

Access to technical & business support to implement nanotechnologies





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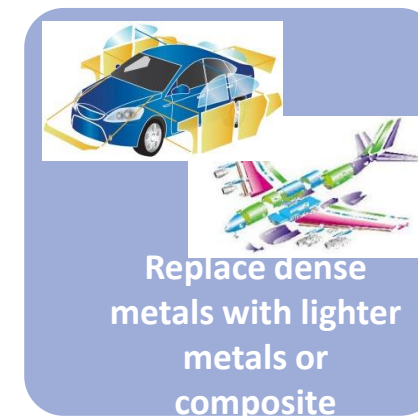
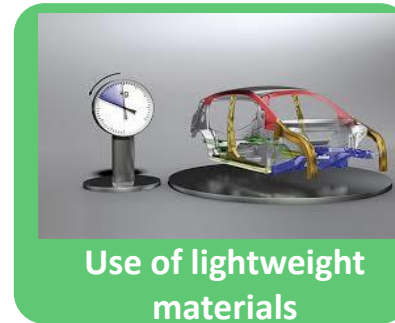


Open Access Single entry point for scale-up of innovative Smart lightweight composite materials and components

Innovation action-GA 814581



PROBLEM



PROBLEM:

1. **Composites and lighter metals individually: Insufficient properties:** do not meet all requirements for mechanical, electrical or thermal abilities
2. **Nanotechnology** cannot easily be introduced into composites and metallic supply
3. **Lack of industrial scale** manufacturing of nano-enabled products
4. **Not sufficient quantities** are currently produced for the high demanding industries
5. **High Cost** of intermediate nano-enabled products, especially for SMEs
6. **Tailored solution for each application:** different chemical content, production process, etc
7. **Limited accessibility** to SME producers

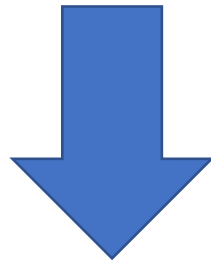




PROBLEM



NANOTECHNOLOGY + ADVANCED MATERIALS
ADVANCED MANUFACTURING



LIGHTER MULTIFUNCTIONAL ESTRUCTURES





PROBLEM



Companies and new technologies- Introduction of nanotechnologies in metallic and polymer composites in **today's industrialized systems** as part of advanced materials and advanced manufacturing processes



Bottlenecks

- Need for specialized expertise
- Investments cost too high
- Novel techniques not a priority
- RTO not offer facilities and services covering the full value chain
- Development of new products may require Access to finance and optimised business plan

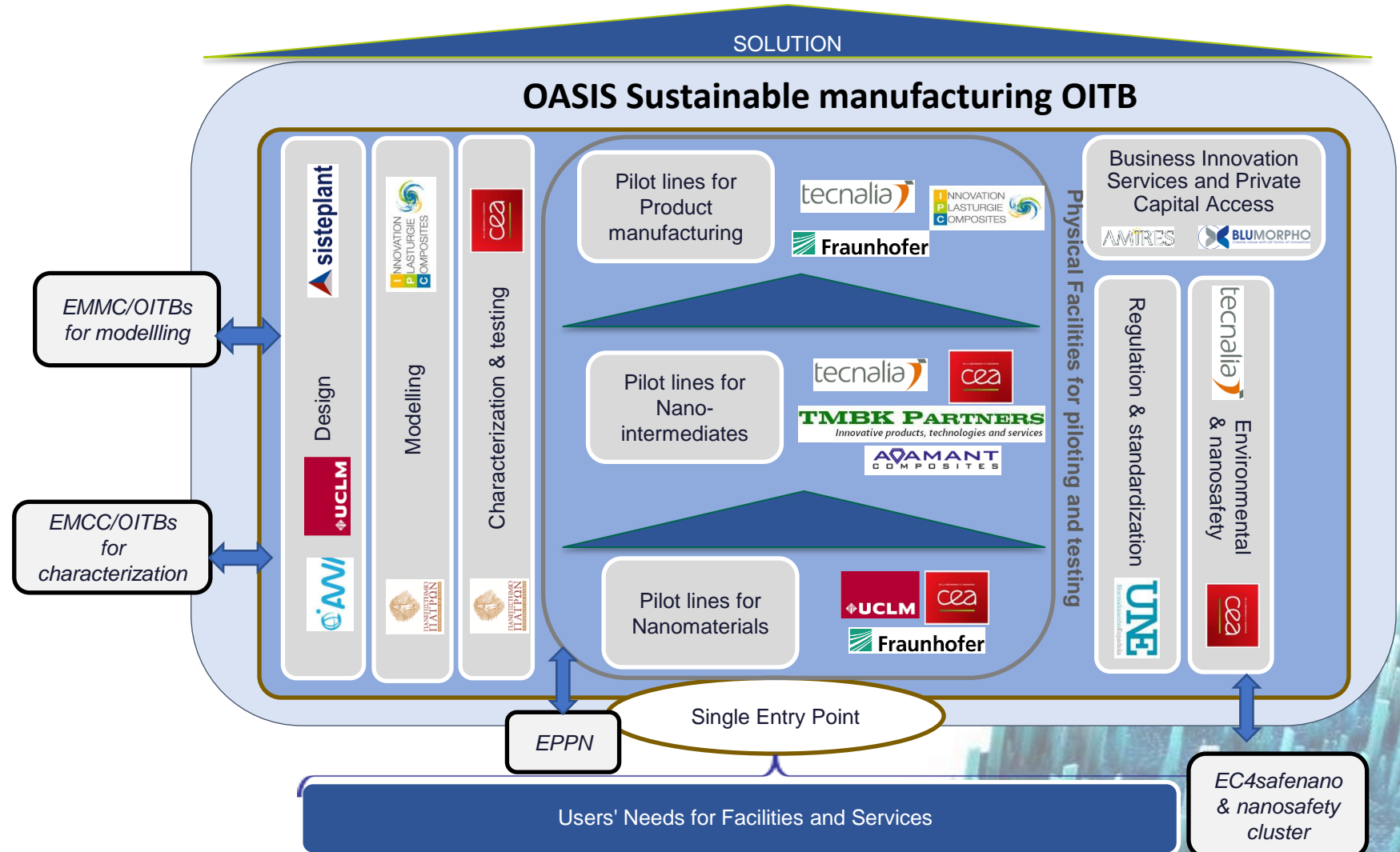


SOLUTION



Develop and organize a **sustainable Open Innovation Test Bed** for innovative scale-up of smart lightweight aluminium and polymer-based composite compounds and products to which




Companies - and more precisely SMEs - can gain access through a **SEP** to **develop, test and adopt, new lightweight**, high performance, **multifunctional**, safe and environmentally friendly high value **materials, components and structures** in a cost-effective and sustainable way



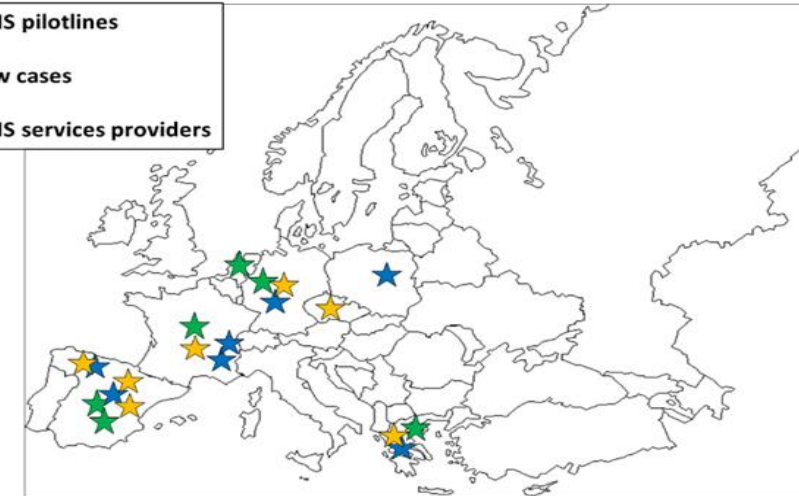
OASIS- ADVANCED MANUFACTURING FACILITIES ECOSYSTEM



Pilot lines for nanoscale structures in unprocessed form with intrinsic functionalities

- SiO₂ nanoreinforced aerogels 
- Nanoparticles and nanomaterials synthesis by wet chemical route 
- Magnetic and flame retardant nanoparticles and nanocomposites 

- ★ OASIS pilotlines
- ★ Show cases
- ★ OASIS services providers



Pilot lines for intermediate product with nanoscale features

- Buckypapers 
- CNT treated thermoplastic veils
- CNT treated preregs 
- Sheet to sheet smart printed sensors and actuators
- Nanoreinforced metallic alloy ingots 

TMBK PARTNERS
Innovative products, technologies and services

Pilot lines for Nanoenabled-products

- Nano-enabled injected cast parts
- RTM polymer based composites
- Nano-enabled Al/composites hybrid products
- Nano-enabled pultrudates

tecnalia

INNOVATION
PLASTURGIE
COMPOSITES

Fraunhofer



OASIS Sustainable manufacturing OITB



12 PILOT LINES

Competitive, quality, safe, environmental friendly production of nano-enabled products

Development and commercialization support of lightweight multifunctional products based on aluminium and polymer composites

TECHNICAL SERVICES

From primary concept to final qualification of the product

- ✓ Material selection
- ✓ Manufacturing processes
- ✓ Product and process Design
- ✓ Modelling & simulation
- ✓ Characterisation & testing
- ✓ Sustainable-manufacturing diagnosis
- ✓ Environmental and nanosafety
- ✓ Safe-by-design approaches
- ✓ LCA (recycling concerns)



business support SERVICES

Accelerate market commercialization

- ✓ Diagnosis methodology
- ✓ Training
- ✓ Business support
- ✓ IP
- ✓ Coaching to SMEs
- ✓ Access to finance/investors



SOLUTION



SEP



Pilot line facilities are efficient catalysts for innovation, helping overcoming upscaling barriers and the “crossing of the valley of death” between invention and market.



Validation of upscale/upgrade of pilots and services



OASIS Sustainable manufacturing OITB

PILOT PLANTS



...

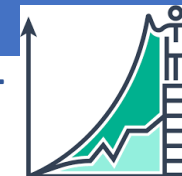
TECHNICAL SERVICES

- ✓ X
- ✓ Y
- ✓ Z
- ✓ ...



BUSINESS-SUPPORT SERVICES

- ✓ A
- ✓ B
- ✓ C
- ✓ ...



SEP

ONE STOP
FULL
PACKAGE
OFFER

Nano-enabled pultrusion for lightweight construction

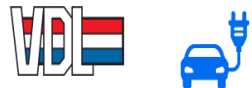
Structural nanoreinforced Al castings by HPDC process

Multifunctional heatable pannels

Energy Storage in prefabricated walls

Multifunctional nanobased layer for aeronautical structure

Battery module nanocomposite packaging



OASIS Sustainable manufacturing **OITB**

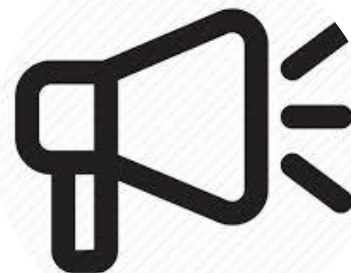
PILOT PLANTS



TECHNICAL SERVICES



business support
SERVICES



OPEN CALL (OC)

- New SMEs
- Industries
- Individuals
- Acaemia
- RTOs

Will be attracted

DEMOCASES (6 months)
Development of specific demonstrators
Access to specific services

MULTIFUNCTIONAL NANO-ENABLED PRODUCTS

Open Call for Democases



What?

- OASIS, an Open Innovation Test Bed ecosystem of 12 nanotechnology manufacturing pilot lines, is organizing an Open Call for Democases with the objective of
providing support to organizations in order for them to develop and test novel nano-enabled products taking advantage of top-notch European infrastructure.
- Specifically, the aim of each supported Democase will be to **transform a product idea into a functional product/part demonstrator** and develop its associated **exploitation plan** targeting early market adoption.



Why?

- All successful applicants to the OASIS Open Call will get **free access to an ecosystem of 12 nanotechnology manufacturing pilot lines**, providing nanomaterials, nano-intermediates, nano-enabled products and associated services for the development and commercialization of **lightweight multifunctional products based on aluminium and polymer composites**.
- The selected applicants will be provided with **customized support through a complete set of services integrating technical and business expertise** which will enable them to build up sustainable business cases.
- The **free of charge** contribution by the OASIS consortium is composed of:
 - Qualified human resources dedicated to the execution of the Democase.
 - Consumables and materials required for the product demonstrator.
 - Access to top-notch equipment and infrastructure of the pilot lines.

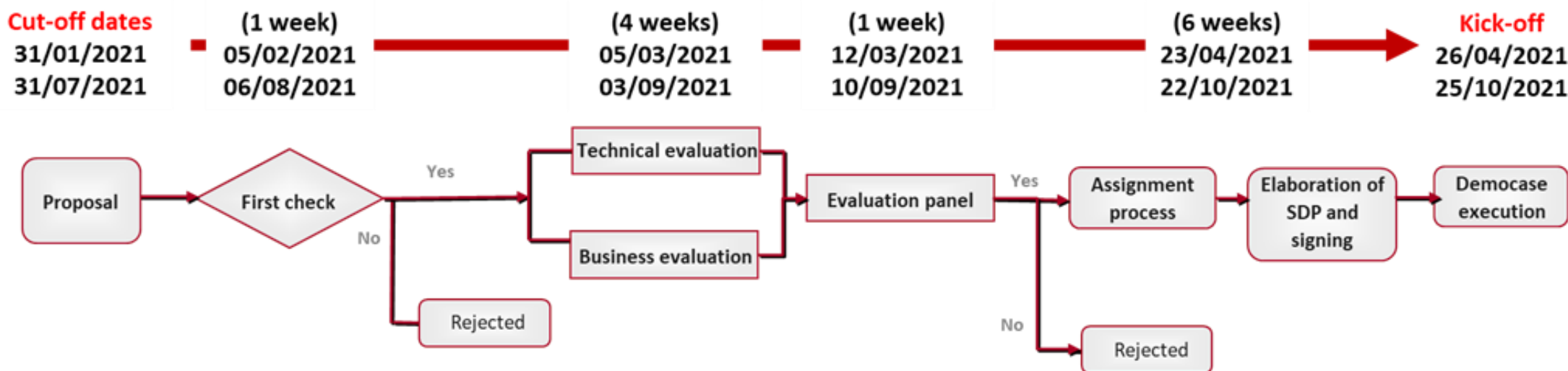
Who?

- The call is open to all organizations **regardless of their type, size or field of activity**. The following categories are being used in the Call:
 - PRC (Private for profit, excluding education)
 - **SME (Small and medium-sized enterprises)**
 - REC (Research organisations)
 - HES (Higher or secondary education)
 - PUB (Public body, excluding research and education)
 - OTH (Other)
- Important:
 - Given the project's aim of fostering the competitiveness of European businesses, the **primary target of the OASIS Open Call are Small and Medium-sized Enterprises (SMEs)**. A minimum of **50%** of the supported Democases will be dedicated to SMEs, provided they score above the required threshold. **Which means they may take priority over higher ranked proposals submitted by other types of organizations.**

When?

- The Call will be open from **29th June 2020 to 31st July 2021** and applicants will be able to apply anytime.
- Submitted proposals will be evaluated following one of the two cut-off dates
 1. **31st January 2021**, 5pm CET
 2. **31st July 2021**, 5pm CEST
- Applicants can work on their proposals in the system up until the cut-off date. However, after they „**submit**“ their proposals, **they won't be able to change them anymore.**

Process?



- Submitted proposals will be evaluated by 4 evaluators (2 for technical and 2 for business aspects). The maximum overall score is 15. The standard **threshold for individual criteria is 3**, and the **standard overall threshold is 10**.
- However, apart from the proposal-level evaluation there will also be a **portfolio-level assessment** done by the Evaluation Panel which will take into consideration also other factors like balanced use of the services and the available capacities to execute the Democases. **These factors might change the final ranking of the proposals.**

How?

1. Check out www.project-oasis.eu.
2. Browse through the [Catalogue of Services](#) to see how they match your needs.
3. Download & read the [Application Guidelines](#).
4. Register through the submission software at <https://apply.project-oasis.eu/>.
5. Fill in the application data including your preliminary choice of services (a minimum of 2 technical and 1 business supporting service).
6. Download the Application Form from the software.
7. Complete the Application Form, save it as a PDF file (MAX 5 pages), upload it and submit it through the submission software.



Contact

- If you need assistance with applying to the Call, or explanations about technology offerings and your possibilities with OASIS, please send us your enquiries

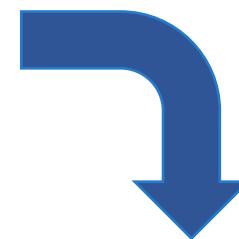
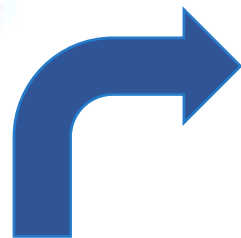
by phone to: +420 226 217 422

by email to helpdesk@project-oasis.eu.

- Helpdesk will be active Monday - Friday from 9am to 5pm (CE(S)T). We will be happy to help you.

- **We encourage all applicants to check the technical and business feasibility of their ideas well in advance of submission.**





SHOW CASE #1 Nano enabled Pultrusion for Lightweight Construction



Javier Sacristan Bermejo PhD.

Acciona Construction Tech Center; Polymers and Composites Group





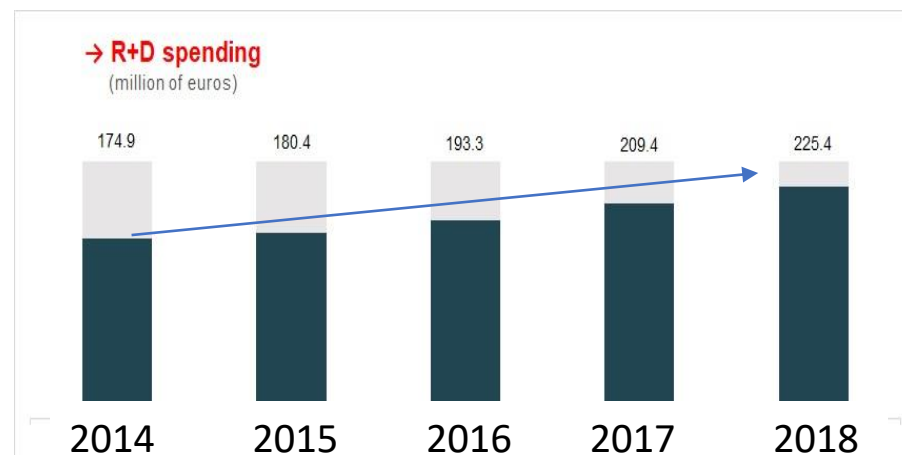
A Worldwide presence



+39600 employees
In 65 countries, 5 continents

€7129m€
In revenues in 2019

€1357m€
EBITDA 2019



Role in OASIS

ACCIONA participates in OASIS through the Construction Technology Center located in Madrid as an **End-user of the Civil engineering (Construction)** sector providing our expertise and capabilities to develop novel and more sustainable materials and processes for the Construction sector.

Objective

- Develop more sustainable light-weight construction materials and processes.
- Widen the use of FRP composites in the construction sector: **Efficient design, reduce cost and Enhance material performance.**

Acciona Experience in composite materials



1. Design of **large-dimension lightweight prefabricated** elements made of FRP for vehicular and pedestrian bridges. (FRP Pedestrian bridge. Madrid Rio Project)



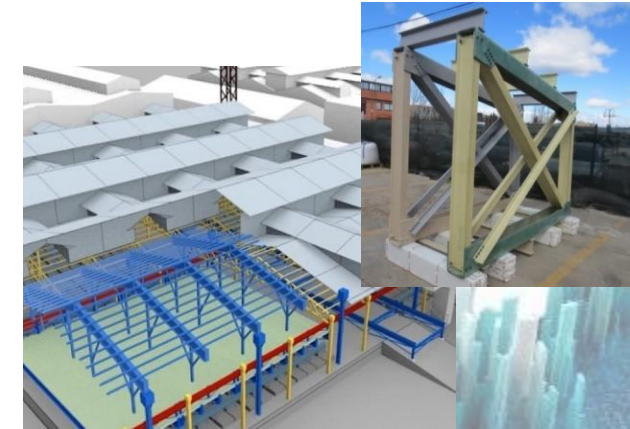
2. Lightweight and **durable modular panels** to control **water infiltrations** in tunnels. (FRP drainage system. Pajares Tunnel Project)



3. **Electromagnetic transparent reinforcement** materials. (FRP Bars. Sabadell subway line Project).



4. **High durability materials for marine structures using modular elements.** (FRP Lighthouse. Valencia Port Project)



5. Design of **modular trusses** for buildings, bridges and any structural application. (Experience in FRP Truss design for industrial buildings)



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Overall challenges

Corrosion of reinforcing steel and other embedded metals is the leading cause of deterioration in concrete.

The annual direct cost of corrosion to bridges alone in the USA, is estimated to be US\$ 6 billion to US\$ 10 billion

FRP bars and stirrups appear to be promising alternative to steel

Challenges

1.- Processability

- FRP bars are made of a thermosetting resin + Continuous fibers

2.- FRP bars are sensitive to some environmental conditions.

1. Alkaline environment
2. Moisture
3. Extreme temperatures

Degrade their mechanical properties (e.g., tensile strength, ultimate strain, and modulus of elasticity)

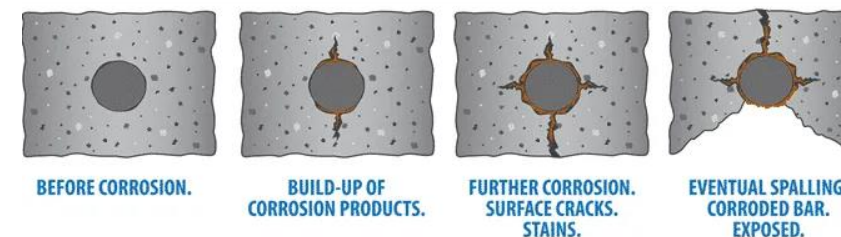
3.- Regulations/Standards

Strictest fire resistance regulations/codes

New Spanish Technical building code might restrict the use of FRP rebars.

4.- Cost

Moisture, Oxygen, Carbonation, Chlorides,



als an
novation programme under grant agreement No 814581

SHOW CASE #1 Nano enabled Pultrusion for Lightweight Construction

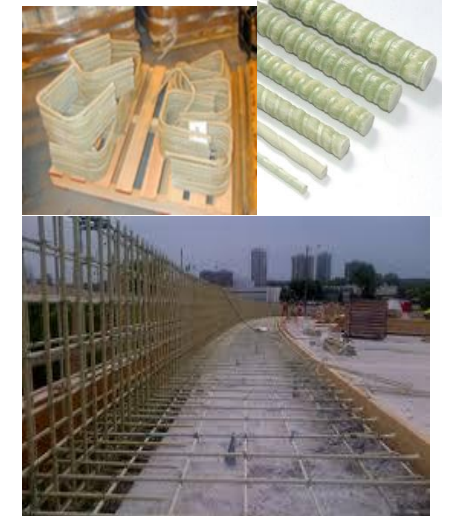


Pilot Plants involved

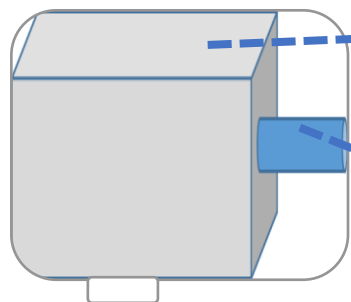
PL3 and PL13 (Processing/optimization). PL1 Nanoparticles

Pultrude **Fire retardant and highly Corrosion resistant FRP rebars and stirrups (curved rebars)** for casting reinforced concrete structures, which after its production will be treated with a nanomodified corrosion resistant coating to protect RC surface

Functionalities: Fire retardant, Corrosion resistant, magnetic particles (induction curing), hydrophobic NPs



Partners involved: FhG IGCV, FhG ISC, UCLM, TEC, CEA and ACI



Concrete: UCLM (corrosion resistant coating), and ACCIONA

Rebars: FhG IGCV (pultrusion), FhG ISC (NPs) , TECNALIA, (Fire solutions) and ACCIONA

CEA
Nanosafety

Testing : TECNALIA/ACCIONA: Design and evaluate Fire resistance solutions
ACCIONA: Mechanical tests and validation in a marine environment

Showcase #1

Entire process chain is covered by OASIS partners

PL#12 Nano-enabled pultrudates. Owner: FhG_IGCV



Pultrusion:

1. Injection-pultrusion
2. Induction curing system
3. Corrosion-inhibition
4. Enhance adhesion fiber/resin
5.

PL#3- Nanocomposites. Owner: FhG-ISC.

PL#3



Nanobuilding-blocks:

1. Magnetic nanoparticles
2. Layered double hydroxides
3. Corrosion-inhibition
4. Enhance adhesion fiber/resin
5.

Nanosafety

• Owner CEA

Validation tests

FhG, ACI and TEC

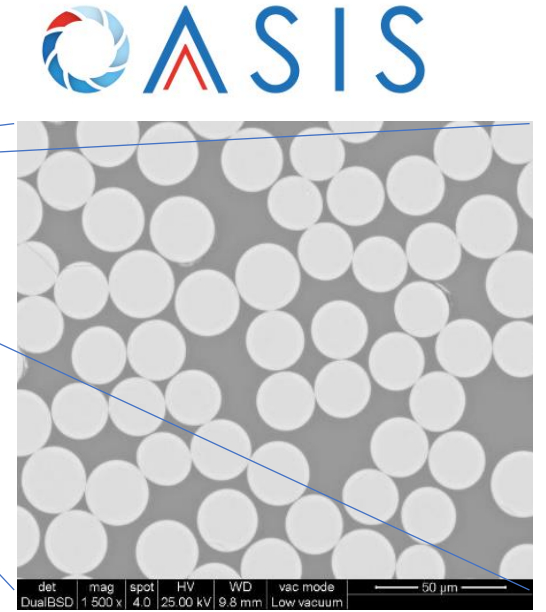
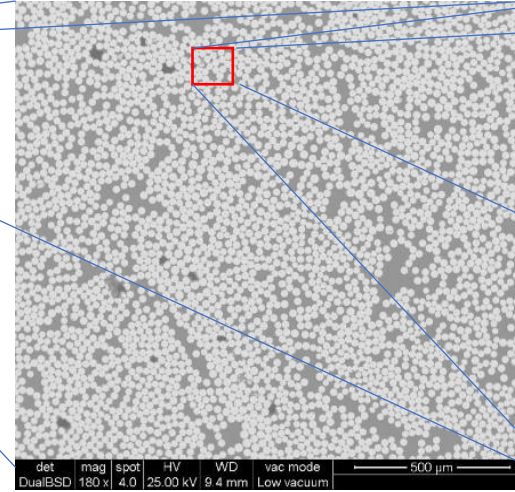
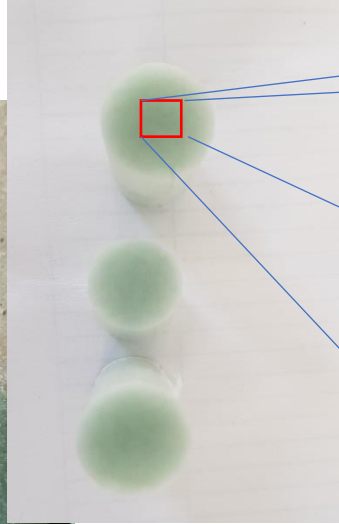
- Thermal
- Mechanical
- Fire
- a) Rebars
- b) Rebars/concrete



PL#1 will provide nanomodified coatings to protect concrete beams Owner: UCLM

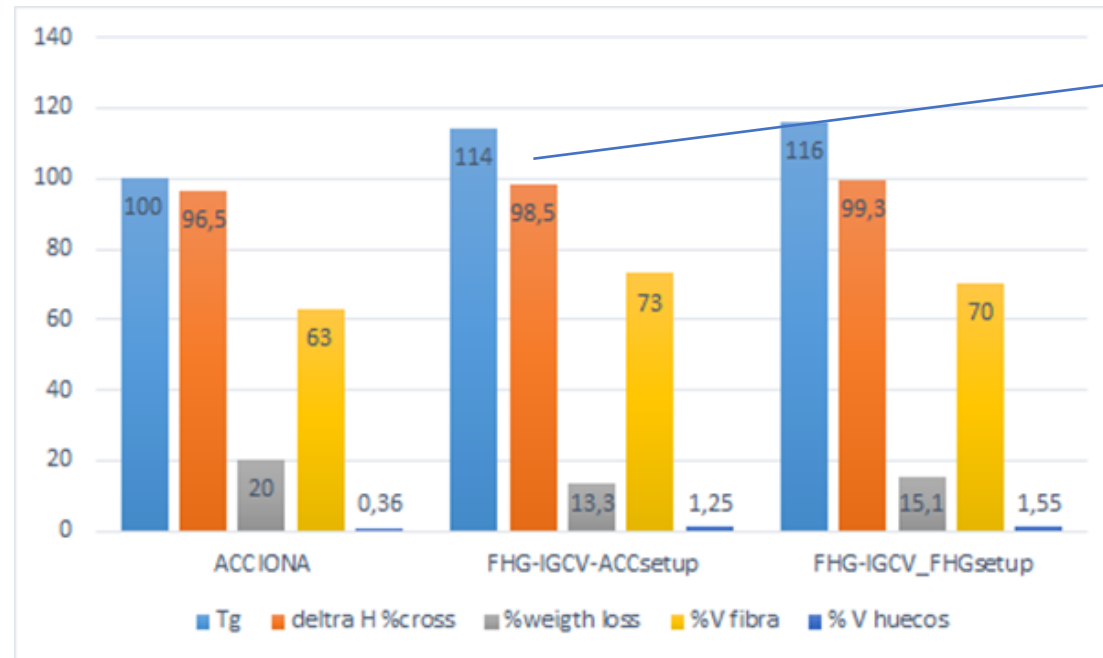


First rebars from FHG:



Key Performance Indicators (KPI):

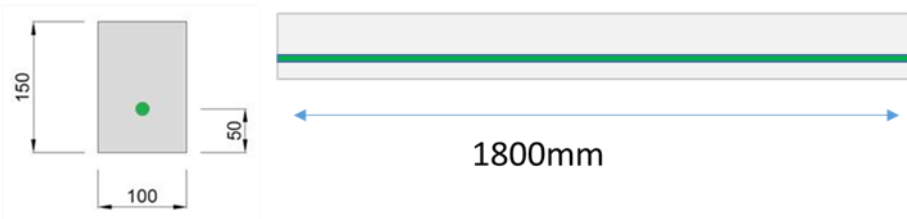
- Glass Transition Temp. > 90°C
- Curing degree > 98%
- Fire Volume fraction > 70%
- Fire retardancy EN1363-1 > 120min
- 20% final cost reduction
- 15% less energy consumption



Phase 1: Concrete reinforced beams (reference system)

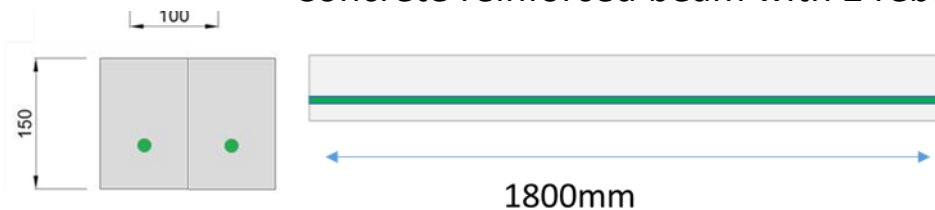
1.- Fire Resistance Tests:

Concrete reinforced beam with 1 rebar



2.- Mechanical test (3PB):

Concrete reinforced beam with 2 rebars

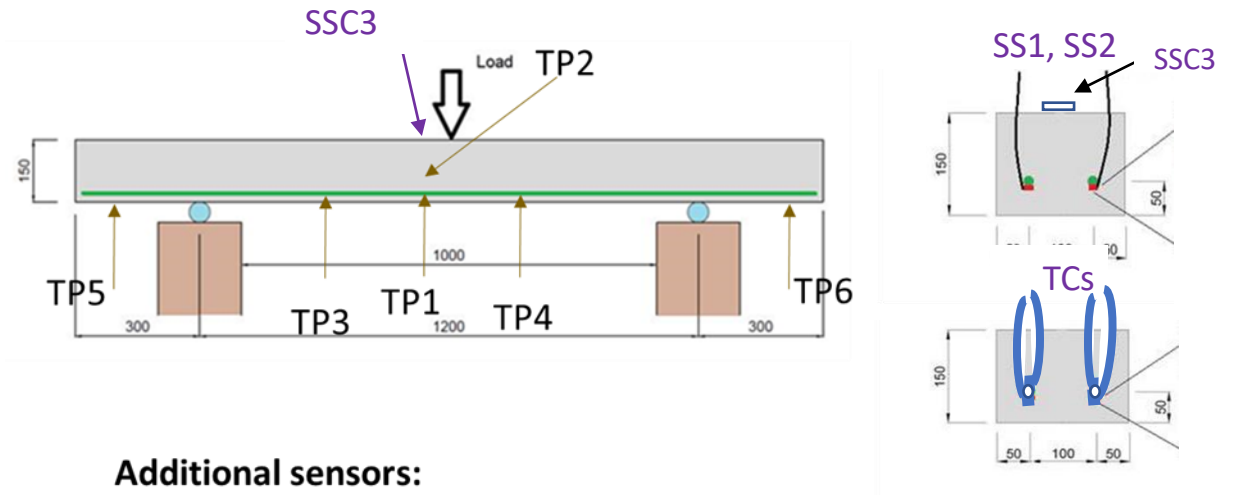


TECNALIA. Experimental furnace

Furnace dimensions: 1200x1400mm
Exposed (fire) area: 1000 x 1000mm



SENSOR types and location



Additional sensors:

- Measure max. deformation
- Strain sensors suitable for high temperatures

ACCIONA 3PB tests

Max load: 60kN
Max L. 6m
Max H. 1m
Max W. 0.5m



1ST Fire TEST

Beam at the end of FIRE Resistance Test



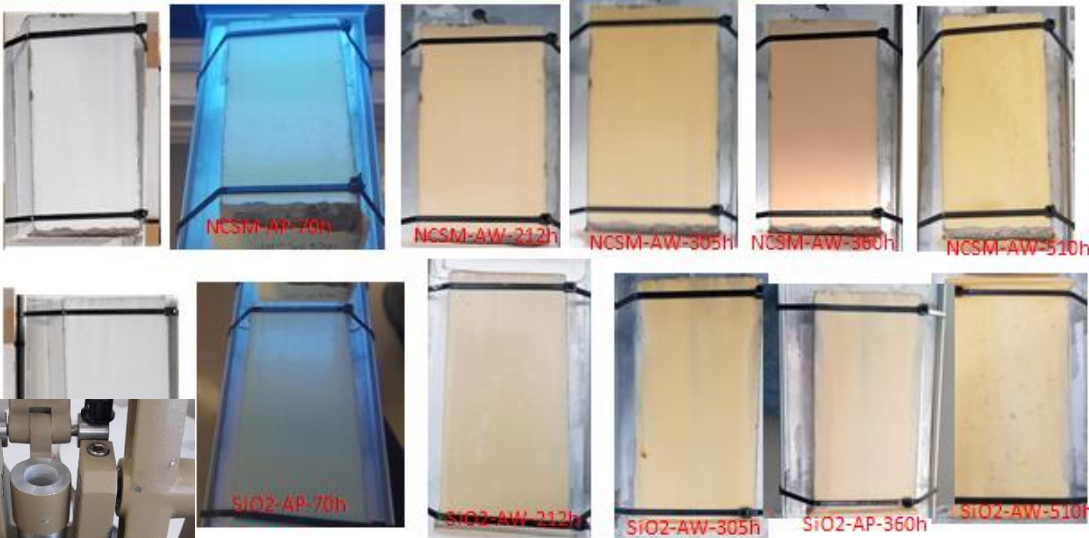
1^o During visual observation subsequent to the completion of fire testing, rebars which were extracted by chipping away the concrete, were found to have undergone thinning and carbonisation due to combustion (exposed part of the beam).

2^o However, at both beam ends (beam area not exposed to fire), there is no degradation. In this area the composite keeps its integrity and adhesion to the concrete matrix.

Corrosion resistant Coating UCLM



Acc. Aging tests



Abrasion resistance



Validation on a Relevant Environment



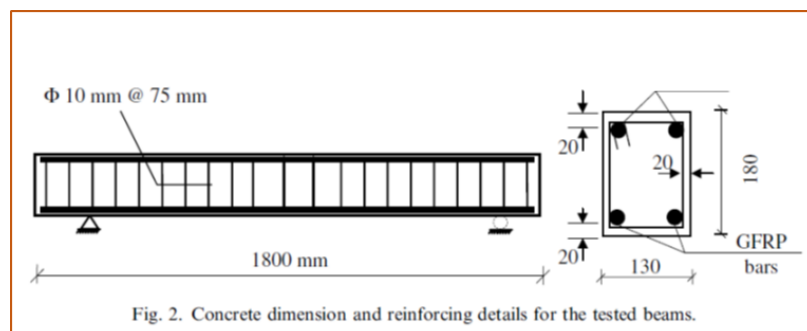
1.- Durability, Salt, UV, sea water, rain...



4 point bending tests before and after aging

3.- Fire Resistance

FRP reinforced beams exposed at the Port of Gijón

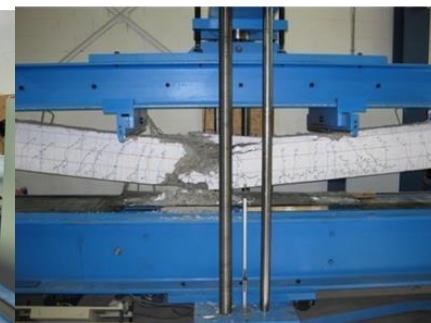


Sampling: t0, t6, t12, t24

Under-reinforced beam



Over-reinforced beam



2.- Thermal analysis, SEM



Full scale +2years

SC1 Highlights (unique selling points)

- **Replace steel rebars in RC in infrastructures** located in aggressive environments by highly durable and fire retardant lightweight composites.
- **More durable and competitive construction** solutions for aggressive environments (Processing optimization will lead to a cost reduction)
- Open **new market** for FRP rebars thanks to their multifunctionality including no special restriction regarding fire/flames) (**marine environment, cold weather climates, civil works, industrial plants...**)



- **Considerable saving costs (less maintenance)** of steel reinforced concrete using nanoenabled corrosion resistant coatings.

Showcase: Multifunctional composite panels

VDL Fibertech Industries





Multifunctional composite panel



Structural composite panel for the automotive sector

Produced in a Resin Transfer Moulding process

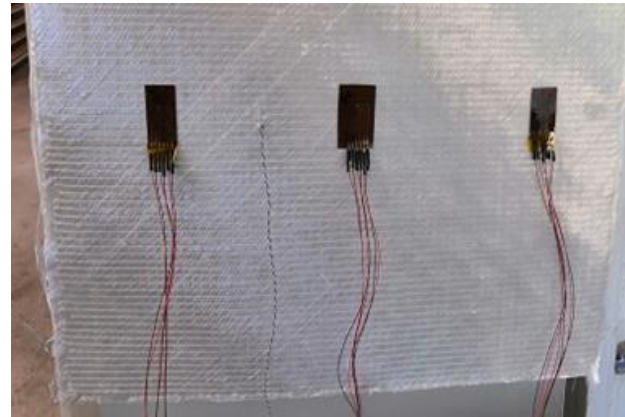
Benefits:

- Reduction of cycle time (produce high volume) -15%
- Decrease final product weight -10%
- Increase thermal comfort (-10% energy consumption)
- Fast verification of the control monitoring (predictive maintenance)
- No increase in costs +/-0%



Function integration

- Strain gauges → predictive maintenance
- Thermocouples → control modelling during manufacturing process (control temperature trajet) → shortest in mould cycle time
- Touch sensors → reduction of assembly time in further process and decrease weight



Material integration

Veils to increase strength after impact

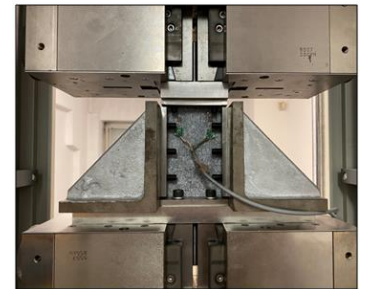
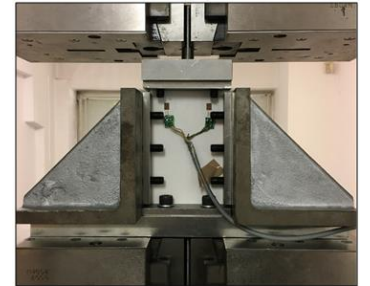
- CNT-doped veils for increase in impact resistance
- Act directly as finishing layer (prevent printthrough)
- Integrating veils on top of fabrics to shorten cycle time

Increase thermal comfort

- Aerogel foam for increasing insulation
- Incorporating buckypapers as heater elements

Fire retardancy powder integration

- Affects permeability, mechanical strength



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Optimisation by simulation

- Increase/optimize strength → FEM modelling of different lay-up and influence of nano-enabled technologies → Mechanical justification
- Simulation of cure cycle
- Validation of simulations through mechanical testing

Safety of nano-enabled products



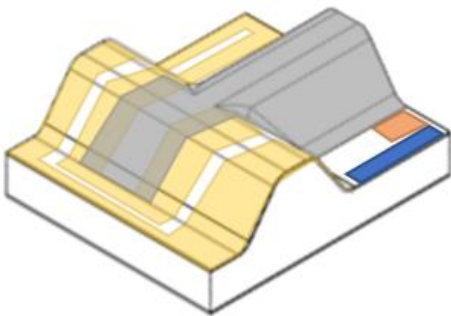
Processability on production floor

- Storage of nano-enabled products
- Release of nano-particles during production proces of final product (safety of operators)
- Disposal of waste (dry fabric with NP/CNT and cured part e.g. milling)
- Regulations (European, worldwide)



Advantages of attending the OASIS-project

- Direct link from raw material to final product → act fast
- De-risking before full production
- Cooperation between partners to combine expertise of different nano-enabled technologies → VDL + IPC
- Link to knowledge partners



Benefits:

- Reduction of cycle time (produce high volume) -15%
- Decrease final product weight -10%
- Increase thermal comfort (-10% energy consumption)
- Fast verification of the control monitoring (predictive maintenance)
- No increase in costs +/-0%



Industrial showcases presentation



Showcase 4 Smart Nanocomposite Casing for avionic battery module

THALES

Grégory Pognon

September 15th 2020

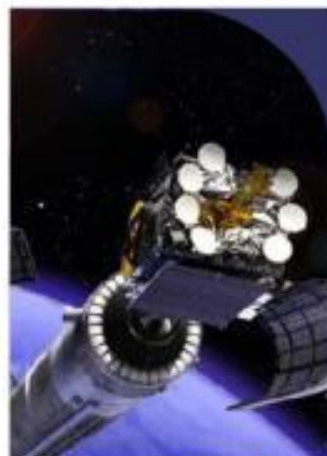


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THALES



AEROSPACE



SPACE



GROUND
TRANSPORTATION



DEFENCE



SECURITY

**WHEREVER SAFETY AND SECURITY ARE CRITICAL, THALES DELIVERS.
TOGETHER, WE INNOVATE WITH OUR CUSTOMERS
TO BUILD SMARTER SOLUTIONS. EVERYWHERE.**



Context of the showcase

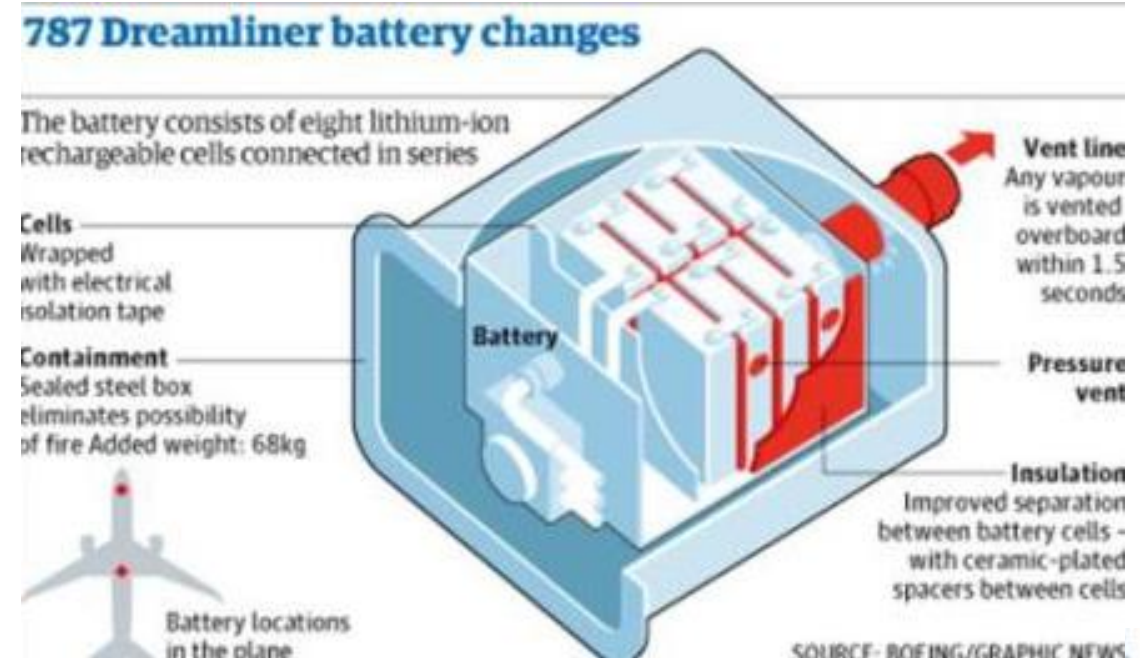


main objective → replace the existing battery pack with a safer one

Current solution



8 high energy prismatic cell modules packed together



Find innovative technological solutions enabling a high level of safety while increasing the energy on board



Showcase scope and objectives

Safe and robust battery pack

Develop a solution for a lightweight/safe/efficient/cost-effective **smart casing for batteries modules/pack** based on nano-enabled composites material + network of integrated sensors for in-operando diagnosis of batteries modules.

2 axes of innovations

- Addition of suitable nanostructured materials/intermediate to improve mechanical properties, contain thermal runaway + reduce weight in the structure. → selected from different pilot lines : PL#2, PL#3, PL#4, PL#5, PL#6, PL#12 → benchmarking materials
- Integration in the casing structure of a network of non-intrusive low-cost printed sensors, providing multiple information to prevent thermal runaway: Temperature, pressure and acoustic emission → interface with BMS for life cycle monitoring

3 main technical KPIs

KPI1 : Increased gravimetric energy density of the battery module by 10-20%.

KPI2 : Resistance to thermal runaway of one cell, reducing the risk of fire propagation.

KPI3 : Anticipated detection of thermal runaway.

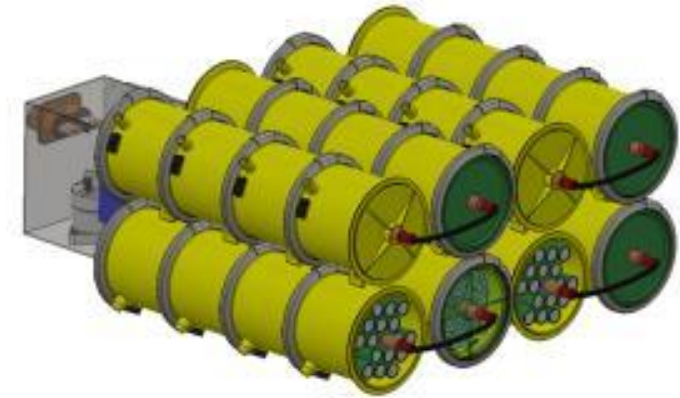


New battery pack



**SHOWCASE 4
PRODUCT**

- Composite Casing for a 16 cells in parallel module
- Small low energy cells avoiding thermal runaway propagation between cells
- Integrated sensors in the structure + near the cells to follow the health and behavior of the cells



Whole battery pack

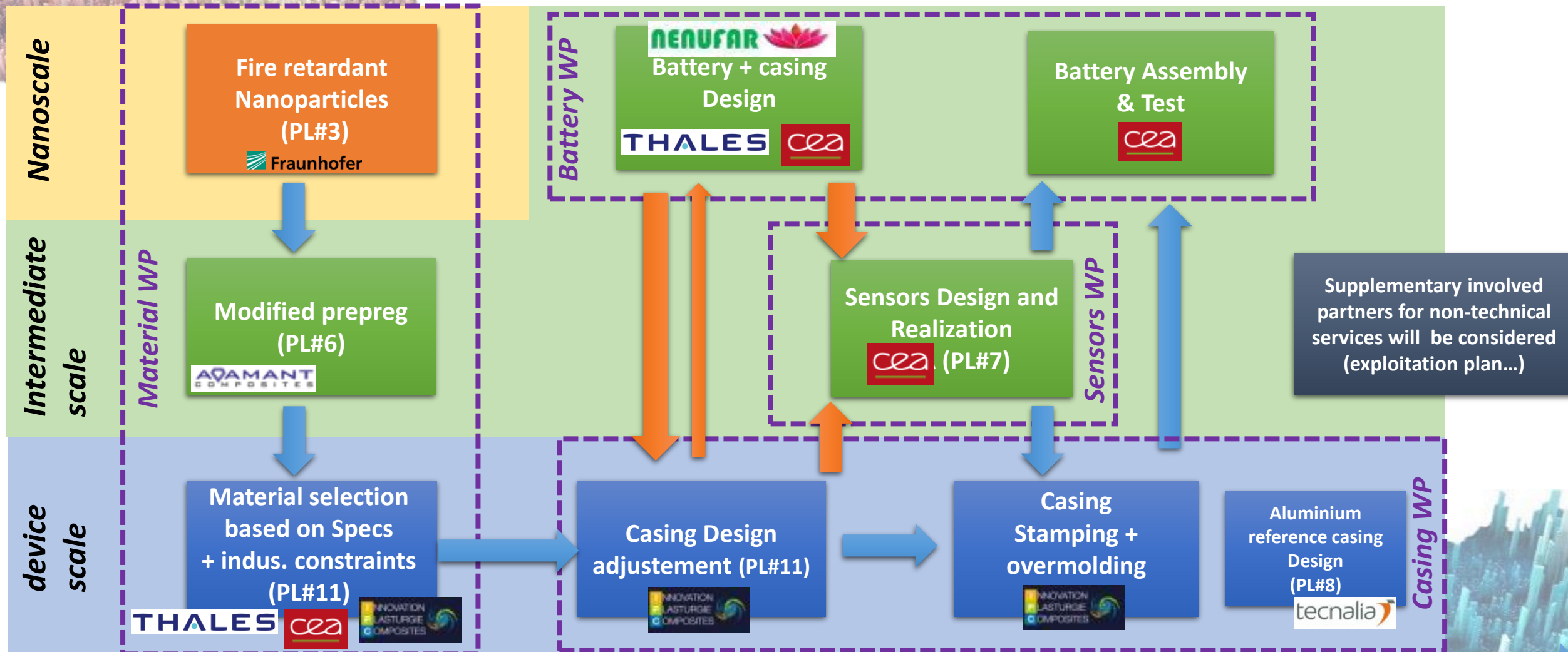
- Battery pack with 32 modules plugged in serial
- No additional casing weight for the module



SC4 organization of the activities



→ 6 involved partners



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Progression: 50 % of planned work done



- **Materials selection and evaluation :**

- Multiple ply PPS/C + PPS/glass external folds + overmolding PPS/glass
- Fire retardant nanoparticles → no real improvement observed yet
- Electrical, Chemical and Mechanical characterisations of material done → all materials are validated



- **Sensor selection, location and design**

- Printed thermocouple on Kapton + printed PVDF piezo acoustic sensor
- First integrations and evaluations in the matrix
- Design under finalisation



- **Mold fabrication started :** 2 half cylinder + 1 bottom/top + overmolding of reinforcements

- **Module Design finalized and validated :** 88% weight gain vs current solution **KPI1 OK**



- **Simulation and modelling of thermal and mechanical behavior :** passed up to 20 bars **KPI2 OK**

- **Design of a reference casing made of aluminium :** 21 Kg → 15% gain using our composite material



→ To be done :

1. Material : characterisations on processed material (Dec 2020).
2. Sensors : Design of sensors (sept 2020) + fabrication (Oct-Dec 2020).
3. Casing : Mould validation (Jan – Feb 2020)
4. Battery : Design finalization (Sept 2020) + realization (Dec 2020)
5. Assembly of several modules for test in relevant environment (Mar-Apr 2020)



Requested services in the catalogue

Subcategory : Nano-materials

- Magnetic and flame retardant nanoparticles and nanocomposites

Subcategory : nano-intermediates

- Sheet to sheet electronic printed devices
- Nano-enabled prepregs and dry fabrics for composite products

Subcategory : Nano-enabled products

- Nano-enabled composite plates for lightweight and multifunctional applications
- Stamping/overmoulding process for thermoplastic nano-enabled and/or smart composite products

Subcategory : process engineering

- Industrialization – process development (Manufacturing cost calculation/projection for ex.,...)

Subcategory : Designs

- Product design and material selection based on customer's specifications

Subcategory : modelling and simulation

- Thermal, mechanical and multi-physics and multi-scale modelling
- Process simulation (to avoid defect in the product)

Subcategory : Testing and characterization

- Durability tests (mechanical behavior...)

Subcategory : Business supporting services

- Business support and coaching (Financial analysis and projection (cost analysis, manufacturing) for ex.) → A tailor-made support service to maximize business value

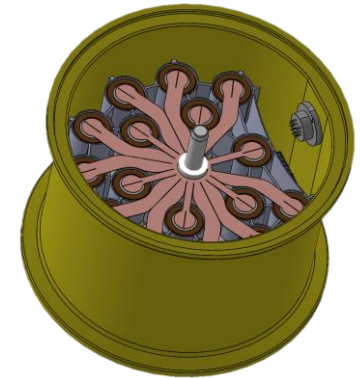


OASIS for Thales



- **Definition of a unique nano-enabled composite smart casing reaching our KPIs for battery module thanks to :**

- Suitable materials from PLs,
- specific designs,
- advanced production processes,
- relevant experimental tests and simulations
- combined expertise from every specialist involved



- **Results are already meeting our expectations**

- Have a direct access to the most relevant, reliable and advanced solutions for the development of a safer lithium-battery pack for avionic applications
- Possibility to evaluate/benchmark different new nano-enabled composites and other smart material technologies and advanced processes for high-productivity/high performance systems and parts
- Develop a new network of partners on composite materials



Timeline

- Introduction of the last two Showcases in November 2020
 - Recordings can be accessed on project-oasis.eu



Nano-enabled pultrusion for lightweight constructions

responsible partner: ACCIONA



Structural Nanoreinforced aluminum castings

responsible partner: Ford-Werke



Multifunctional RTM composite panels

responsible partner: VDL Fibertech Industries



Smart battery casing in nanocomposites

responsible partner: Thales



Multifunctional nanobased layers

responsible partner: AIRBUS Operations



Energy storage in prefabricated walls

responsible partner: Pleione Energy



Timeline

- Introduction of the last two Showcases in November 2020
 - Recordings can be accessed on project-oasis.eu
- Application Deadline:
 - 1st batch: 31 January 2021 (5pm CET)
 - 2nd batch: 31 July 2021 (5pm CEST)
- Start of Democase development:
 - 1st batch: May 2021
 - 2nd batch: November 2021



Thank you!

