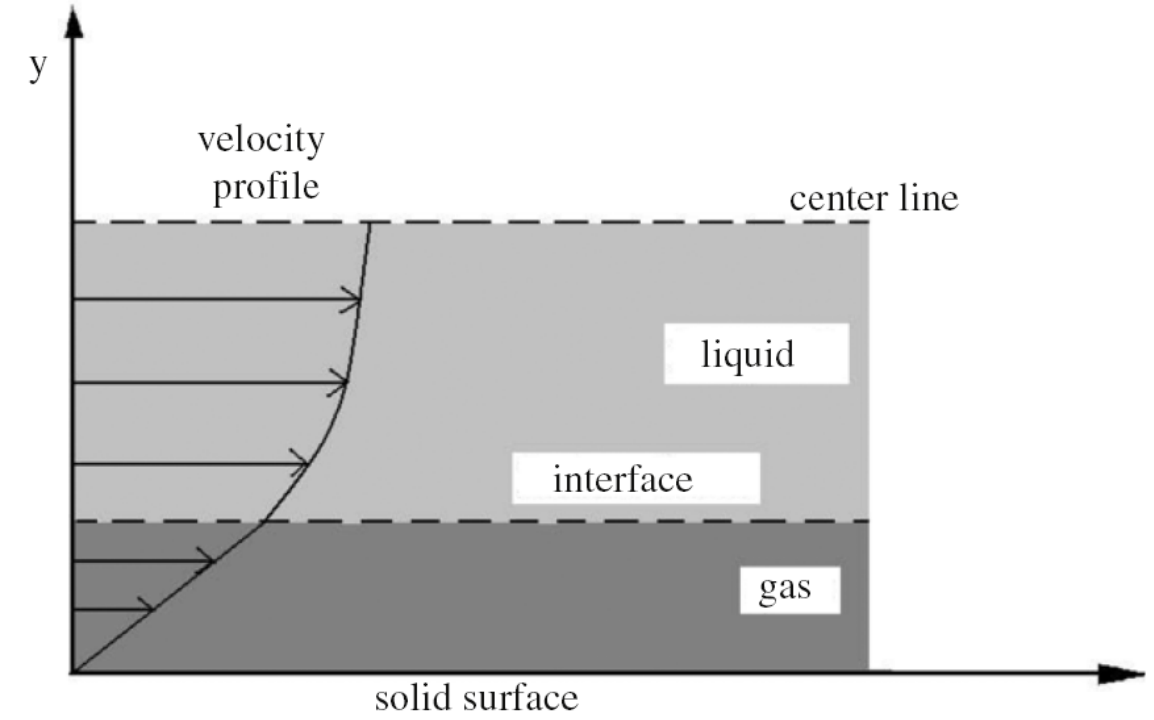
4- Fluid mechanics



The theoretical model for an ideal superhydrophobic surface.

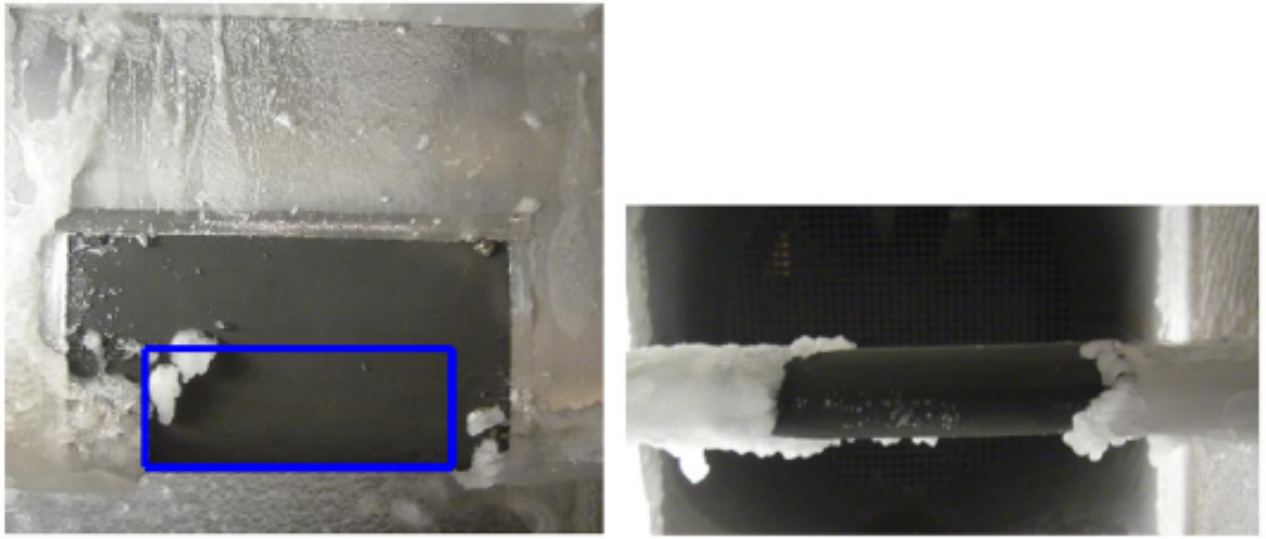
Some Examples:

- **Piplines**
- **Microfluidics**
- **Sea transportation**

4-Numerical investigation on drag reduction with superhydrophobic surfaces by lattice-Boltzmann method , Computers and Mathematics with Applications 61 (2011) 3678–3689

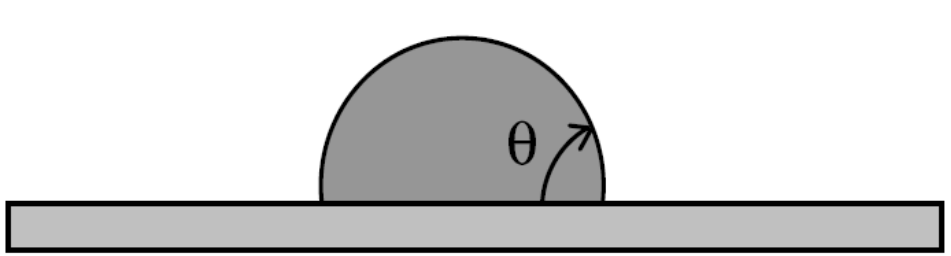
Applications of Super Hydrophobic Surfaces(SHS)

5- Ice-phobicity

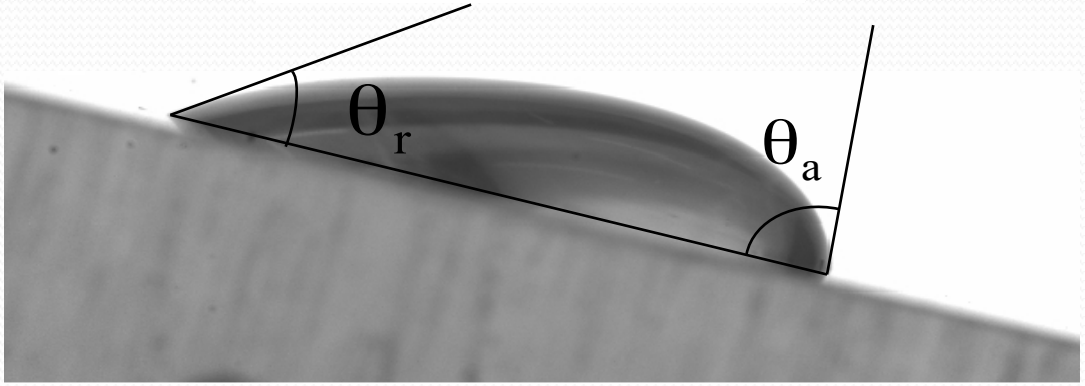


5- Understanding the effect of superhydrophobic coatings on energy reduction in anti-icing systems, Cold Regions Science and Technology 67 (2011) 58–67.

Theory of contact angle and hysteresis angle (dynamic contact angle)



$$\cos\theta = \frac{\gamma_{SV} - \gamma_{SL}}{\gamma}$$



θ_a= Advancing angle, θ_r= Receding angle

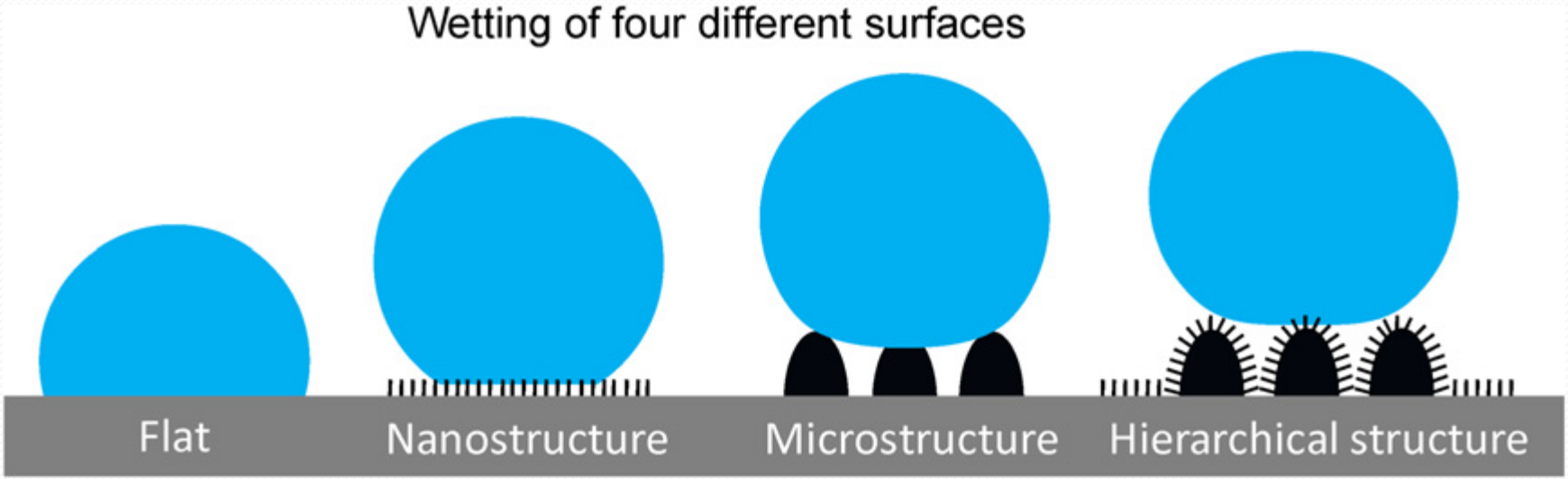
6-Non-sticking drops, Rep. Prog. Phys. 68 (2005) 2495–2532

Hydrophobic surfaces (surface energy aspects)

Highly hydrophobic surfaces made of low surface energy (e.g. fluorinated) materials may have water contact angles as high as ~120°

Wikipedia.org

Super hydrophobic surfaces

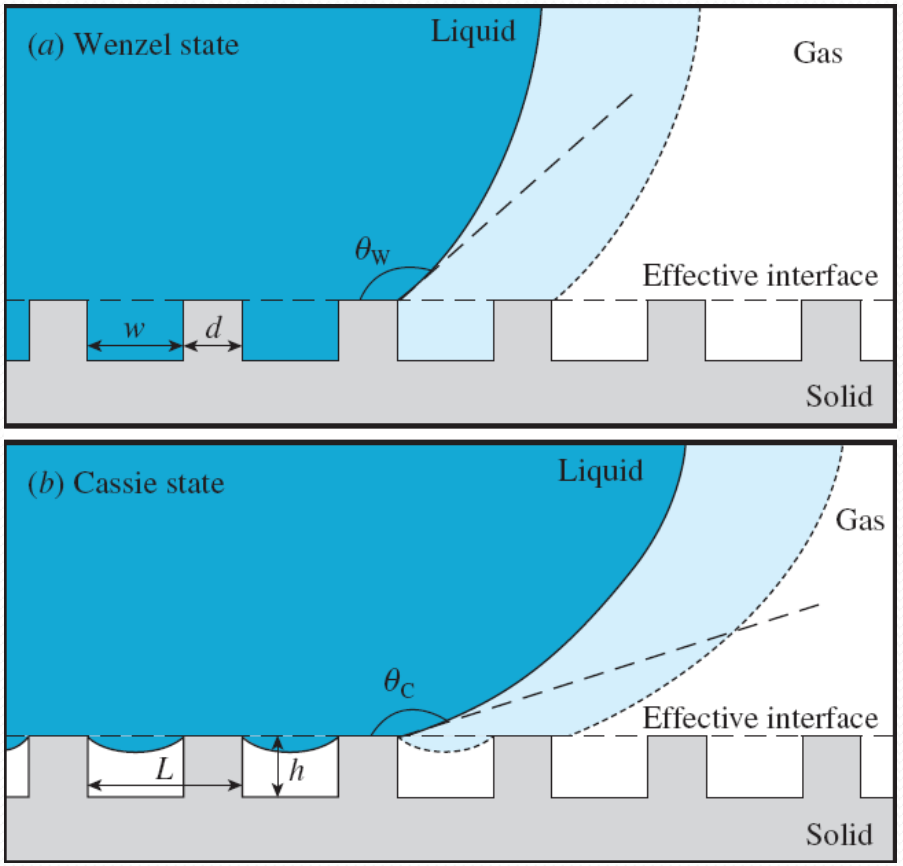


7- Natural and biomimetic artificial surfaces for superhydrophobicity, self-cleaning, low adhesion, and drag reduction Progress in Materials Science 56 (2011) 1–108

Modeling (effective contact angle)

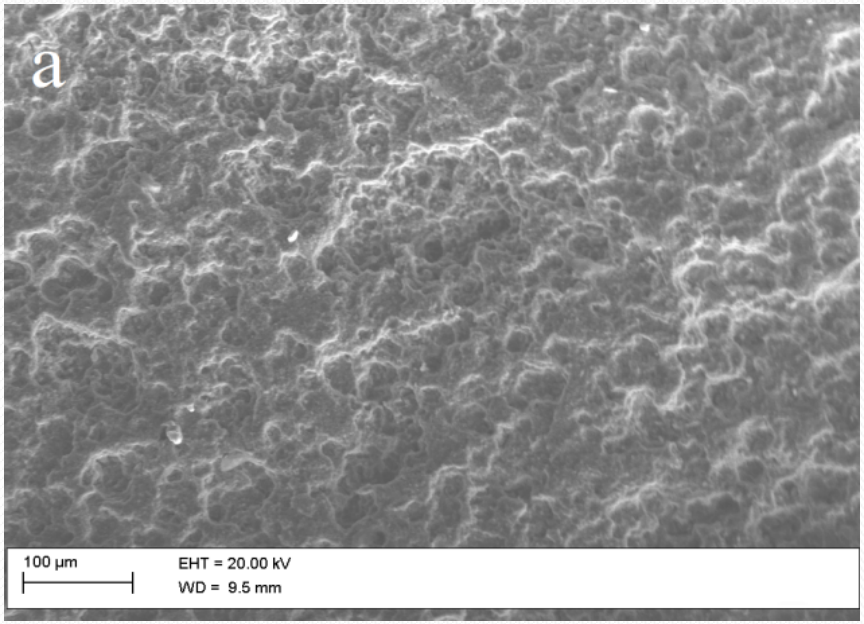
$$\cos\theta_W = r\cos\theta$$

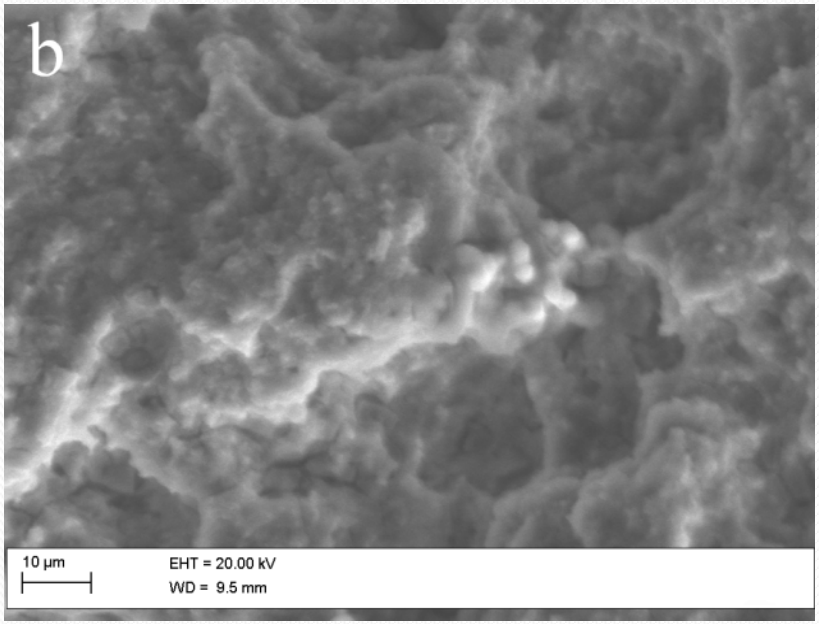
$$\cos\theta_C = \varphi_S - 1 + \varphi_S\cos\theta$$



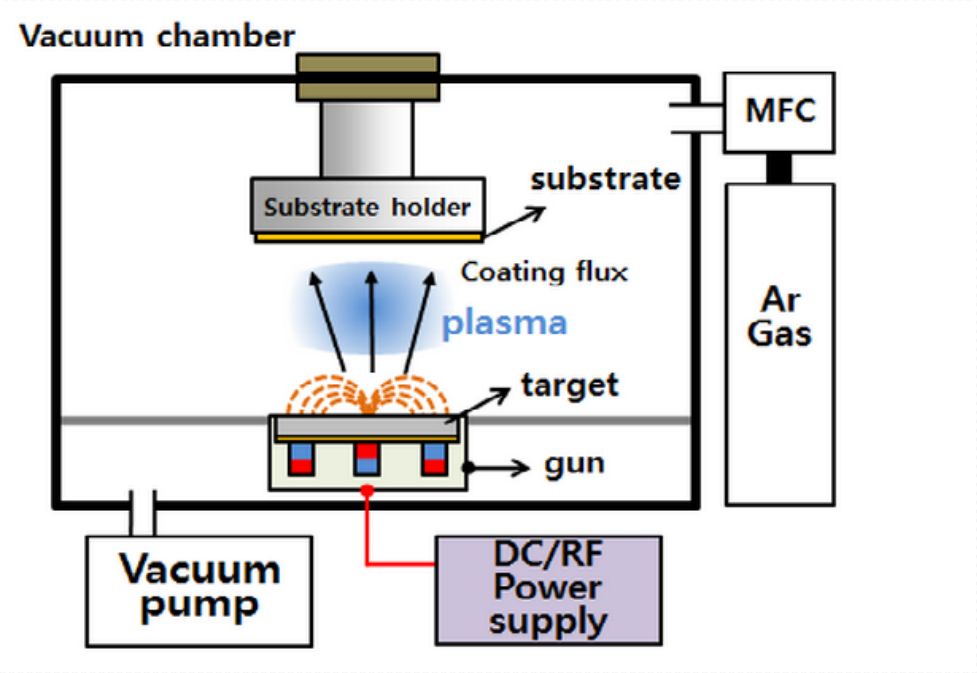
8- Superhydrophobic textures for microfluidics, Focus Article, *Mendeleev Commun., 2012, 22, 229–236*

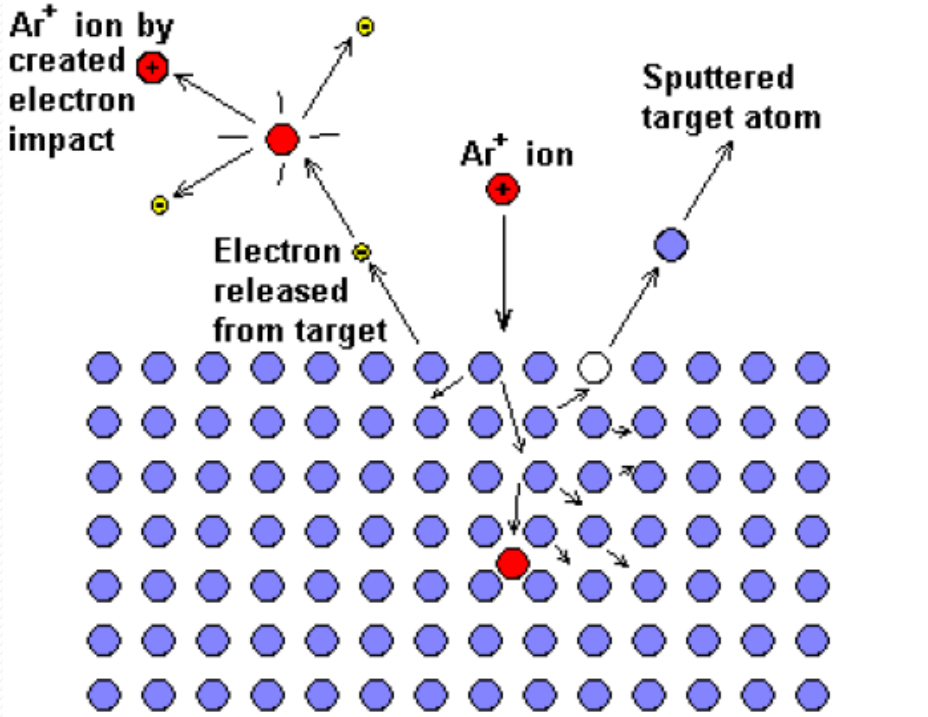
Chemical Etching of Substrate



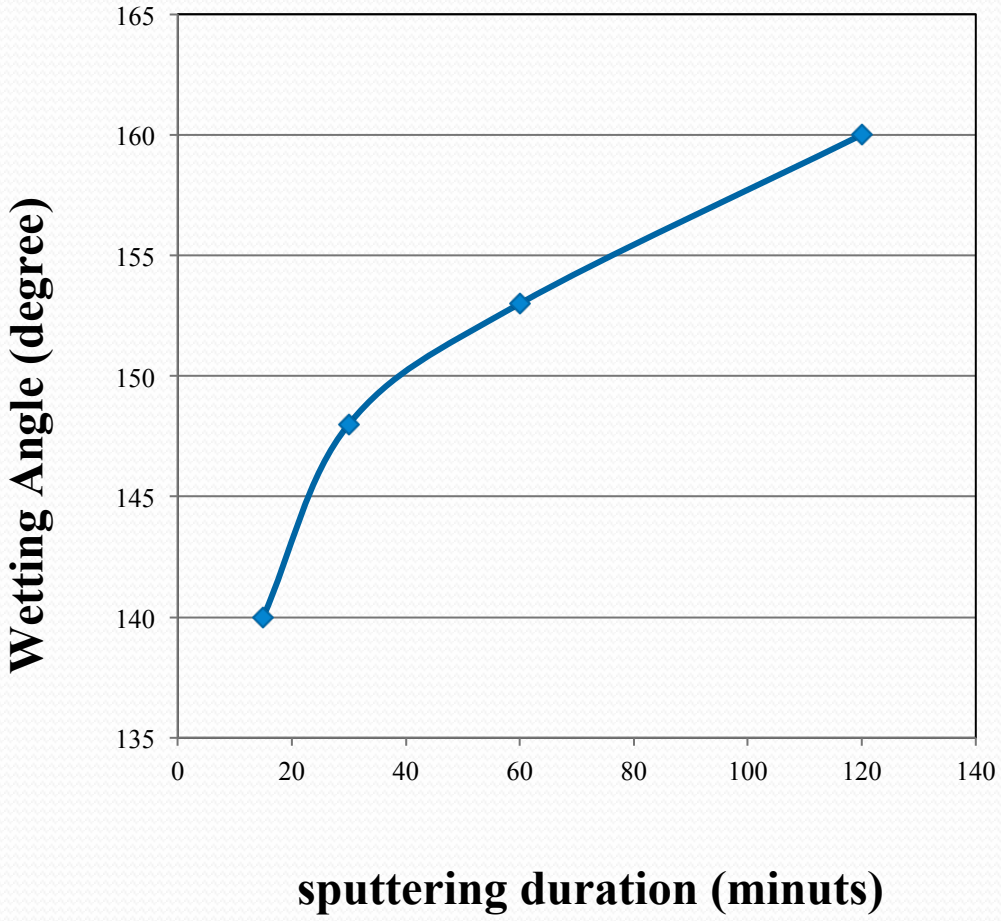


Radio Frequency Plasma Sputtering

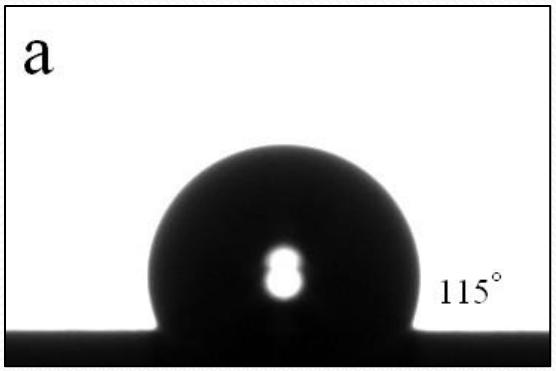


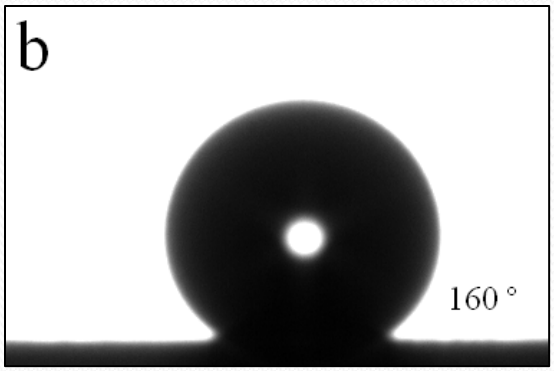


Deposition Time and Its Effect on Contact Angle



Roughness Effect:





Conclusions:

- Thin films of PTFE were deposited successfully

- The roughness effect on wettability was investigated and approved that it can dramatically increase C.A up to 30%.

- As fabricated samples showed complete super-hydrophbicity

- Some characteristics such as durability of specific propeorties and ice-phobicity of them should be studied in more details.

- There are other roughening techniques also other hydrophobic materials than PTFE. Much more studies are needed to find an optimized combination.