PANNA

PLASMA AND NANO FOR NEW AGE SOFT CONSERVATION

SEVENTH FRAMEWORK PROGRAMME

INNOVATIVE REMOVABLE COATINGS

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ChemStream

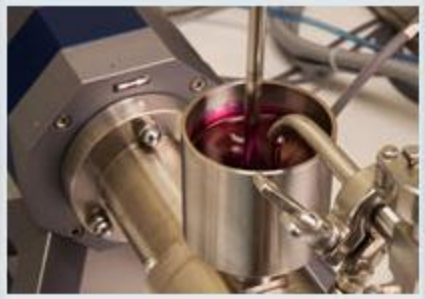
Situated @ Edegem (Antwerp) – Belgium

Since: April 2010

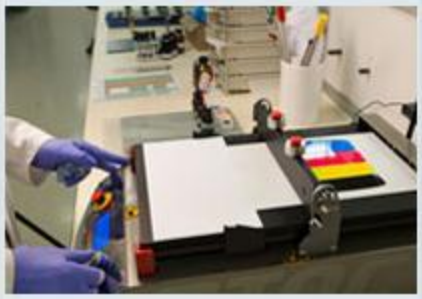
Staff: 5 PhD's in Chemistry – Material sciences

Core activities:

- Customized product development
- Innovative contract research
- Designing, formulating, prototyping
- Organic synthesis, analytical techniques, modelling, D.O.E., …



DISPERSIONS >

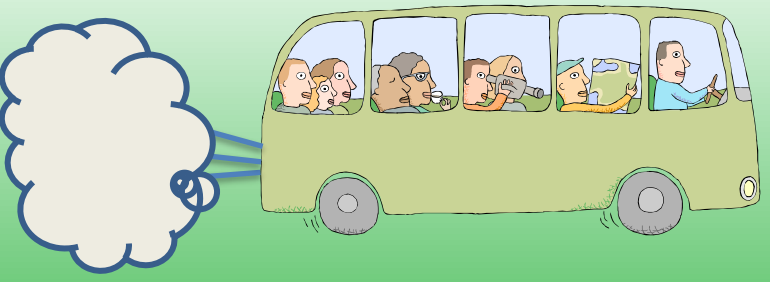


COATINGS >

INKJET INKS >

FUNCTIONAL FLUIDS >

Surface protection

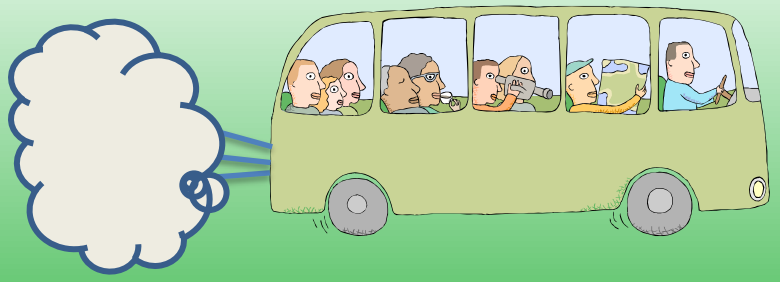


Air pollution

Surface protection

Environmental conditions

Biological factors



Air pollution

Coating

- Major culprit in deterioration is **water**
- Water carries pollutants into the interior of the artefact
- Freeze-thaw cycles may cause cracks
- Salt dissolve in water to produce acidic solutions which can corrode metal artefacts

Coatings can offer protection

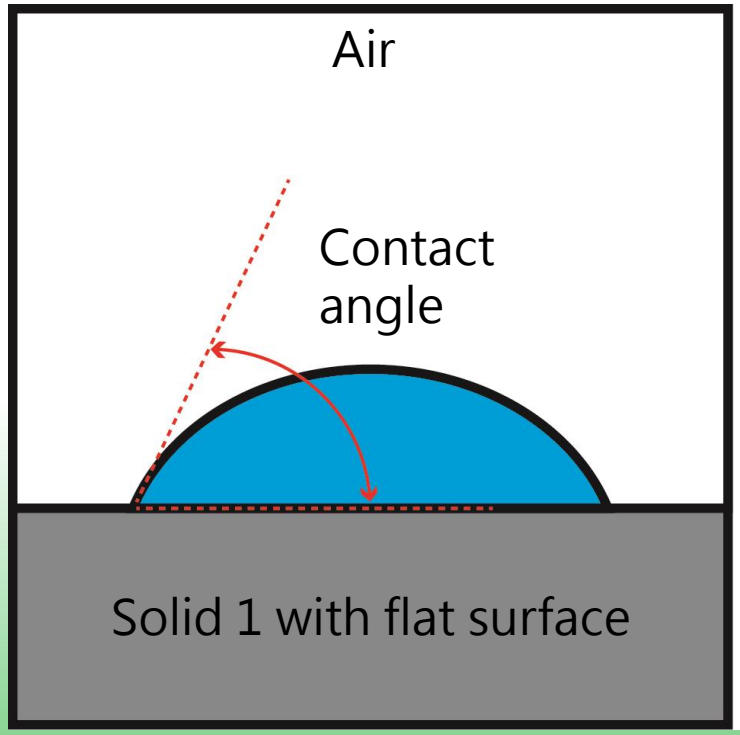
Coatings

- **Criteria**
  - Reduction of water in and on the artefact
  - Good adhesion to substrate
  - Durability against mechanical stress
  - Durability against environmental conditions
  - Transparency
  - Colour stability
  - Removability

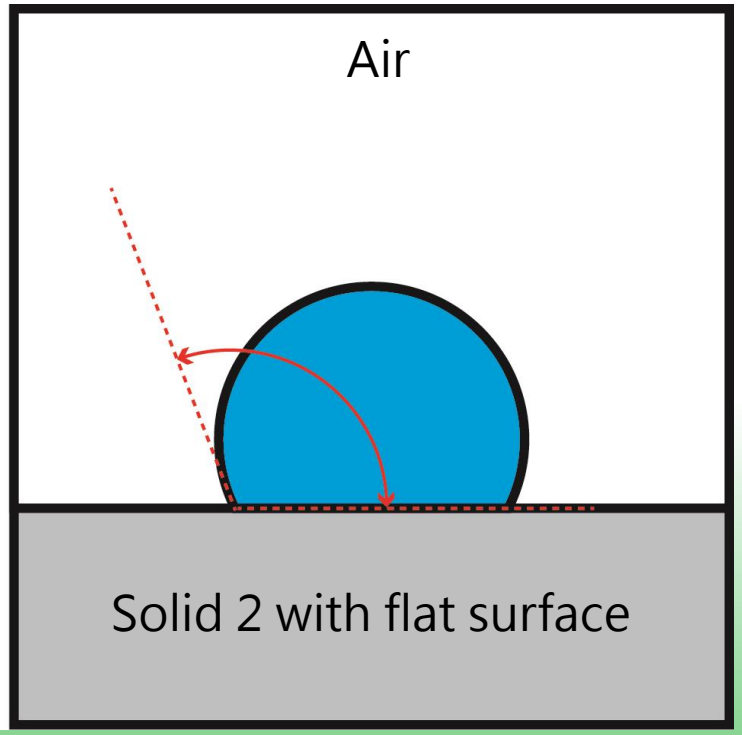
Water repellence

To prevent deterioration is to prevent water penetration

Coating must repel water from the surface



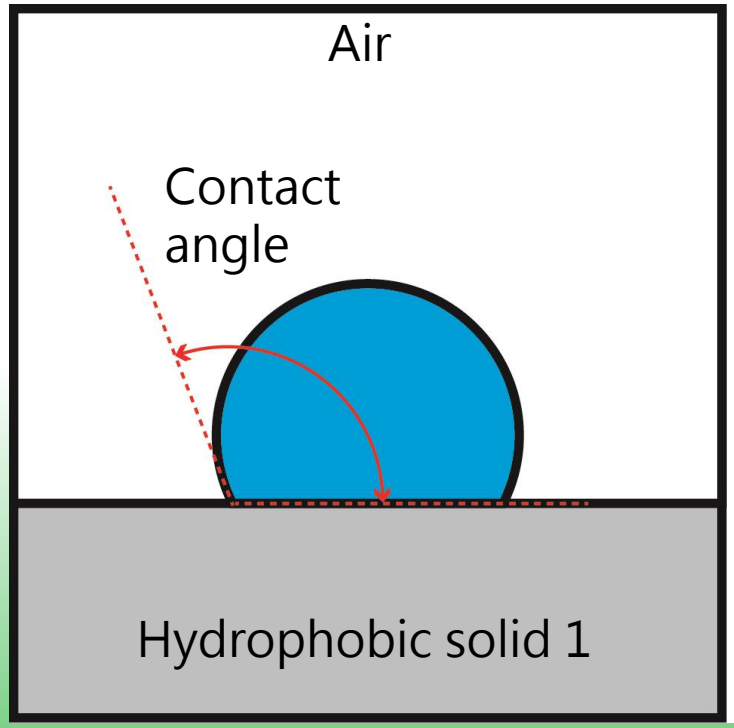
Hydrophilic surface
if contact angle < 90°



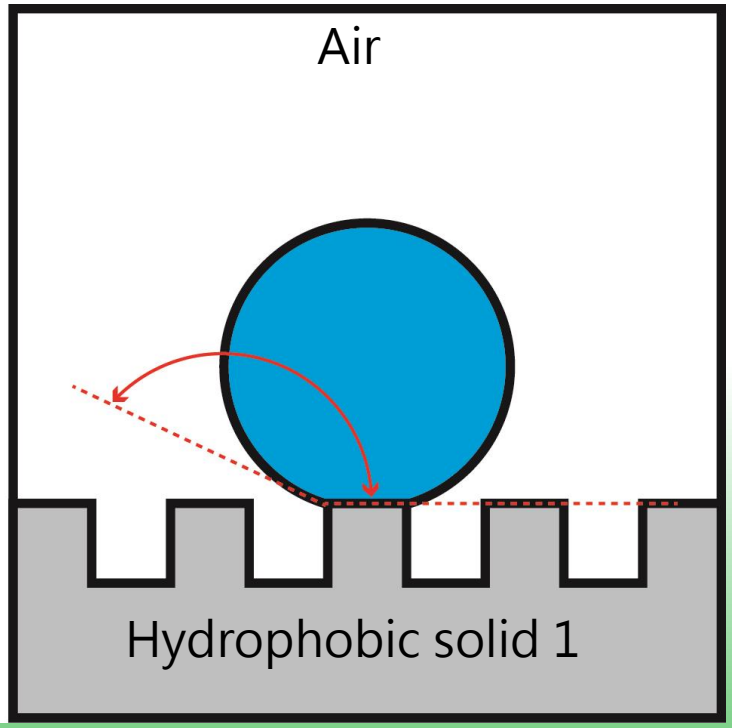
Hydrophobic surface
contact angle > 105°

Lotus effect

- **Hydrophilic surface:** enhanced surface roughness increases hydrophilic character
- **Hydrophobic surface:** enhanced surface roughness increases hydrophobic character



Smooth surface
contact angle > 90°



Rough surface
contact angle > 120°

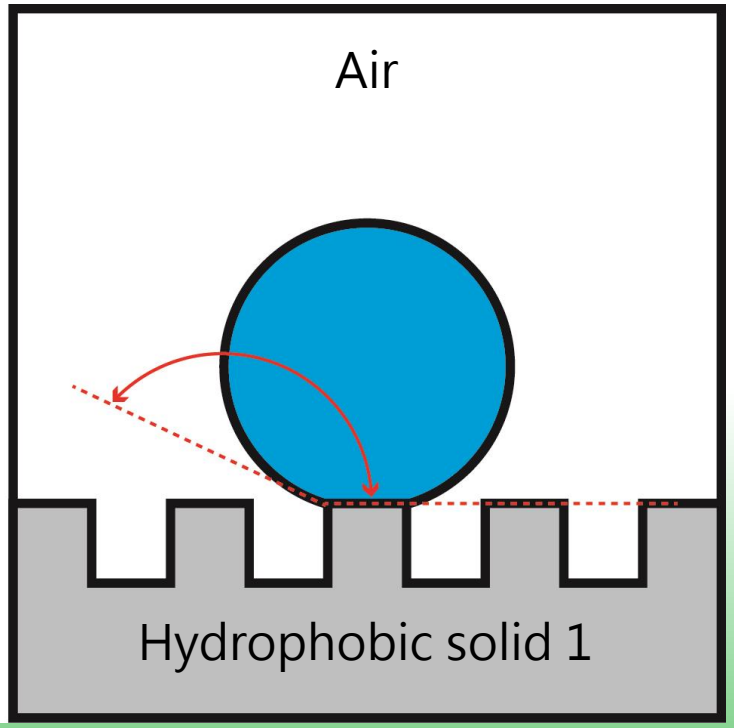
Lotus effect

Lotus effect:

- Pockets of air between water droplet and surface.
- Water droplet does not want to interact with the air pocket
- Droplet contracts to a perfect sphere in order to minimize its contact with the air.
- Contact area with solid is small and droplet rolls of the surface at the slightest tilt.

rface roughness increases hydrophilic

surface roughness increases

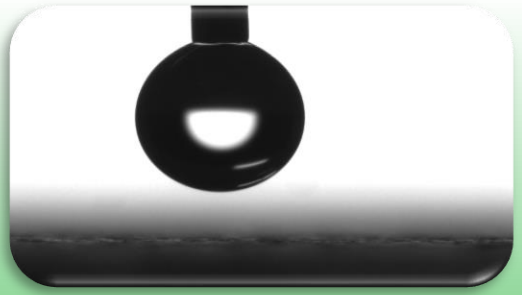


Smooth surface
contact angle > 90°

Rough surface
contact angle > 120°

Water repellence

Uncoated Sandstone



Porous surface
Water is absorbed

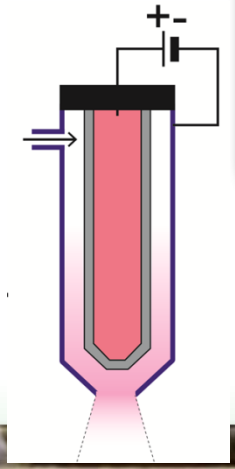
CHEM 1 on Sandstone

Contact angle: 150°

Plasma removability

Uncoated Sandstone

CHEM 1 on Sandstone



CHEM 1 plasma cleaned

PANNA Coatings

Product	Description	Contact angle (°)
CHEM 1	Acrylic polymer with hydophobing agents and particles (large)	150
CHEM 2	Acrylic polymer with hydophobing agents and particles (small)	113
CHEM 3	Acrylic polymer matrix with hydrophobing agents	113
CHEM 4	Acrylic polymer matrix with hydrophobing agents and particles (medium)	130
UV-1	UV-curable coating with different acrylate monomers	105
UV-2		110

Coatings on stone

Substrate	Coating	DE*	Contact angle (°)	Water absorption by capillary raise	Water vapour diffusion resistance coefficient	Plasma removable
Marmo cotto	Silres BS 280	0,2	100	Slight inhibition	45	No
	CHEM 1	0,3	140	Slight inhibition	36	Yes
	CHEM 3	0,4	94	High	101	Yes
Istra limestone	Fluoline	1,2	94	High	363	No
	CHEM 1	1,47	127	High	140	Yes
Serena sandstone	SILO111	1	116	Slight inhibition	21	No
Serena sanstone	CHEM 1	1,88	139	High	25	Yes

% in relation to uncoated substrate

Coatings on metal

Substrate	Coating	Colour	Contact angle	Corrosion resistance	Removable
Ag (925)	No coating		80	No	
	Paraloid B72	1,8	75	Improved	Yes
	CHEM 2	1,5	112	Improved	Yes
	CHEM 3	2	112	Improved	Yes
Polished Bronze	No coating			96	
	Paraloid B72	1,9	81	313	Yes
	CHEM 2	3,5	90	142	Yes
	CHEM 3	3	90	142	Yes
	UV-1	2	103	193	Yes
	UV-2	1,5	107	313	Yes
Patinated Bronze	No coating	-	78	96	
	Cosmoloid H80	5,5	90	313	Yes
	CHEM 1	3	150	142	Yes
	CHEM 4	6	97	313	Yes
	CHEM 4 + wax	4	90	313	Yes

#hours needed for 3% of surface to be corroded

Coatings on wall paintings and icons

Wall paintings

Comparison between Paraloid B72 and CHEM 3

Similar performance between both coatings in terms of water resistance, colour preservation and reversibility. Hydrophobic properties are **maintained after ageing**.

Icon

Comparison between Varnish Crystal (Pebeo) and CHEM 3

Similar performance on aesthetic quality

CHEM 3 **less permeable** to liquid water

CHEM 3 **better reversibility** by plasma.

Conclusions

	New coatings, developed in WP2			
Substrate	**CHEM coatings (solvent based)**	**UV-curable coatings**	**Water based coatings**	**Commercial product**
Carrara marble	CHEM 1	/	/	Silres, Wacker
	CHEM 3			
Istria limestone	CHEM 1	/	Water 2	FluolinePE, CTS
Serena sandstone	CHEM 1	/	/	Silo 111, CTS
Sterling silver	CHEM 2		/	Paraloid B72, Rohm and Haas
	CHEM 3			
Brass and Bronze	CHEM 1	UV-1	/	Paraloid B72, Rohm and Haas
	CHEM 2			
	CHEM 3	UV-2		
	CHEM 4			
Wall paintings	CHEM 3	/	Water 1WP	Paraloid B72, Rohm and Haas
			Water 2	
Icons	CHEM 3	/	/	Varnish crystal Pebeo

Thanks for listening…