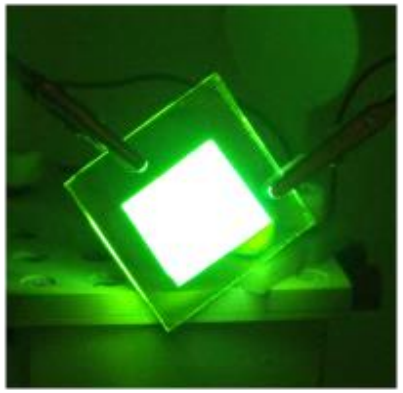
Ceramic-like (sol-gel) coatings for durable aesthetics and cleanliness

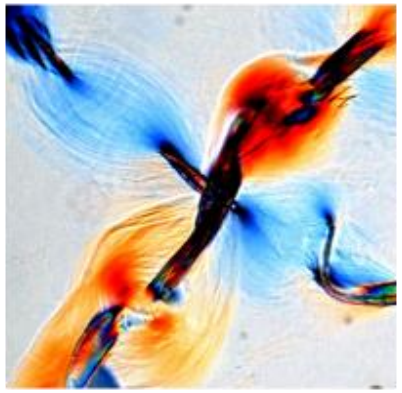
Mireille Poelman, Marie-Eve Druart, Rob Onderwater, Tangi Sénéchal



- 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



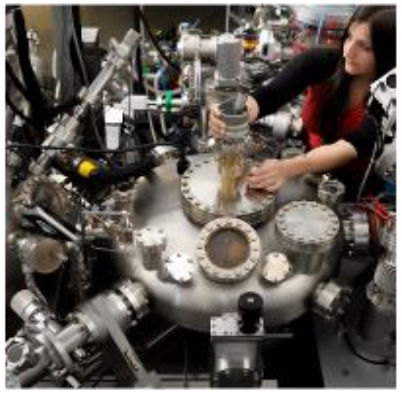
CELLS FOR MATERIALS AND MATERIALS FOR CELLS



MULTIFUNCTIONAL SURFACES



LIFE CYCLE THINKING



CHARACTERIZATION PLATFORM

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The Innovation Chain : Converting Science into Wealth

Fundamental research → Scientific Valorisation → Feasability → Process Design → Validation → Up-scaling → Production → Equipements sales

UMONS Université de Mons

UCL ULB Université de Namur ULg

MATERIA NOVA Materials R&D Center

Fraunhofer IVT

cidetec surface engineering

B-SENS nano

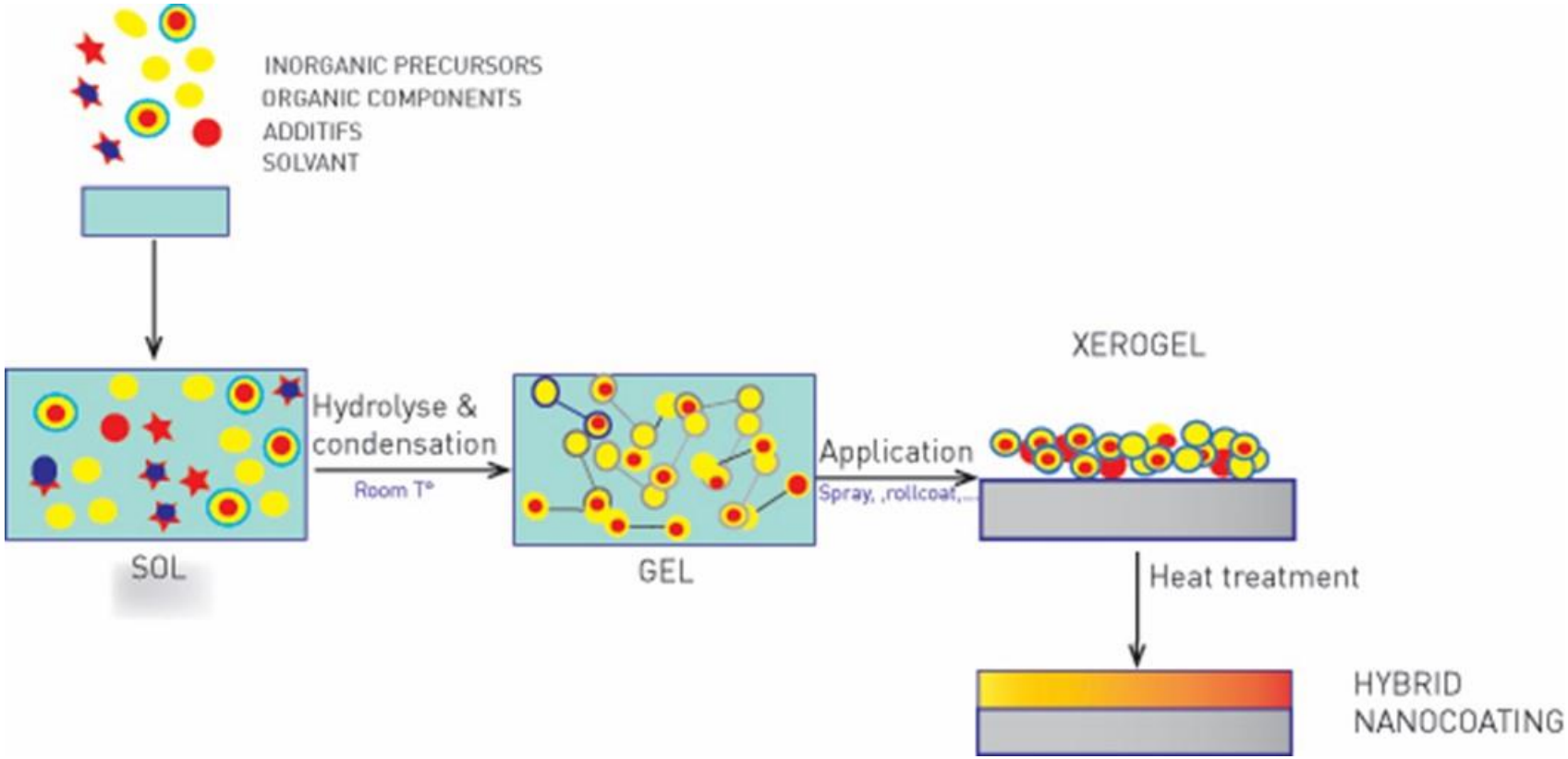
ESIX SURFACE TECHNOLOGIES ionics surface technologies

Open and collaborative innovation



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Ceramic-Like coatings by sol gel



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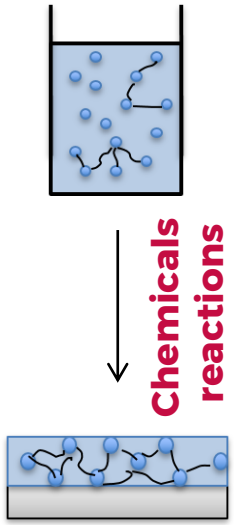
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Ceramic-Like coatings by sol gel

Sol

=

Solution with précursors/solvent/ catalysor



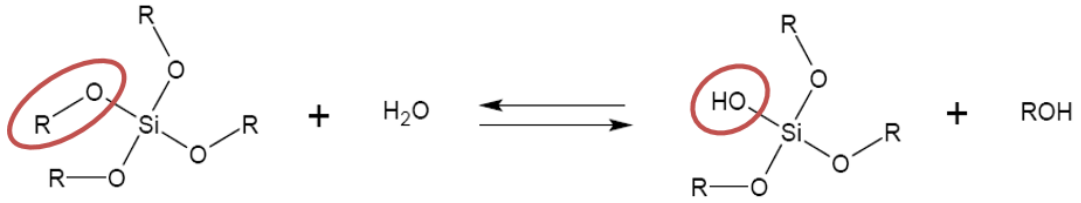
Gel

=

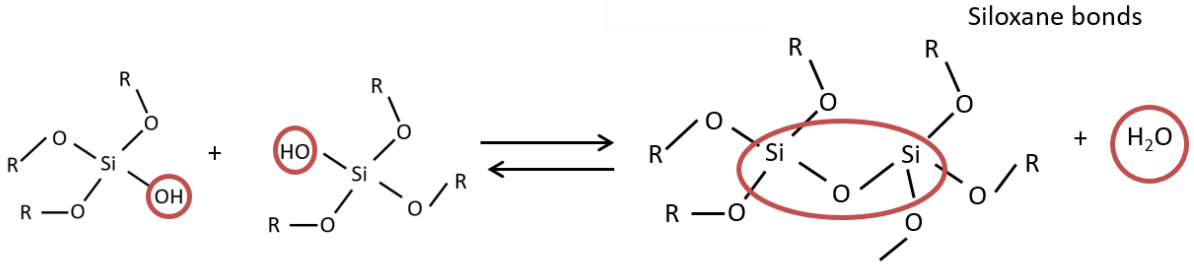
Network cross-linking

Ex: siloxane network

Hydrolysis



Condensation

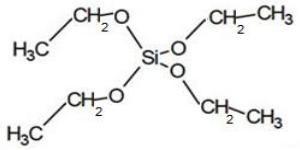


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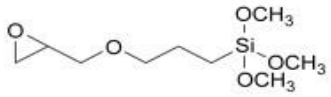
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Ceramic-Like coatings by sol gel

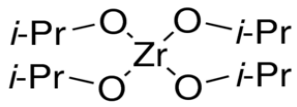
TEOS



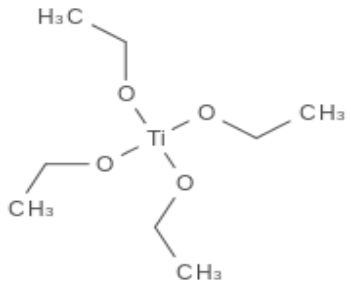
GPTMS



TPZ



$Ti(OEt)_4$



Precursors

Water

Solvent

SOL

Organic monomers (hybrid coating)

Additives (tensio-actives,...)

Catalysis (acid or alkaline)

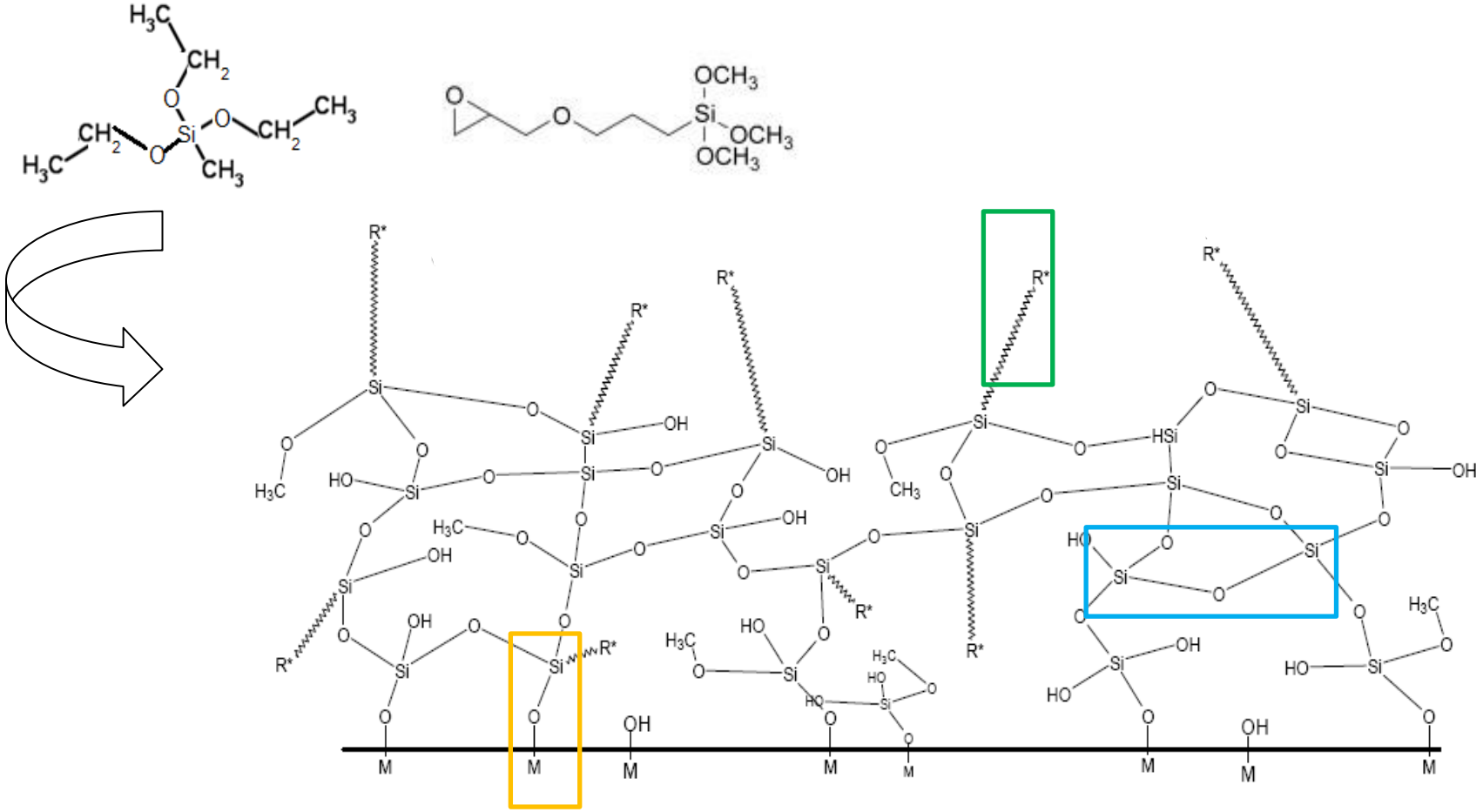
+ charges

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Ceramic-Like coatings by sol gel

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



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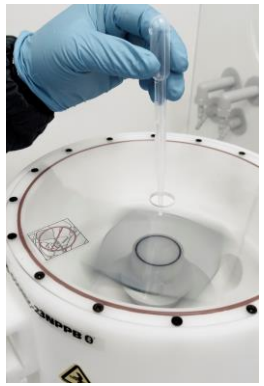
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Ceramic-Like coatings by sol gel

Synthesis



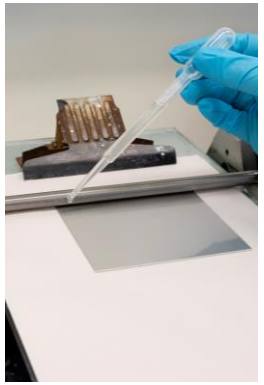
Spin coating



Dip coating



Roll coating



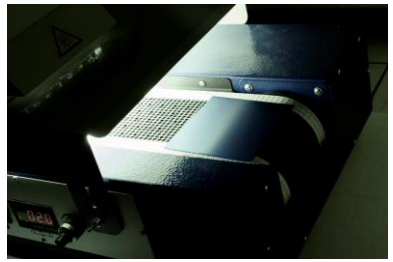
Spray coating



Cross-linking

Thermal - UV

Example : UV exposure



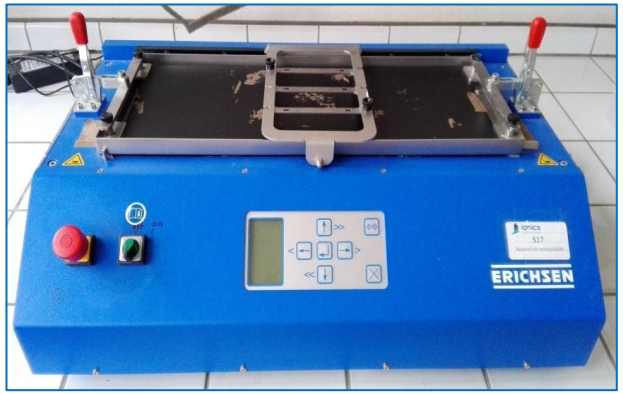
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Some key properties

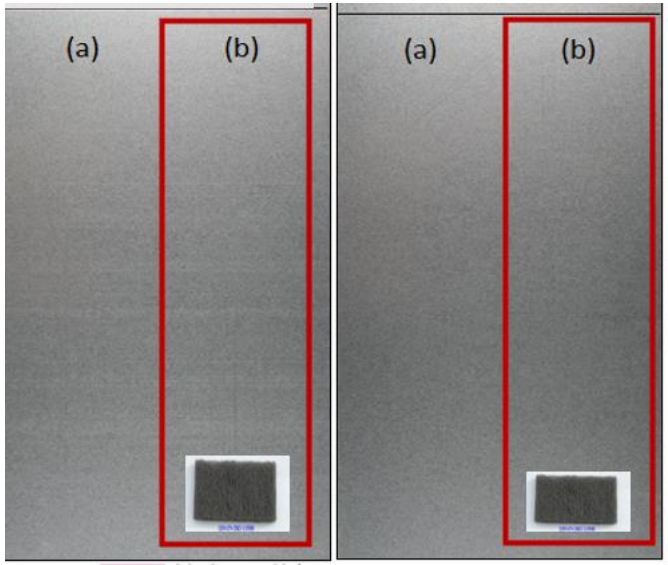
Adherence (ISO 2409)	**Flexibility** (mandrel diam : 5mm)	**Impact Resistance**	**Scratch Resistance** ISO 1518
Class 0	No peeling, no crack	1kg/ 10 – 50 cm with no cracks	No penetration to the substrate for a load >15N : OK





Humid Abrasion Resistance Test





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Some industrial applications



Kitchen appliances (stainless steel, titanium)



Luxury items (Ti, brass, gold, etc)

Pharmaceutical industry (clamps, etc) (stainless steel)





Building (aluminium)



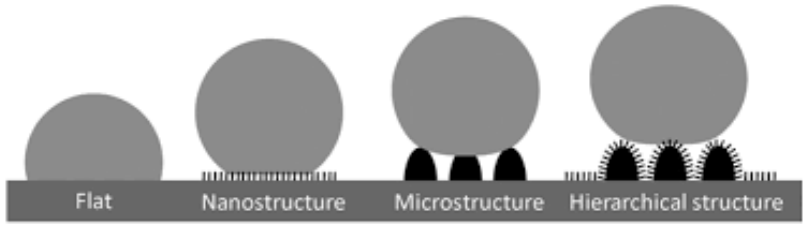
ESIX SURFACE TECHNOLOGIES

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Sol gel for « clean surfaces »

Thin layer that does not affect the appearance of the material



Anti-adhesion properties based on (super) hydrophobic

Use of anti-microbial agents or biofilm growth inhibitors

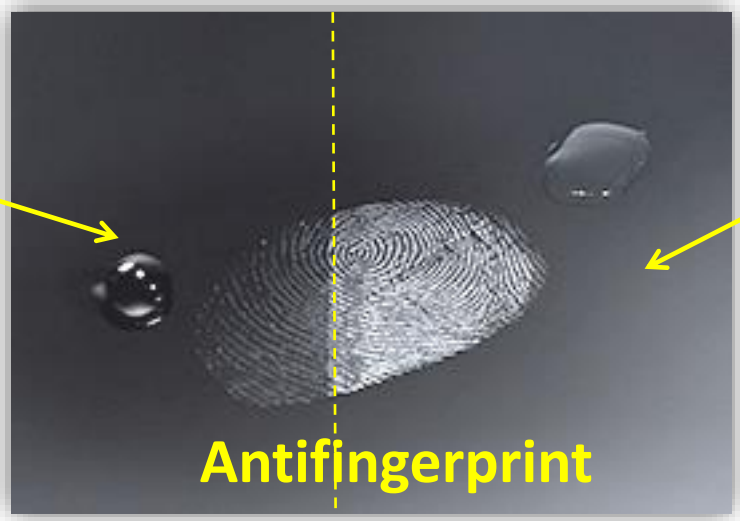
Choice of treatment technology depending on the material or the specifications

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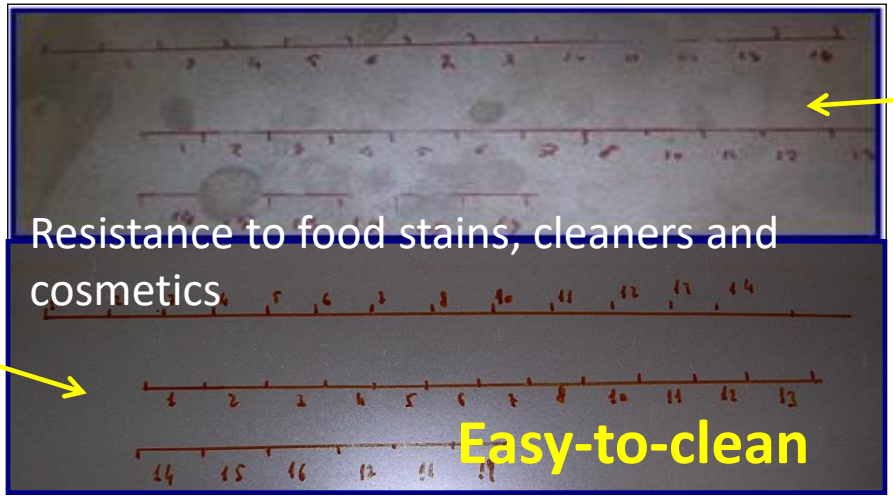
Easy-to-clean : hydrophobic sol gel

Stainless Steel + Sol gel



Stainless Steel non coated

Titanium + sol gel



Titanium non coated

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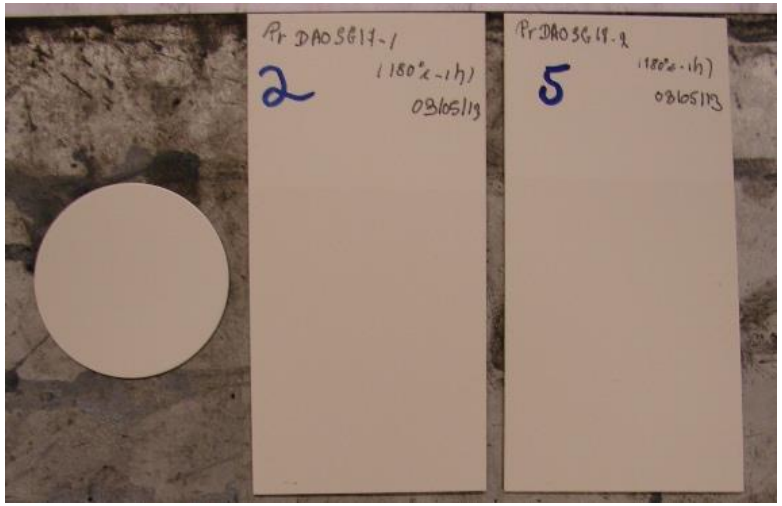
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Anti-Dirt thin sol gel coating for outdoor applications (application on prepainted steel)

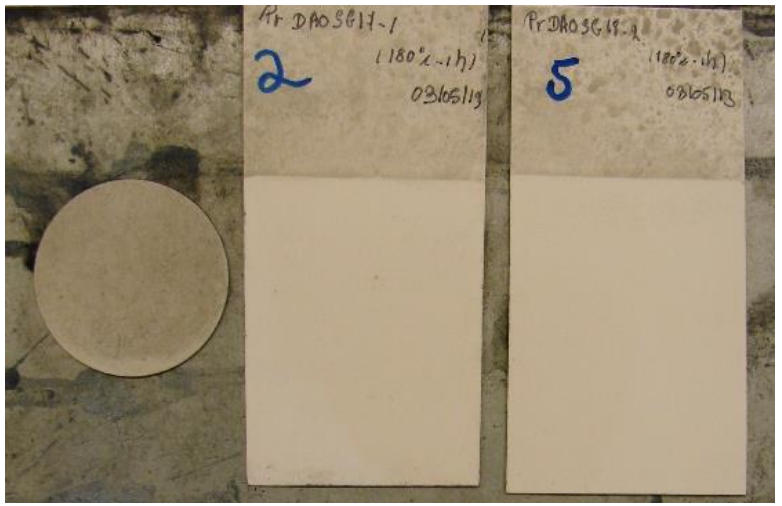
Application on prepainted steel : thin invisible (super)hydrophobic (Fluoro-based) layer with high resistance against carbon black dirtying. With sol gel the surface remains clean after 4 cycles of carbon black spray, drying and cleaning process



Initial



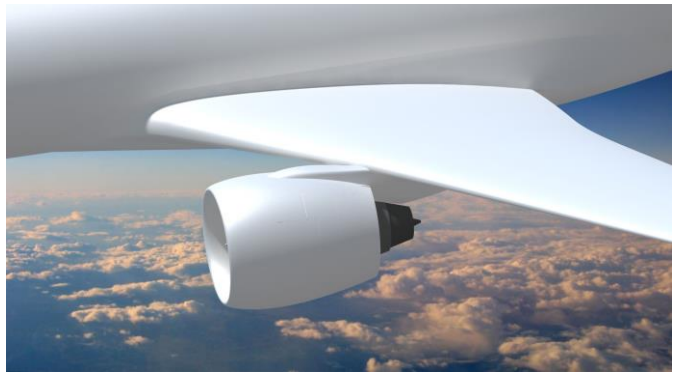
After 4 CB/cleaning cycles

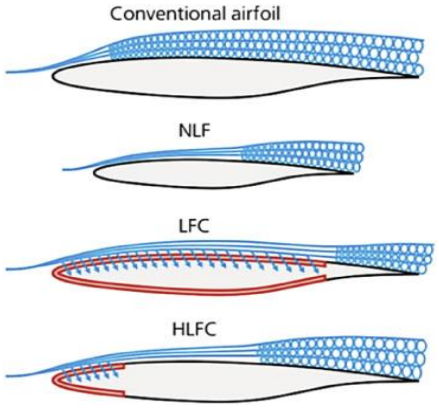


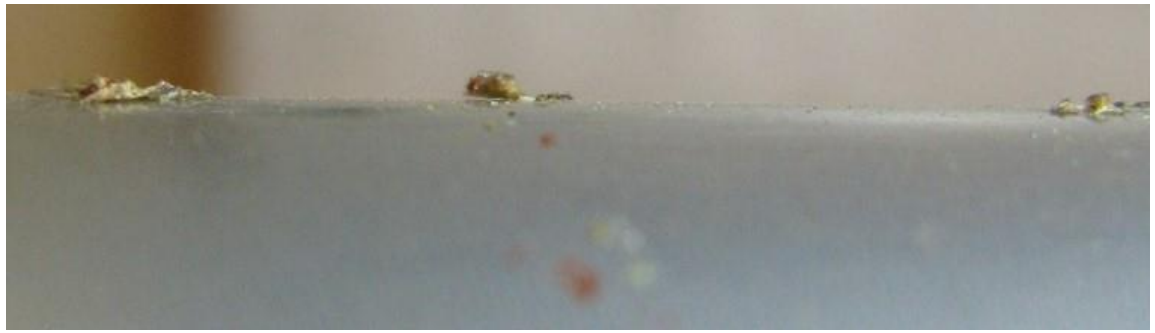
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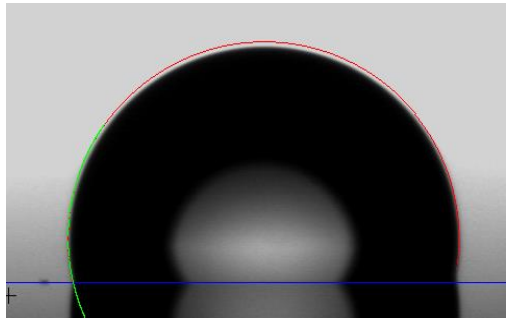
Anticontamination coatings for leading edges applications







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

HOPIN

STELLAR

Clean Sky

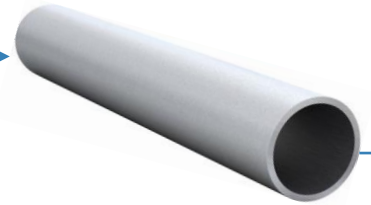
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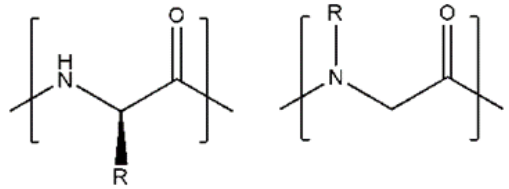
ANTI-FOULING sol gel coatings for power plants



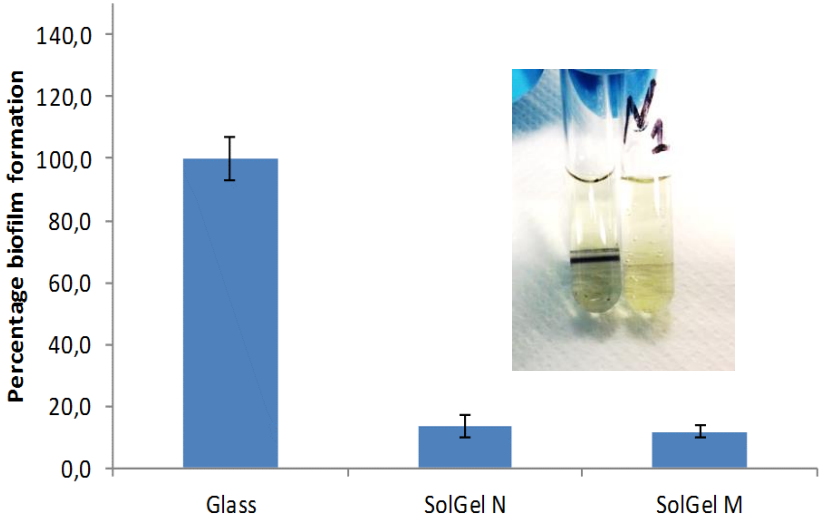
Improving long-term efficiency of heat exchangers

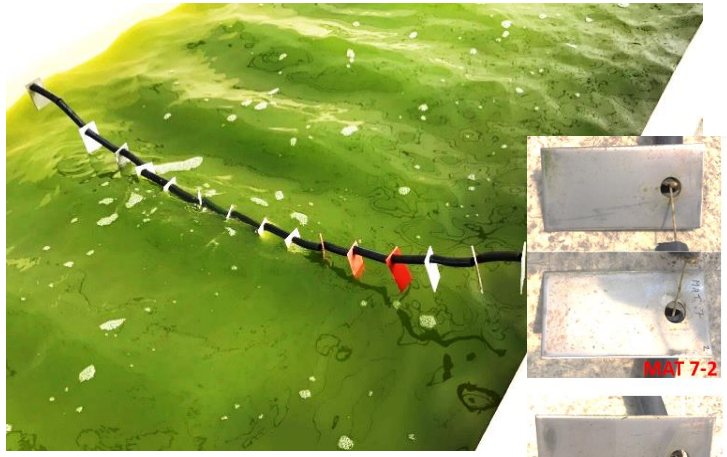


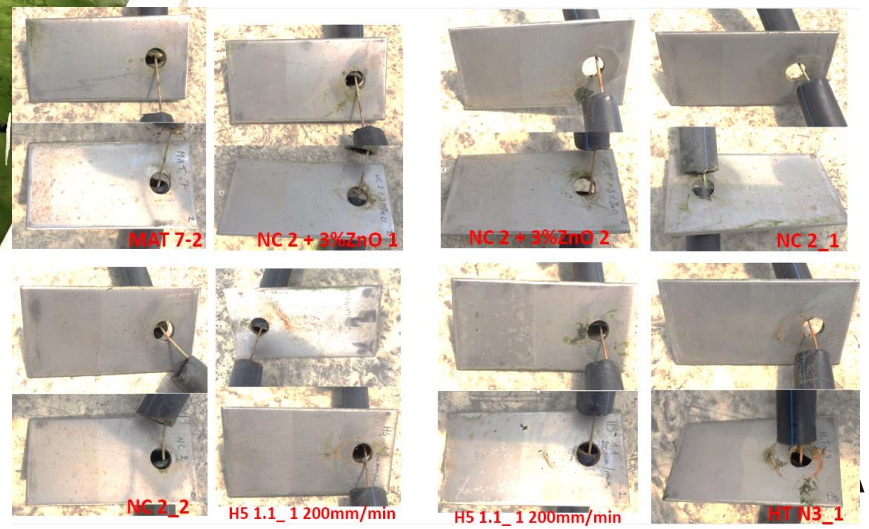
Combination of hydrophobic sol gel and peptoids having the biomimetic antifouling effect of peptides



Peptide Peptoid







THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

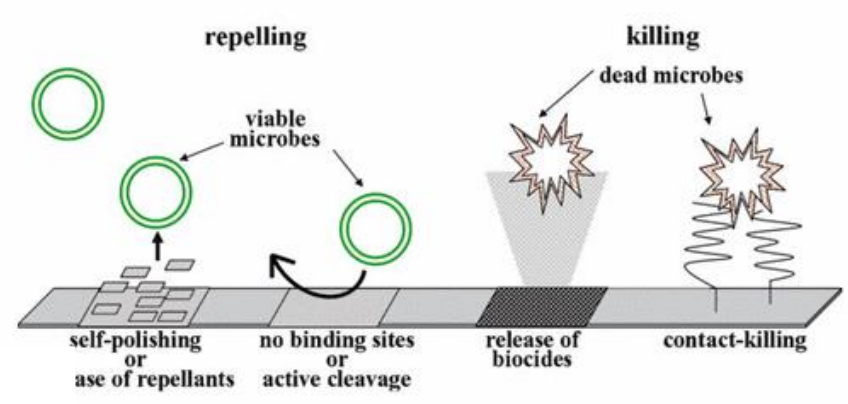
MATChING
MATERIALS & TECHNOLOGIES FOR PERFORMANCE IMPROVEMENT OF COOLING SYSTEMS IN POWER PLANTS

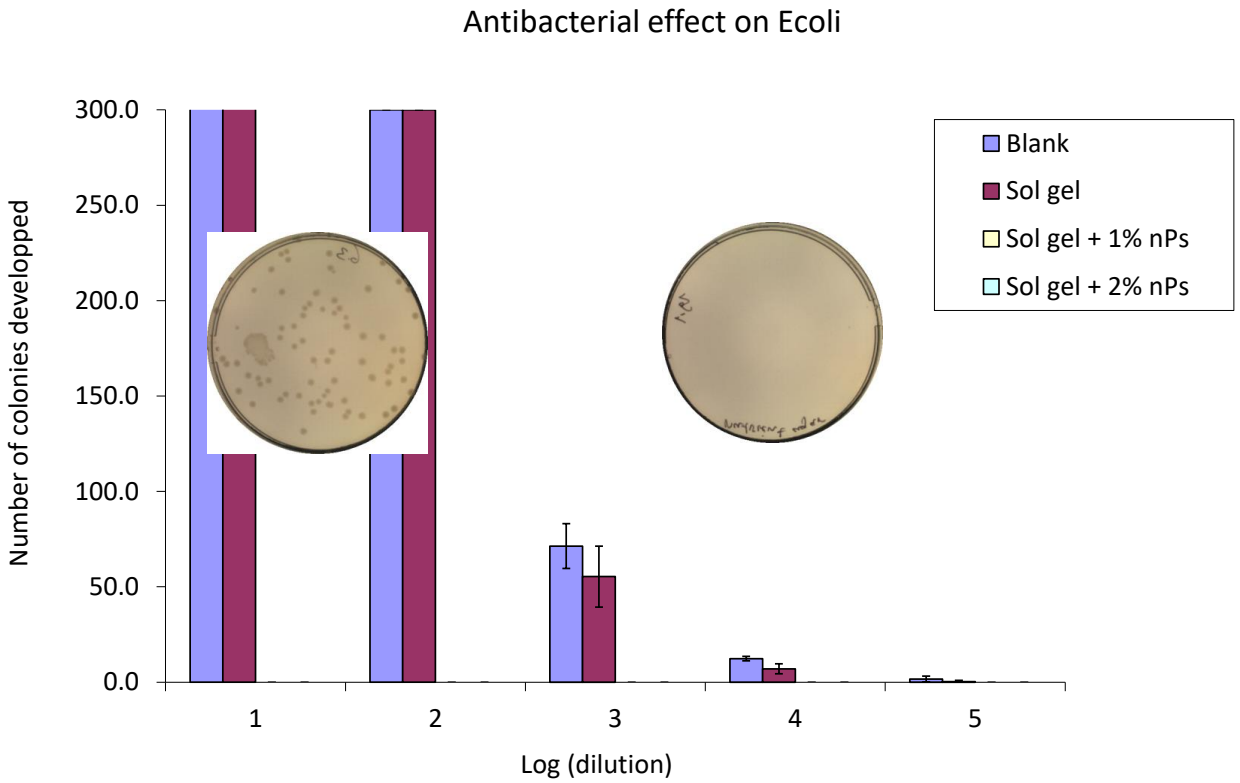
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ANTI-MICROBIAL sol gel coatings

Antimicrobial properties

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





Tests with virus ongoing !

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Conclusions



- ✓ Low thickness of the coating inducing **small modification of the surface aspect and topography**
- ✓ **Versality 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

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