Coatings and Surface in TWI

Materials Joining and Engineering Technologies

Coatings & Surfacing in TWI

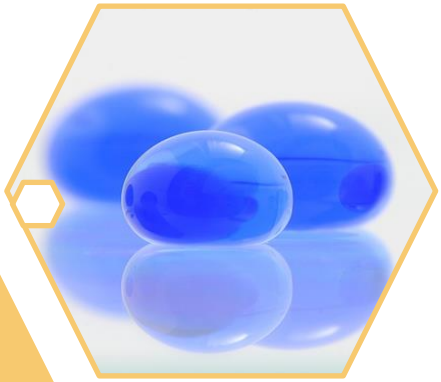
- **More than 35 staffs (including 5PhD/EngDoc Students between 3 sites:**
  - Cambridge (New materials, formulation, Plating, surface engineering(TSA, HVOF)
  - Sheffield (Laser cladding)
  - Middlesbrough (coating process, surface understanding & interpretation)
- **Competences:** Chemists, Materials Scientists, Material & Chemical Engineers...

SECTORS OF INTEREST

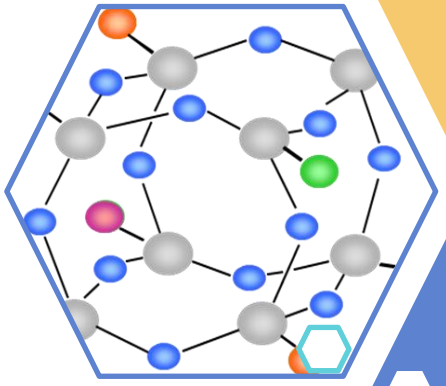
ENERGY	AEROSPACE	CONSTRUCTION	OIL&GAS	TEXTILE

NEW MATERIALS / COATINGS

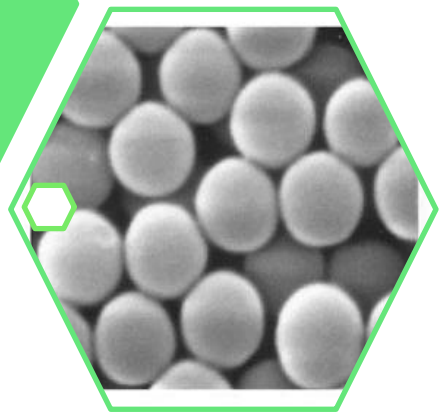
Our Aim: to produce enabling technologies that will allow production of durable functional coatings



Properties

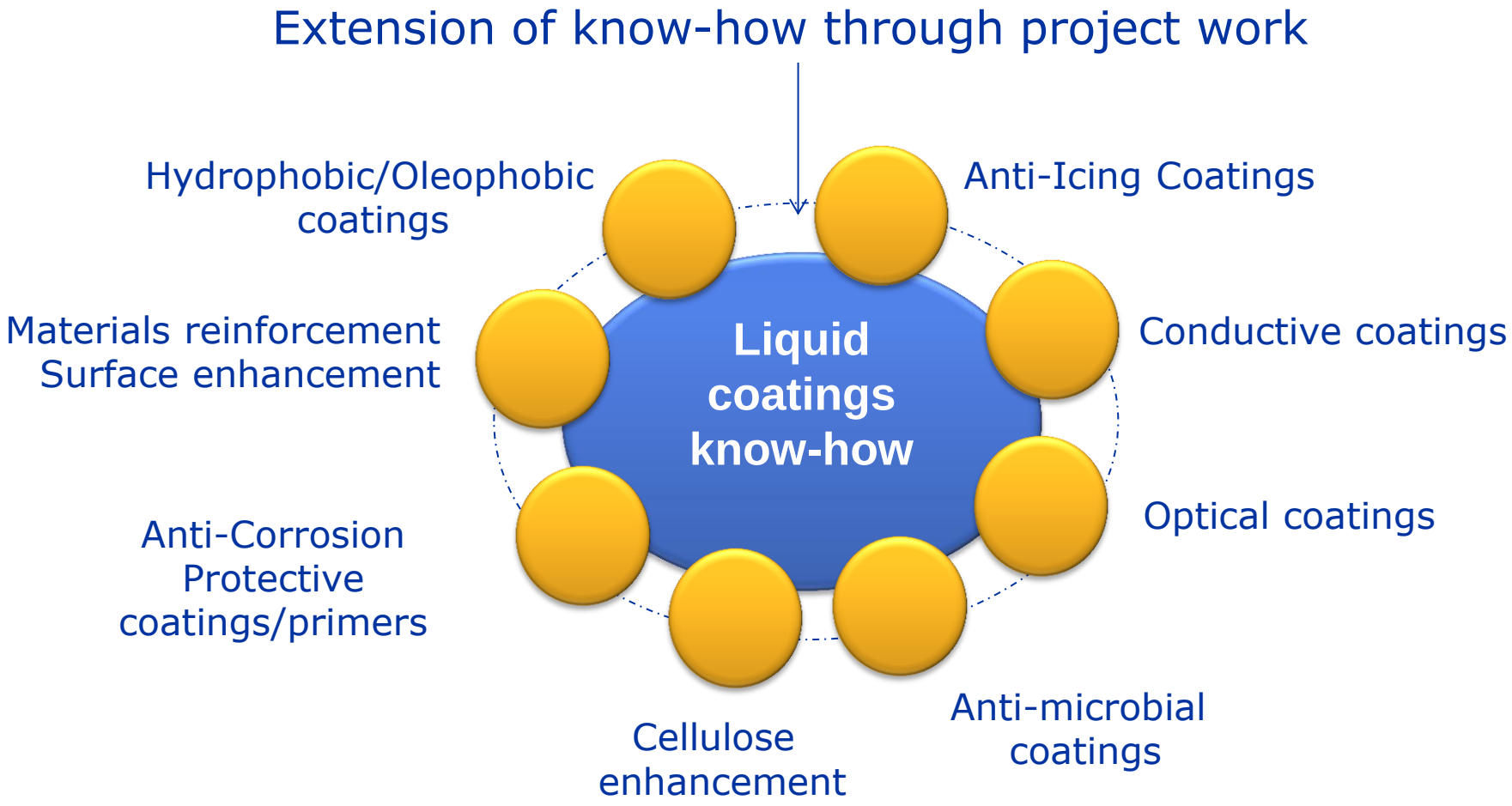


Structure



Composition

Technology Hot Topics

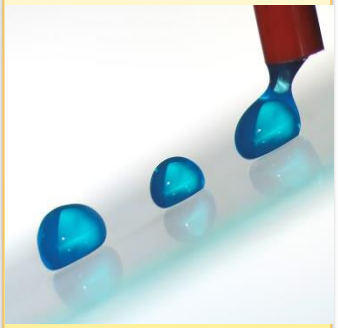
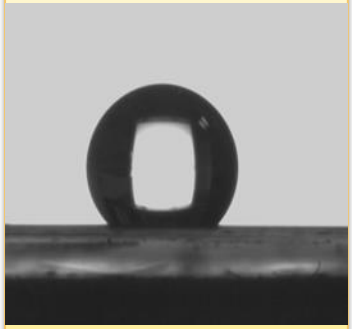


Controlling Surface Energy

Deposition of functionalised silica nanoparticles onto the substrate

Easy deposition: Dip coated or flow coated
Dry oven or UV cure
Solvent: IMS or others
Silica content: 8-9%
WCA on glass : 150°

Super-hydrophobic properties result from dual-scale roughness and low surface energy

Aluminium	Glass	Textile	Wood	Polymer
				

Video

WeldaPrime

Self-repairable Zinc-free Weldable Anti-corrosion Primer for Steel Protection

Rust develops on steel during transportation, handling and storage.
→ Material waste and higher costs

Project aim:

To develop an anti-corrosion weldable, zinc free primer that lasts at least 1 year and that does not need grinding before welding or blast-cleaning before finishing.

Coating development aspects:

- Synthesis
- Formulation
- Deposition and curing
- Testing
- Demonstration

Application of sol-gel derived materials to address:

- Corrosion performance
- Weld-through characteristics
- Compatibility with the final top-coat (applied to the welded structure)
- Low VOC and Zinc-free

ICE-FREE

Development of durable easy to apply anti-icing polyurethane coating for aluminium overhead power lines (OHL)

Ice accretion on high voltage power lines is a severe problem for power networks and it can cause insulator flashover, wire breakage and tower collapse

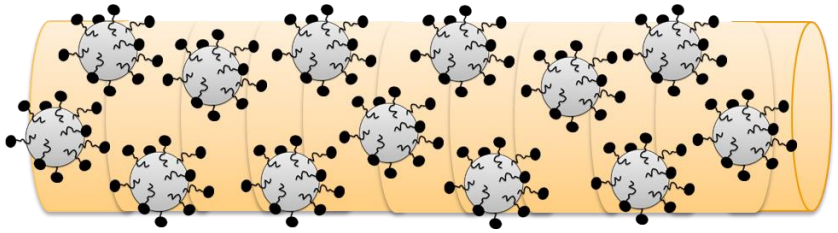


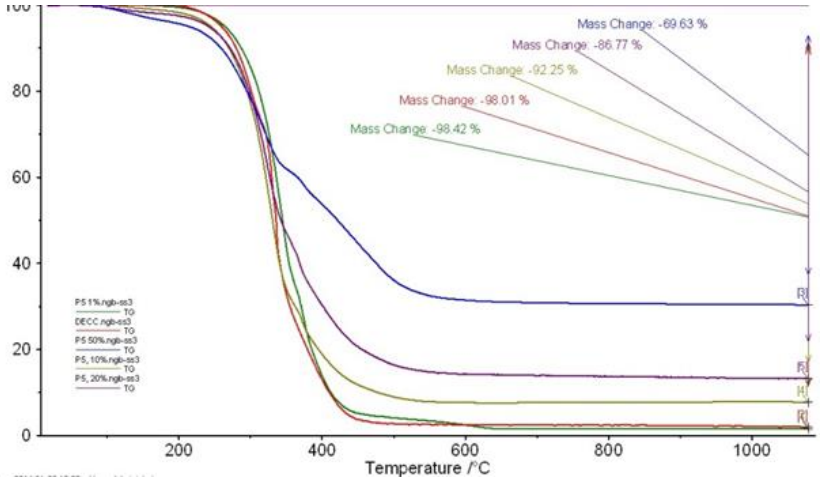
Figure Hybrid high functional coating deposited on power lines to reduce ice accretion

COEUS TITAN

CoeusTitan is developing a gel-coat that will extend the life of composite moulds for the manufacture of plastic and composite components, with the associated cost saving.

The addition of a proportion of silica nanoparticles into the epoxy resin matrix (~50%wt) can provide to the tool mould:

- Thermal stability
- Low surface energy (non – stick properties)
- Higher mechanical robustness



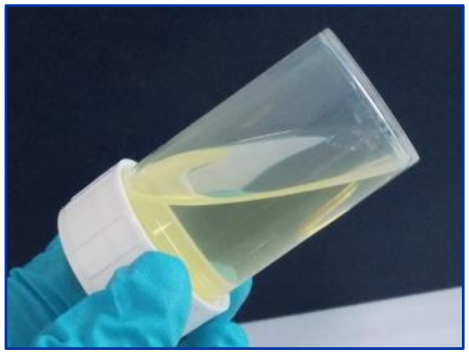


Figure 1 Low viscosity epoxy resin with ~50%wt in silica nanoparticles loading

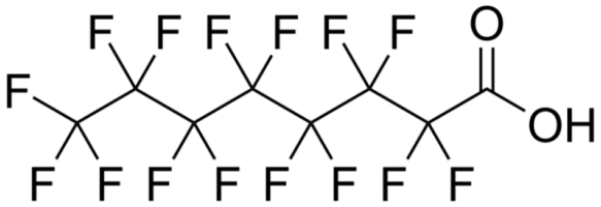
Figure 2 Epoxy resin blocks with and without ~50%wt of silica loading

TEXSHIELD

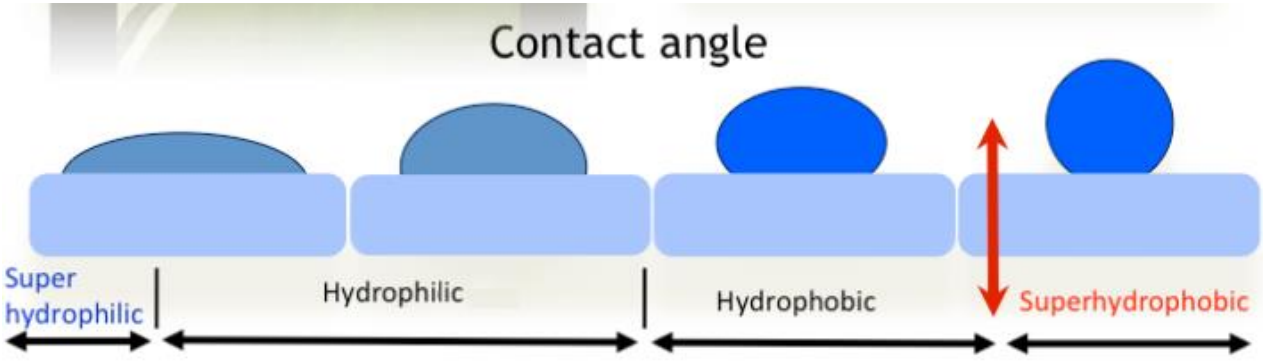
Environmentally Friendly and Durable Oil and Water Repellent Finish on Technical Textiles

Providing a cost effective alternative treatment to C8-PFCs by reducing the total fluorine content in the treatment for the Textile industry. This treatment will allow textiles to have durable anti soiling/anti-staining properties.

Chemical structure of C8-PFCs



Creating additional functions such as anti-static and anti-microbial properties



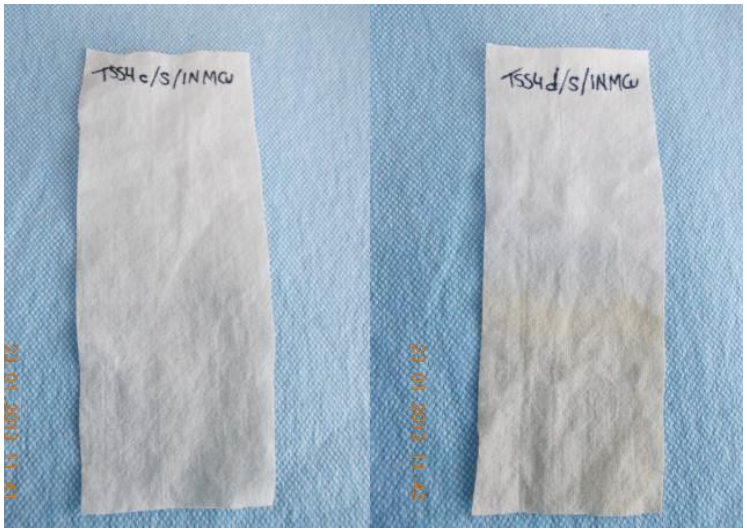
Different hydrophobicity depending of the type of surface

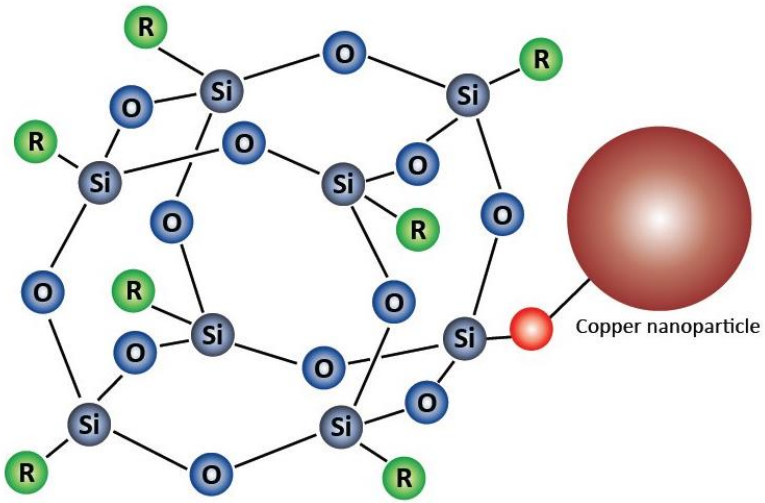
CuVITO

Nano-Structured Copper Coatings, based on Vitolane® technology, for Antimicrobial applications

Development of anti-microbial coatings for textiles for public buildings using :
Copper nanoparticles
Vitolane-based functionalization

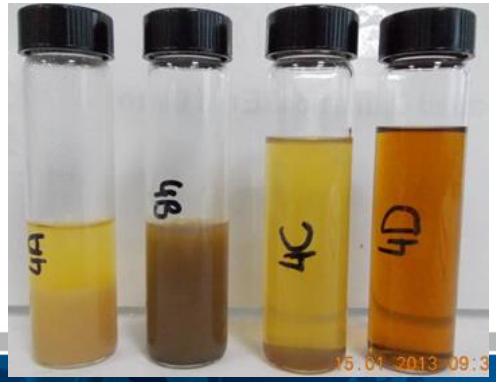
Joint EC/Mexico project





A molecular-scale cage structured silsesquioxane additive (Vitolane® technology) with a Copper nanoparticle.

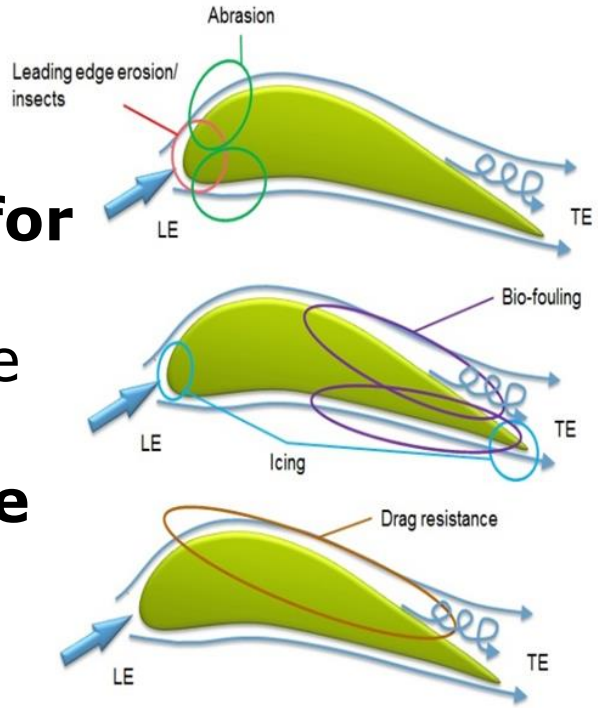
Copper inks on cotton sheet swatches.



NATURAL

NATURAL aims

- to develop of the first generation of **metrology standards** that relate structural hierarchy **to performance for nanostructured coatings**.
- to develop a robust, rapid and accurate methodology that allows the **determination and prediction of the durability and performance** of the coating for wind blade.



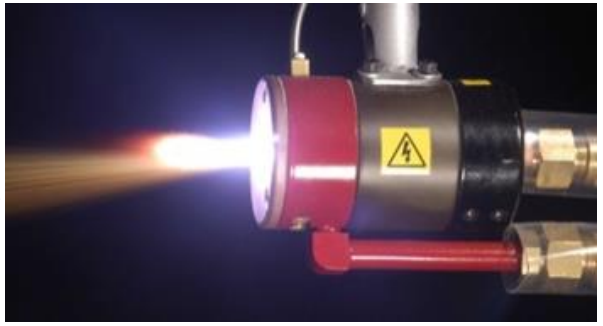
SURFACE ENGINEERING

Cold Spray Alumina Coatings

- Rapid build-up of metal deposits with minimal porosity and no oxidation
- High pressure He or N2 mixtures
- No melting of consumables

Surface engineering

Thermal Spray coatings



- Ceramics (Al_2O_3, ZrO_2…)
- Zirconia based coatings

Hydroxyapatite and other bioactive materials

Process development to tailor coating properties and control phases

- Can create composite, graded & multilayer coatings

HVOF Coatings

- TopGun HVOF system used for ceramic coatings e.g:
  - Alumina
  - Zirconia
  - HA
- Bearing surface applications

Surface Engineering Hot Topics

Thermal spray coating of polymer composites – Aerospace
Cold spray technology – Aerospace, Electronic, Biomedical
H_2 embrittlement testing (coated high strength alloys) – Aerospace, Oil & Gas
Automated surface preparation (grit blasting) – All industry sectors
Testing and characterisation of thin film, slurry, plating, thermal spray coatings – Oil & Gas
High temperature coatings e.g. biomass, waste combustion, metal dusting– Power Generation
Offshore applications for thermal spray Al (TSA) – Oil & Gas, Wind, Wave & Tidal

Joint Industry Projects (JIP)

Recently Completed

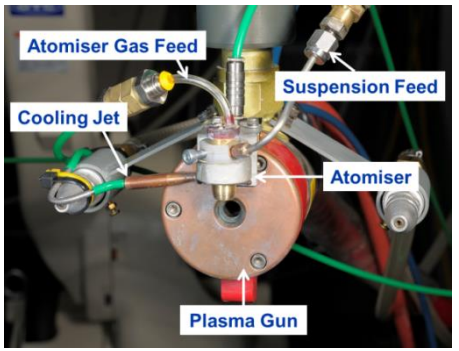
- Improved splash and tidal zone coatings for a 40-year design life (oil & gas, wind power).


- Development of coatings for corrosion mitigation in biomass, waste-to-energy and other process plants (power generation).

Currently running

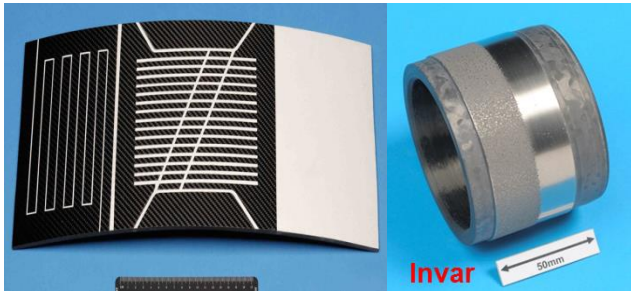

Recently Completed UK Collaborative Projects

- TSB: Cold spray Al-B_4C coatings for neutron capture (nuclear power).
- TSB: Development of photo-catalytic coatings for splitting H_2O (using suspension spraying) (renewable energy).
- 22665 RGF/BIS: Automated application of 40-year life coatings for wind turbine structures (renewable energy)



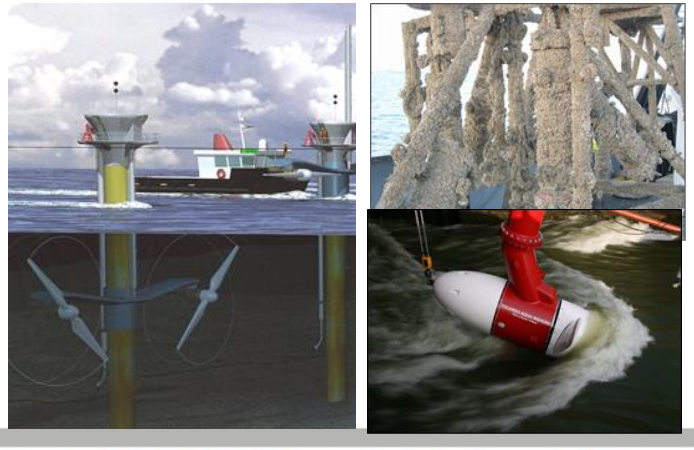
Current EU Collaborative Projects

- 23506 FP7 Clean Sky: *COMPOCOAT* - coatings for composite gas turbine blades (aerospace)



- 23405 FP7 Thematic: *CORSAIR* - cold spray coatings and repair (aerospace)

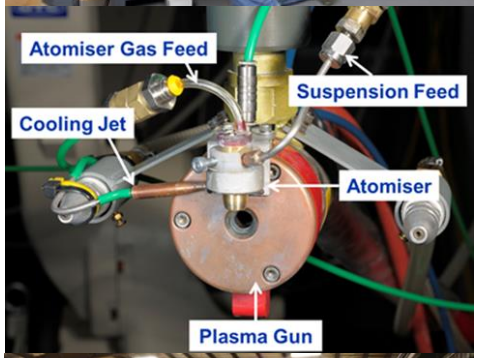
- 23789 FP7 R4S: *ACORN* TSA / anti-fouling duplex coatings for wave & tidal energy generation devices (renewables)



2012-2015
Core Research Programme (CRP)

22407 Automated surface preparation methods for thermal spray coating (grit blasting)

22438 High temperature corrosion testing (including metal dusting)



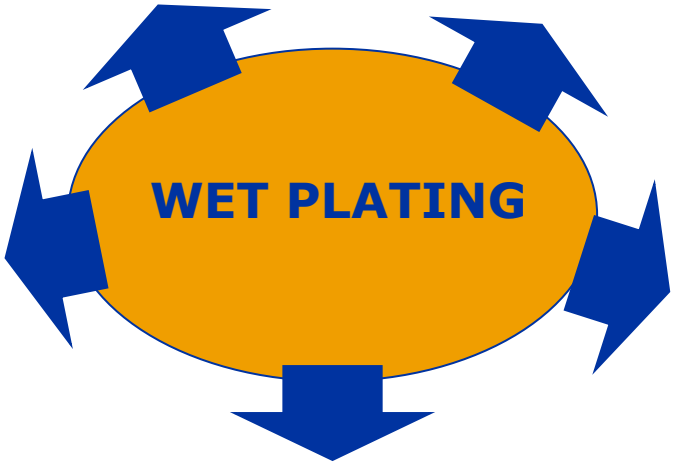
22419 Further development of Cold Spray process - deposition of more challenging coating compositions (Ni718)

22466 Development of a suspension spraying capability (nano-scale powders)

ELECTROPLATING

Electroless (or 'autocatalytic') deposition of metal films

Electroplating (or 'electrodeposition') of metal films



Conversion coatings (usually phosphates/chromates of Fe, Zn, Mn)

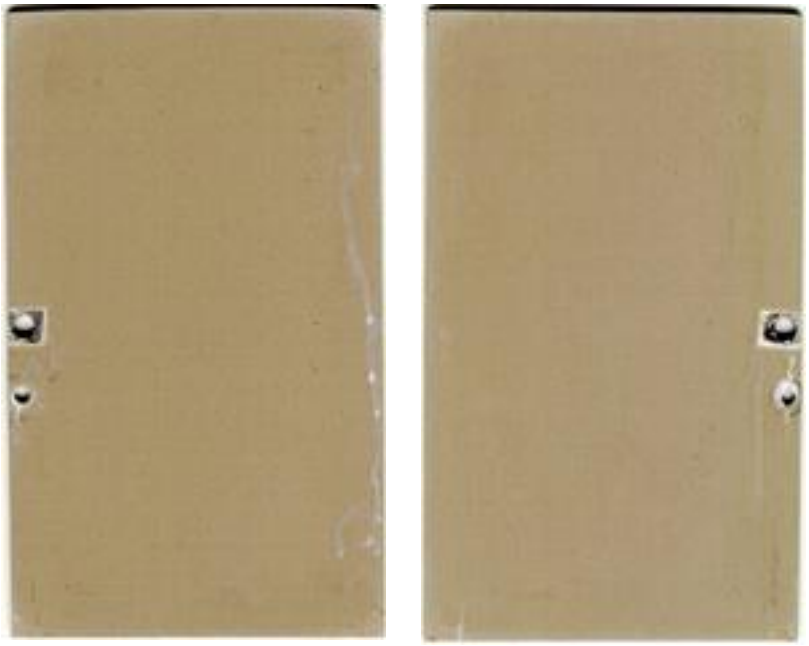
Anodising (oxide film growth on non-ferrous metals):conventional, PEO and Hard Anodising.

'Hot-dip' coatings
(eg. galvanising - using a bath of molten Zn)

wear and corrosion protection using wet plating.

Corrosion performance:
Salt fog test (5% NaCl)

168 hrs

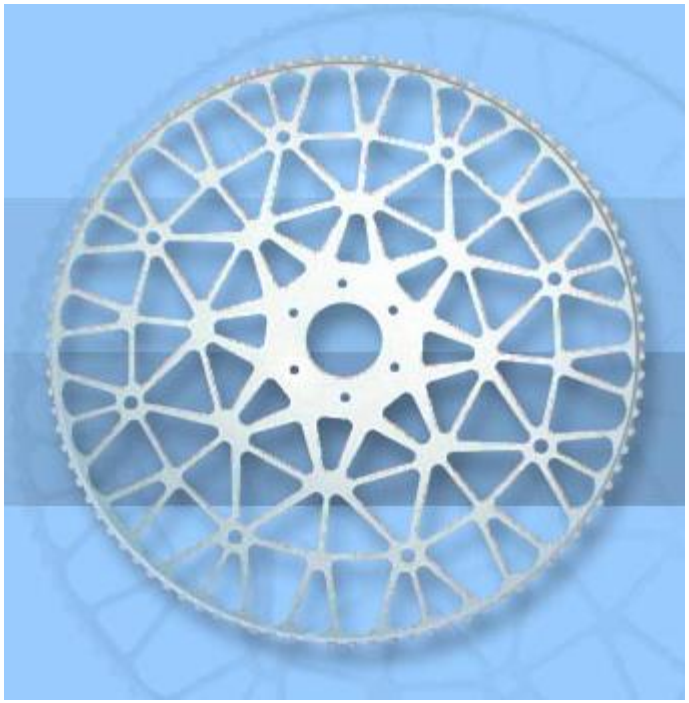


336 hrs

- Plasma electrolytic oxidation (PEO) coatings show no signs of corrosion after 336 hrs exposure in 100% humid atmosphere with NaCl
- Thus, thin (10 - 20 μm) PEO coatings on Al can provide effective barrier against corrosion attack in chloride environments

Courtesy of WPAFB

Examples of PEO applications for Aluminium



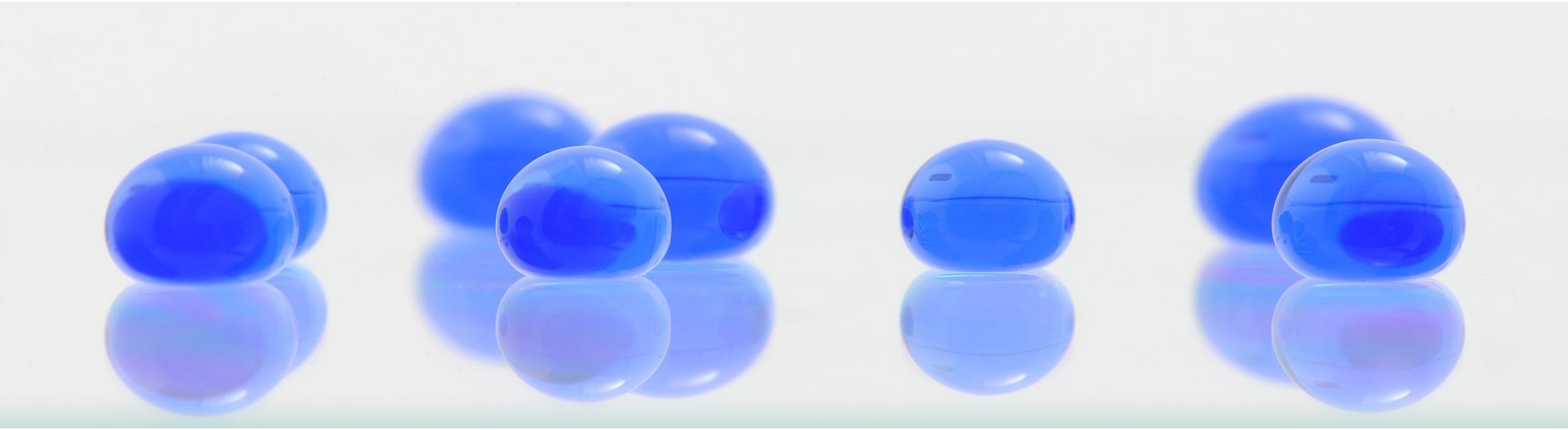
Al wheels with PEO or PEO+PTFE coated teeth reduce wear against belts and chains.
No lubrication required.

Thermal barrier PEO coatings reduce temperatures in automotive piston crowns and improve overall engine performance.

Al moulds with PEO+PTFE coating reduce adhesive wear during casting. Tool production costs also reduced.

Source: www.keronite.com

THANK YOU



Coatings@twi.co.uk

http://youtu.be/t1S1KaN95W8?list=UUVyzolRz8436963AmklQM4Q