Nano4CSP

Nanomaterials for reduced maintenance costs in CSP plants

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Overall Objective:
To reduce the O&M costs and water consumption while increasing the efficiency of a CSP solar collector field

Specific Objective:
Tuning the properties of **self-cleaning surfaces** to the specifications of CSP applications:
maintaining high mirror reflectivity
reduce the plant water consumption
(1% reflectivity loss → 1% increase of cleaning cost)

Tasks:
Tuning of scalable processes in order to:
Minimize diffuse reflectance
Keep very high optical transmittance in the 250-2500 nm range
Keep stability to UV, humidity, dust/wind abrasion,
high temperatures, thermal cycles, etc
Durability - lifetime similar to that of the heliostat: 20-30 years

Testing in real operational environment

Market study

Partners – Roles

Coating Materials:
National Centre for Scientific Research “Demokritos” (NCSRD) - *Greece*
- Electron Microscopy and Nanomaterials
- Nanotechnology Processes For Solar Energy Conversion and Environmental Protection
- Plasma Enabled Nanofabrication and Applications

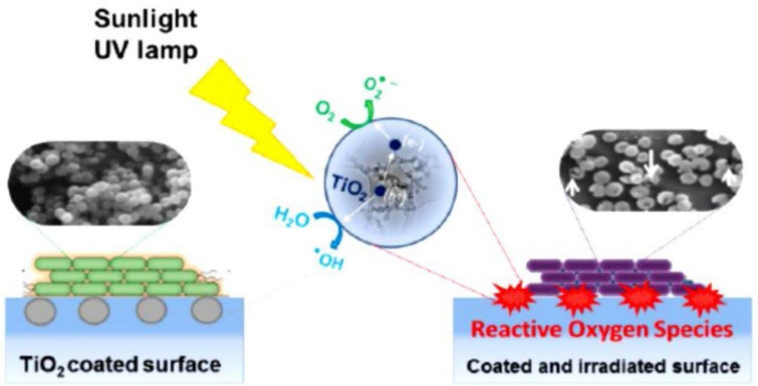
Montanuniversitaet Leoben (MUL) – *Austria*

BFP Hellas (BFP) - *Greece*

CSP evaluation:
Cyprus Institute (CYI) - *Cyprus*

Coating Material	Function	Method	On existing mirrors	Thickness scale	Partner
Undoped TiO_2	Superhydrophilic	Magnetron Sputtering	Yes	10	NCSRD
Undoped TiO_2	Superhydrophilic	Hydrosol – Dip Coating	No	40 nm	NCSRD
Doped TiO_2 & Nanoparticles of TiO_2	Superhydrophilic	Magnetron Sputtering	No	10-100 nm	Leoben
Polymers (COC etc)	Superhydrophobic	Surface nano-texturing and plasma treatment	Yes	μm	NCSRD
SolarSkin & Thorasil	Hydrophobic	Spraying	Yes (application also on site)	• μm	BFP

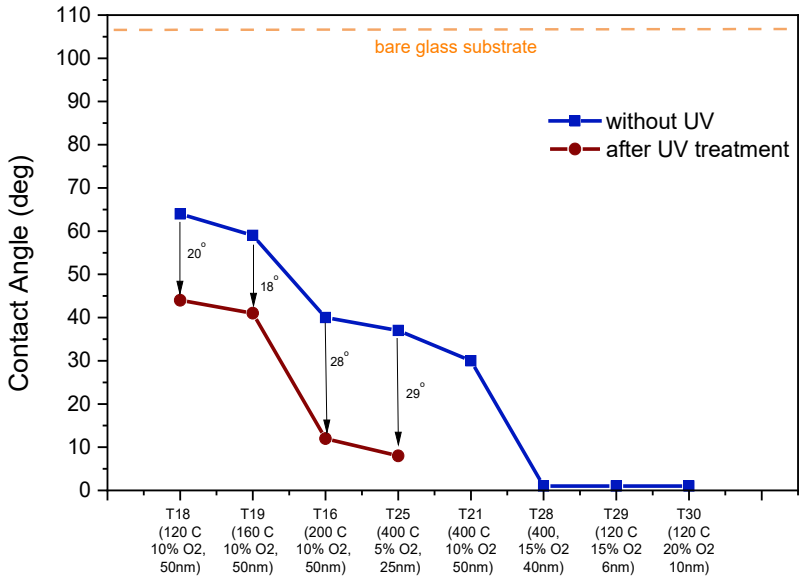
Self-Cleaning Mechanism (A)

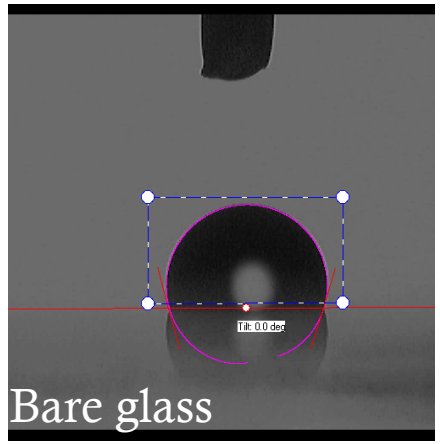


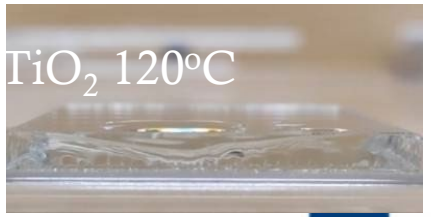
An example of work (Sputtered TiO_2)

Transparency: Ultra-thin
Low cost: Low Temp (on existing mirror)

Contact Angle Measurements
- Bottom: TiO_2 coated at 120°C: <1°

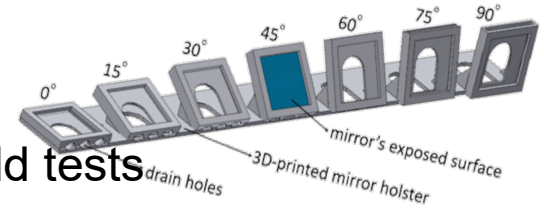


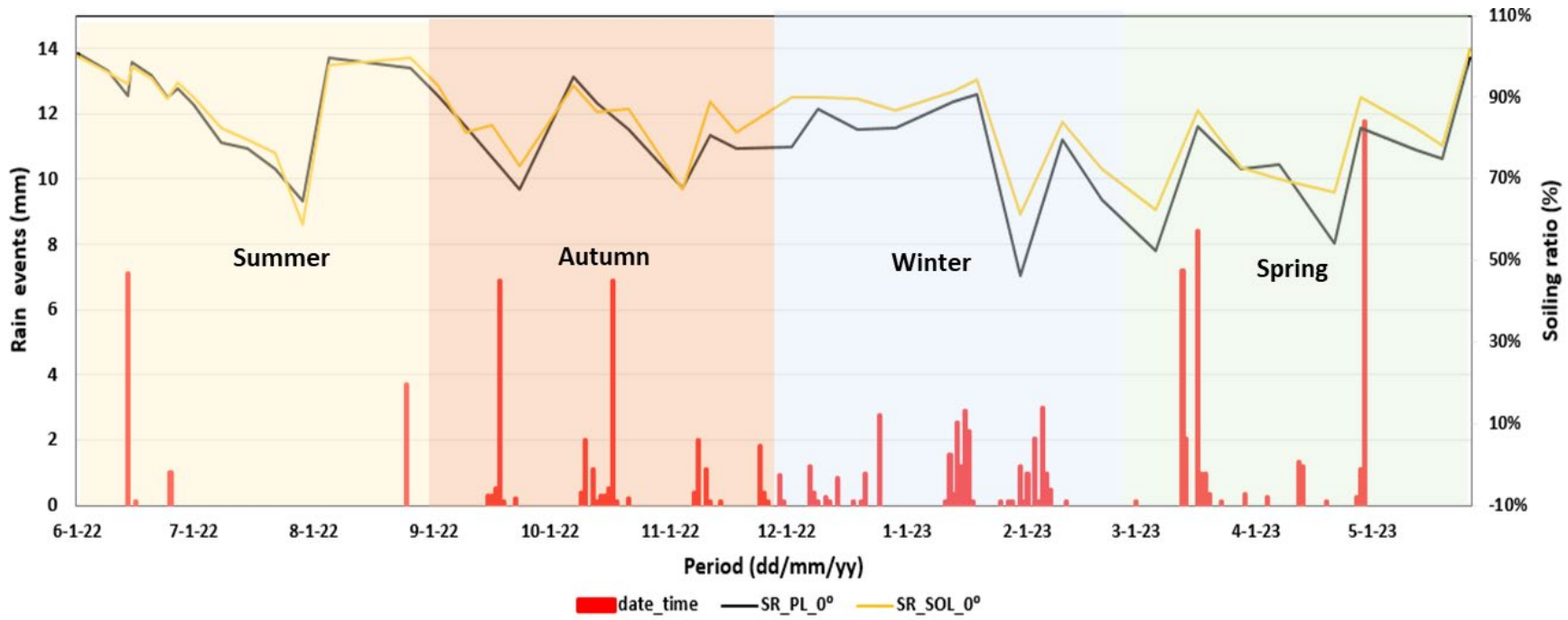




Field Testing (CYI)

Field tests





Sol-Gel - 0 deg

Result Summary

Dependance on the coating /substrate used - All technologies showed positive aspects

<u>Simulations show (based on our measurements):</u>

Annual reflectance efficiency increase:	1-3% / 5-8%
Mirror cleaning cost decrease:	3-8%
Reduction in water consumption:	3-8%
Weighted average levelized cost of electricity (LCOE) decrease:	0.8% - 1.5%
Cost of coating:	2- 5 €/m^2

<u>Durability</u>

Best results came from the less durable samples

Need to collaborate with mirror manufacturers

Experience gained in transnational set-up

- Importance to **cross scientific disciplines**: one's weakness is someone else's strength
- Importance to **cross borders:** Good partners are not necessarily near you
- There is a wild variation of **bureaucracy** in Europe: from minimal to maximal

Critical factors and lessons learned for future successful transnational R&I projects

- There is a need for precise planning of the **funding flow**
- Such projects provide a great opportunity to **harmonise** the various national funding rules across the EU

Thank you!

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