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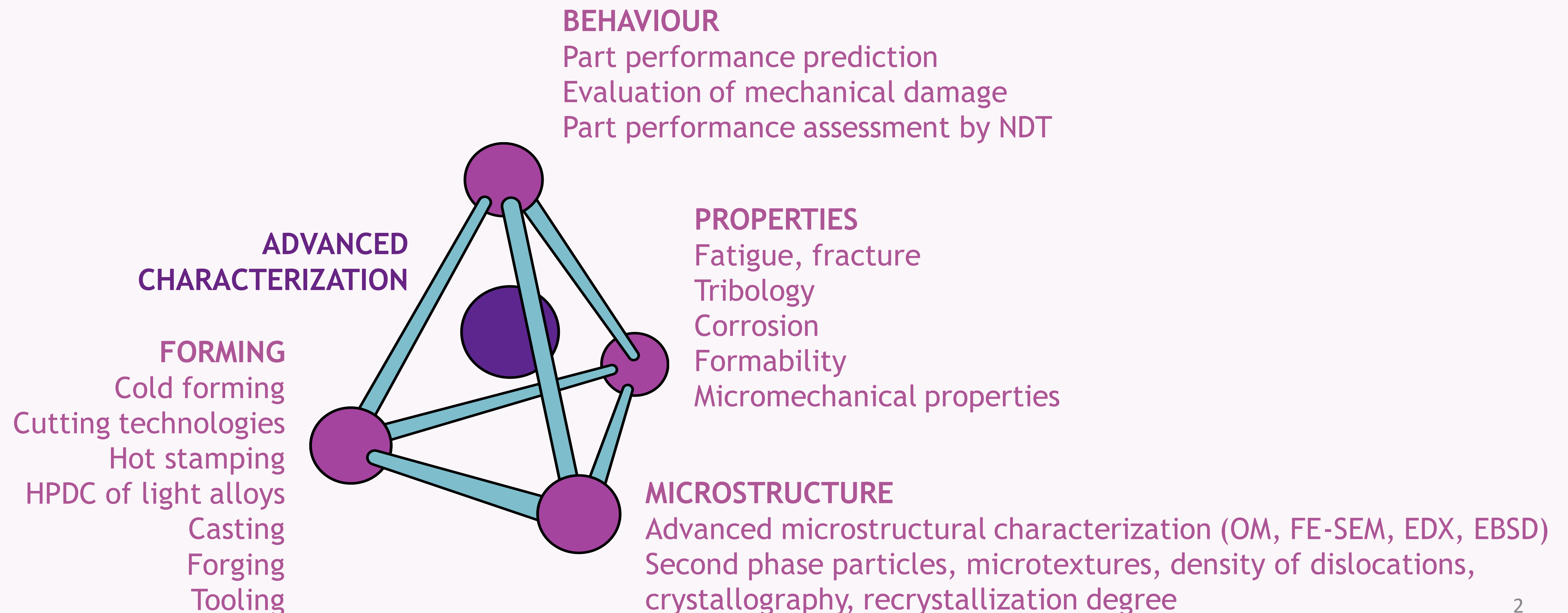


Metallic and Ceramic Materials Unit



"innovating for business"

Our R&D activities focus on the development of high performance materials solutions, to obtain **LIGHTWEIGHT / RESISTANT** materials and **FUNCTIONAL SURFACES** able to withstand severe mechanical and environmental requirements.





Advanced Solutions for LIGHTWEIGHTING and high MATERIALS PERFORMANCE

- Mechanical Behaviour, Fracture and Fatigue
- New Processes for Advanced Materials
- Light Alloys Casting



Customized FUNCTIONAL SURFACES for harsh environments

- Corrosion & Degradation
- Tribology: Wear, Friction and Lubrication
- Surface Technology & Coatings

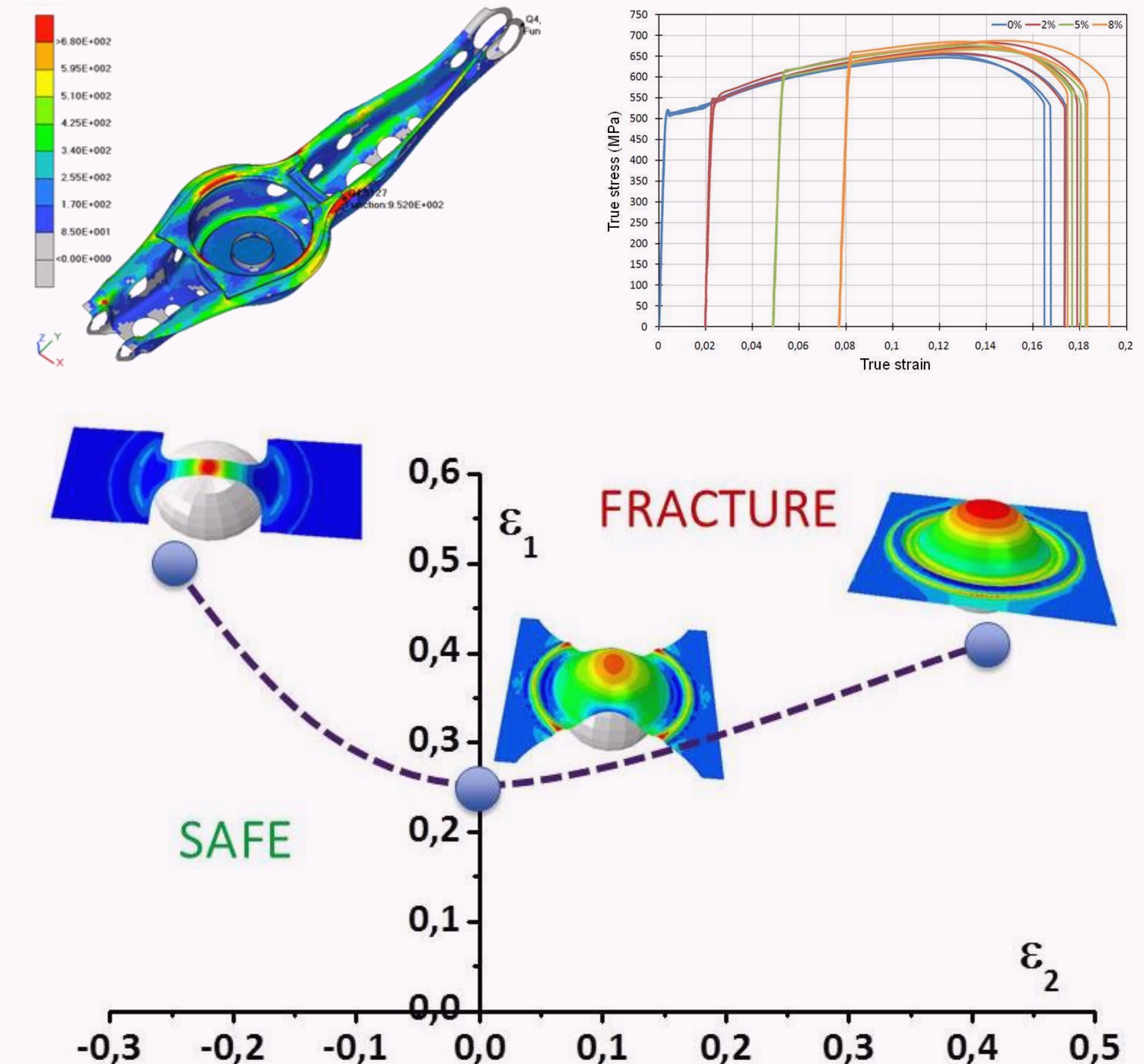
Mechanical Behaviour, Fracture and Fatigue research line

Advanced Solutions for LIGHTWEIGHTING and high MATERIALS PERFORMANCE

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AIM: Boost the applicability of advanced high-strength steels (AHSS), stainless steels and high-strength aluminium alloys. Transfer to the industry tools and methodologies to predict damaging mechanisms towards zero-defect.

- **Sheet metal forming:**
 - Formability studies (FLC Nakajima & Marciniak, drawability)
 - Advanced mechanical characterization of relevant parameters for cold and hot sheet metal forming
 - Selection of materials and coatings for forming tools
- **Fatigue and fracture behaviour of alloys, ceramics and elastomers**
- **In-service part and tool behaviour:**
 - Forecasting through fracture mechanics
 - Implementation of on-line and NDT inspection techniques: I4.0
 - Identification of possible fatigue-related failures. Solutions proposed in order to avoid catastrophic failures in use
 - Definition of tests and models for predicting part lifetime in absence of regulation or specific testing system
- **Joints: characterization of mechanical, adhesive and mixed joints**
- **NEW: Essential Work of Fracture (EWF). Use of patented tool to produce specimens to assess toughness of thin blanks. See video**



Mechanical Behaviour, Fracture and Fatigue research line

Advanced Solutions for LIGHTWEIGHTING and high MATERIALS PERFORMANCE

Noteworthy projects

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TOUGHSTEEL

Flexcrash

**FATIGUE
4LIGHT**

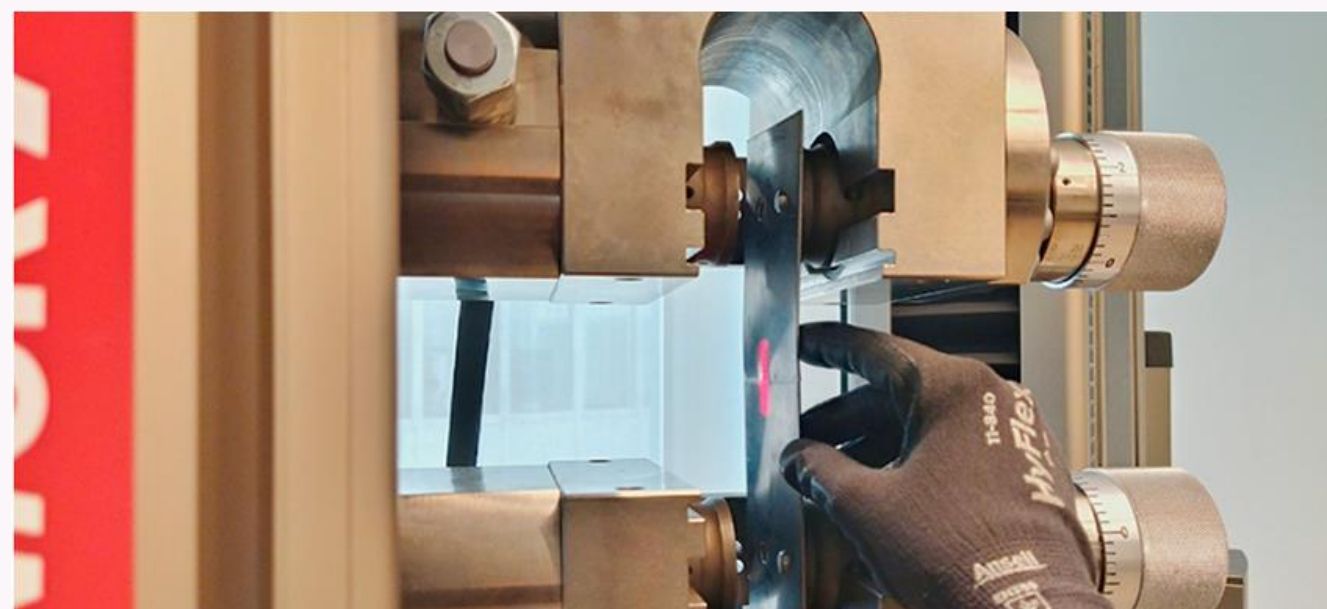
Fracture toughness as a tool to address cracking problems in forming and in-service performance of AHSS. Valorisation and dissemination

Flexible and hybrid manufacturing of green aluminium to produce tailored adaptive crash-tolerant structures

Fatigue modelling and fast testing methodologies to optimise part design and to boost lightweight materials deployment in chassis parts

The ToughSteel project involves and engages the main stakeholders around the steel sector with the objective to promote, disseminate and transfer the know-how acquired in previous projects about the use of fracture toughness as a tool to address cracking problems in forming and in-service performance of AHSS.

www.toughsteel.eu



The project is dedicated to advancing a versatile and hybrid manufacturing technology that utilizes aluminum alloys. This technology involves applying surface patterns through additive manufacturing onto preformed parts. The primary focus of this endeavor is to enhance lightweight construction and boost passenger safety. Specifically, the project aims to produce crash structures that are not only safer and lighter but also designed with circularity in mind. The ultimate goal is to promote vehicle lightweighting and enhance passenger safety.

www.flexcrash-project.eu

The project will apply new materials tailored to the requirements of vehicle chassis, such as advanced high-strength steels, special automotive stainless steels, high-strength aluminium alloys and hybrid metal-fibre reinforced polymeric materials.

The goal is to reduce vehicle chassis weight compared to the current solutions, taking into account eco-design and circular economy aspects.

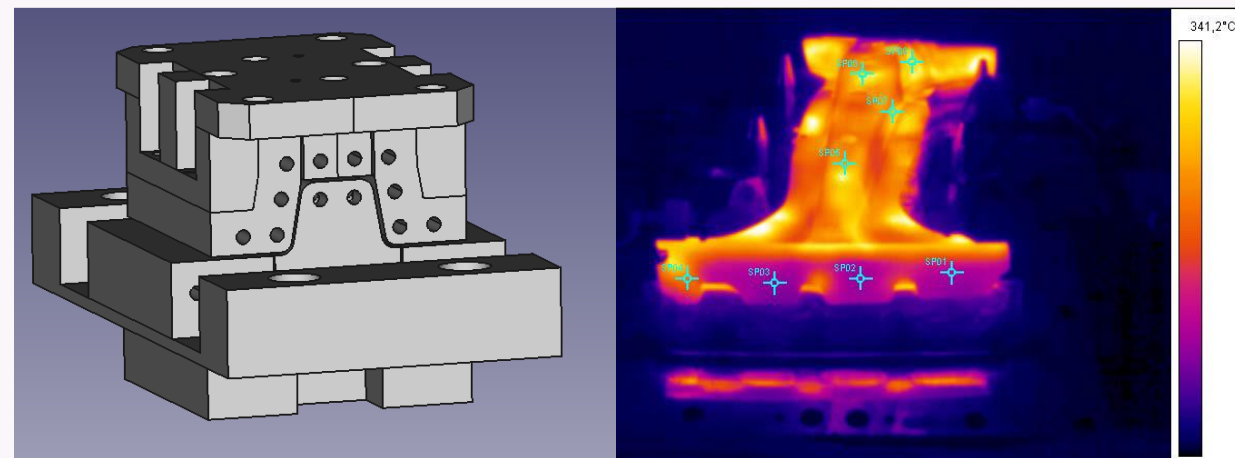


<https://fatigue4light.eu/>

New Processes for Advanced Materials research line

Advanced Solutions for LIGHTWEIGHTING and high MATERIALS PERFORMANCE

AIM: Develop metal forming processes combining the use of temperature and plastic deformation to obtain complex products and microstructural tailoring.



- Study of forming processes for metallic materials, from laboratory conditions to pilot scale
- Material characterization (coating thickness, composition, mechanical, cleanliness, CCT and TTT), tool surface and performance.
- Thermomechanical forming of sheet metal: hot stamping of Boron steel, Aluminium alloys, stainless steels.
- Severe plastic deformation processes: Equal Channel Angular Pressing (ECAP)
- Metal powder atomization: production and characterization
- Additive manufacturing: 3D metal printing

New Processes for Advanced Materials research line

Advanced Solutions for **LIGHTWEIGHTING** and high **MATERIALS PERFORMANCE**

Noteworthy projects

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ICARFA

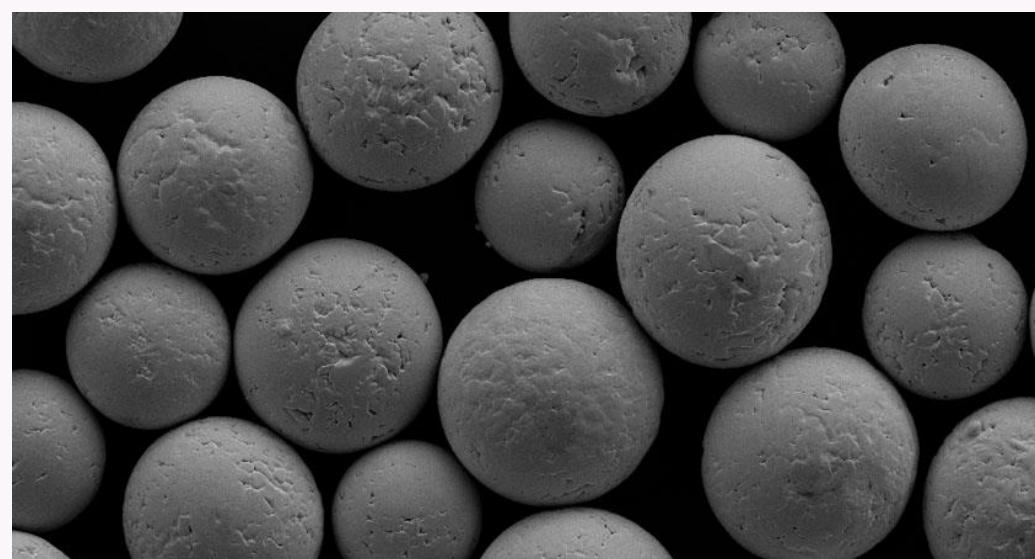
Increased Recycled Aluminum Content for High Formability Automotive Parts

The main objective of ICARFA is the development of new variants of existing alloys that are more robust in the presence of impurities, allowing for a high content of recycled material through 1) the incorporation of small additions in the composition; 2) the development of temperature-assisted stamping processes to optimize the loss in formability due to the presence of impurities.



Valorization of Ceramic and Metallic Waste through Powder Generation for Additive Manufacturing and Other High-Value Applications

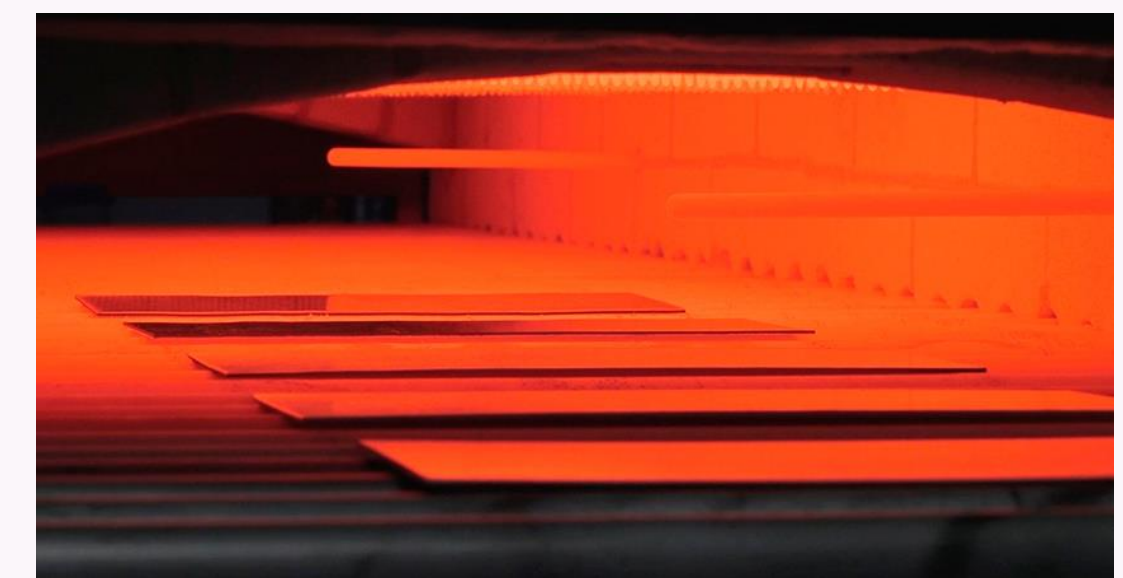
The general objective is to conduct industrial research on the valorization of waste materials from composites, metals, and ceramics through the generation of recycled powder for its incorporation into the feedstock of i) additive manufacturing processes, such as hopper-fed thermal extrusion (Fused Feedstock Manufacturing, FFM) and Selective Laser Melting (SLM), and ii) Laser Cladding (LC).



Advanced metallurgical and micromechanical modelling to deploy the microstructural tailoring potential of press hardening

The MiPre project has the objective to improve the accuracy of metallurgical and mechanical modelling to predict material properties in press hardening. Together with improvements in sensing and process control, these advances will allow a further level of microstructural tailoring, leading to components with locally optimized properties.

<https://eurecat.org/es/portfolio-items/mipre/>



Light Alloys Casting research line

Advanced Solutions for **LIGHTWEIGHTING** and high **MATERIALS PERFORMANCE**

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AIM: Design of more sustainable aluminium alloys with higher amount of recycled aluminum and fewer critical raw materials. High Pressure Die Casting of structural aluminium parts.



- Development of recycled aluminium alloys with tailored properties: Analysis of effect of impurities micro-addition of selected elements to minimize the deleterious effect of impurities, casting of parts by HPDC, PMC and Sand Casting, microstructural and mechanical characterization.
- High Pressure Die Casting (HPDC) Facilities: Complete HPDC cell with state-of-the-art vacuum equipment, versatile testing die for Vacuum Assisted High Pressure Die Casting (VPDC), extended experience in VPDC process, component post-processing, heat treatment and characterization.
- Selection and implementation of sensors and development of Industry 4.0 technologies for foundry processes.
- Ultrasonic Degassing Technology: Efficient degassing technology without gas consumption and gas release into the atmosphere, lower dross formation than with standard rotor degassing, similar hydrogen content and mechanical properties in components produced by HPDC and LPDC.

Light Alloys Casting research line

Advanced Solutions for **LIGHTWEIGHTING** and high **MATERIALS PERFORMANCE**
Noteworthy projects

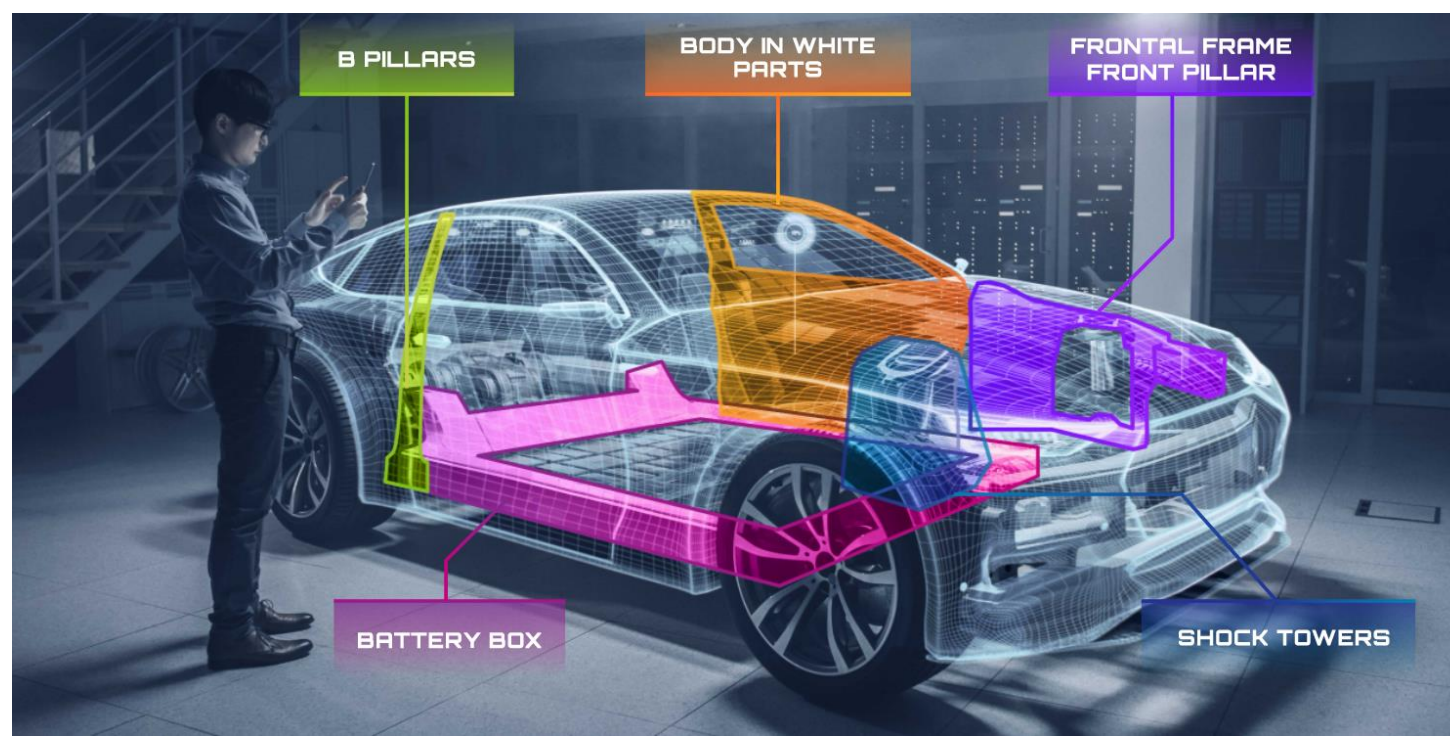
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Substitution of critical raw materials on aluminium alloys for electric vehicles

High performance aluminium grades make use of a wide range of alloying elements, and some of those (notably Si and Mg) are elements of strategic importance for many major engineering applications which the European region needs to import. SALEMA develops and implements novel aluminium alloys substituting CRMs.

<https://salemaproject.eu/>



FREE4LIB

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Feasible recovery of critical raw materials through a new circular ecosystem for a Li-Ion battery cross-value chain in Europe

The FREE4LIB project aims to develop 6 sustainable and efficient processes for the recycling of lithium-ion batteries at the end of their useful life, thanks to the creation of technologies with a technology readiness level (TRL) between 5 and 6. Among them the recovery of aluminium alloys to produce high performance extrusion alloys and Al powder.

<https://eurecat.org/en/portfolio-items/free4lib/>

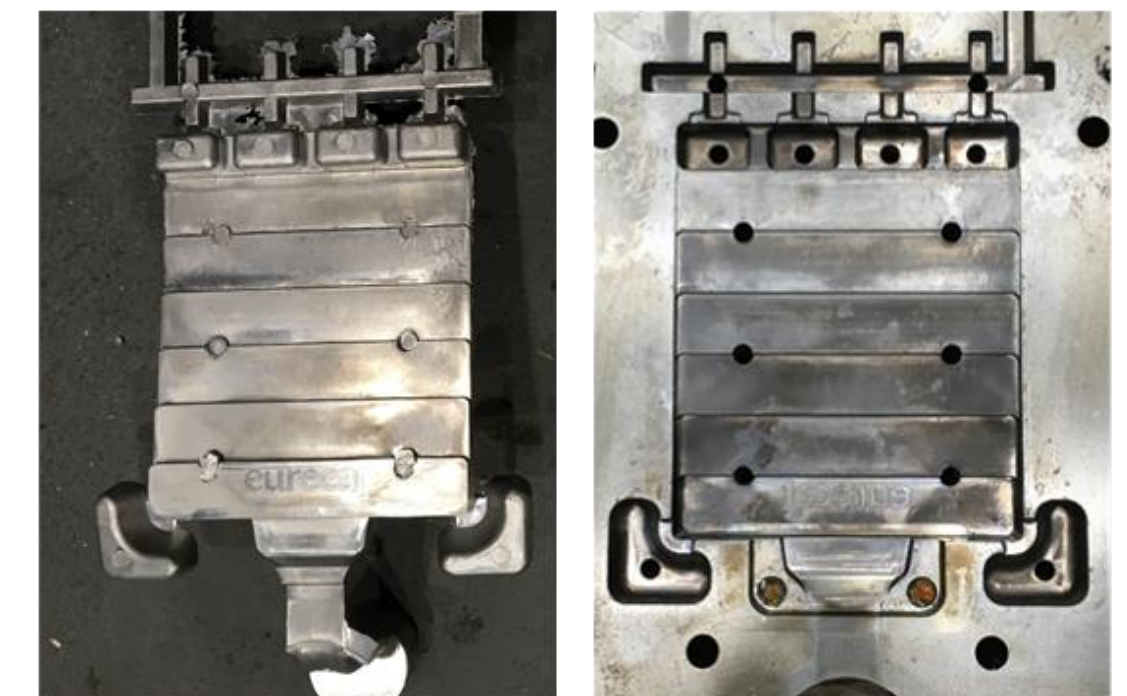


INNOCAST

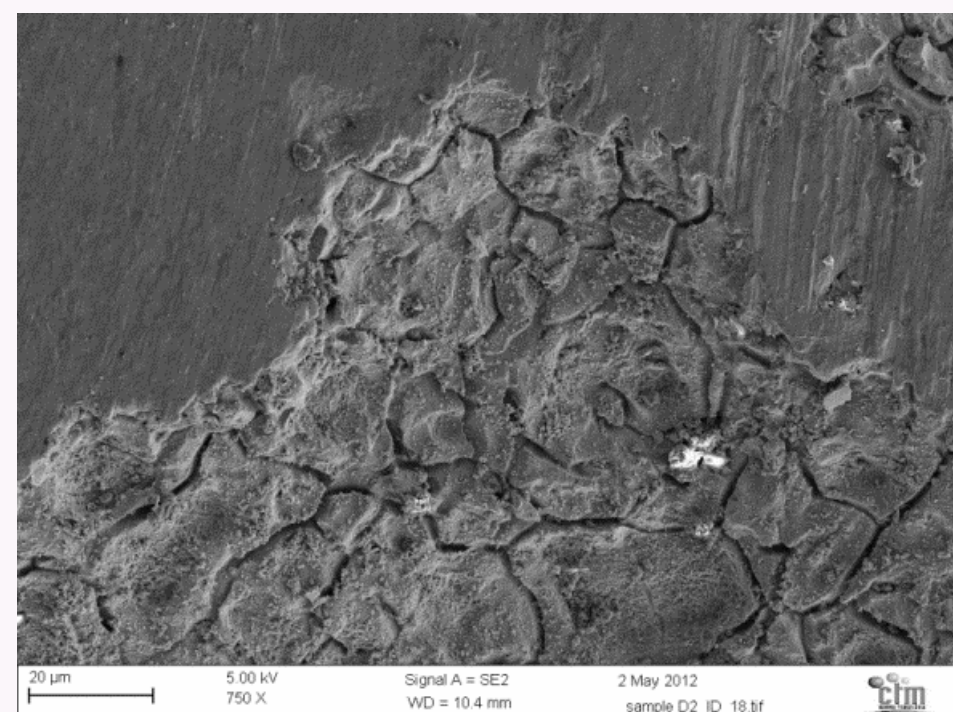
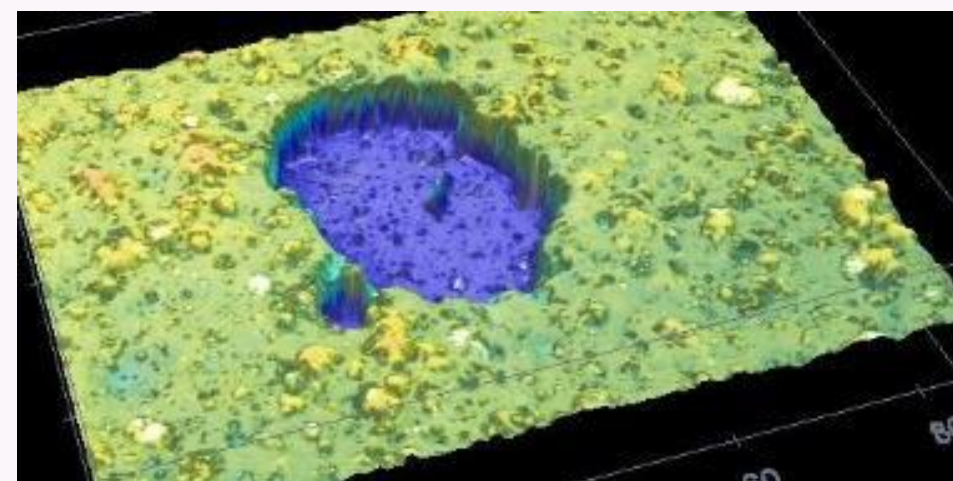
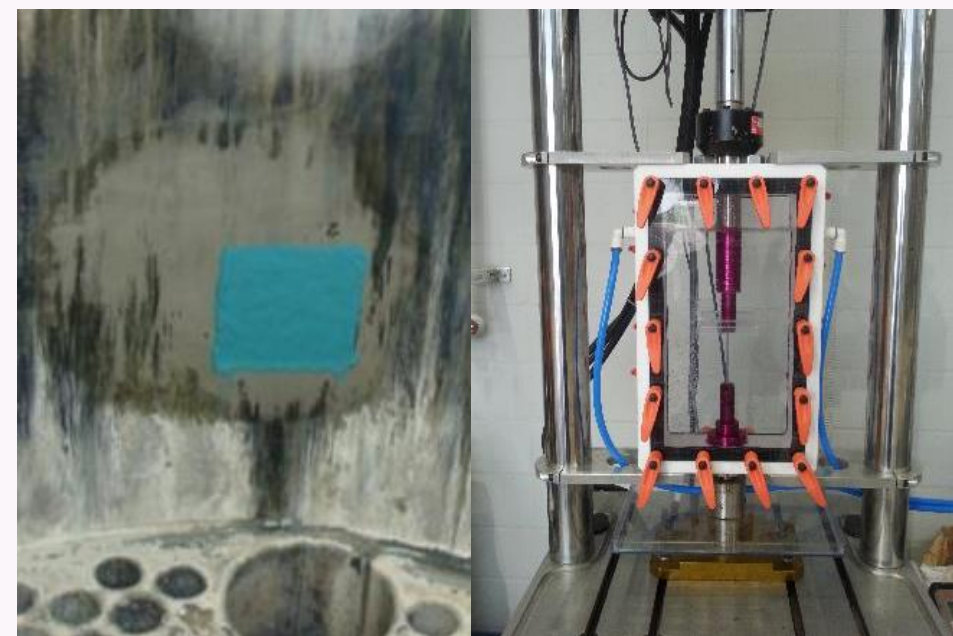
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Innovation on coatings for tools for the production of lightweight aluminium components

The INNOCAST project develops an innovative physical vapor deposition (PVD) coating concept with a nanostructured morphology to generate a complex layer of surface oxides to greatly reduce wettability and attack by molten aluminium. To validate the performance of these new solutions, a pilot environment and a test methodology for surface treatments in HPDC is established.

<https://eurecat.org/en/portfolio-items/innocast/>



AIM: Development of solutions to prevent and minimize material environmental degradation mechanisms in aggressive environments (off-shore, hydrogen, packaging, manufacturing processes,...).



- Development of solutions to environmental degradation problems through advanced characterization techniques in different aggressive environments including exposure to liquids, salts, microorganisms and gases on metallic, polymer, composites, textile and ceramics under certain operating conditions. Identification of corrosion mechanisms, failure analysis, expert studies, etc.
- In situ and non-destructive inspection of corrosion mechanisms and surface degradation, using surface replicas.
- Effect of aggressive environment on mechanical properties: Stress corrosion cracking, Tribo-corrosion, fatigue-corrosion, H embrittlement
- Inhibitor efficiency study
- Reduction of premature failure of components and maintenance costs due to corrosion mechanisms or loss of mechanical properties: Inhibitor efficiency study, proper selection of materials and coatings, corrosive media characterization, anti-corrosion protection solutions.

Corrosion & Degradation research line

Customized FUNCTIONAL SURFACES for harsh environments

Noteworthy projects

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Control of Risk for hYdrogen embrittlement in Steels for Automotive applications

The CRYSTAL project aims to reduce the hydrogen embrittlement risk in high strength steel parts for the automotive industry. The project will use a novel solid-state gas sensor to quantitatively measure in-situ the hydrogen absorbed during the production of steel parts and during their service life. CRYSTAL project will also define and determine the best methodology to evaluate HE during steel production and life span of the components.



<https://crystal-rfcs.eu/>

Food Industry

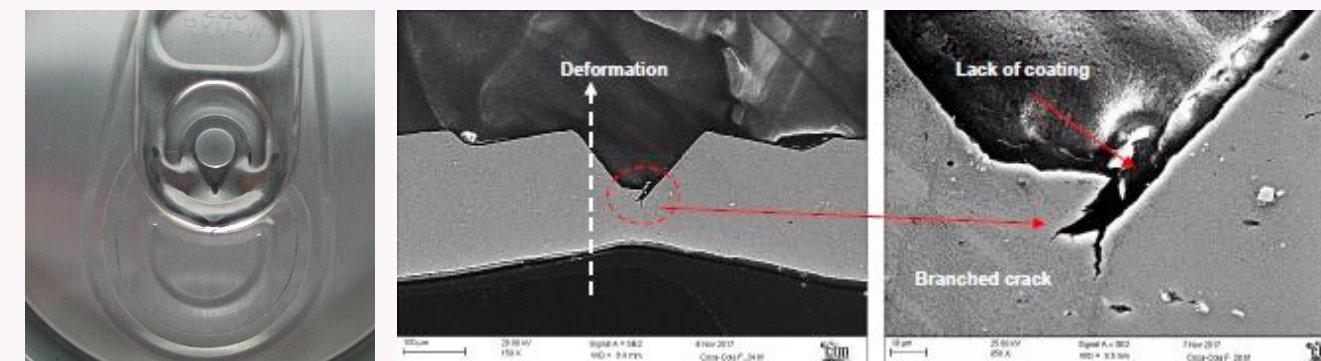
Corrosion in the food industry

The food industry can suffer from corrosion during food processing but also in food packaging. EURECAT has experience in the detection and mitigation of both types of corrosion.

Microbiologically induced corrosion in hot water tank



Uncontrolled can opening



Hydrogen embrittlement resistant new steel links solutions for off-shore wind turbines

The HELIX project aims to provide lower cost, high corrosion resistant, high strength steel and high diameter fasteners to the offshore wind industry to support the ever-increasing size of wind turbines, leading to higher productivity. HELIX will use advanced characterization techniques under both atmospheric and immersion conditions to advance in the knowledge of hydrogen absorption in high strength steels under cathodic protection and in atmospheric conditions.

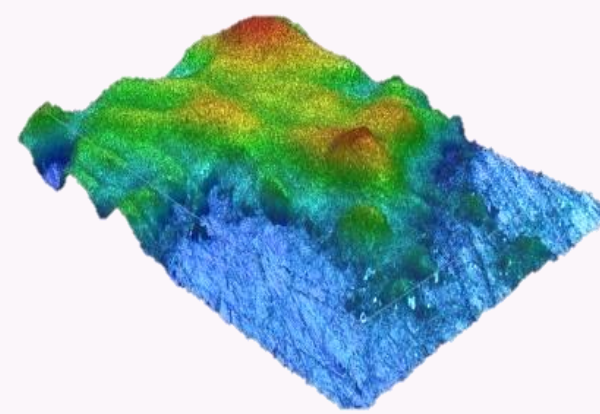
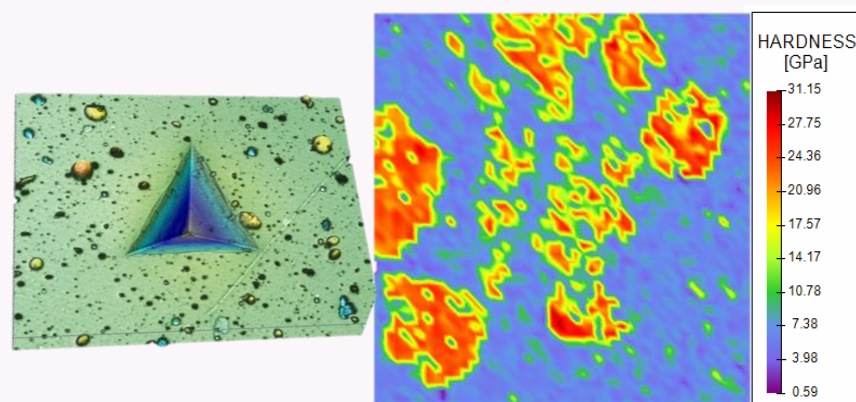


<https://helix-project.eu/>

AIM: Development of solutions to prevent and minimize wear mechanisms under extreme conditions (manufacturing processes, mining, materials handling, lubricated components,...)



- Analysis of friction, wear and lubrication mechanisms acting on surfaces with relative motion.
- Wear prediction, components and tools performance optimization: In situ and non destructive monitorization of wear phenomena by means of sensors and surface analysis techniques.
- Impact wear assessment: design of tailored contact fatigue, multiple impact and micromechanical test.
- Optimization of lubricants consume and performance: from laboratory Stribeck curves to industrial application.



Tribology research line

Customized FUNCTIONAL SURFACES for harsh environments
Noteworthy projects

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HIPERMAT

Advanced design, monitoring, development and validation of novel High PERformance MATerials and components

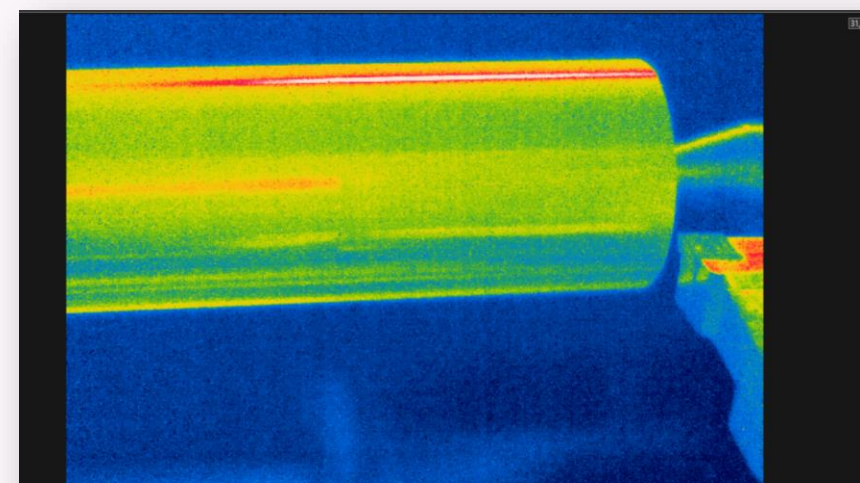
The activities of this project focus on the development of strategies and tools for the efficient development of new alloys and components under demanding operating conditions of high temperature and corrosion in the process industry, specifically for furnace components for hot stamping austenitisation.

<https://www.aspire2050.eu/hipermat>



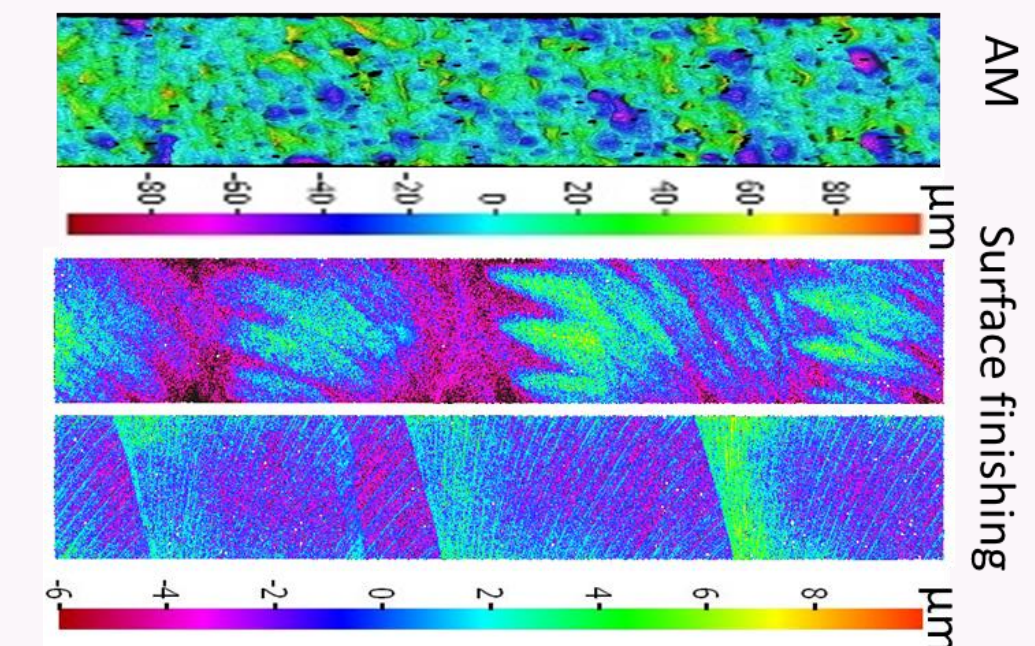
New Intelligent Lubrication Systems for Metal Processing

The LUBRINTEL project aims to research and develop new lubricants and their control systems in order to balance their properties and obtain added value in all their life stages; based on ingredients (avoiding petroleum derivatives) and active ingredients (additives) that favour efficiency, without losing sight of the in situ control of the fluid (for prediction and remediation), respecting the environment and meeting the increasingly demanding needs of companies.



PREdictive simulation of finishing operations in steel Additive Manufacturing for optimal SURface integrity

SuPreAM has the objective to optimise the surface integrity of Additive Manufactured and Machined steel components and to reduce manufacturing expenditures at the steel industrial sector by minimising the material scrap and reducing the number of re-processing loops during finishing operations.



Surface Technology & Coatings research line

Customized FUNCTIONAL SURFACES for harsh environments

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AIM: Development and application of advanced functional coatings and surface treatments for different sectors

- Development and application of advanced functional coatings for different industrial sectors:
 - PVD, CVD and Ion Implantation technologies
 - Plasma-based surface treatments
- Surface functionalization of materials, devices and components: Wear and corrosion resistance increase, low friction, anti-fouling properties, biomedical, aesthetic and decorative aspects, etc.
 - Hard, wear resistant and low friction coatings for the metal-mechanical sector
 - Corrosion resistant coatings
 - Alternatives to hexavalent chrome coatings
 - Biomedical coatings for prosthesis, implants and surgical tools
 - Decorative and functional coatings for automotive industry
 - Coatings addressed to renewable energies: thermosolar, fuel cells, etc.
 - Transparent and functional coatings for optical and electronic devices
- Technological support in the selection and industrial implementation of coatings and surface treatments



Surface Technology & Coatings research line

Customized FUNCTIONAL SURFACES for harsh environments

Noteworthy projects

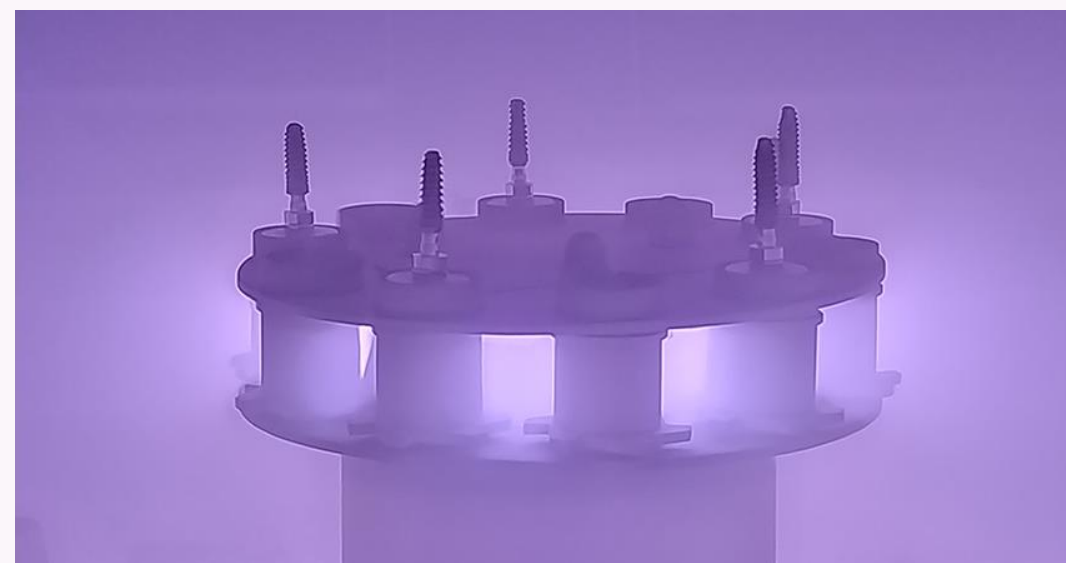
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Development of new designs and advanced antibacterial surface treatments for the improvement of the biomechanical response of dental implants

The BIOIMPLANT project has the objective to develop a new range of dental implants based on a new design of the external geometry, with a new surface finish and provided by a revolutionary bactericidal surface treatment based on silver ion implantation.

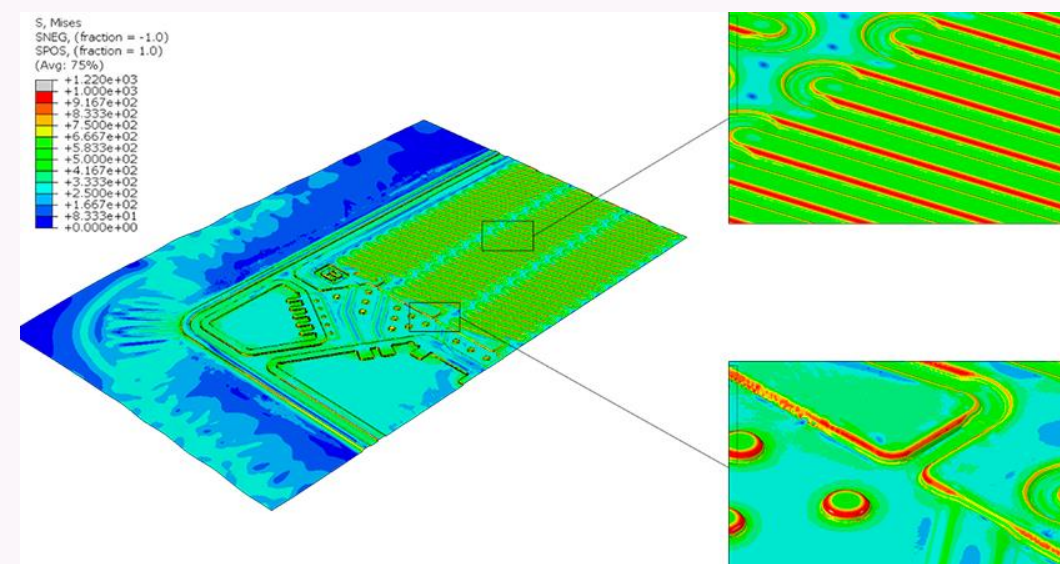
<https://eurecat.org/en/portfolio-items/bioimplant/>



Innovation in materials, design and manufacture of high-performance and durable PEM fuel cell bipolar plates

FormPlate seeks to optimise the energy efficiency, cost and durability of metallic bipolar plates, a key component to guarantee the energy efficiency of proton exchange membrane (PEM) hydrogen fuel cells for application in the automotive sector.

<https://eurecat.org/en/portfolio-items/formplate/>



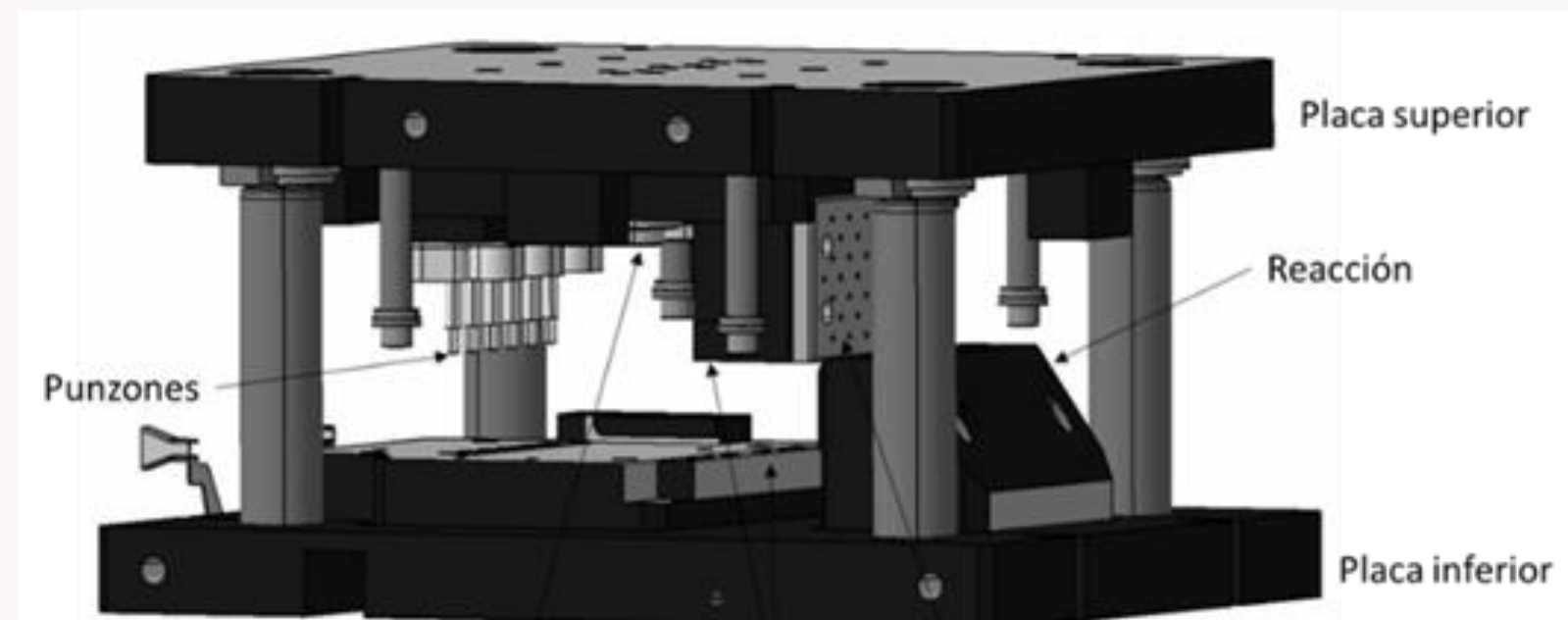
Development of innovative PVD hard coating technology

The project develops an innovative PVD hard coating technology that allows high thicknesses of up to 100 microns to be achieved at high deposition rates (20 microns/hour), enabling its application in new industrial sectors that were previously unapproachable.

<https://eurecat.org/en/portfolio-items/thick-coat/>



- **Microscopy techniques:**
 - Optical microscopy
 - Confocal and focal variation topography (100 to 1500X): determination of 2D and 3D roughness parameters
 - Scanning Electron Microscopy (SEM) with EDX and EBSD.
- **Hardness characterization:** HB, HRC, HV and Shore scales.
- **Nano and micromechanical characterization:** hardness and Young modulus of thin layers and multiphase materials.
 - MTS nanoindenter
 - KLA nanoindenter
 - Instrumented Microindenter
- **Mechanical tests:** tensile, bending, compression tests (up to 250 kN)
- **Formability tests:** Drawability (defects and anisotropy), Bending, Stretch flangeability, Hole expansion, Forming Limit Curve
- **Fatigue tests:** SN and EN curves, staircase method, Goodman and Haigh diagrams
- **Fracture toughness:** Sheet metal (EWF methodology), K_{ic}, J_{ic}, COD, Crack propagation kinetics
- **Chemical composition analysis:**
 - Spectro
 - Leco (C, S, N and O)
- **Tribological tests:** coefficient of friction, wear rates, impact wear, tribocorrosion and lubricant behaviour.
 - UMT-2 Tribometer: up to 100 N and 700 °C
 - Roller to roller tests: up to 1000 N and 600 °C
 - Abrasive wear tests: up to 30 N
 - Lineal Taber Abrader
 - Multiple impact tests
 - Contact fatigue and fretting
- **Dilatometry:** TA Instruments DIL805A/D quench dilatometer
 - CCT, TTT curves on bulk or sheet metal
 - Reproduction of thermomechanical cycles
- **DSC:** recrystallization, phase change, Cp determination
- **Corrosion:**
 - CASS, NSS tests, cyclic corrosion test, humidity test
 - Stress Corrosion Cracking, fatigue-corrosion, tribo-corrosion
 - Hydrogen embrittlement
 - Galvanic corrosion, exfoliation, pitting corrosion,
 - Potentiometric tests
 - Biocorrosion
 - Tests tailored to customer specification



- Equipment

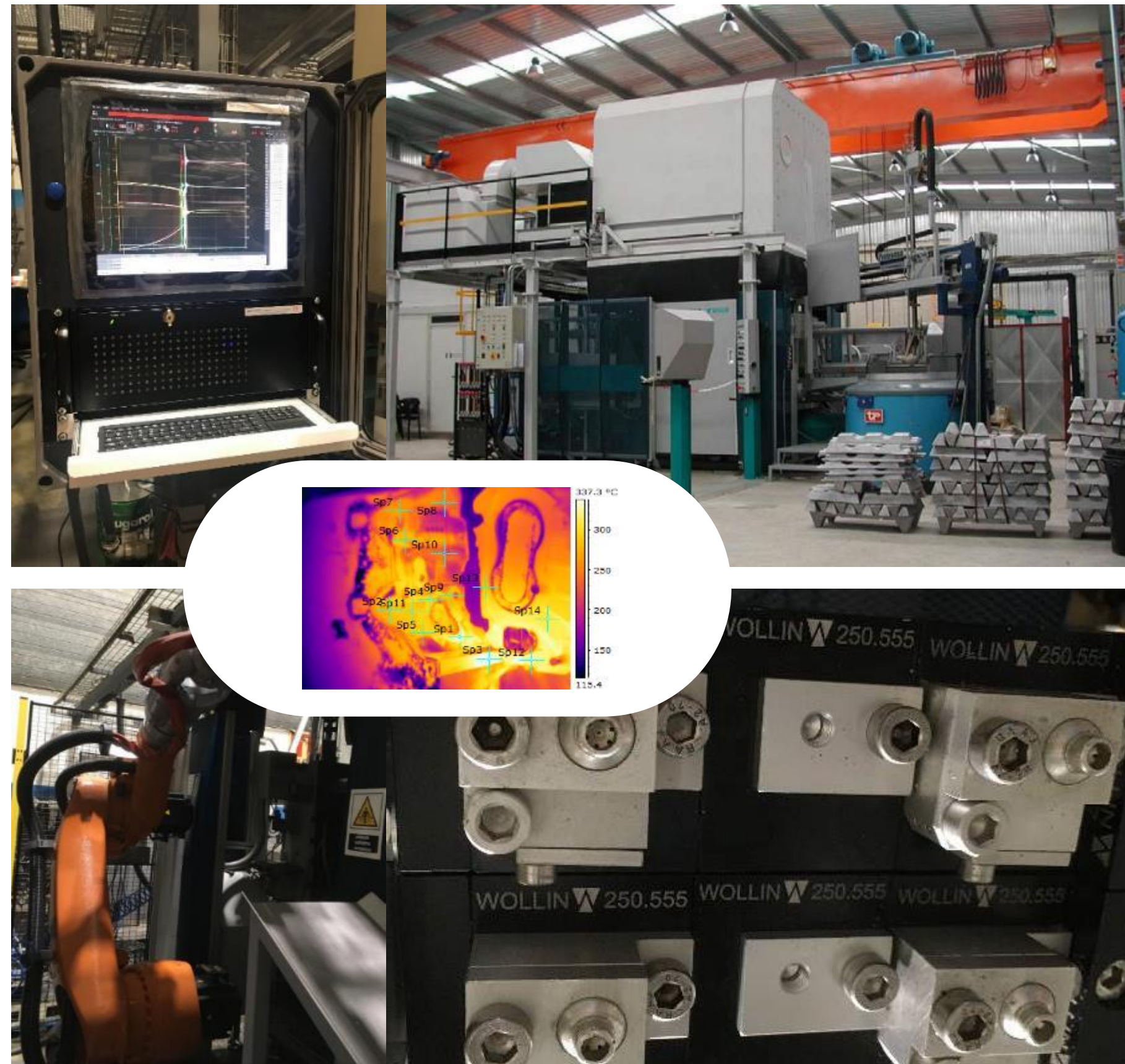
- Mechanical (100 t) and hydraulic (150 t) presses
- Continuous roller hearth furnace, up to 400 x 300 mm blanks
- Batch furnaces
- Measurement and imaging equipment, incl. thermal imaging

- Possibilities

- Optimization of forming parameters
- Forming process sensitive materials
- Demonstration of new processes
- Evolution of part performance obtained at different tooling stage
- Analysis of tool and process solutions
- Tooling performance (tool materials, coatings, etc.)
- Lubrication
- Process control and Industry 4.0 concepts

- Processes

- Cold Forming
- Punching and Cutting
- Hot stamping and press hardening
- Possibility of adapting customer tools and custom-built rigs



- Equipment

- Bühler Evolution 53D with updated control panel
- KUKA robot with WOLLIN nozzles
- ProVac Vacuum unit
- MK vacuum density-tester
- CastQuality equipment from Electronics GmbH
- Sensorized machine and die
- Permanent thermographic camera
- Furnaces of different sizes to develop new alloys

- Possibilities

- Die certification and pre-series
- Process optimization
- Test of lubricants, coatings, tool steels,...
- Die simulation and optimization
- Implementation of industry 4.0 processes



- Equipment

- Melting furnaces to produce tailored alloys
- Mould to produce extrusion billets
- Extrusion pilot plant
- Tool equipped with multiple sensors
- Force up to 80 Tn
- Billets Ø35 mm and 100 mm length
- Extrusion tie with L-profile: 16 x 16 x 1.5 mm
- Length of extruded profile up to 2 m

- Possibilities

- Alloy tailoring and development
- Characterization of new materials
- Sensing and control of extrusion process
- Development and trial of ancillary equipment
- Analysis of tool and process solutions
- Tooling performance (tool materials, coatings, etc.)
- Lubrication





- Equipment

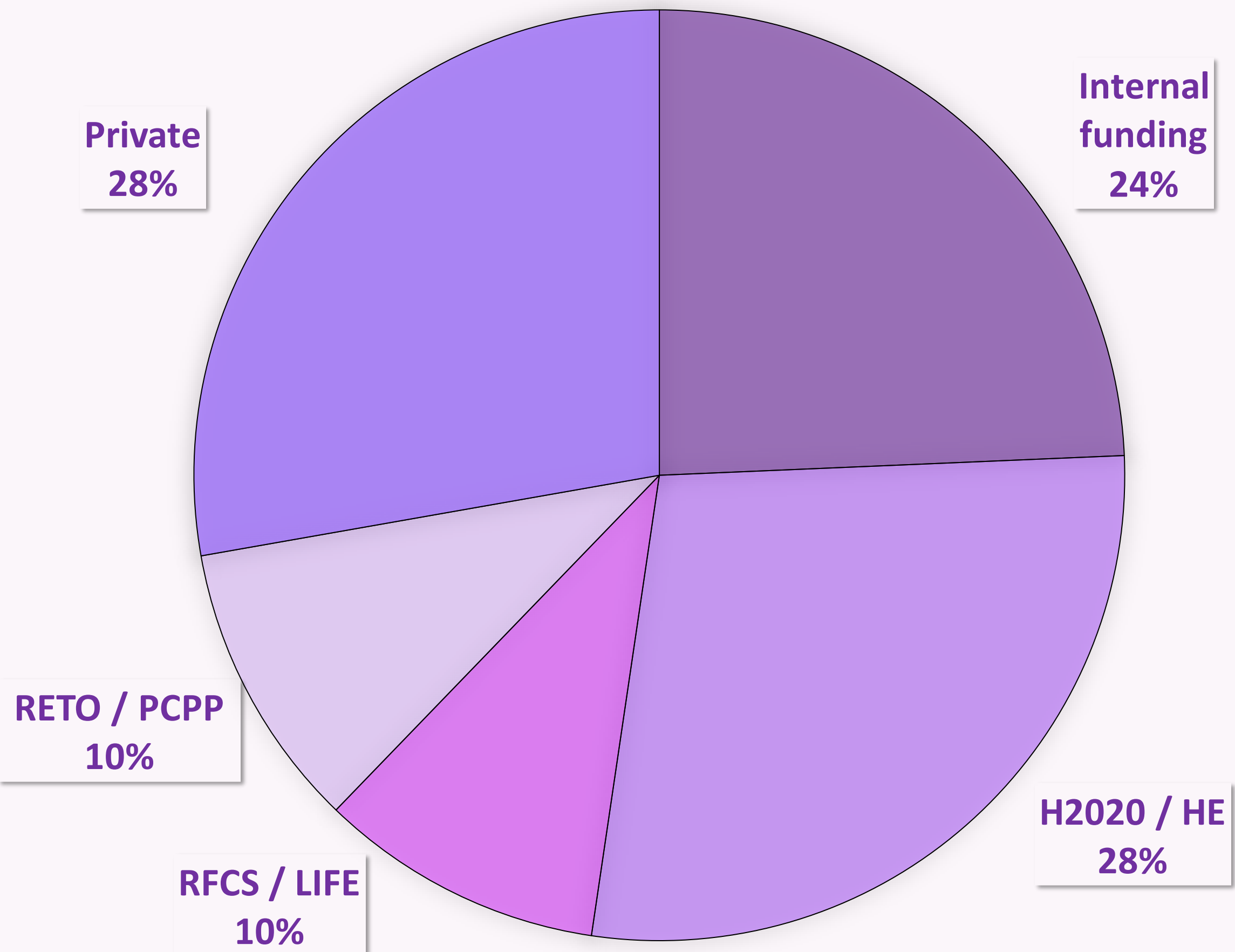
- Industrial PVD reactor
- Lab-scale PVD reactor

- Possibilities

- Hard ceramic and oxide coatings
- Carbon-based coatings
- Metallic coatings
- Plasma polymerized coatings
- Plasma-based surface treatments

- Processes

- PVD: Cathodic Arc Evaporation (filtered, pulsed and DC)
- PVD: RF magnetron sputtering
- Pulsed injection MOCVD
- Glow discharge deposition
- Plasma polymerization
- Ion implantation



Ongoing projects 2023

- 6 H2020
- 2 HORIZON EUROPE
- 6 RFCS
- 1 LIFE
- 5 RETO; 6 PCPP
- + 40 Private contracts
- + 18 Own R&D projects

We strengthen our innovative capacity on an international level by participating in Open Innovation Test Beds, R&D in steel and raw materials programmes.

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Thank you!



"innovating for business"