Transparent nanostructured coatings with UV-shielding and superhydrophobicity properties

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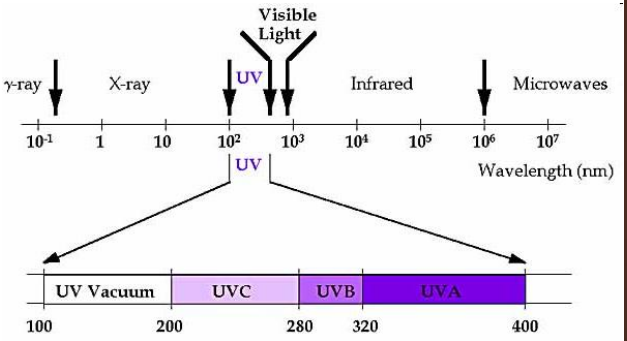

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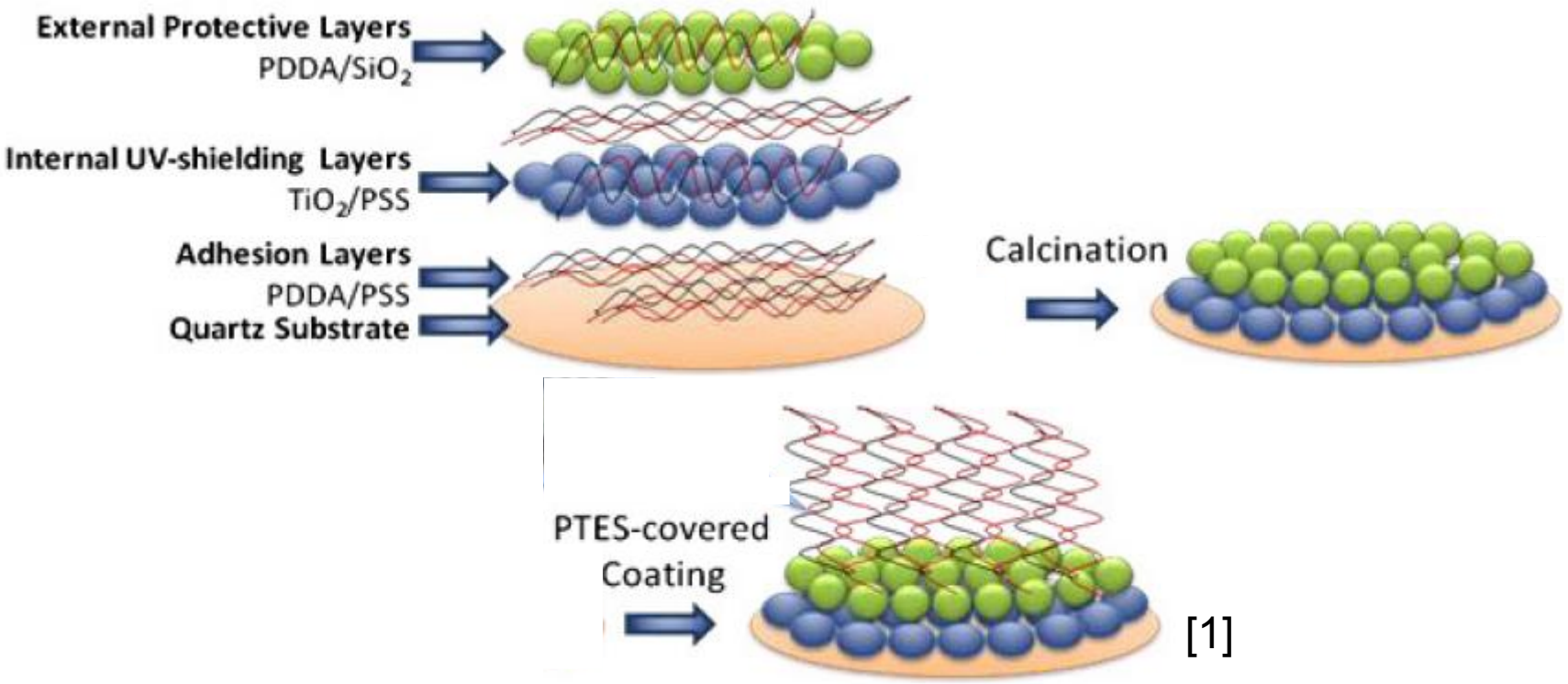
Structure of the presentation

- Introduction
- Layer-by-layer depositon
- Superhydrophobicity
- UV-shielding properties
- Stability of the system
- Results from a related work

general concept:

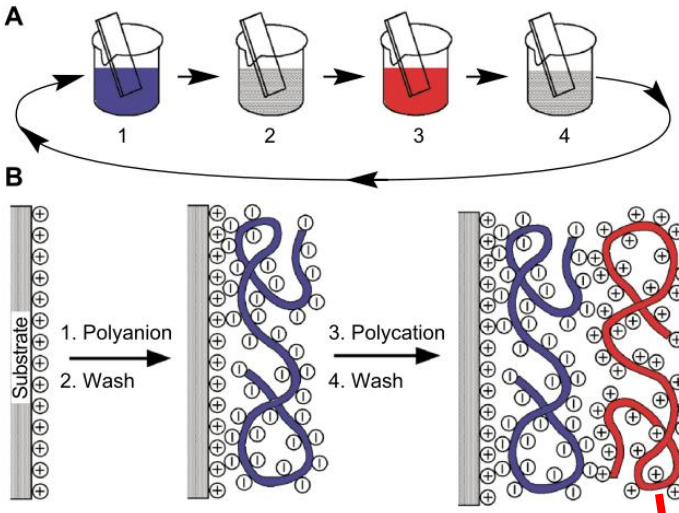
- use of multi-layers
- all layers have to satisfy the condition of transparency with respect to visible light
- TiO_2 used as UV absorbing material
- fluorinated polymer used to establish superhydrophobicity



[1]

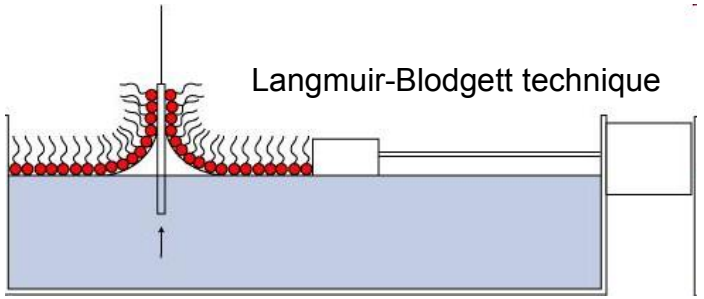
[1] Taoye Wang, Tayirjan T. Isimjan, Jianfeng Chen and Sohrab Rohani, *Nanotechnology* **2011**, *22*, 265708
[2] A. Nakajima, K. Hashimoto and T. Watanabe* *Langmuir* **2000**, *16*, 7044

Layer-by-Layer deposition



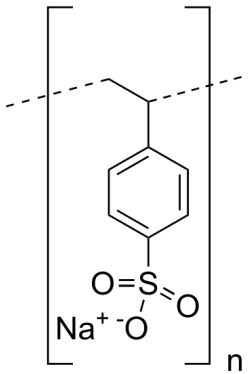
[1]

PSS: poly(sodium 4-styrenesulfonate)
PDDA: poly(diallyldimethylammonium)

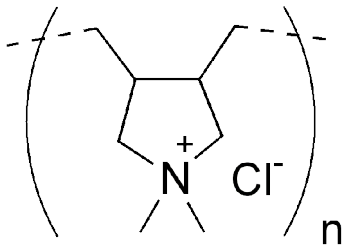


+ charged TiO_2(aq) at pH 3.0

- charged SiO_2(aq) at pH 8.0



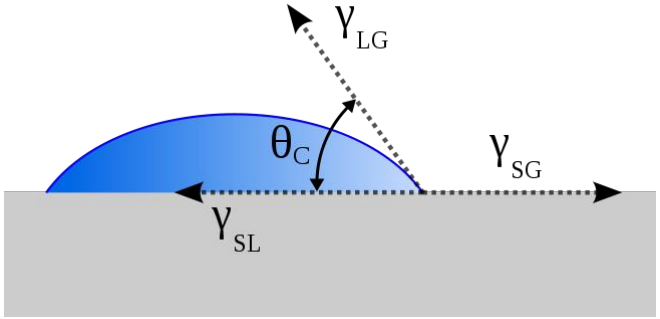
PSS

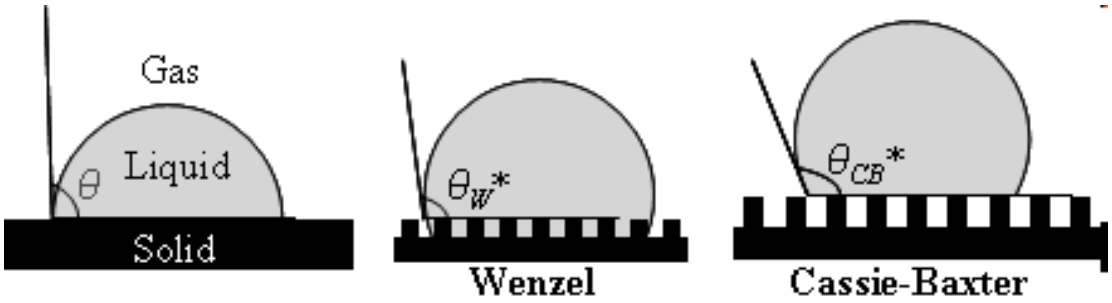


PDDA

[1] G. Decher, *Science* **1997**, *277*, 1232
[2] K. Schulze and S. Kirstein, *Applied Surface Science* **2005**, *246*, 415

Superhydrophobicity





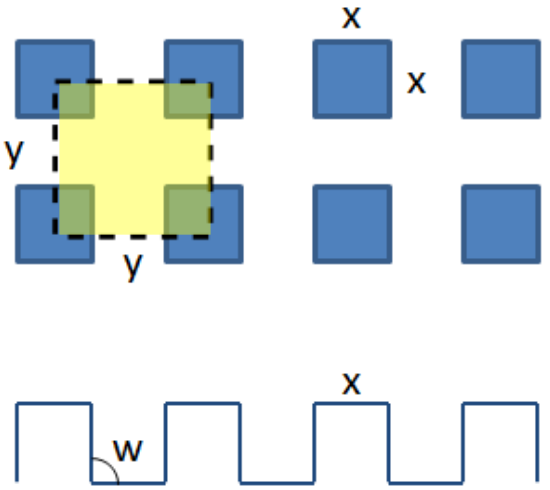
Thomas-Young equation:

$$\gamma_{SG} = \gamma_{SL} + \gamma_{LG}\cos(\theta_C)$$

$$\cos(\theta_{CB}) = \Phi(\cos(\theta)+1)-1$$

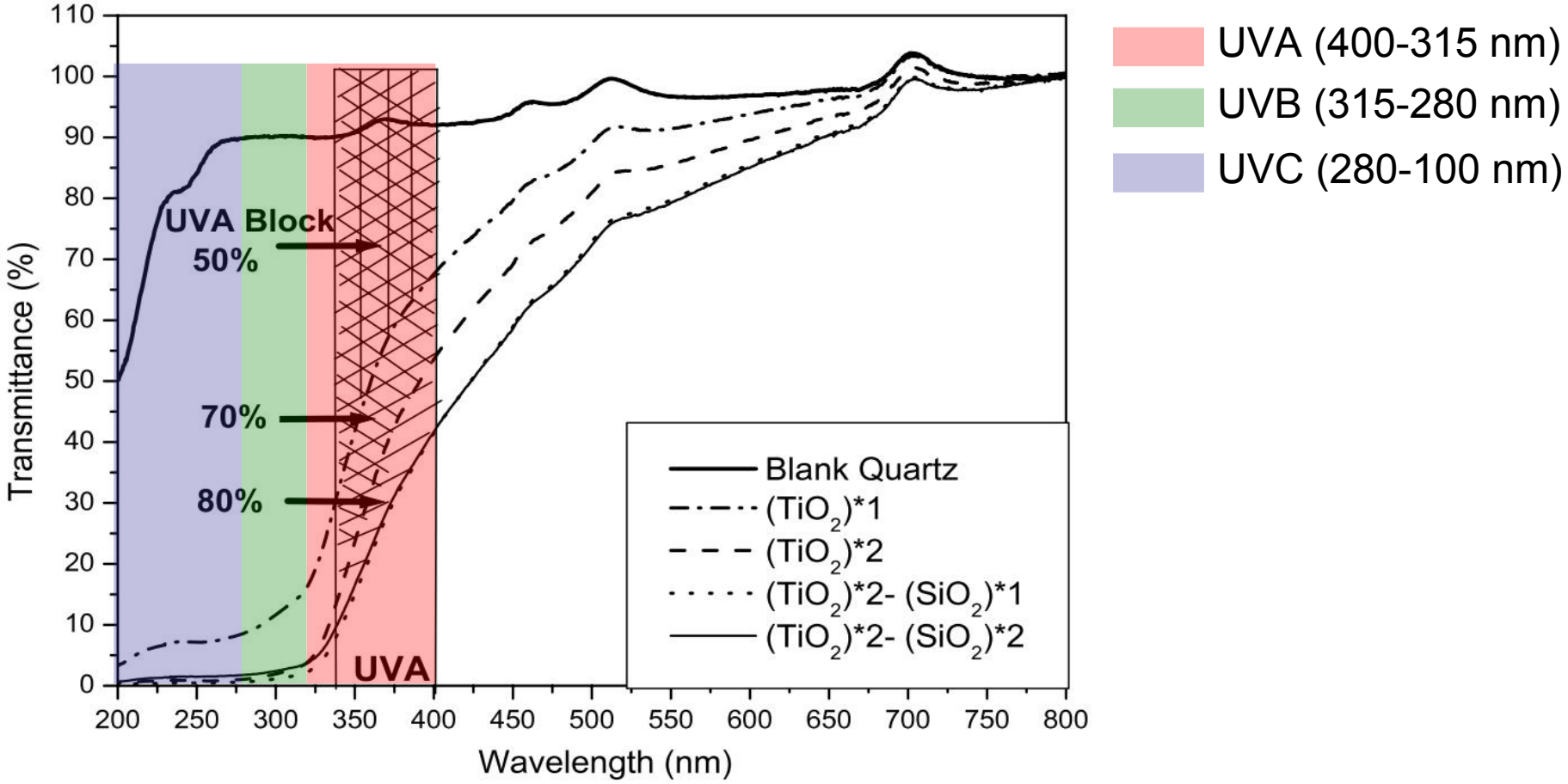
Leaf of the *Lotus-flower*

$$\Phi = \frac{A}{A_0}$$



[1] http://en.wikipedia.org/wiki/Superhydrophobe (21.11.2011)
[2] Taoye Wang, Tayirjan T. Isimjan, Jianfeng Chen and Sohrab Rohani, *Nanotechnology* **2011**, *22*, 265708
[3] A. Nakajima, K. Hashimoto and T. Watanabe* *Langmuir* **2000**, *16*, 7044

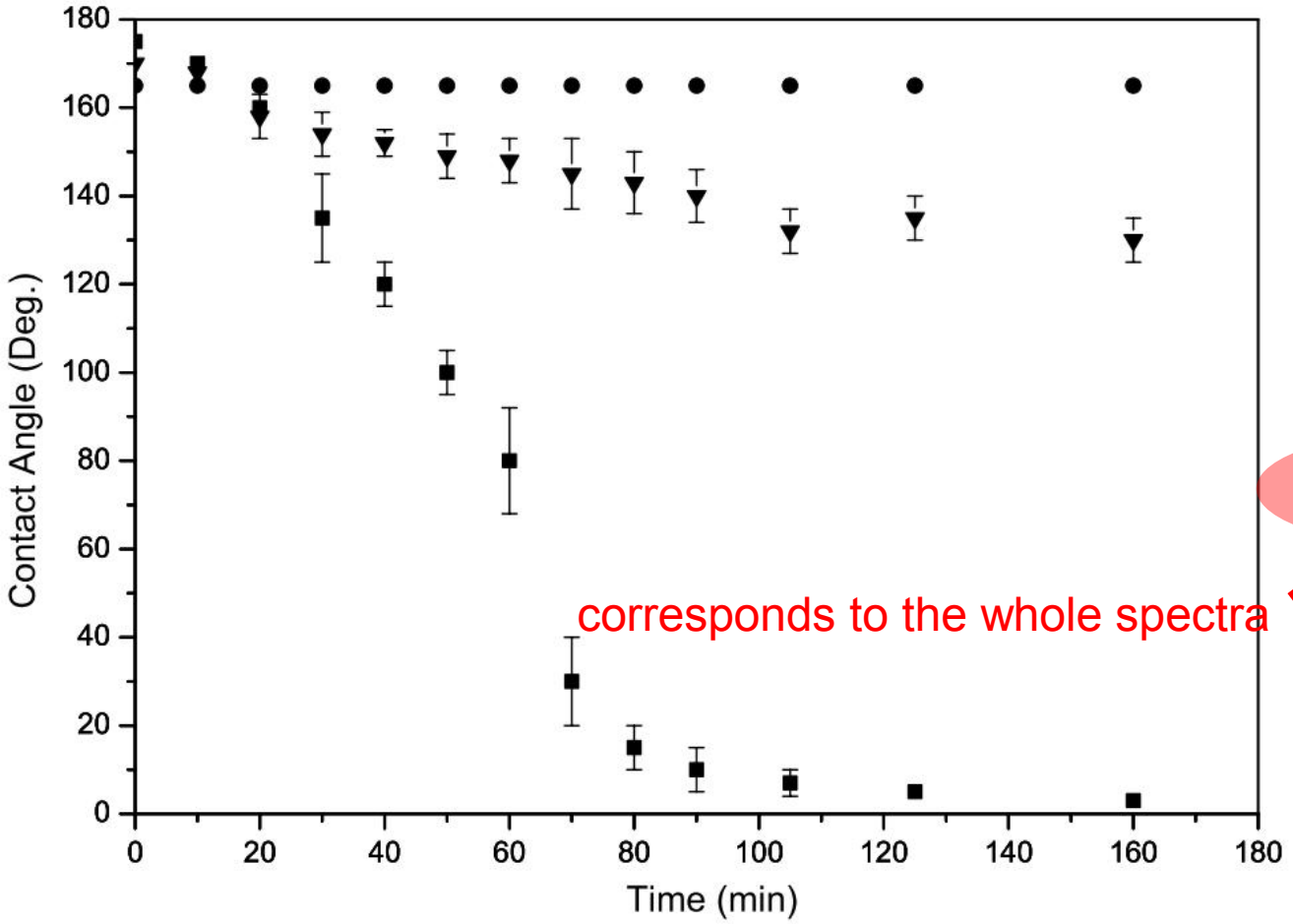
UV-shielding properties



Transmittance spectra after layer-by-layer deposition on the quarz substrate

Stability of the system

● = (TiO_2)*2-(SiO_2)*2 ▼ = (TiO_2)*2-SiO_2 ■ = (TiO_2)*2



UV source (275 nm) with an energy of 75 mW/cm²

corresponds to the whole spectra

Stability of the system

Solar constant outside the atmosphere:

$$W_{space} \approx 1413 W / m^2$$

averaged energy per m² on earth:

$$\frac{\pi * r^2}{4 * \pi * r^2} * W_{space} = W_{earth} = 342 W / m^2$$

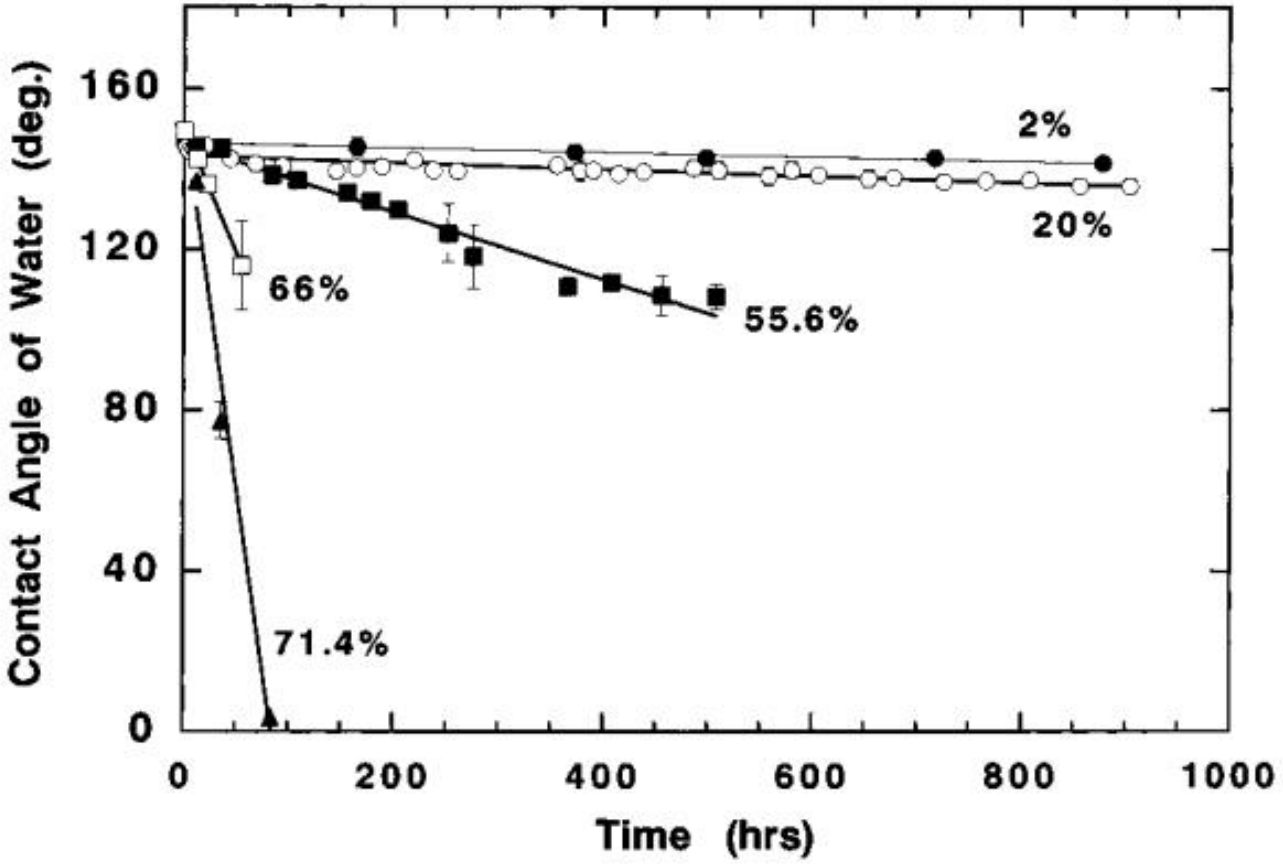
averaged energy per m² arriving on earth:

$$W_{earth\_surface} \approx 200 W / m^2 = 20 mW / cm^2$$

corresponds to the whole spectra

Imputs from a related paper

UV source
with an energy of
1.7 mW/cm^2



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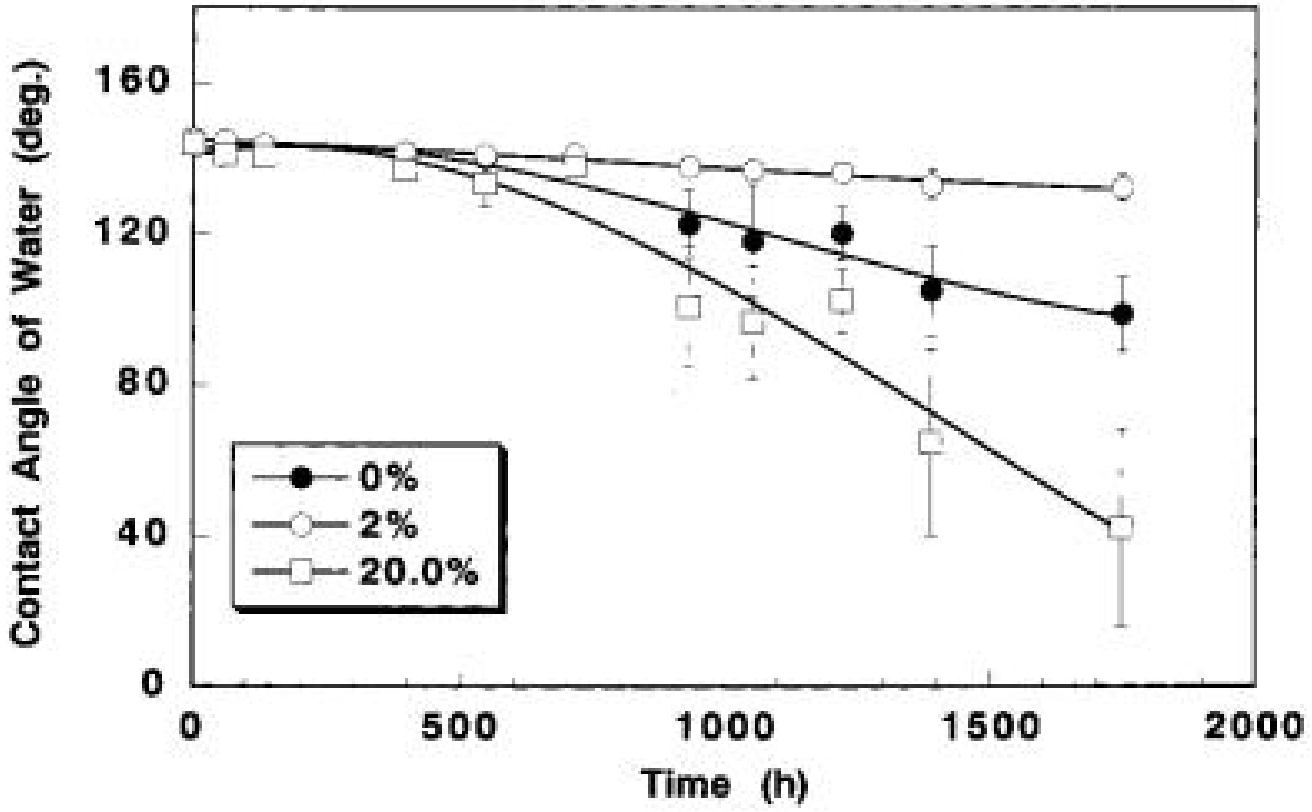

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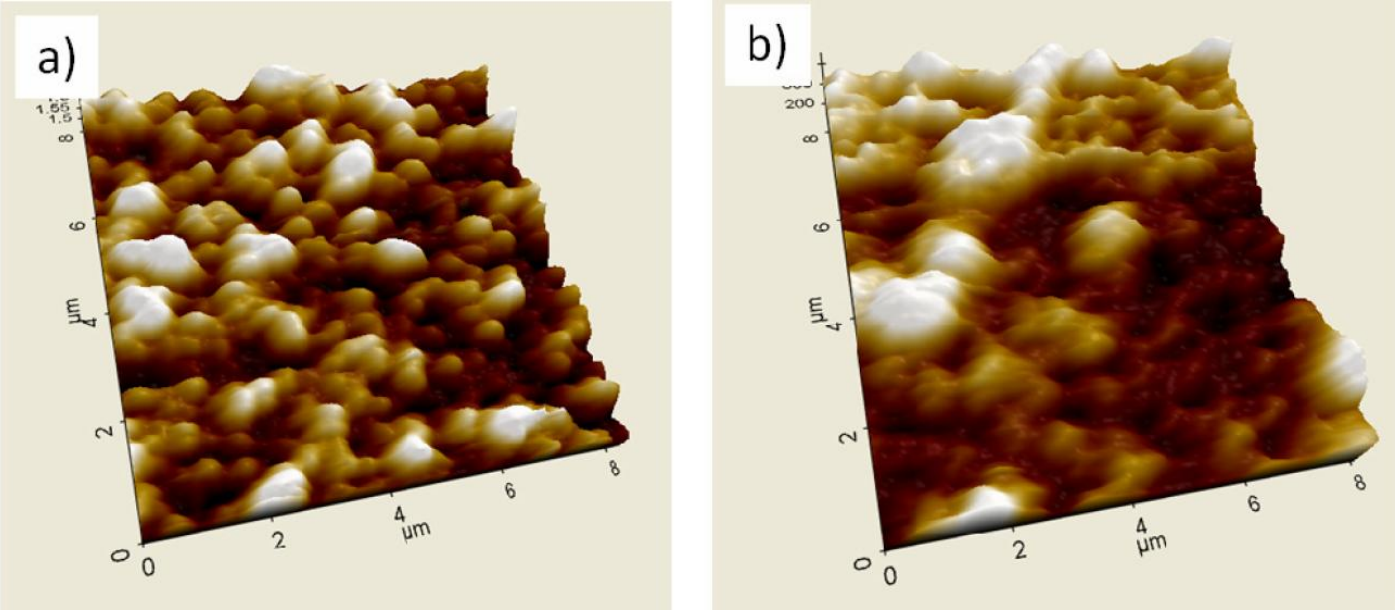
Questions?!

Thank‘s for your attention!



AFM image of a) TiO_2*2 and b) TiO_2*2 - SiO_2*2

Films	(TiO_2)*2	(TiO_2)*2-(SiO_2)*1	(TiO_2)*2-(SiO_2)*2
Water Contact Angles (°)	175	170	165
Water Slide Angles(°)	<1	<1	<2

Water contact angles of nanoparticles deposited surface