



Recubrimientos resistentes a la contaminación superficial para incrementar el rendimiento de las energías renovables

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cidetec >
surface engineering

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Outline

CIDETEC overview

Introduction

Omniphobic technologies CIDETEC:

- Approaches

- Performance and functionalities – use cases

Scaling - up

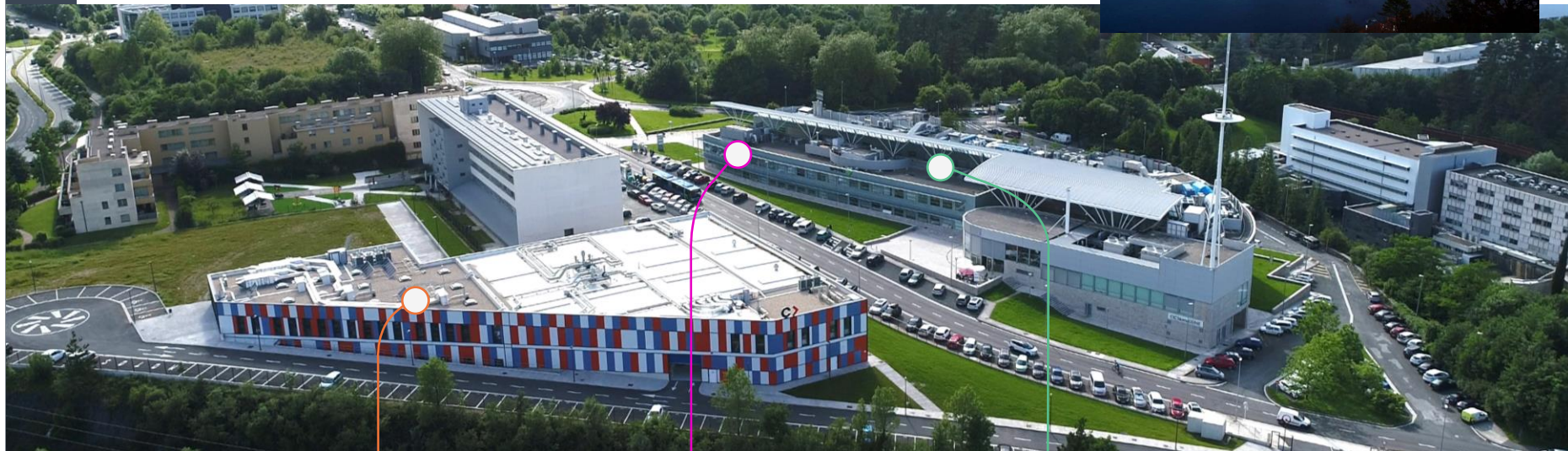
Current challenges



CIDETEC overview



complex



surface engineering



nanomedicine



energy storage





18 M€	260	82	
	54 %		32
Key Data	20	260	8



A big player in Surface Engineering

CIDETEC is one of
the major European
technological centres
specialised in surface
processing and
finishing

180+

Customers
in 2022

H2020



26

(10 of them
coordinated)

HEU



9

(2 of them
coordinated)

8



**PATENT
FAMILIES**

STAFF

Researchers &
Technicians



81

3



Spin-offs: INNOMAT,
KERA-COAT, TUBA-COAT

6



**PhD theses in
progress**

A big player in Surface Engineering

CIDETEC is one of
the major European
technological centres
specialised in surface
processing and
finishing

cidetec >
surface engineering

Coatings and
Surface
Treatments
Unit

Nanosurface
Unit

Polymers &
Composites
Unit

9 Researchers
4 Technicians



Introduction



Introduction

Impact of surface contamination

1. Huge negative impact on a broad range of applications



< Safety and health risks

< Detrimental impact on performance

< High maintenance costs

2. Surface cleaning has become in a routine activity for different sectors

< Industrial applications

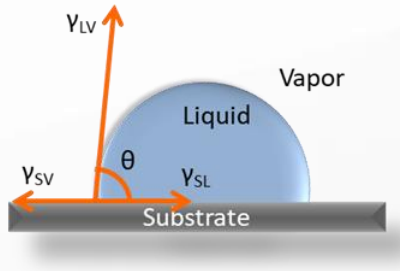
< Household activities

< Electronic devices

3. The cleaning processes are costly and time-consuming but they are essential to ensure optimum performance of materials.

Introduction

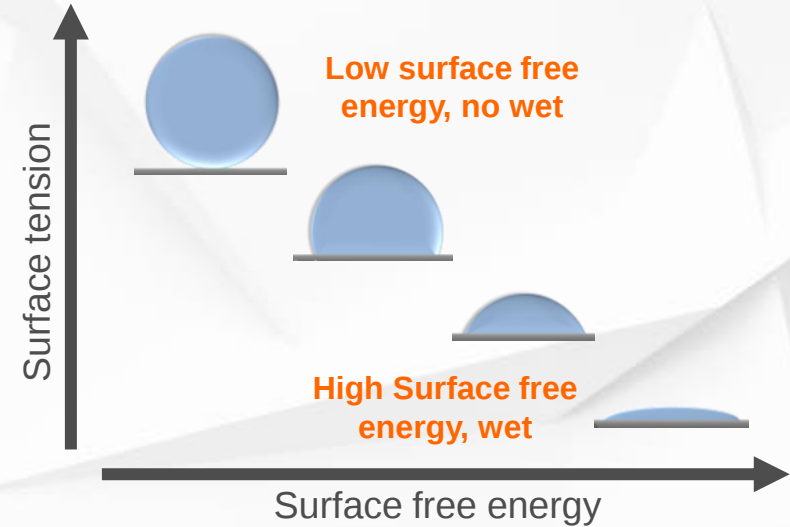
Contact angle



$$\cos \theta = \frac{\gamma_{SV} - \gamma_{SL}}{\gamma_{LV}}$$

- The most widely used parameter to characterize the wetting characteristics of solid surfaces.
- Defined as the angle formed between the solid surface and the tangent of the liquid-vapor interface of the drop.

Wetting



Surface tension <
Surface free energy



Surface tension >
Surface free energy





Introduction

Hydrophobicity:

Repellence of water molecules from a specific material.

Omniphobicity:

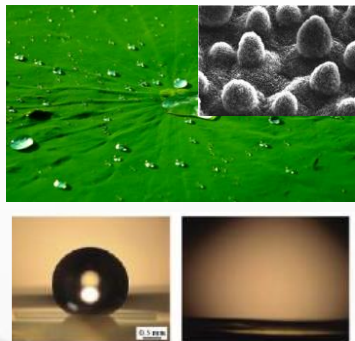
Repellence of any type of liquid from a material, regardless their liquid surface tension.



Introduction

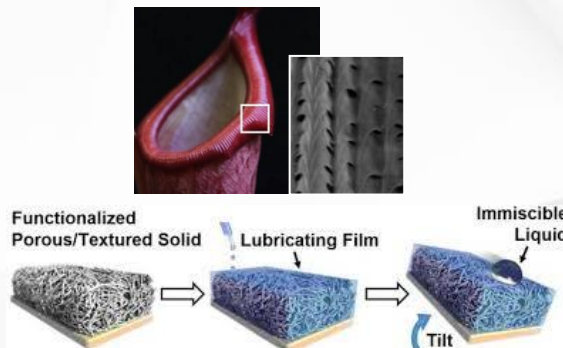
Liquid repellent surfaces

Superhydrophobicity

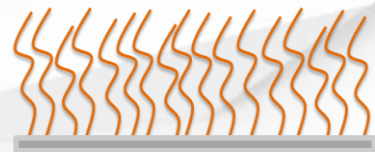


Omniphobicity

Slippery Liquid-Infused Porous Surfaces (SLIPS)



Slippery Omniphobic Covalently Attached Liquid (SOCAL)



Solid particles self-cleaning surfaces



- Superhydrophobic surfaces

- Superhydrophilic surfaces

- Photocatalytic surfaces



CIDETEC's technologies



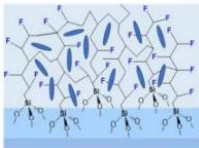
CIDETEC's technologies

Approaches

IONOGEL

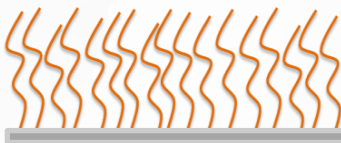
(EP 3564324 A1; WO 2018/122428 A1)

Ionic liquid embedded in a crosslinked polymeric ionic liquid



Chemical-modified surfaces

Slippery Omniphobic Covalently Attached Liquid

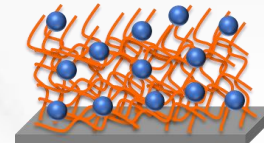


Polymer-modified surfaces

PCT/EP2021/071277; WO 2022/023476

PCT/EP2023/080076

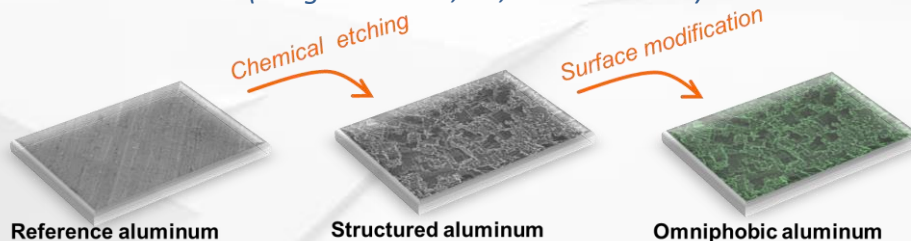
Omniphobic cross-linked polymer covalently attached to surfaces



Surface structuration

In combination with chemical modification surfaces.

(Langmuir 2020, 36, 10916–10922)



Glass, metals, plastics, composites, ceramics, fabrics, paper,...



CIDETEC's technologies

Use cases

< **IONOGEL**

< **Chemical-modified surfaces**

< **Polymer-modified surfaces**

< **Surface structuration**

Anti-insect contamination

Anti-soiling: solids repellency

Anti-icing

Easy-to-clean

Anti-fingerprint

Anti-graffiti



CIDETEC's technologies

Use cases

< Anti-insect contamination

< Anti-soiling

< Anti-icing

< Other applications

The presence of insect residues is the main cause of contamination on the leading-edge surface; it substantially modifies the air flow distribution, increasing friction and fuel consumption.



Coatings with **Hydrophobic** or **Omniphobic** Properties against **IN**sect contamination

Development of **SmarT** Eco-friendly anticontamination technologies for **LA**mina**R** wings



- 50% reduction in wing friction.
- Up to 5% reduction in fuel consumption and, consequently, lower CO2 emissions.



CIDETEC's technologies

Use cases

< Anti-insect contamination

< Anti-soiling

< Anti-icing

< Other applications

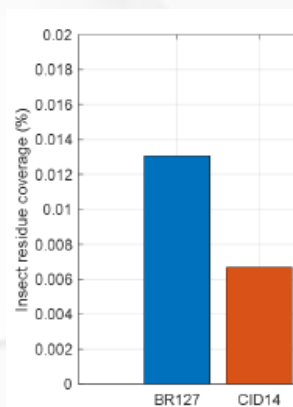


Development of **SmarT** Eco-friendly anticontamination technologies for **LAminar** wings

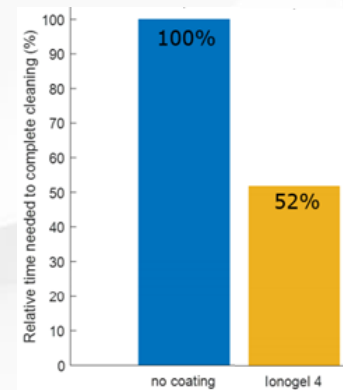


Development of highly durable low adhesion coatings with insect mitigation and easy-to-clean properties.

EP22383305



Overall residue was reduced



The time needed to completely clean the sample is significantly shorter for the coated sample





CIDETEC's technologies

Use cases

< **Anti-insect contamination**

< Anti-soiling

< Anti-icing

< Other applications



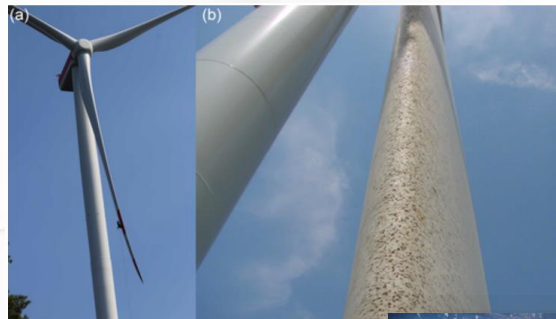
Development of **SmarT** Eco-friendly anticontamination technologies for **LaminaR** wings



Other potential applications

Development of highly durable low adhesion coatings with insect mitigation and easy-to-clean properties.

EP22383305





CIDETEC's technologies

Use cases

< Anti-insect contamination

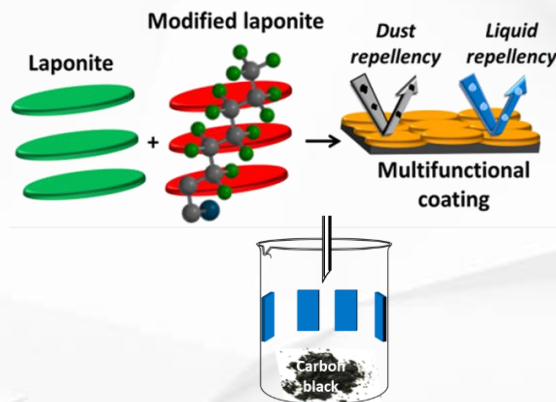
< **Anti-soiling**

< Anti-icing

< Other applications

OMNIphobic coatings

M. Fenero et al. ACS Appl. Mater. Interfaces 2017, 9, 39078-39085
WO 2022/023476



Furniture

Automotive interiors

Building facade

Solar energy



CIDETEC's technologies

Use cases

< Anti-insect contamination

< Anti-soiling

< Anti-icing

< Other applications



Functional and advanced **Insulating and energy harvesting/storage materials across climate adaptive building envelopes**



Iclimabuilt is a OITB which aims to tackle the aspects that have been a constraint to nearly zero energy/emission buildings by the strong connection between all involved parties from material and technical system testing and manufacturing to component development particularly regarding building envelope solutions

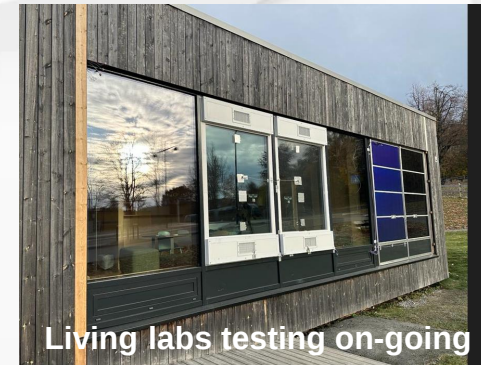
The presence of surface contamination substantially reduces the solar transmittance, leading to significant efficiency losses.

CIDETEC: Development of anti-soiling coatings to mitigate the efficiency losses associated with surface contamination of the PV systems by improving the solar transmittance.

A 5% increase in solar transmittance could result in an improvement of up to 10% in the efficiency of the solar module

Solar energy

Building Integrated Photovoltaics



New project: HEU MASS-IPV



CIDETEC's technologies

Use cases

< Anti-insect contamination

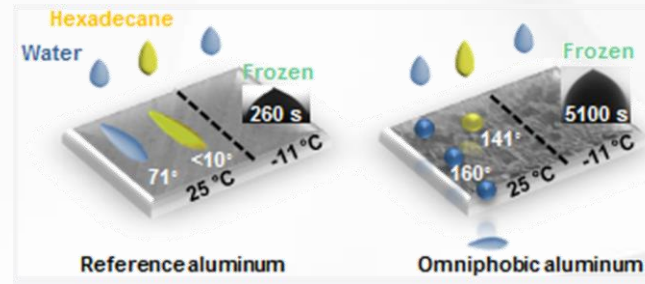
< Anti-soiling

< **Anti-icing**

< Other applications

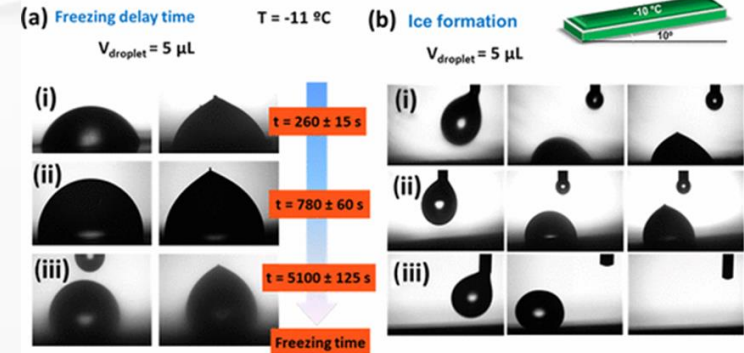
Anti-icing surfaces

M. Fenero et al. Langmuir, 2020, vol. 36, no 37, p. 10916-10922.



Aeronautics

Wind power



CIDETEC's technologies

Use cases

< Anti-insect contamination

< Anti-soiling

< Anti-icing

< Other applications



New generation of offshore turbine blades with intelligent architectures of hybrid, nano-enabled multi-materials via advanced manufacturing

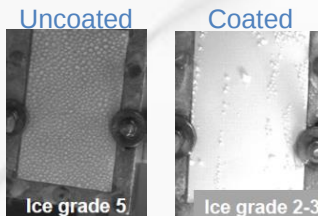


Oct 24

The project CARBO4POWER aims at developing a new generation of lightweight, high strength, multifunctional, digitalized multimaterials for offshore turbine rotor blades (WTB & TTB) to increase their operational performance and durability while reducing cost of energy production, maintenance and their environmental impact.

CIDETEC: Development of coatings to prevent contaminations, incl. ice, soiling, and allow self-cleaning function due to limited contaminant adhesion.

Ice rain test





CIDETEC's technologies

Use cases

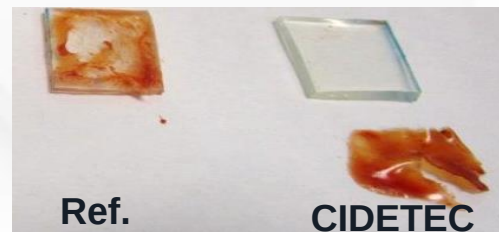
< Anti-insect contamination

< Anti-soiling

< Anti-icing

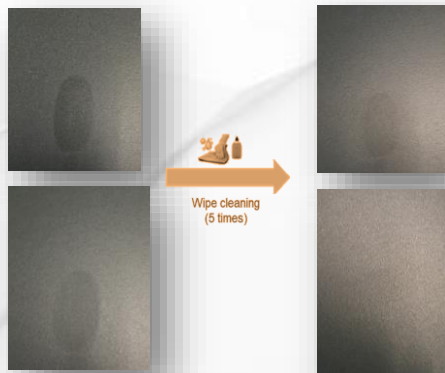
< Other applications

Easy-to-clean / easy emptying



Ketchup (3 days)

Anti-fingerprint



Anti-graffiti





CIDETEC's technologies

Use cases

< IONOGEL

< Chemical-modified surfaces

< Polymer-modified surfaces

< Surface structuration

< Anti-insect contamination

< Anti-soiling

< Anti-ice

< Other applications

< Adhesion (ISO 2409)

< Roughness (ISO 4288)

< Impact resistance (ISO 7265)

< Accelerated aging (ISO
16474-2)

< Corrosion resistance (ISO
9227)

< ...



CIDETEC's technologies

Scaling-up



**DISPERMAT® LH20 VACUUM
DISSOLVER. 20 L TANK**

**PAINT BOX WITH SPRAY ROBOT KUKA
READY2SPRAY (SPRAYHEAD DÜRR)**



✓ Homogeneous coatings. Reach 1.1 m

✓ Application on flat or 3D shapes



**DIP-COATER SERVOMOTOR
60 L TANK**



CIDETEC's technologies

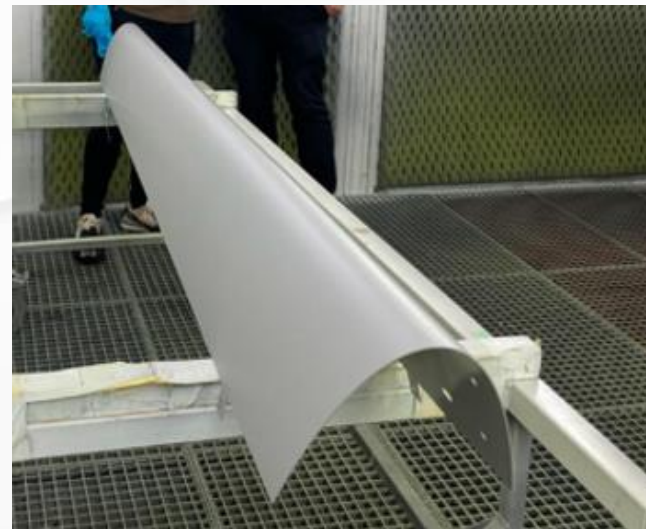
Scaling-up

European projects



Functional and advanced **I**nsulating and energy harvesting/storage materials across **climate** adaptive **building** envelopes

Development of **SmarT** Eco-friendly anticontamination technologies for **LA**mina**R** wings





CIDETEC's technologies

Scaling-up

Industrial projects: Coating application at industrial facilities (TRL 5 – 7)



Paper (roll coater)



Ceramics (roll and spray)
100 x 250 cm²



Current challenges



Current challenges

Development of sustainable/REACH compliance coatings

- < Fluorine-free
- < Water-based formulations (low VOCs content or VOCs-free)

Enhance durability:

- < Improve service life under working conditions
-



Industrial applications

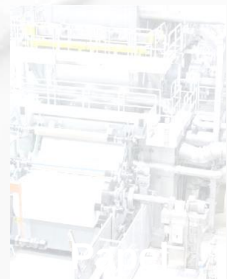


Electronics





Industrial applications



You name the next application!

Thank you for your attention!



a greater future today