Deutsches Elektronen-Synchrotron

Contact Angle measurements on thin films

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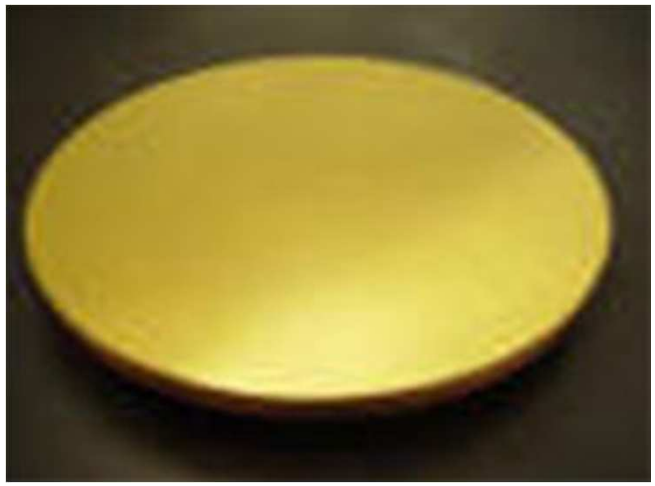
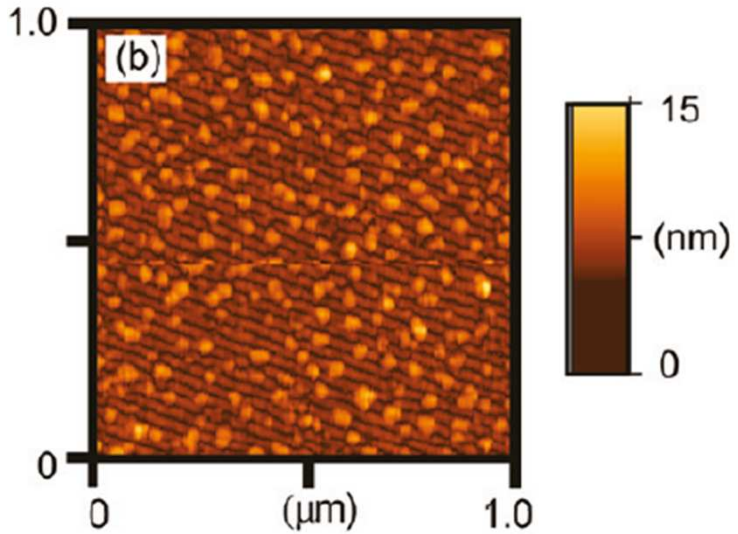
Outline

- Nanoparticle metal-polymer composite thin films
- Contact angle machine
- Temporal evolution of CA after acid cleaning
- Plasma cleaning
- CA measurements on different functional groups
- CA mapping
- Conclusions

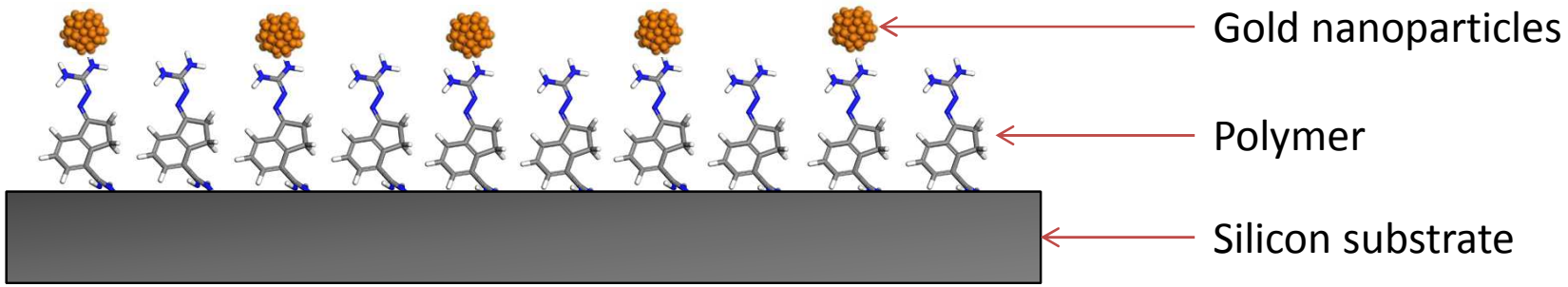
Nanoparticle metal-polymer composite thin films



Naked Eye Image

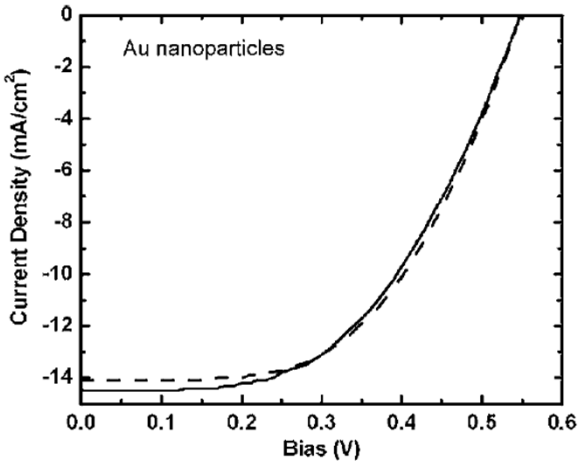


AFM Image



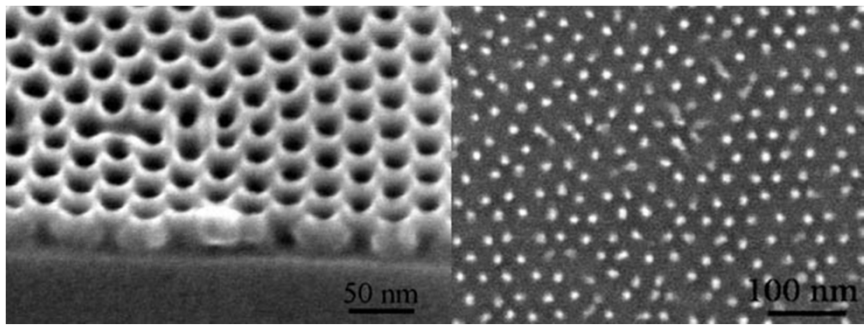
Applications

Efficiency improvement in photovoltaic cells



Matheu et al., Appl. Phys. Lett. 93, 113108 (2008)

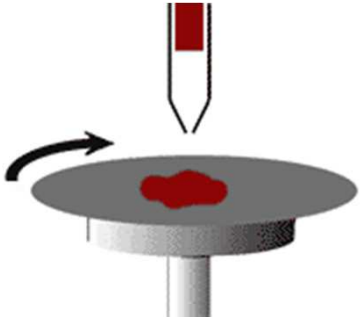
Increasing of data storage capabilities



Films Preparation

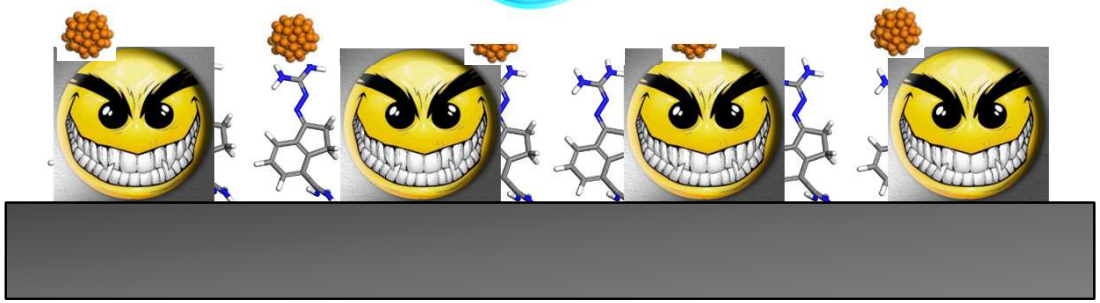
1) Acid Cleaning

2) Polymer deposition through spin-coating



3) Gold nanoparticles in a

osited on the sample

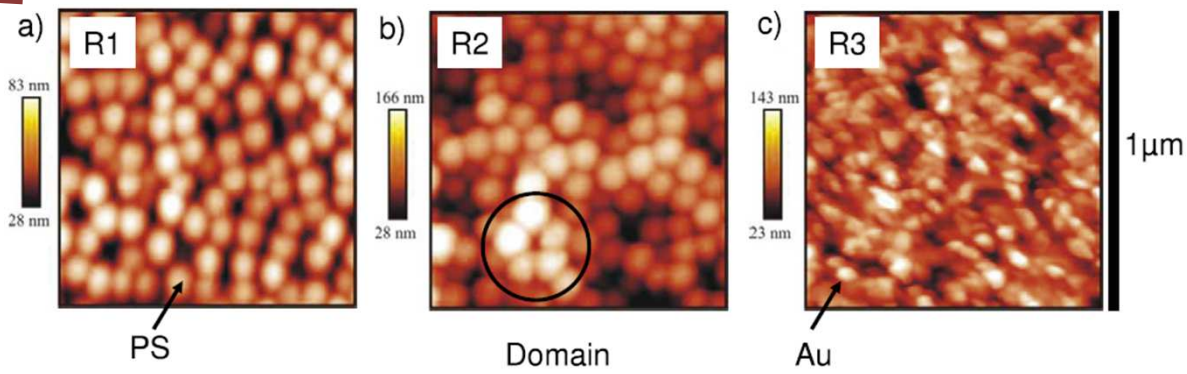


Quality Control - AFM

- High resolution: Till a few atomic distances

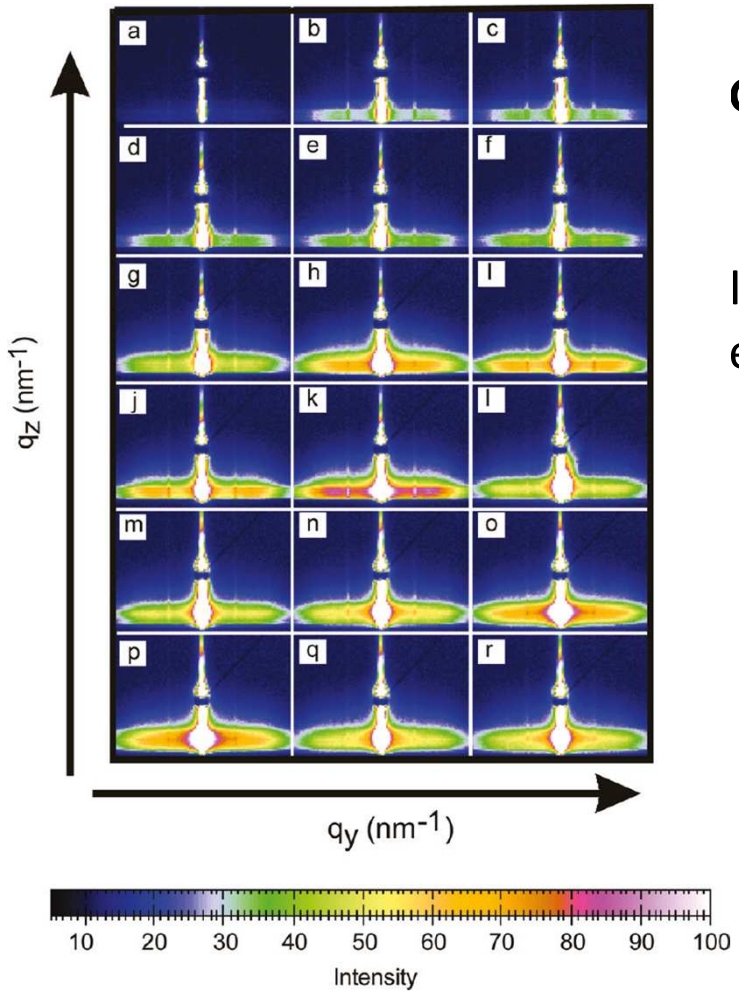
BUT

- Ex-Situ measurement: No possibility to follow the evolution of Gold clusters on the polymer



S V Roth et al., J. Phys.: Condens. Matter **23** (2011) 254208

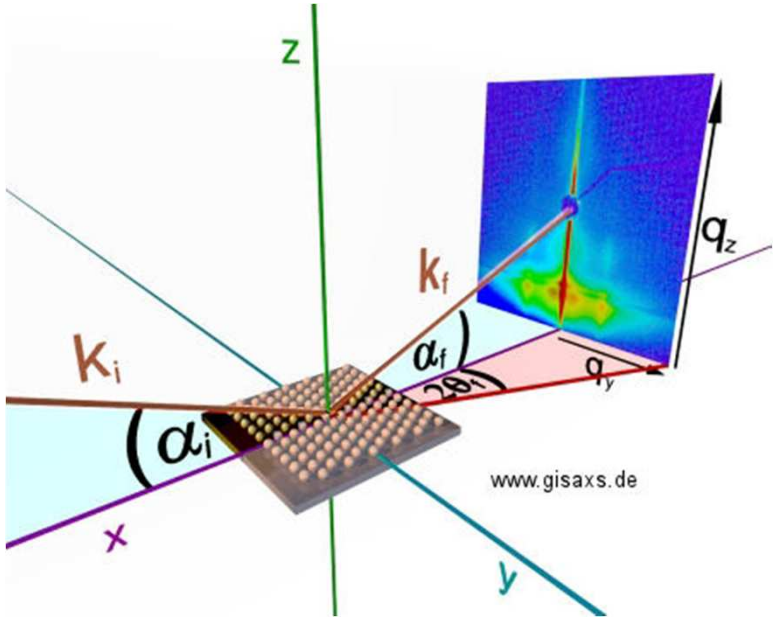
Quality Control - GISAXS



Metwalli et al., Langmuir 2009, 25(19), 11815–11821

Grazing-Incidence Small-Angle X-Ray Scattering

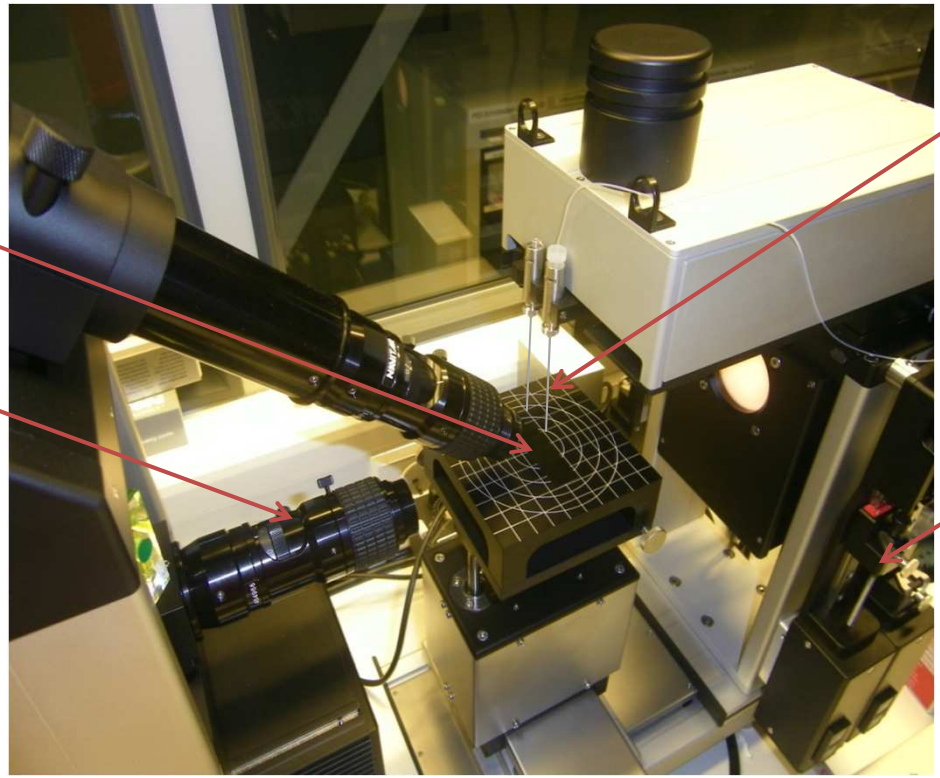
In-Situ measurement: Possibility to follow the evolution of Gold clusters on the polymer



Contact Angle machine

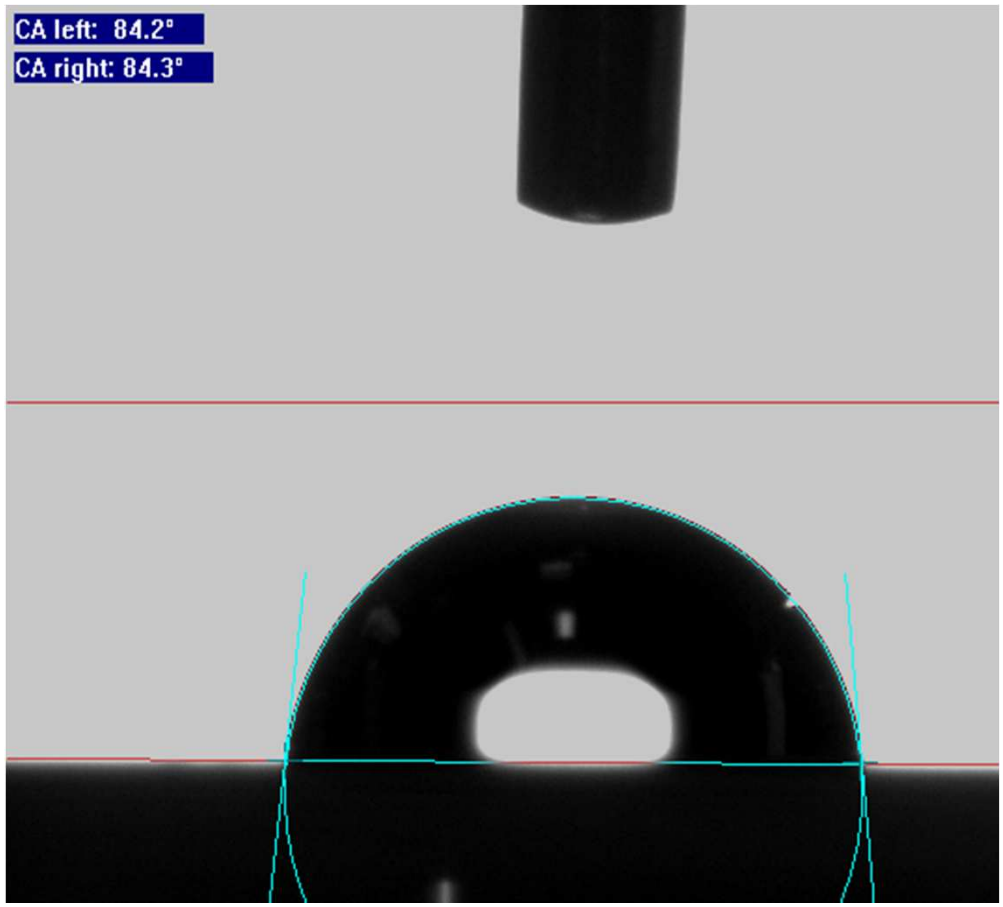
Necessity to control acid cleaning and polymer deposition quality

Contact Angle Measurement



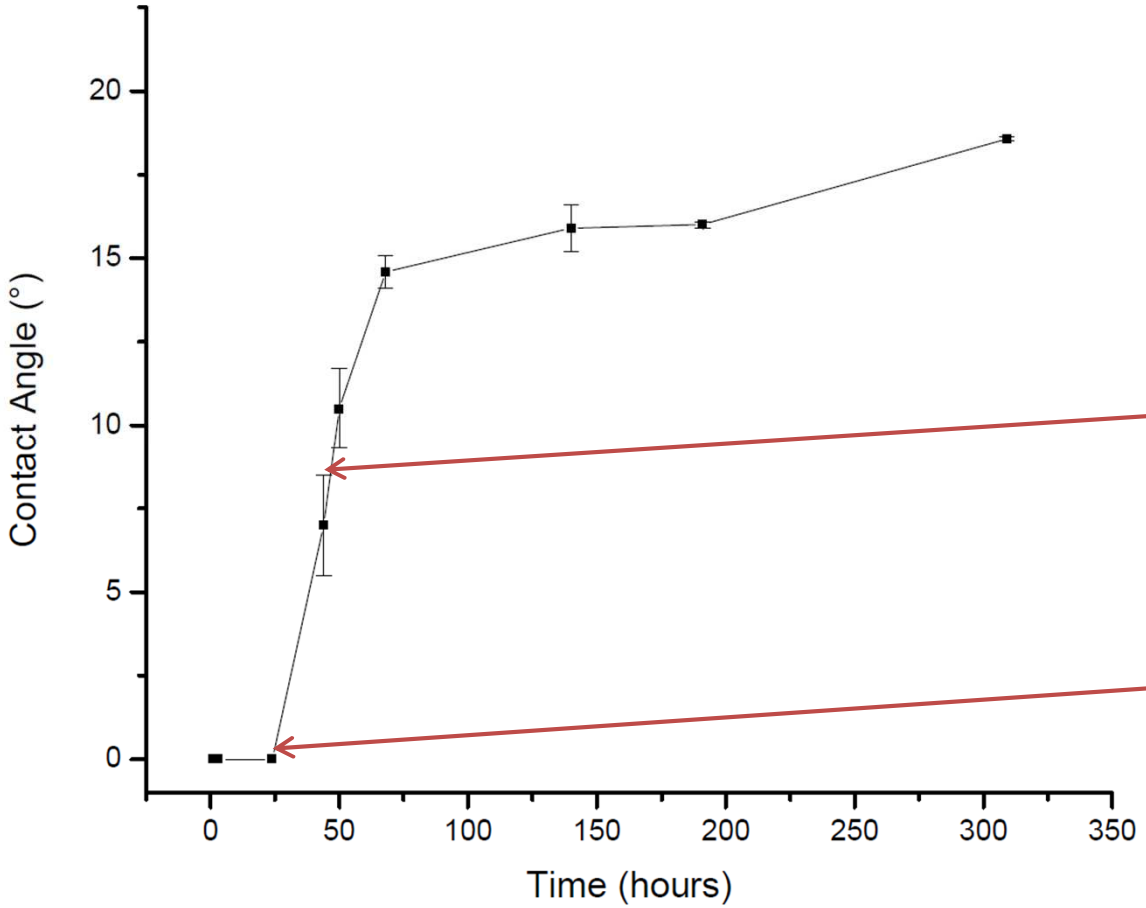
What is a Contact Angle?

- Angle measured at the solid/vapour/liquid interface
- Linked to surface energy
- **Strongly dependent on the surface arrangement**



Temporal evolution of CA after acid cleaning

Acid Cleaned Silicon sample, kept in **low pressure and humidity conditions**

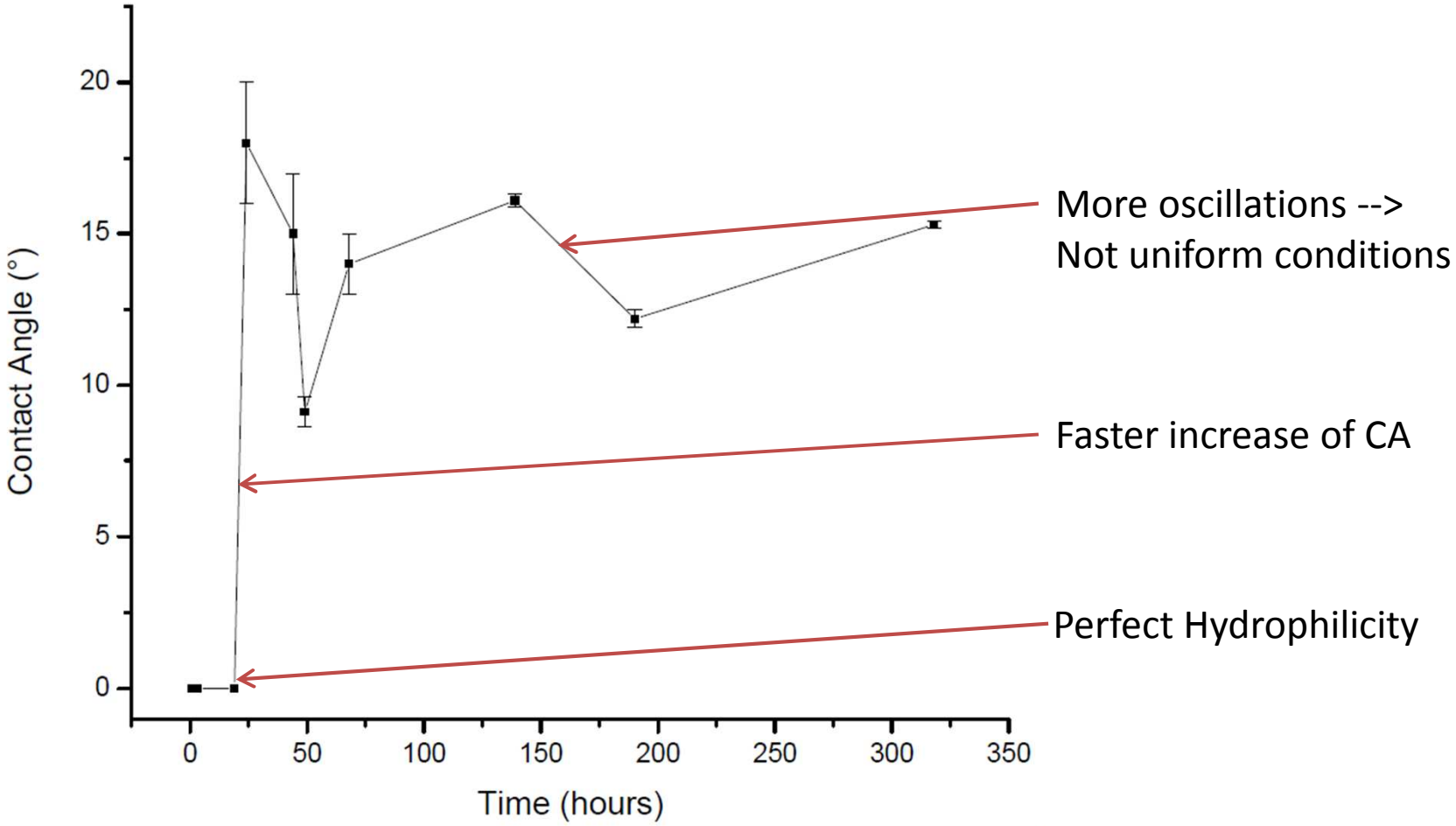


Quick Increasing of CA due to oxydation

Perfect Hydrophilicity

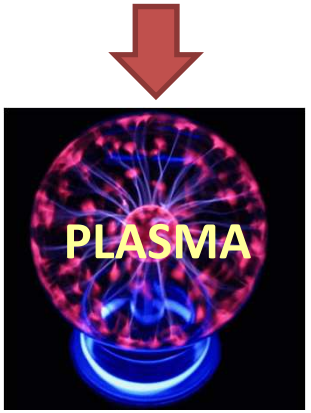
Temporal evolution of CA after acid cleaning

Acid Cleaned Silicon sample, kept in **<u>room conditions</u>**

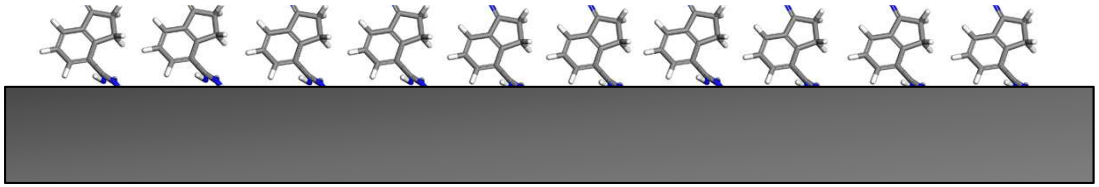


Plasma Cleaning

Oxygen at low pressure is ionized

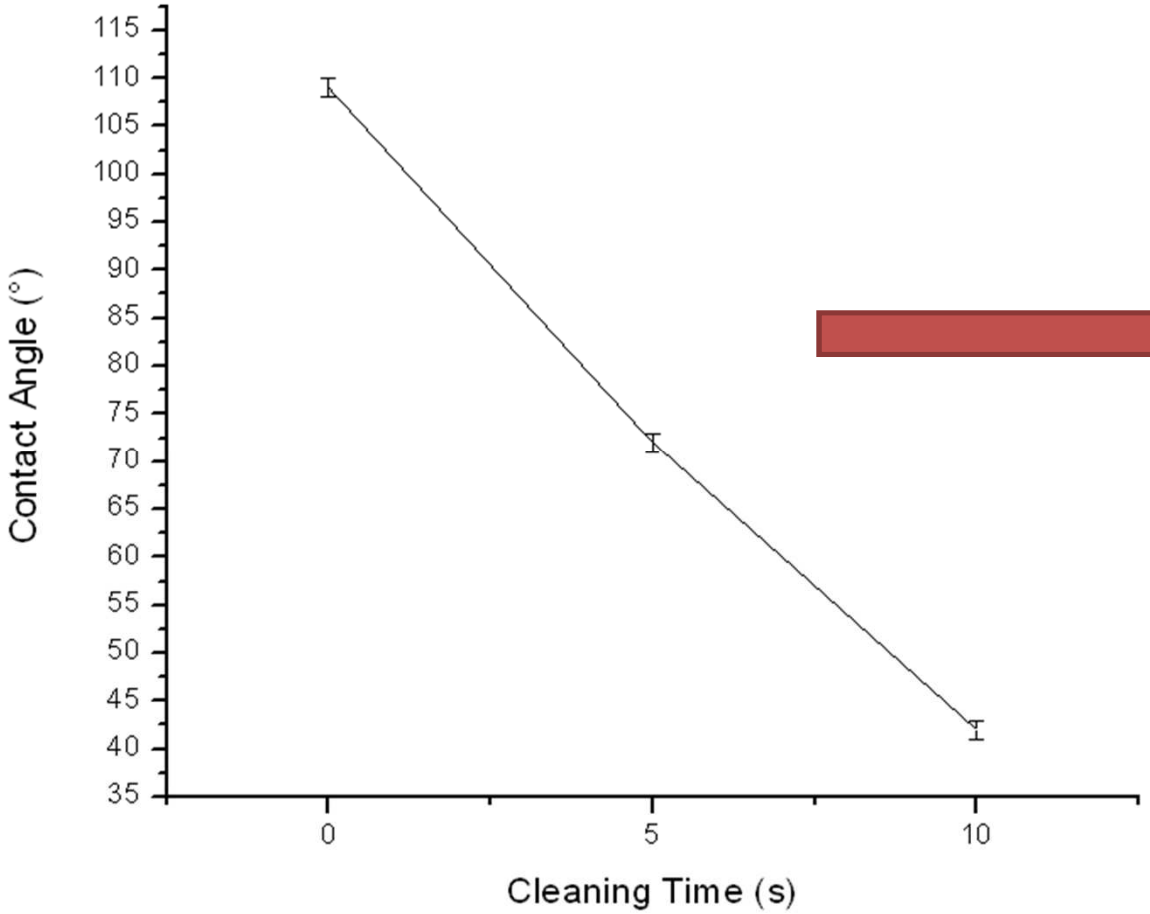


Very effective in the breaking of most organic bonds



Plasma Cleaning

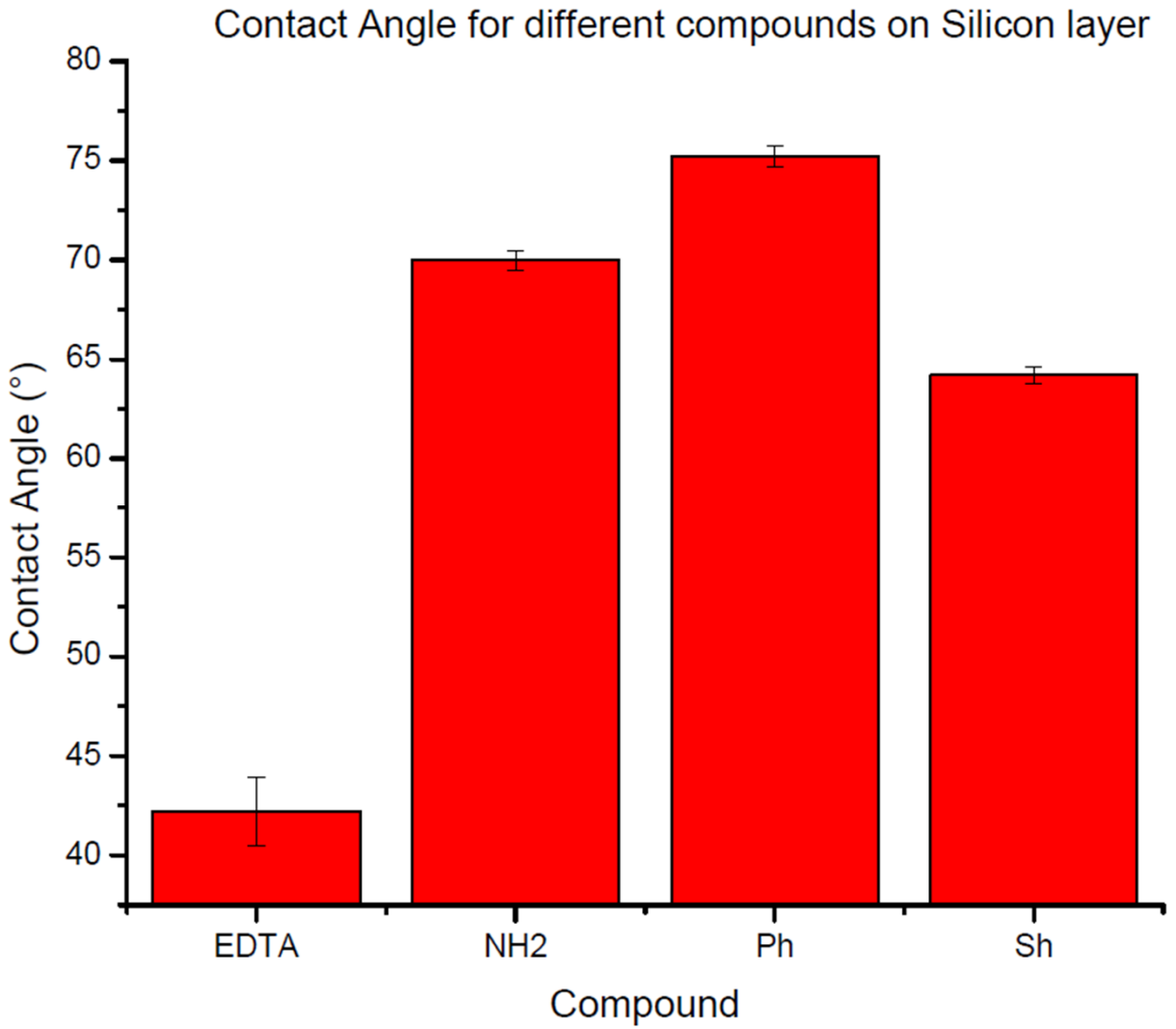
Siloxane on Silicon substrate, Plasma cleaning at the lower intensity



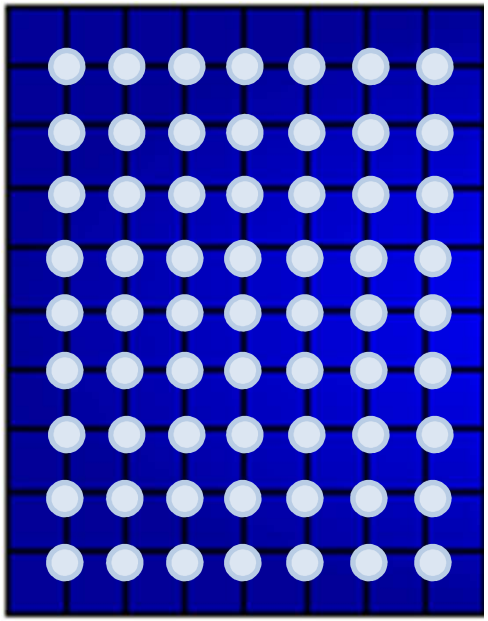
Decreasing of CA

(- 6,7 ± 0,4) °/s

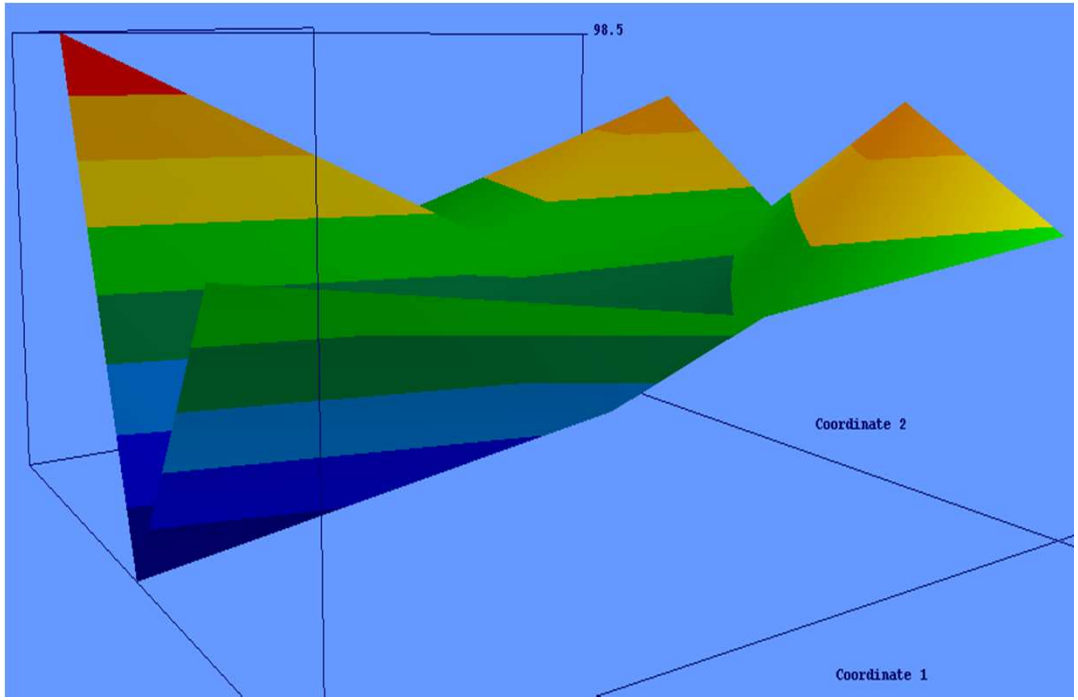
CA Measurements on different Functional Groups



CA Mapping



- To obtain a measure of the sample uniformity
- To increase the statistics, reducing the error
- To obtain a “roughness” profile of the surface



Conclusions

- There is not a clear difference in hydrophilicity between samples stored in room and controlled conditions.
- Plasma cleaning is a suitable way to tune the contact angle. Further analysis can be performed with different materials.
- A CA mapping procedure has been successfully implemented, allowing to have more precise measurements.
- A characterization of different Functional Groups on a Silicon substrate has been performed.

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