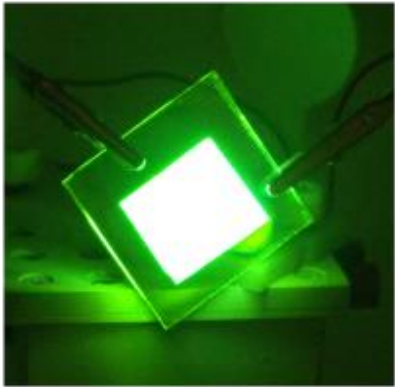


# Ceramic-like (sol-gel) coatings for durable aesthetics and cleanliness

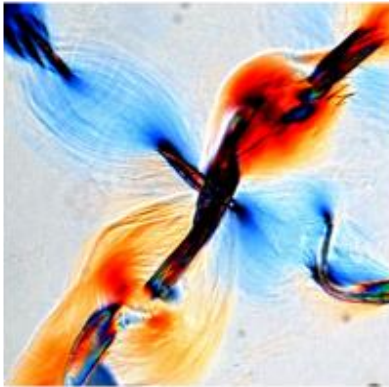
Mireille Poelman, Marie-Eve Druart, Rob Onderwater, Tangi Sénéchal



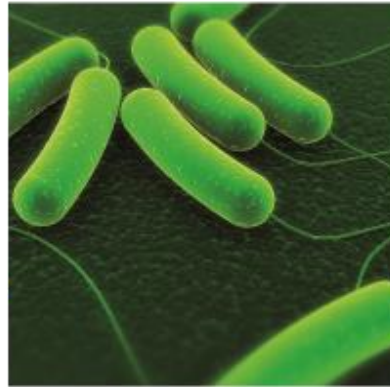
- Non profit R&D center dedicated to **innovative materials**
- Link between fundamental research and industrialization
- Strong link with UMONS
- Subsidiaries : IONICS, NANO4, ESIX, BSENS
- 240 researchers and technicians (80 employees at Materia Nova)
- 2019 : turnover 8,3 M€



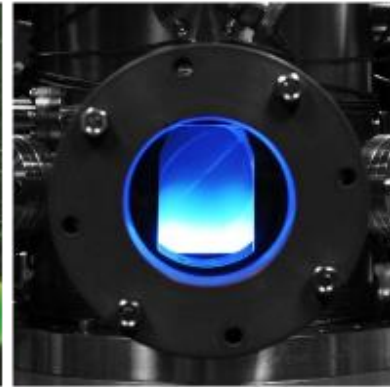
ADVANCED MATERIALS  
FOR ENERGY  
APPLICATIONS



INNOVATIVE AND  
SUSTAINABLE POLYMERIC  
MATERIALS



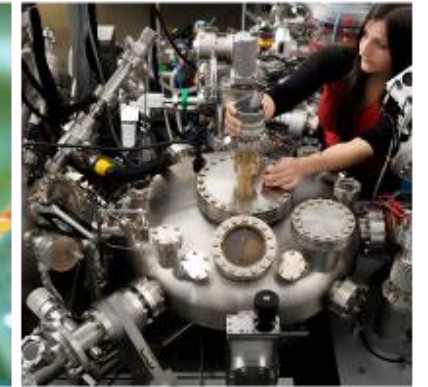
CELLS FOR MATERIALS  
AND MATERIALS FOR  
CELLS



MULTIFUNCTIONAL  
SURFACES

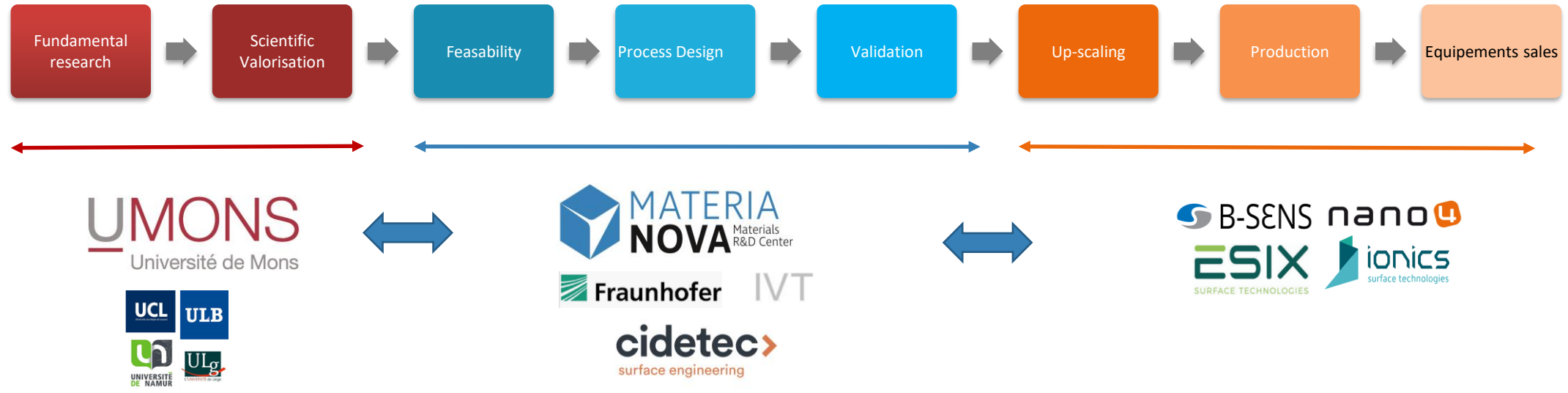


LIFE CYCLE THINKING



CHARACTERIZATION  
PLATFORM

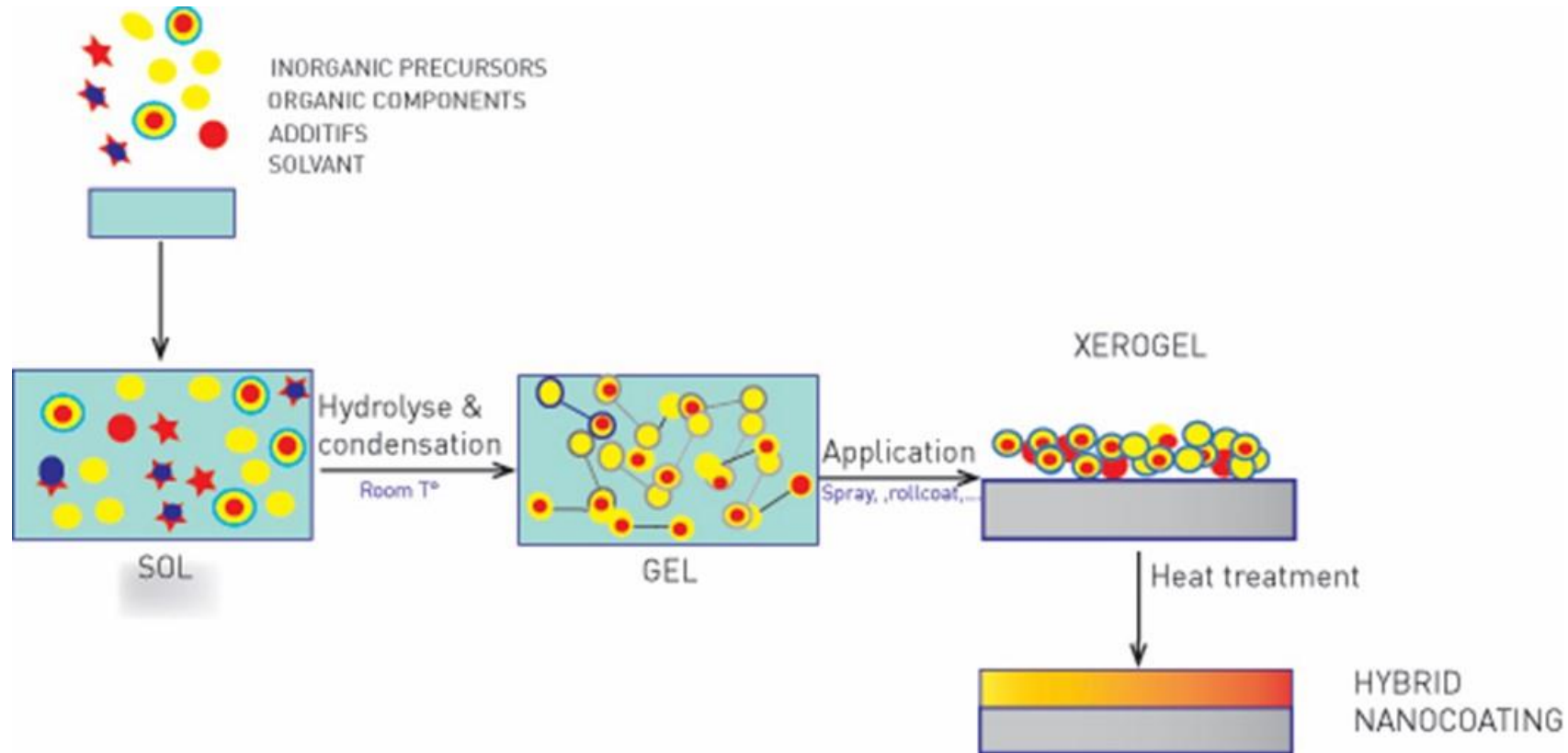
# The Innovation Chain : Converting Science into Wealth



Open and collaborative innovation



# Ceramic-Like coatings by sol gel

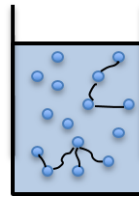


# Ceramic-Like coatings by sol gel

**Sol**

=

Solution with  
précurseurs/solvent/  
catalysor

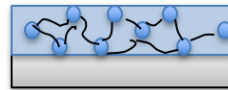


↓  
**Chemicals  
reactions**

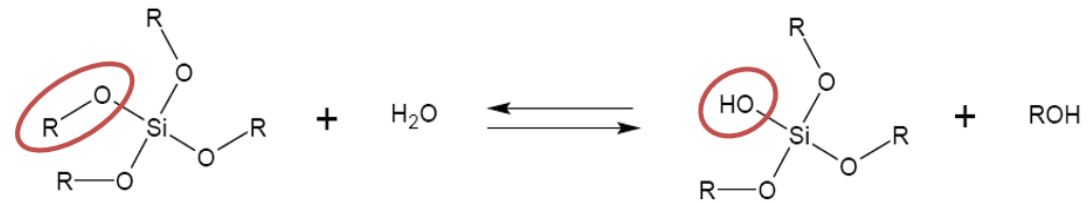
**Gel**

=

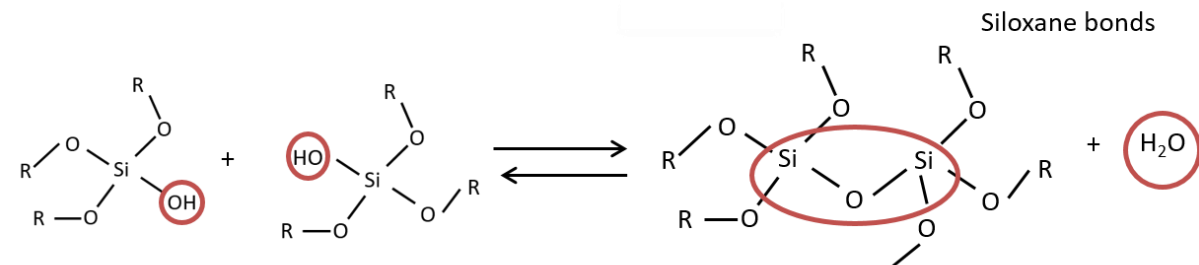
Network cross-linking  
Ex: siloxane network



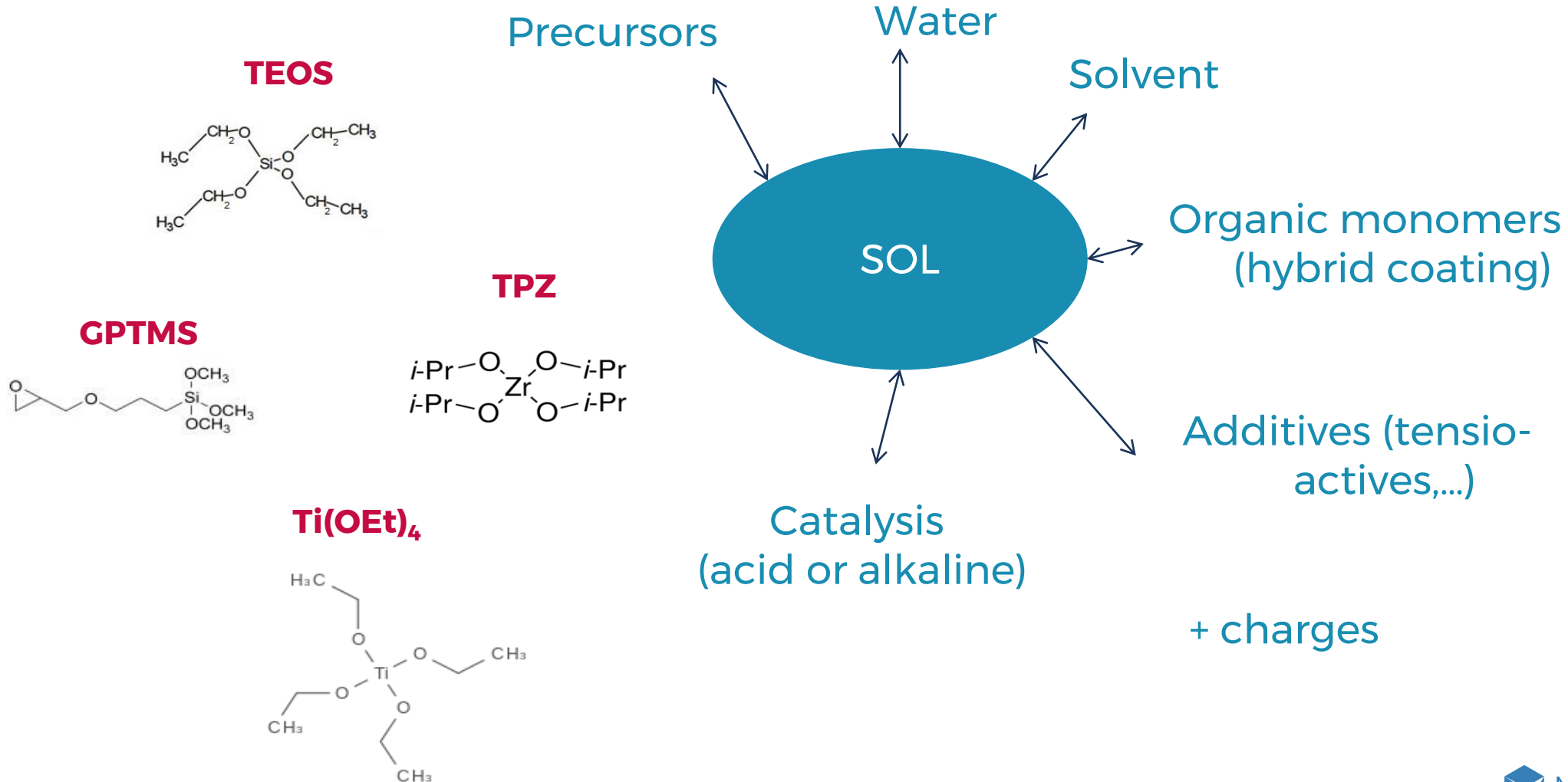
**Hydrolysis**



**Condensation**

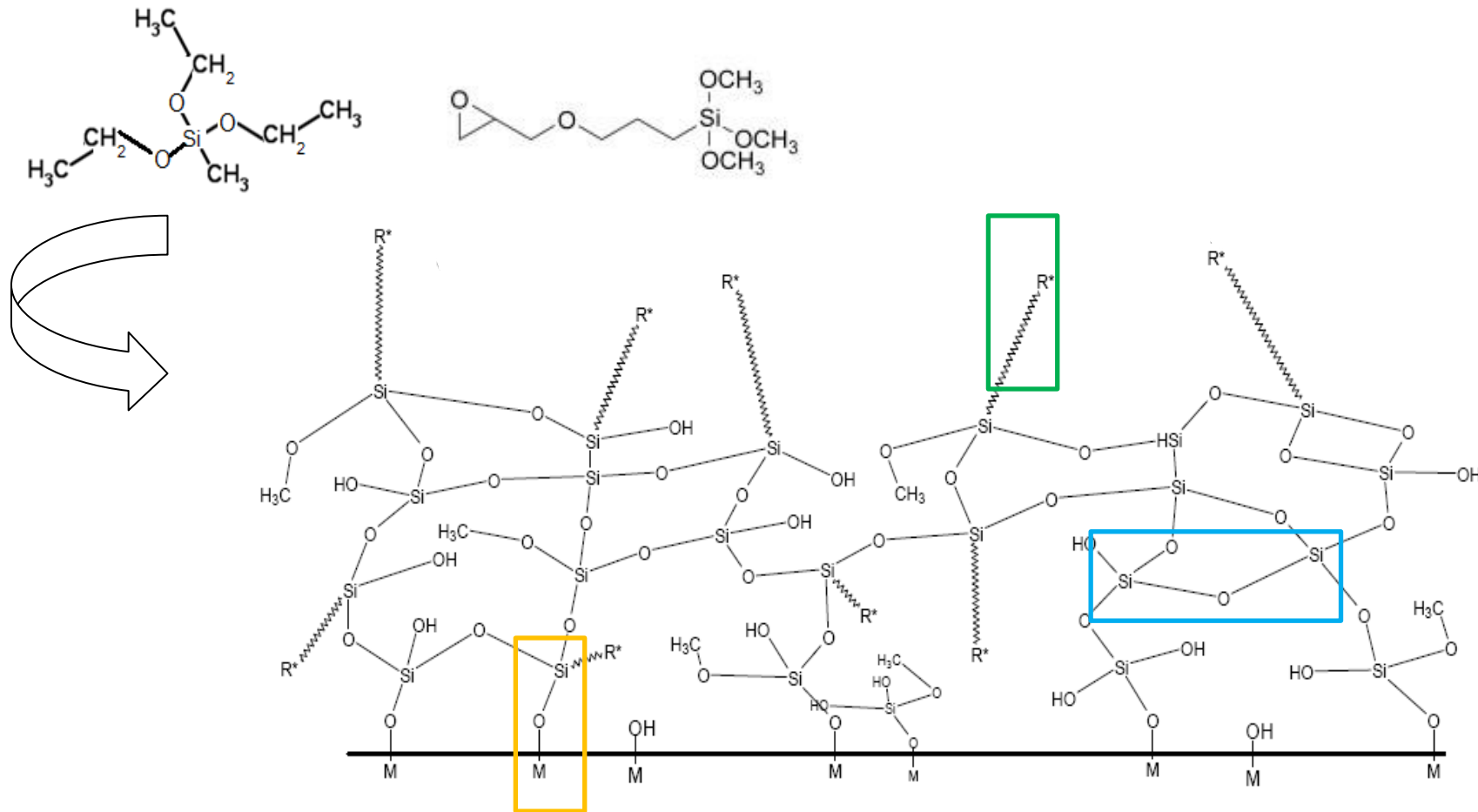


# Ceramic-Like coatings by sol gel



# Ceramic-Like coatings by sol gel

Formation of a 3D-network (condensation and curing)





# Ceramic-Like coatings by sol gel

## Synthesis



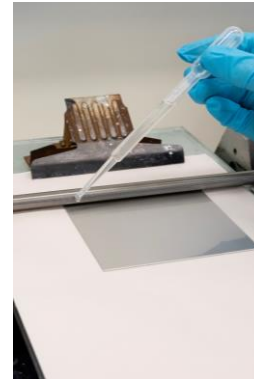
## Spin coating



## Dip coating



## Roll coating

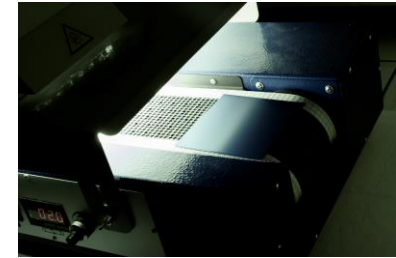


## Spray coating



## Cross-linking

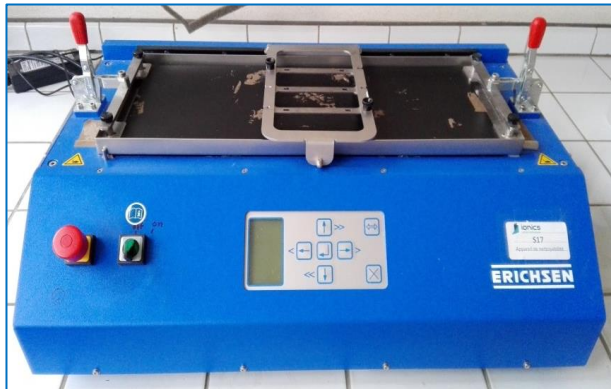
Thermal - UV  
Example : UV exposure



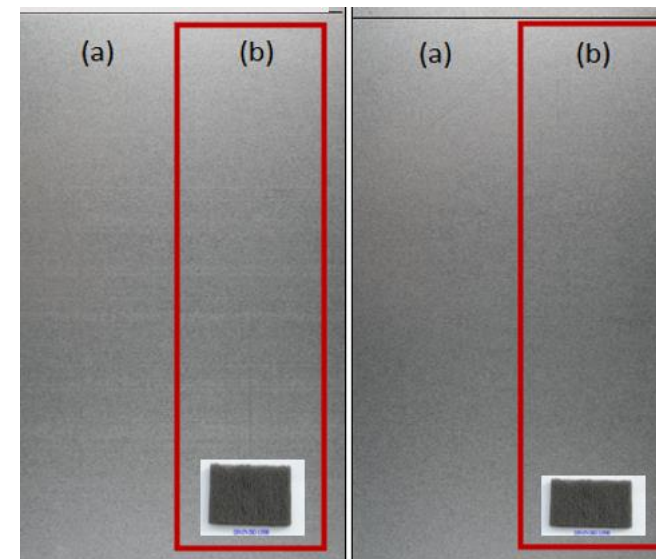


# Some key properties

<b>Adherence</b> (ISO 2409)	<b>Flexibility</b> (mandrel diam : 5mm)	<b>Impact Resistance</b>	<b>Scratch Resistance</b> ISO 1518
Class 0	No peeling, no crack	1kg/ 10 – 50 cm with no cracks	No penetration to the substrate for a load >15N : OK



Humid Abrasion Resistance Test



## Some industrial applications



Kitchen appliances  
(stainless steel,  
titanium)



Luxury items (Ti, brass,  
gold, etc)



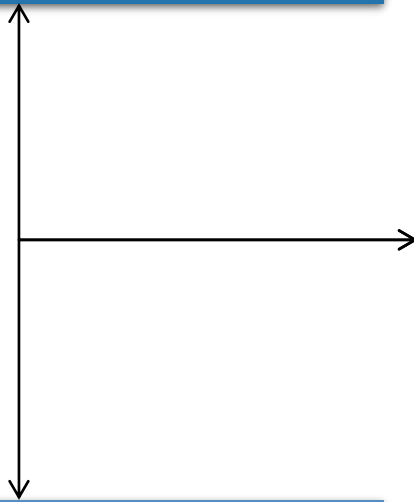
Building (aluminium)

Pharmaceutical industry  
(clamps, etc) (stainless steel)

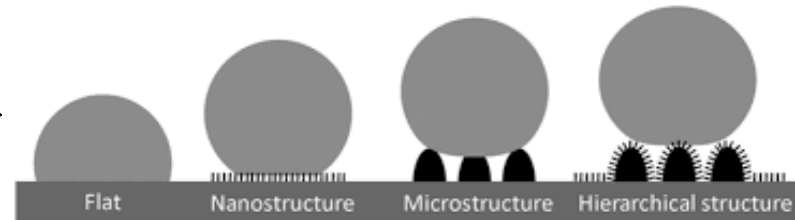


# Sol gel for « clean surfaces »

Thin layer that does not affect the appearance of the material



Choice of treatment technology depending on the material or the specifications

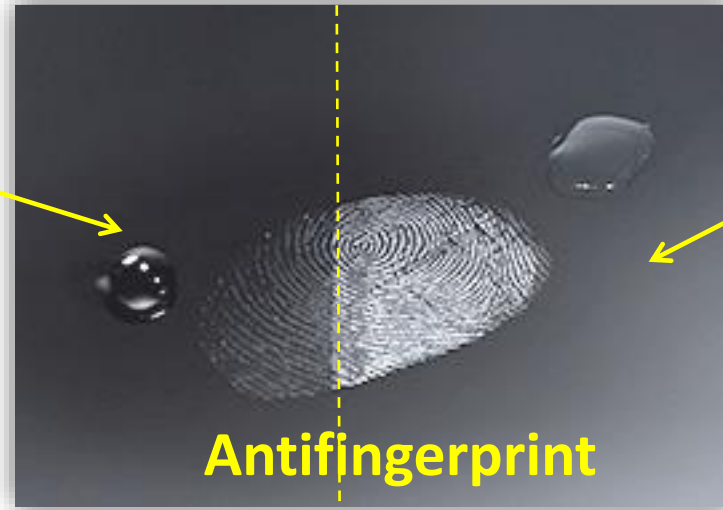


**Anti-adhesion properties based on (super) hydrophobic**

Use of anti-microbial agents or biofilm growth inhibitors

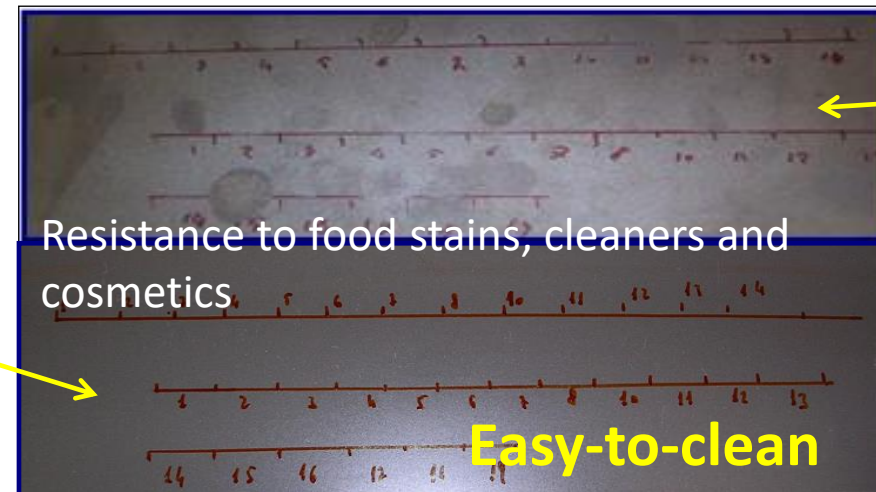
## Easy-to-clean : hydrophobic sol gel

Stainless Steel + Sol  
gel



Stainless Steel  
non coated

Titanium + sol  
gel



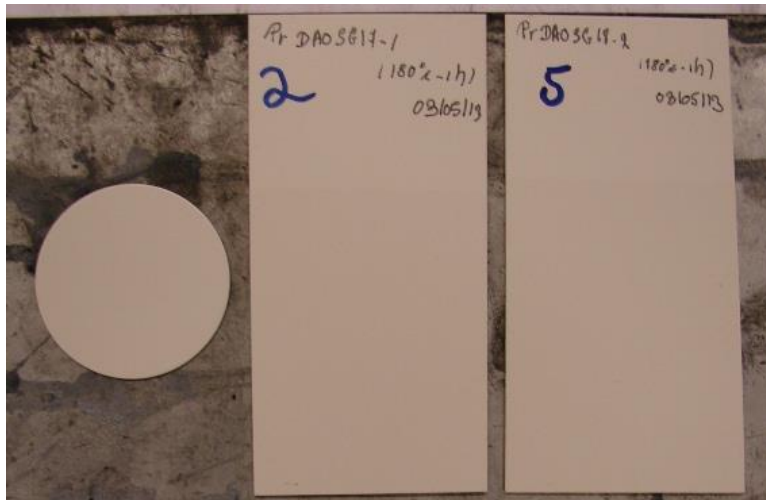
Titanium  
non coated

# Anti-Dirt thin sol gel coating for outdoor applications (application on prepainted steel)

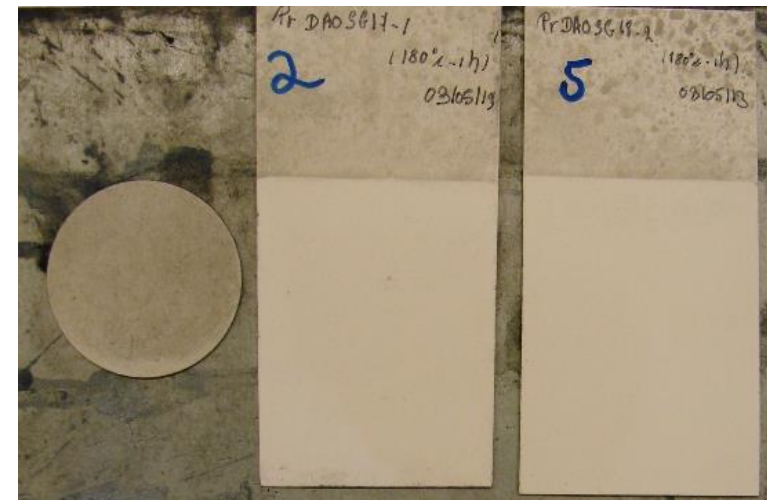
Application on prepainted steel : thin invisible (super)hydrophobic (Fluoro-based) layer with high resistance against carbon black dirtying. With sol gel the surface remains clean after 4 cycles of carbon black spray, drying and cleaning process



Initial

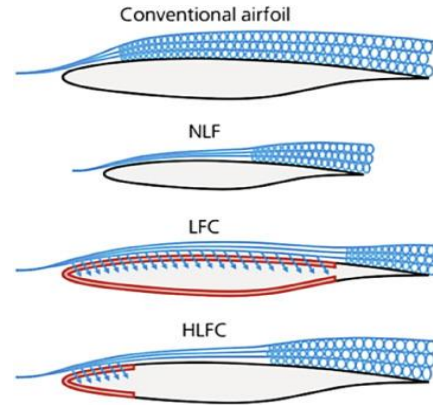
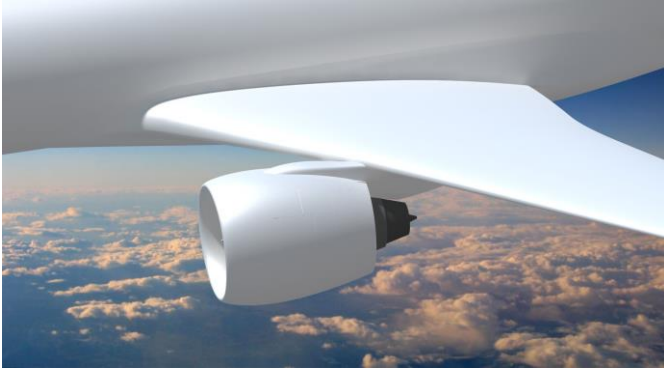


After 4 CB/cleaning cycles

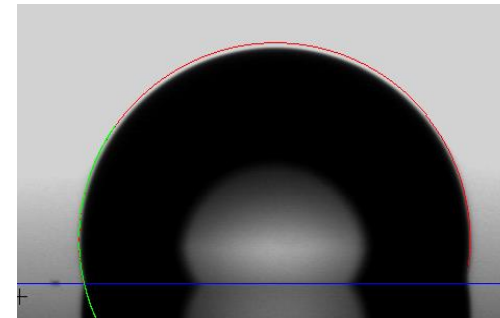




# Anticontamination coatings for leading edges applications



Formulation of high durability sol gel coating with hydrophobic character/low sliding angle : fluoro-based and reinforcement of mechanical resistance with specific additives



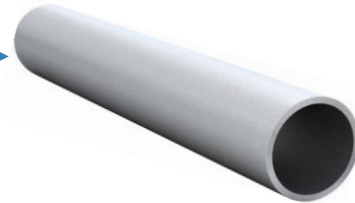
Cleanability after exposure to hemolymph (Schneider's solution) or real insects



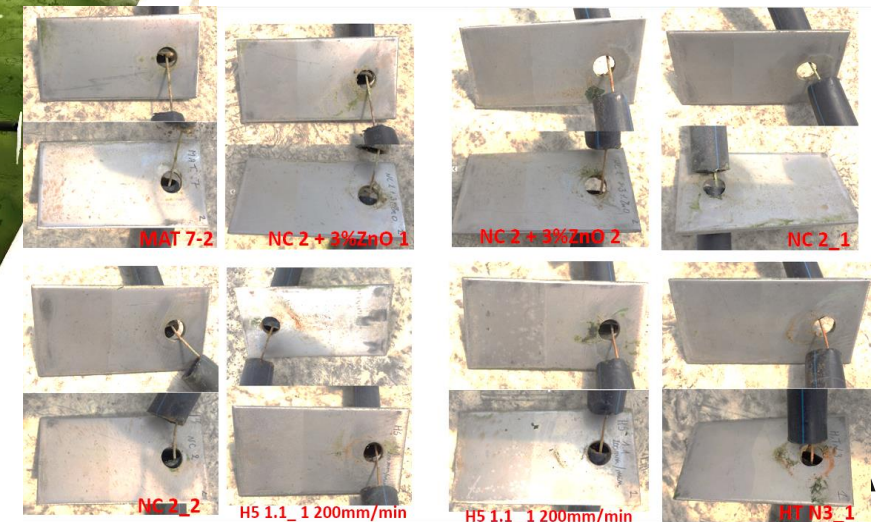
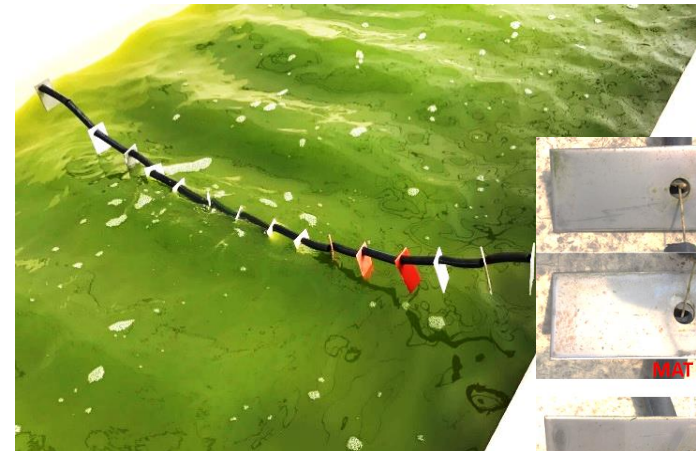
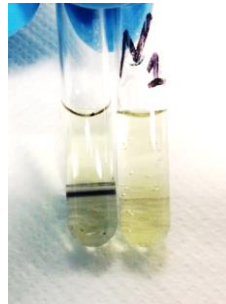
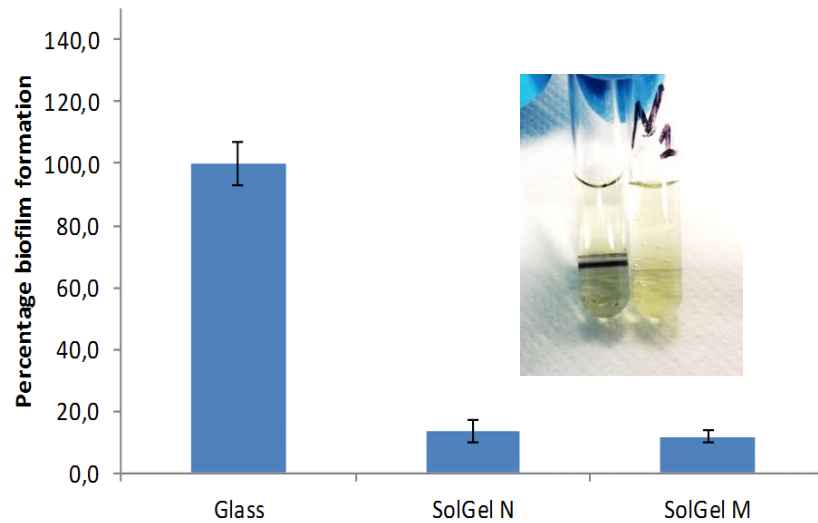
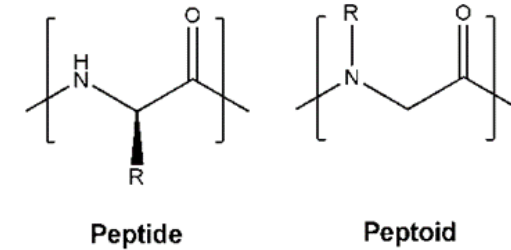
# ANTI-FOULING sol gel coatings for power plants



Improving long-term efficiency of heat exchangers



Combination of hydrophobic sol gel and peptoids having the biomimetic antifouling effect of peptides

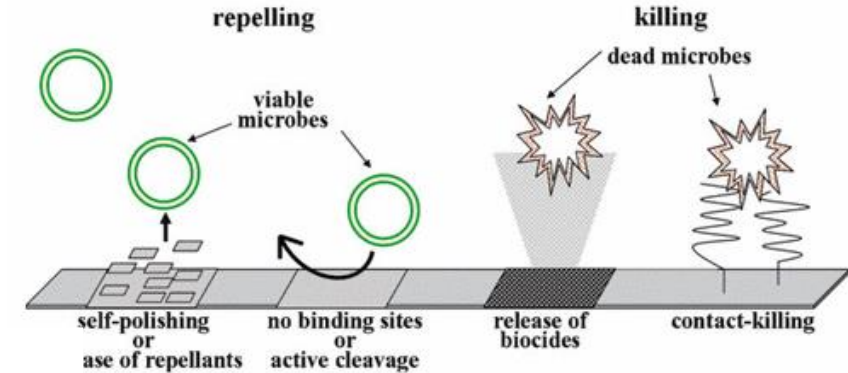




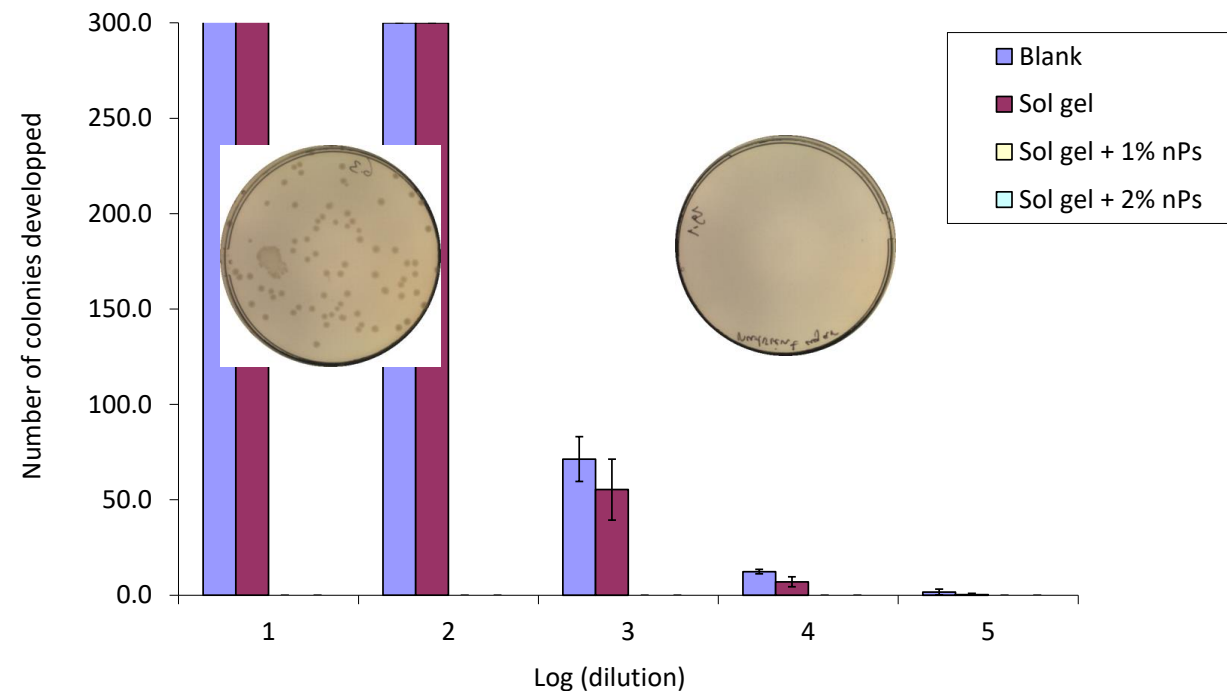
# ANTI-MICROBIAL sol gel coatings

## Antimicrobial properties

- Repelling/no adhesion
- Biocid effect → Killing of the microbes
- Bacteriostatic effect → decrease of microbial development



Antibacterial effect on Ecoli



Tests with virus ongoing !

# Conclusions



- ✓ Low thickness of the coating inducing **small modification of the surface aspect and topography**
- ✓ **Versatility of the application process** making possible application on site or in industrial chains of 3D complex shapes.
- ✓ Compatible with **various substrates** (glass, metals, polymeric substrates, paper,...)

- ✓ **Environmentally-friendly** (low VOC, low temperature of curing) and durable surface treatment.
- ✓ **Good mechanical resistance and flexibility** (compatible with shaping)
- ✓ Large **potentiality of functionalities** (easy to clean, barrier properties, anti dirt, anti microbial, conductivity, thermal insulation,...)

Strong collaboration with ESIX (Walloon SME) which allows R&D products to be commercially available but also to ensure large-scale application

**ESIX**  
SURFACE TECHNOLOGIES



**MATERIA**  
**NOVA** Materials  
R&D Center

[www.materianova.be](http://www.materianova.be)

Contact : [Mireille.Poelman@materianova.be](mailto:Mireille.Poelman@materianova.be)

**UMONS**  
Innovation Center