

Nano Rome, 20-23 September 2016 Innovation

Conference & Exhibition

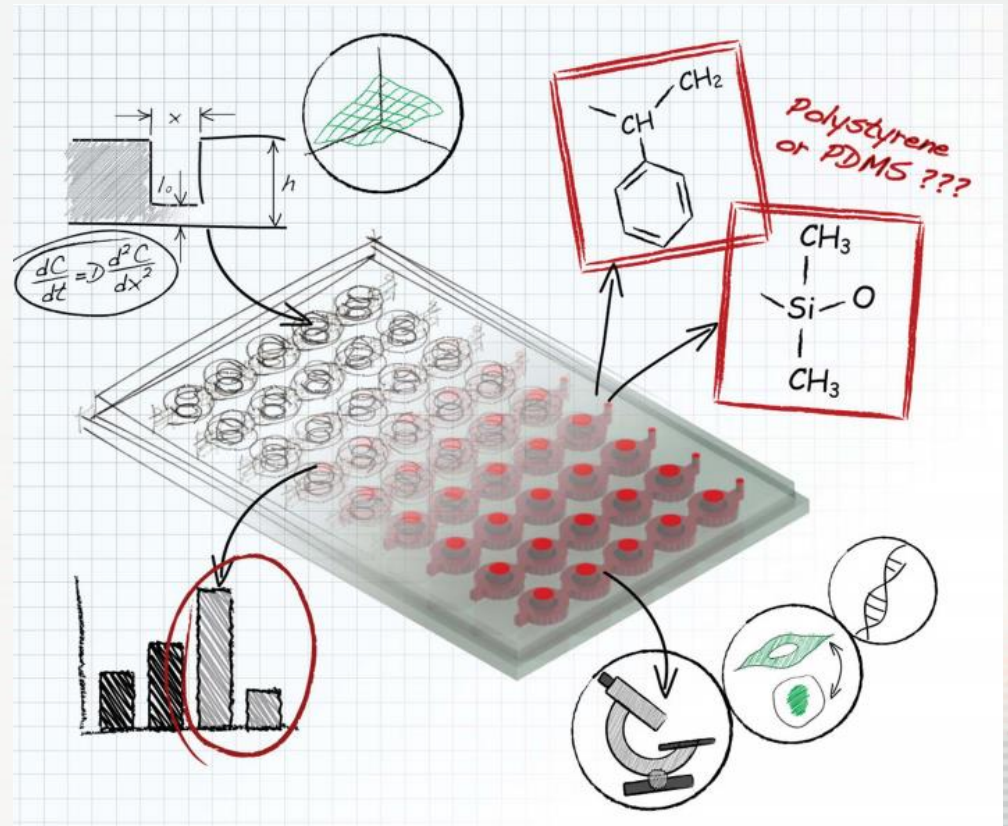
Barbara Cortese

Superhydrophobic Surfaces for
Microfluidics and Lab-on-a-Chip
Applications

Introduction

The primary focus of our research is the design of biosystems to address needs in biology and medicine

These systems require to incorporate functional surfaces and fluidic architectures designed to take advantage of biological characteristics of cells and biological fluids.



Advantages of Microfluidics

Open Microfluidics

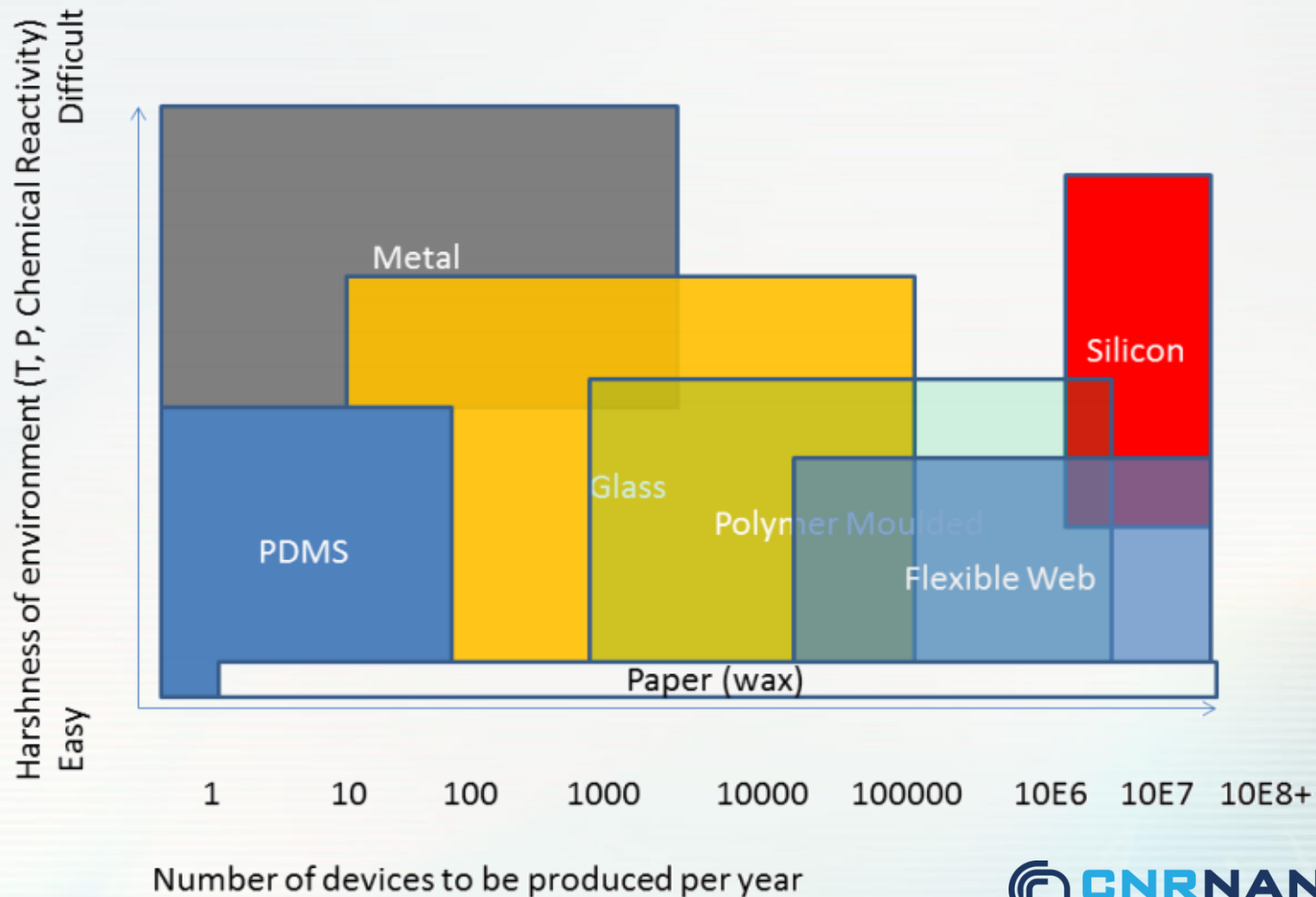
- Small size
- Precise reaction control (quick response)
- Increased accessibility
- Lower costs, fewer inputs, less waste
- Functionality
- Simplicity of fabrication

Issues

- Control of wettability contrast
- Material selection for microdevice fabrication

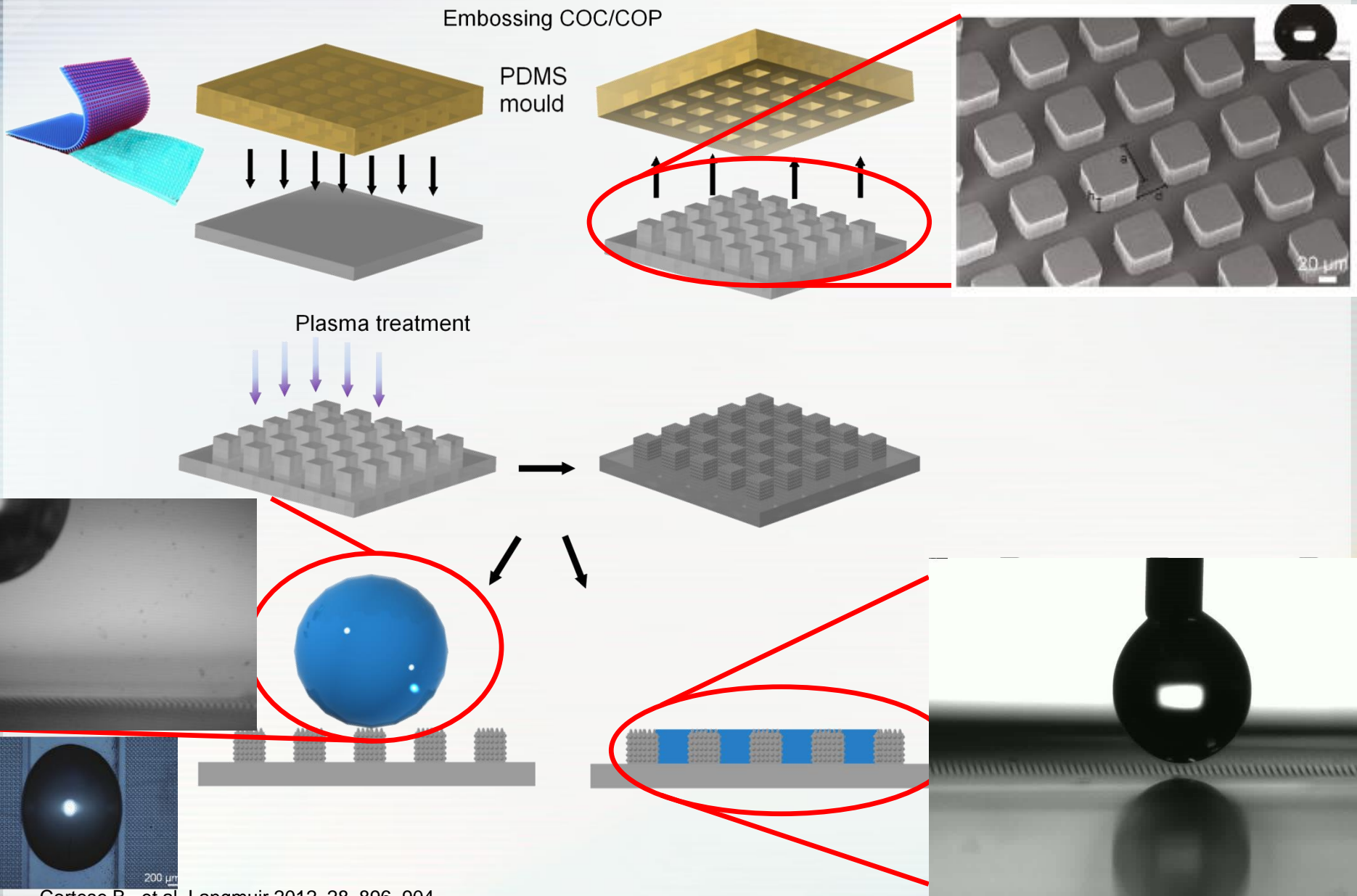
Material Selection

Material Selection is based on the conditions and requirements of the specific application, the desired chip design, and budget of the user.



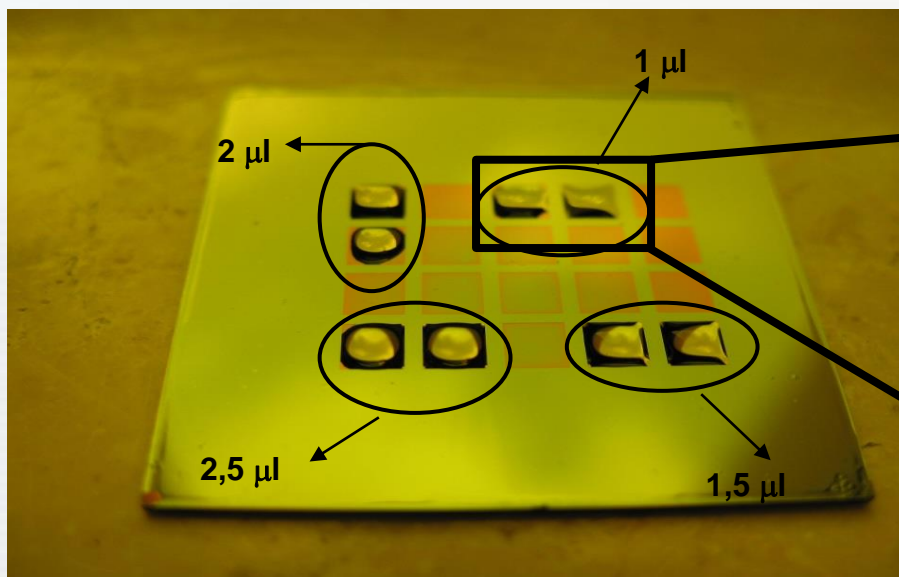
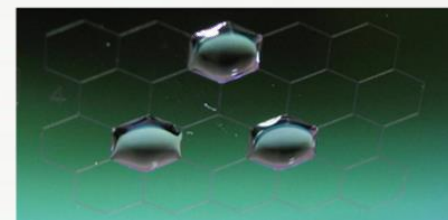
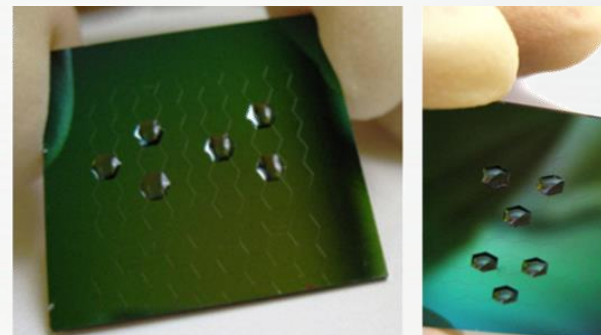
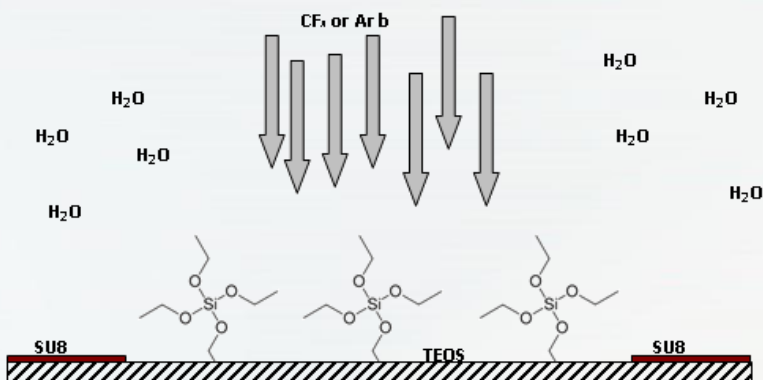


Hydrophilicity vs Superhydrophobicity



Hydrophilicity vs Superhydrophobicity

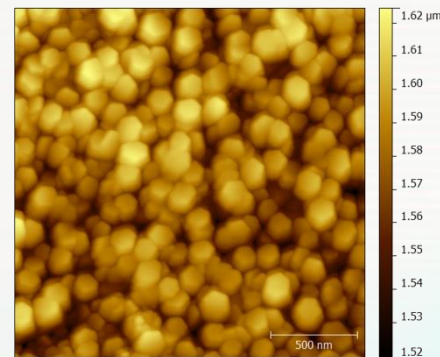
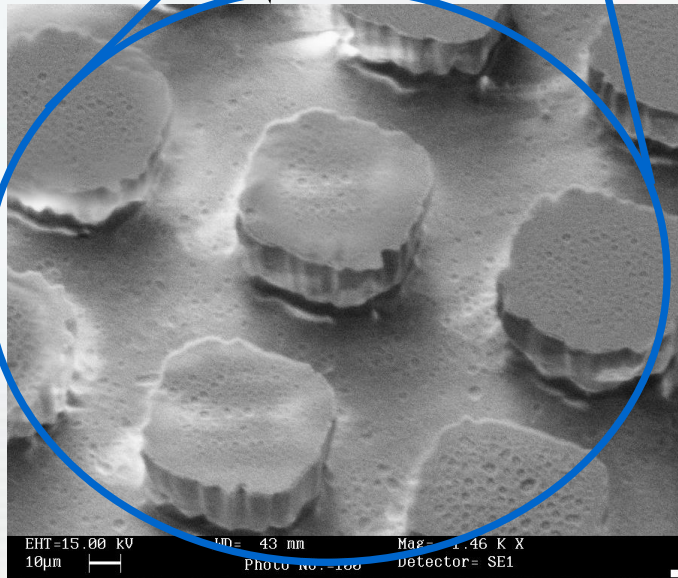
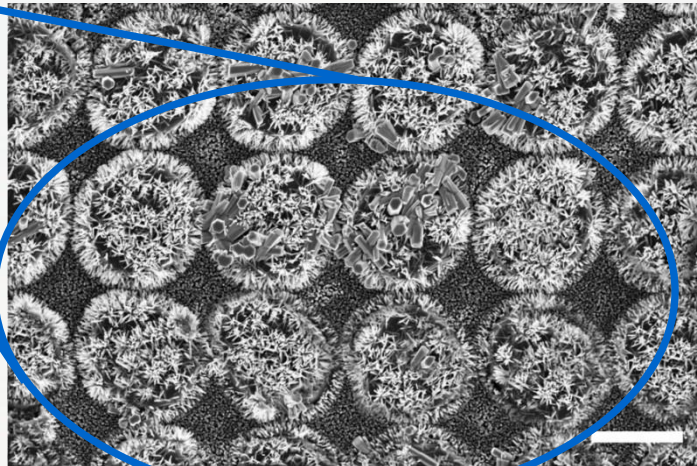
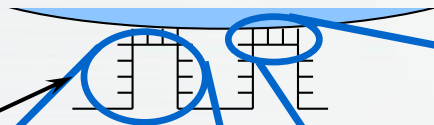
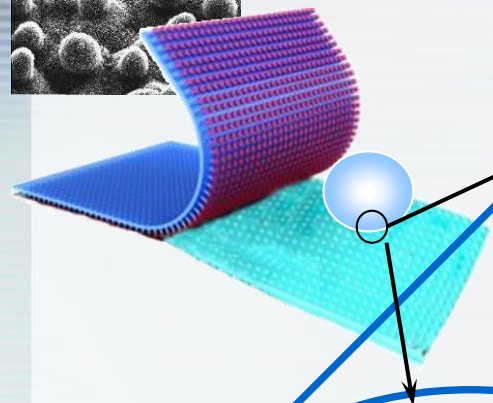
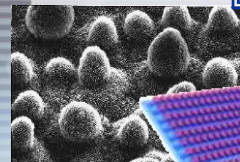
Wettability contrast



Hydrophilicity vs Superhydrophobicity

Hierarchical scale roughness

Nano-Pattern with
ZnO nanorods

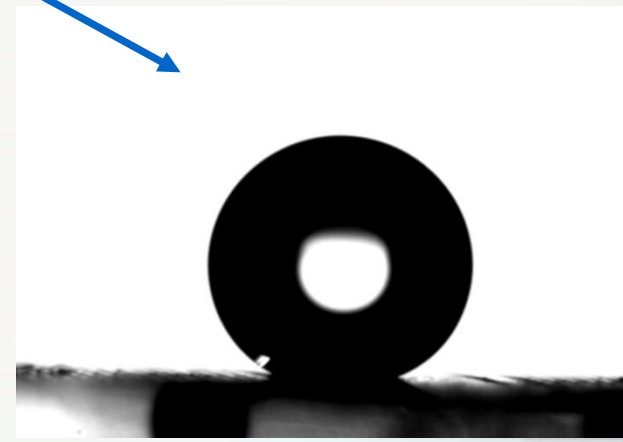
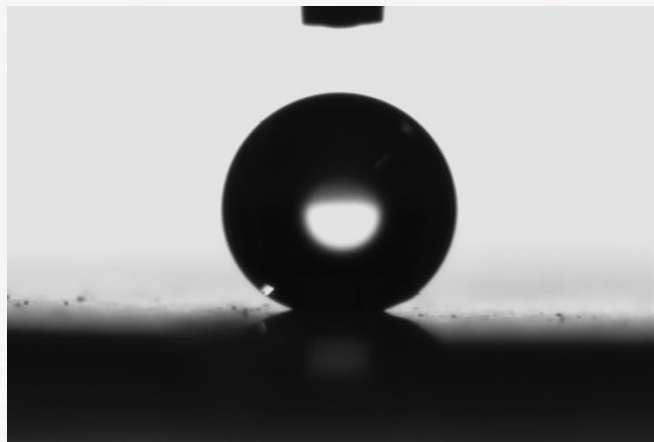
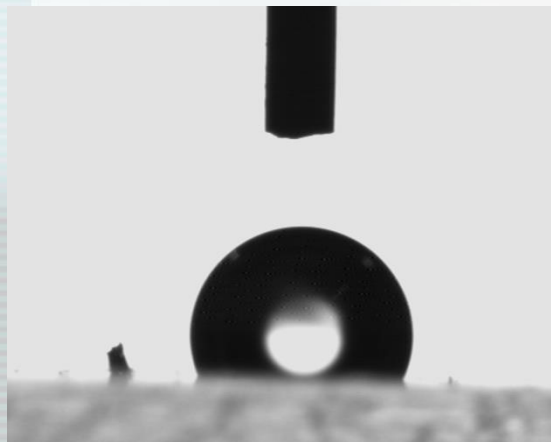
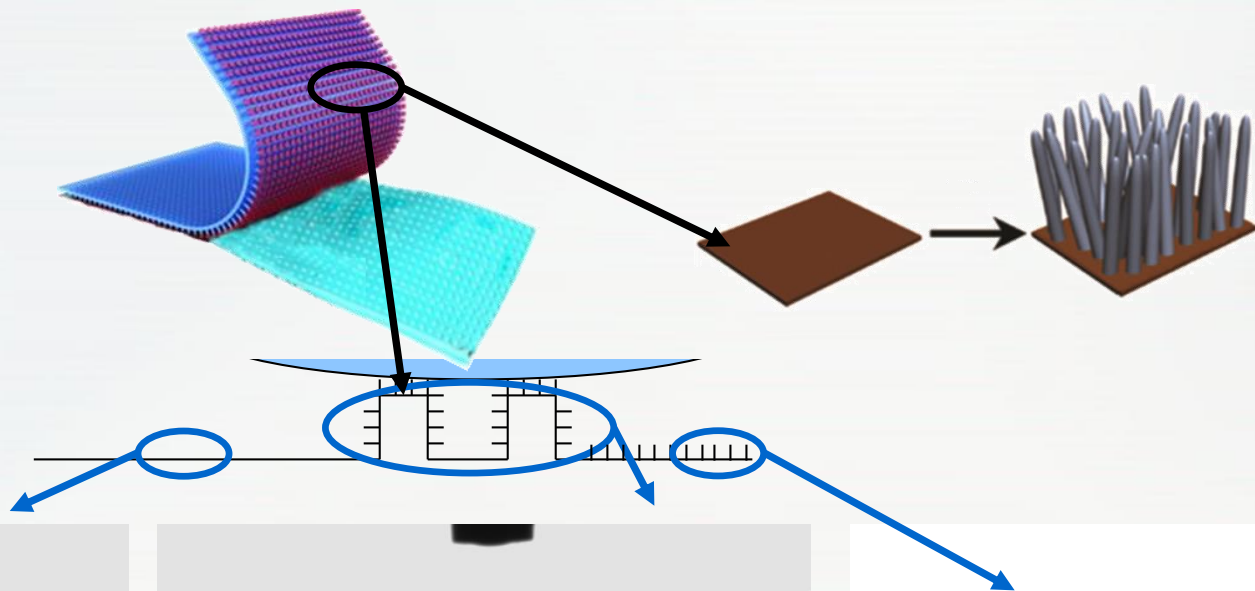


Micro-Patterned
Polydimethylsiloxane (PDMS)
surfaces.

Palamà I.E., et al. *J. Mater. Chem. A*, 2014, 2 (41), 17666 - 17675

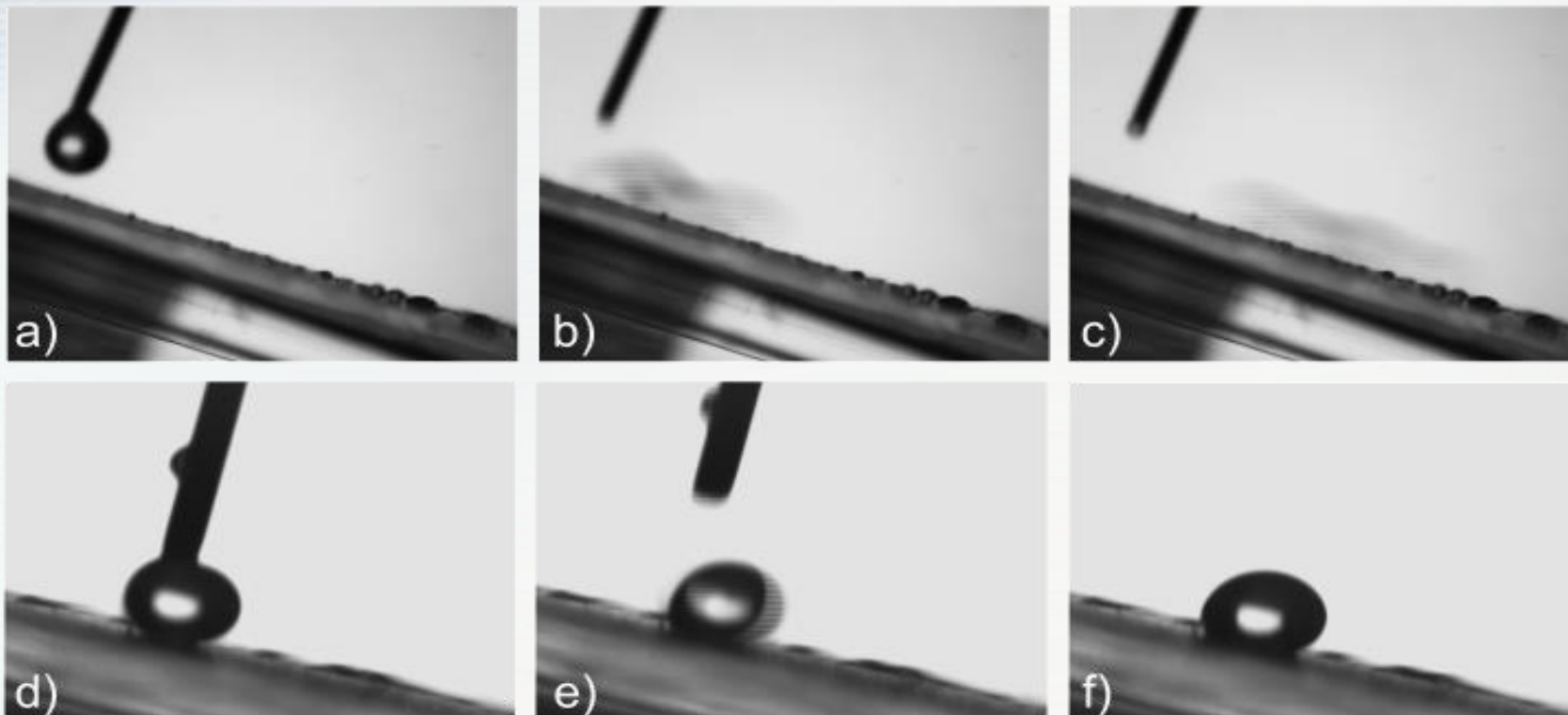
Hydrophilicity vs Superhydrophobicity

Hierarchical scale roughness

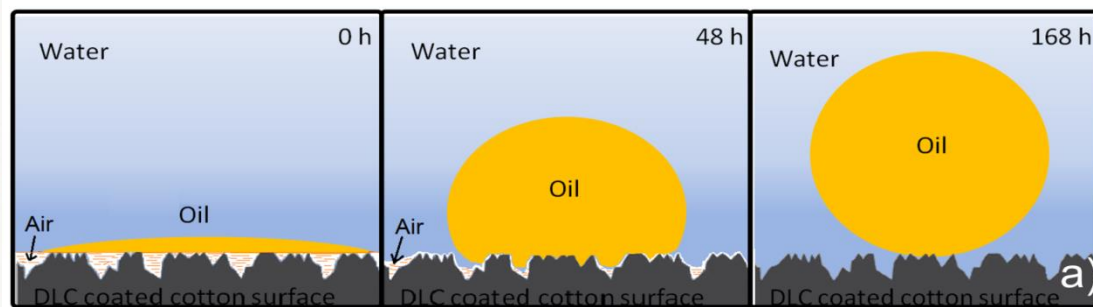


Contact angle measurement on the rough etched pre-patterned PDMS surfaces; the drop pinned to the etched surface beyond the micropattern, but not on the micro scale pattern itself, showing the enhancement of hydrophobicity .

Underwater influence

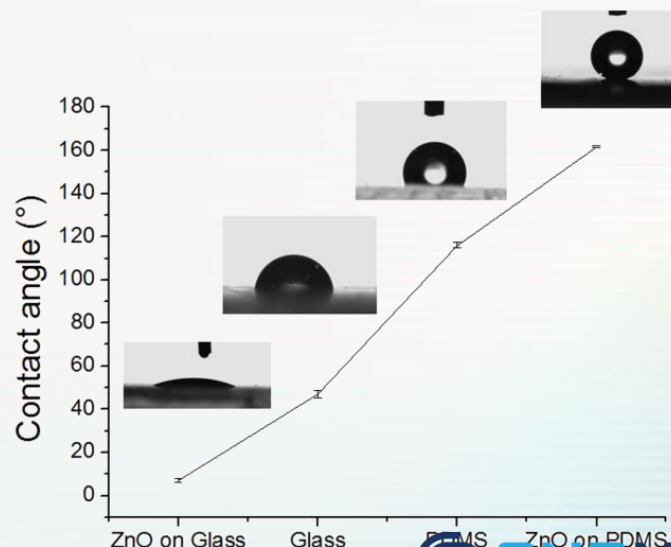
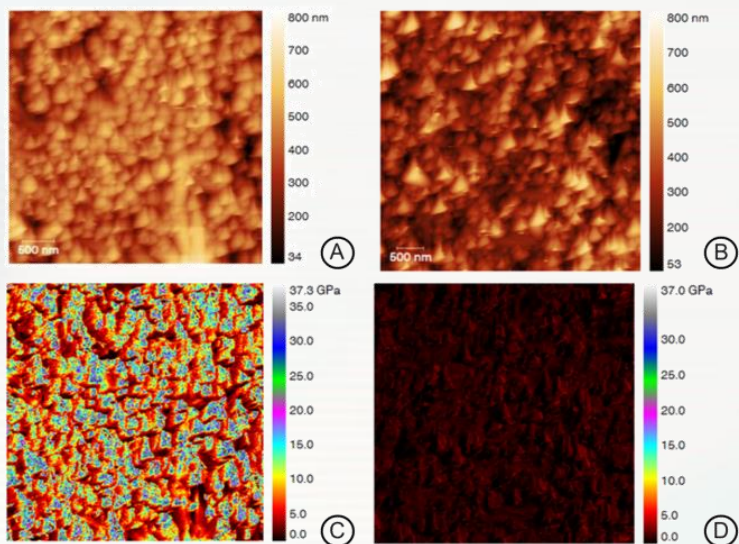
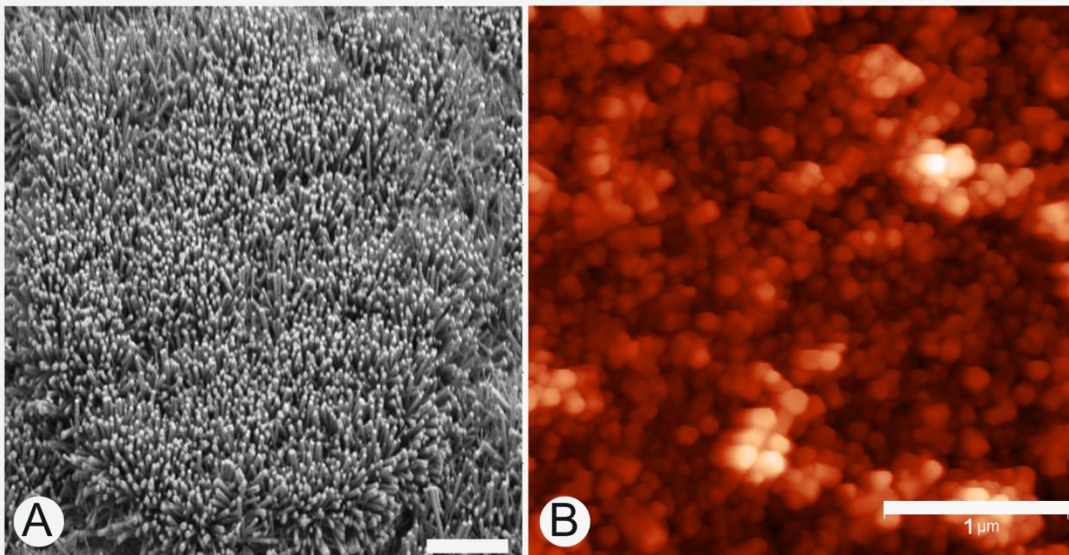


Adhesive force of oil in water. a-c) A droplet of diiodomethane rolling off the micro/nano-structured ZnO surface as soon as the droplet made contact. d-f) Onto the fluorinated surface the drop firmly adhered to the surface and did not roll away indicating a Wenzel state. Roll off angle was $\sim 10^\circ$.

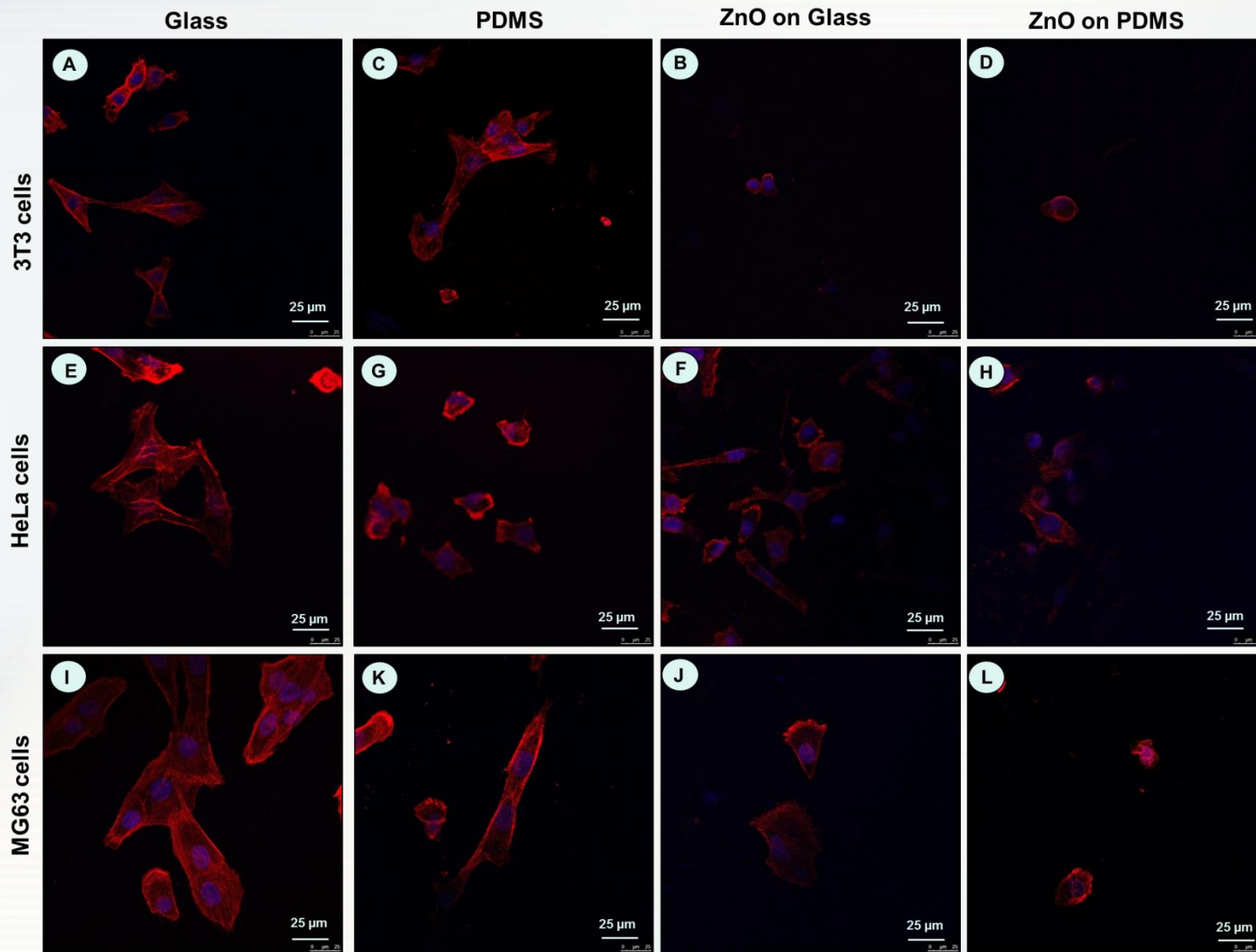


Soft vs Stiff

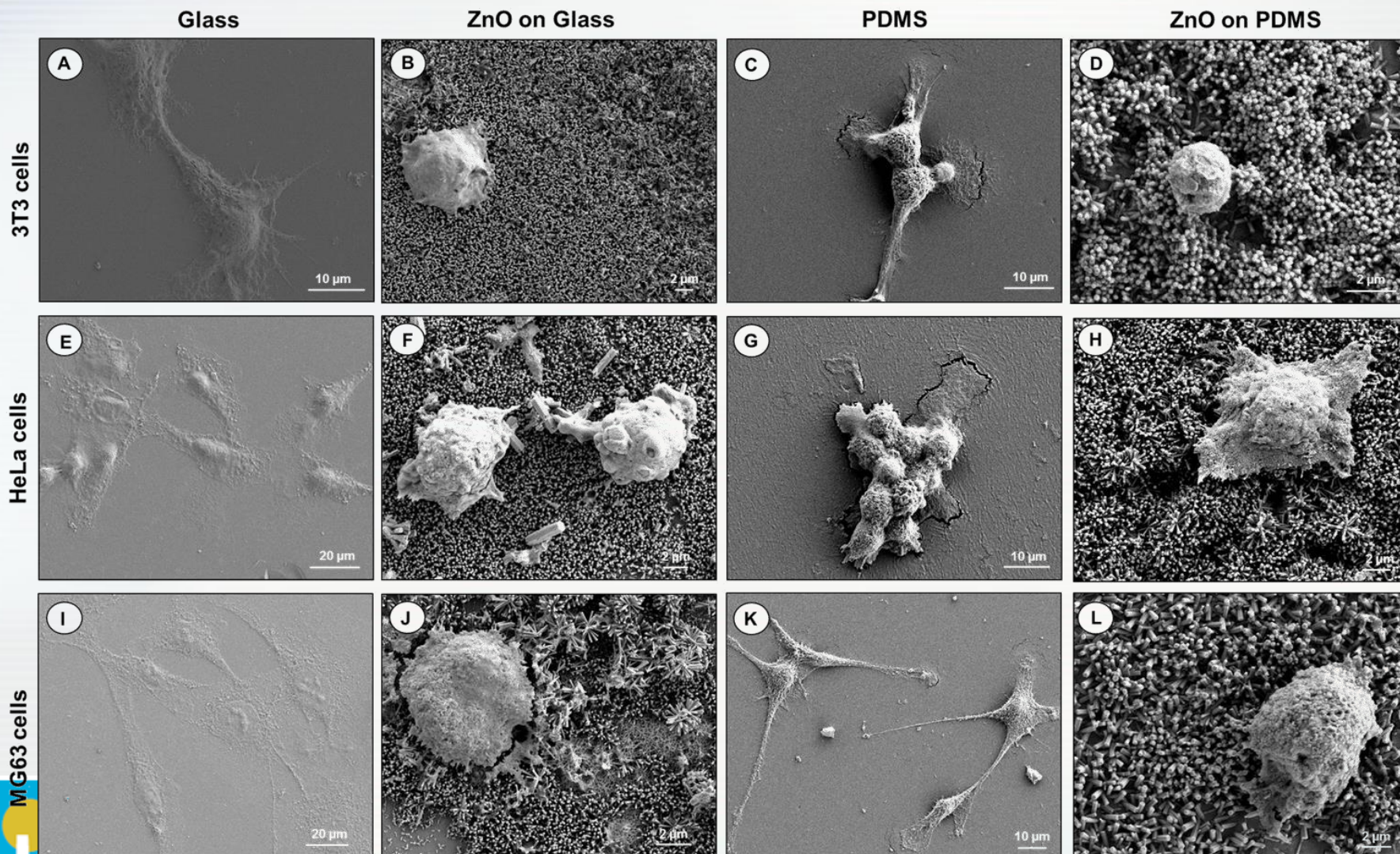
Nanorods on different substrates



Soft vs Stiff

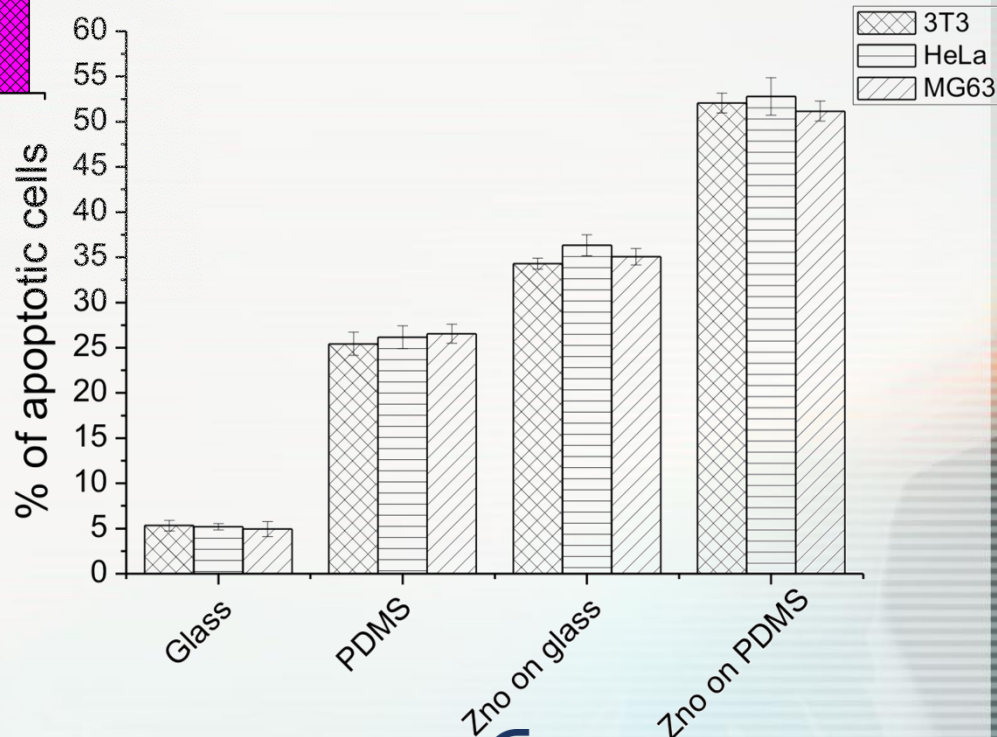
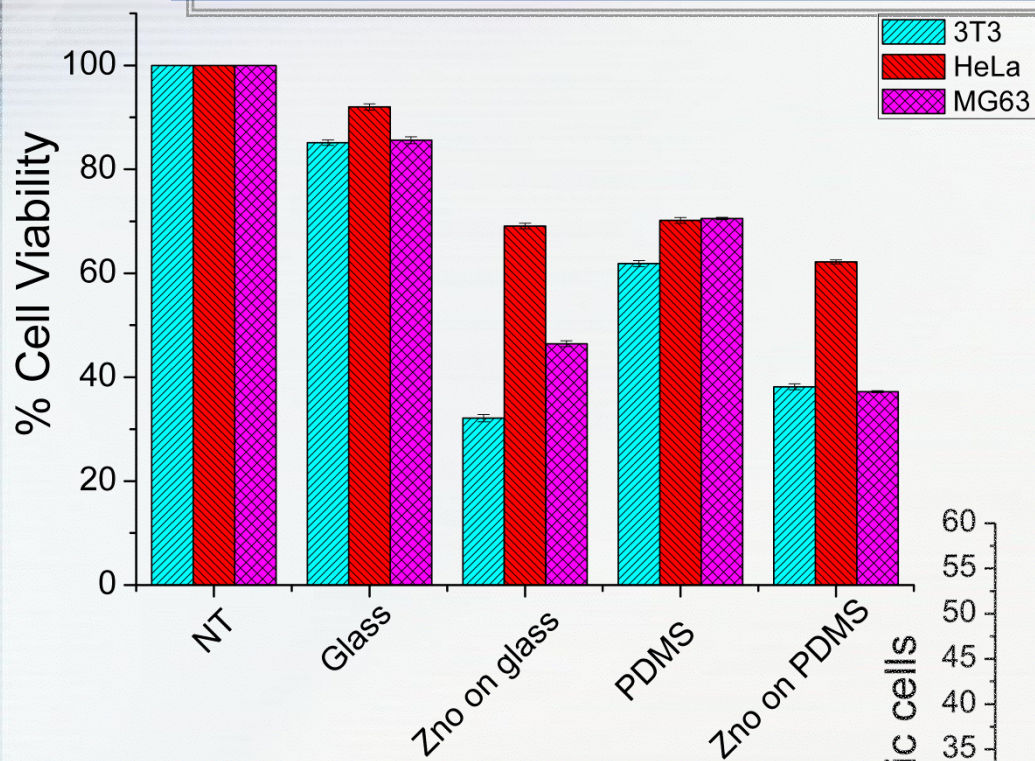


Soft vs Stiff



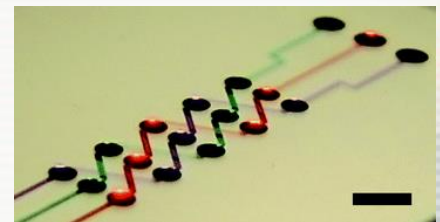
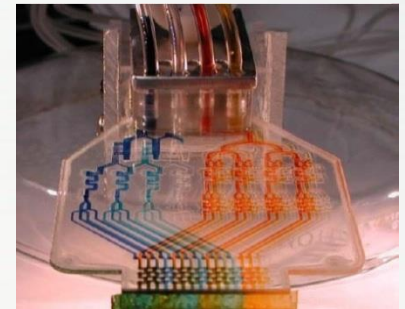
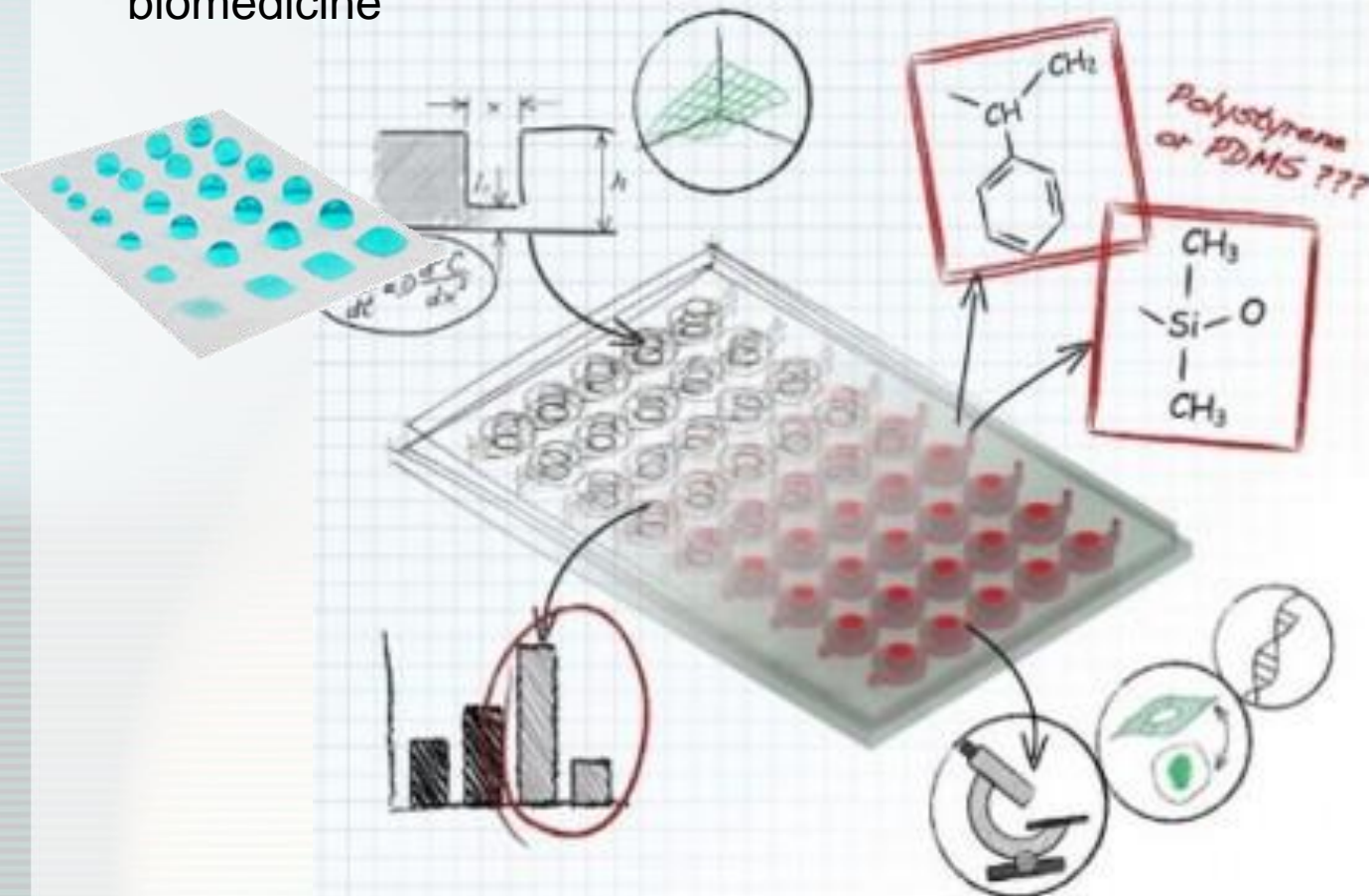


Soft vs Stiff



Future Innovative applications

Combining the physical-chemical surface properties we envisage that more complex and perfect channels with controlled wettability could be patterned on such substrates and this technology has the potential to be used in a variety of applications, including in bioengineering and biomedicine





Collaborations

National collaboration

Roma

- **S. Di Angelantonio, Prof. D. Ragozzino, Prof. C. Limatola, Dipartimento di Fisiologia e Farmacologia, Sapienza Università di Roma**
- **Caschera D., Toro R.M., CNR ISMN (Montelibretti)**

Lecce

- **I.E. Palamà, S. D'Amone, CNR Nanotec Lecce**
- **Prof. A. Sannino, Università del Salento**

Bologna

- **Prof. G. Barbarella**


International collaboration

Glasgow UK

- **Prof. M.O. Riehle**

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Thank you for your attention