

eurecat!



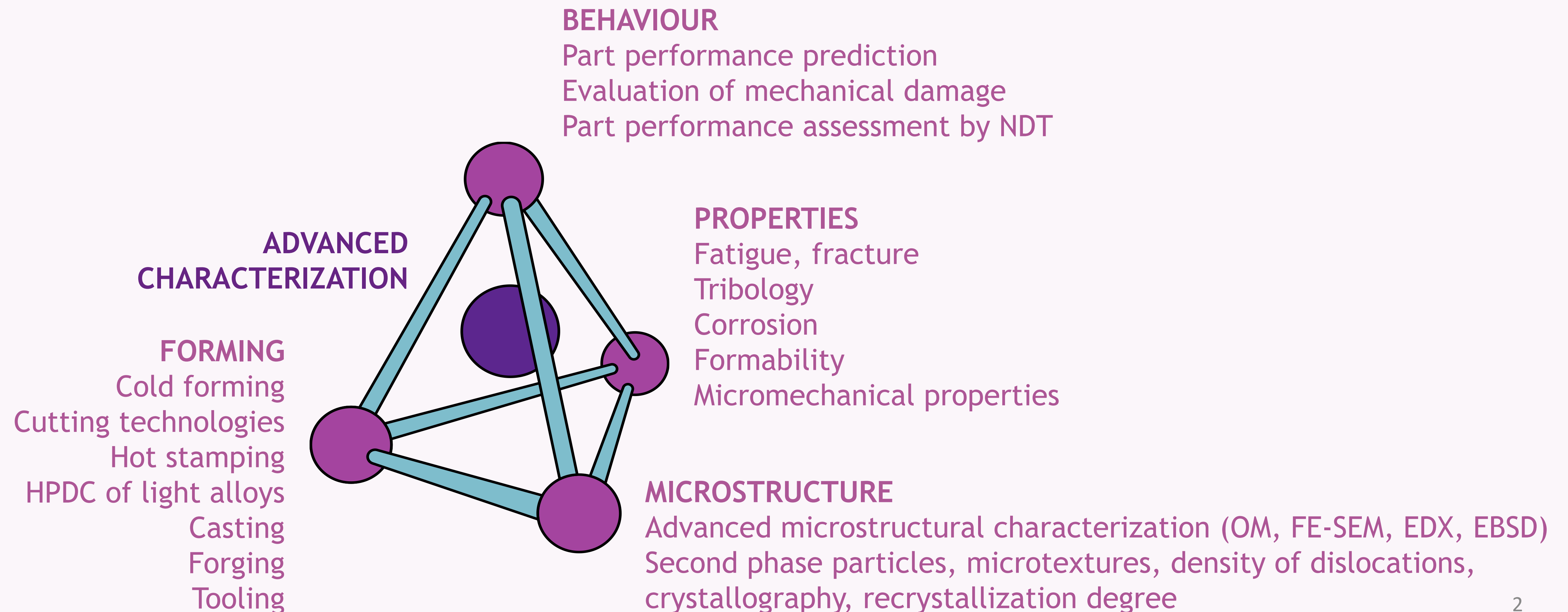
Metallic and Ceramic Materials Unit



"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



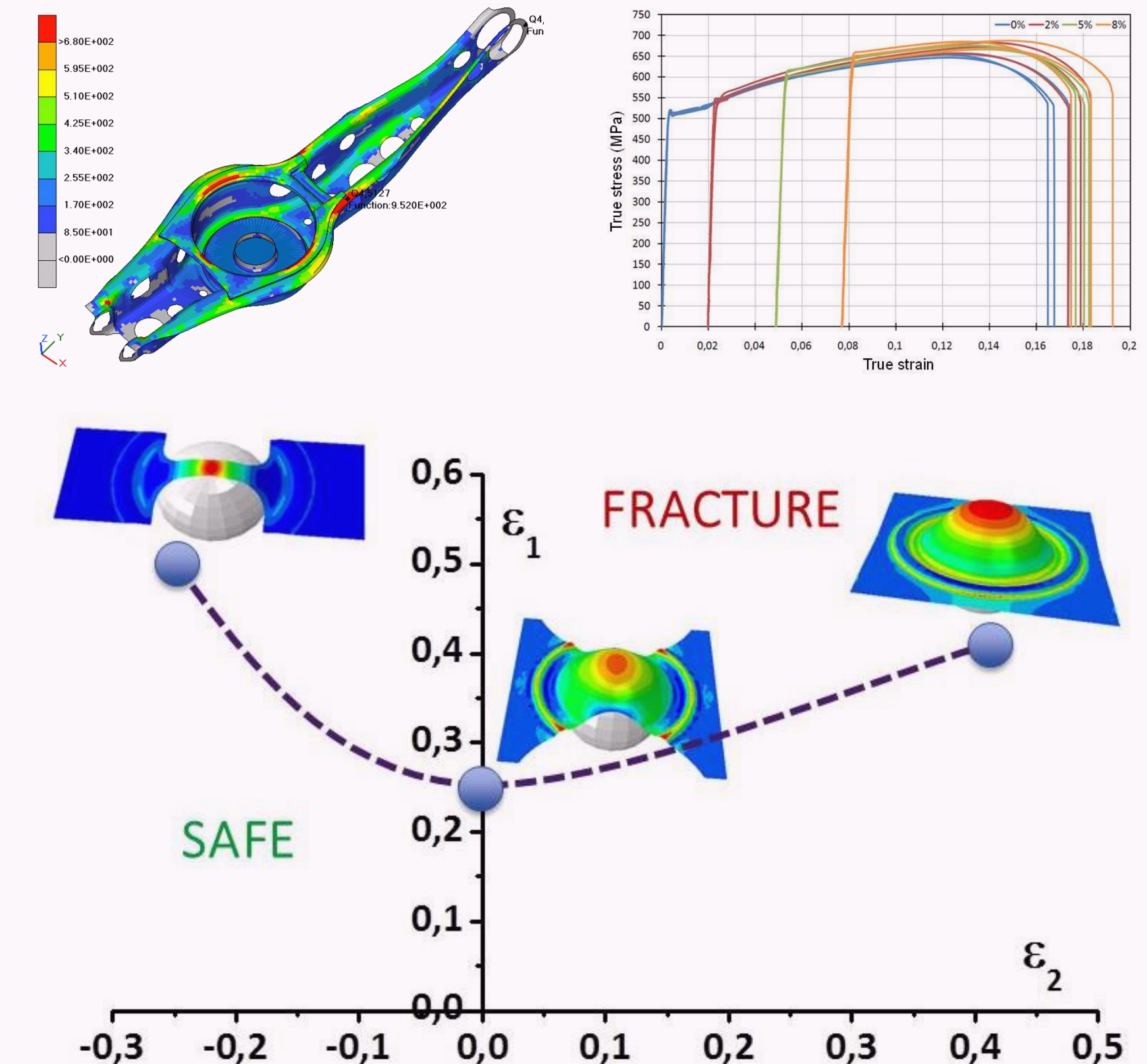
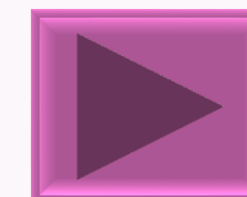
Customized FUNCTIONAL SURFACES for harsh environments

- 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

- 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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SHEET METAL FORMING TESTING HUB

FormPlanet is one of European Union's Open Innovation Test Beds (OITBs) for characterisation, aiming at increasing the productivity of the sheet metal forming industries through the development of new experimental and modelling methodologies to assure zero-defects production and optimise sheet material development, production and performance.

www.formplanet.eu



Facing edge-cracking in AHSS: towards zero-defect manufacturing through novel material characterisation and data driven analytics for process monitoring

CuttingEdge4.0 project develops experimental tools and digital twins for the cutting process and incorporate Industry 4.0 data driven analytics based on Artificial Intelligence and machine learning solutions. The final aim is to transfer to the automotive industry tools and methodologies to predict edge-cracking in the early part design stages, detect edge-cracking defects and assure part quality during forming, boosting the applicability of AHSS-based automotive lightweight parts.

www.cuttingedge-project.eu



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

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.

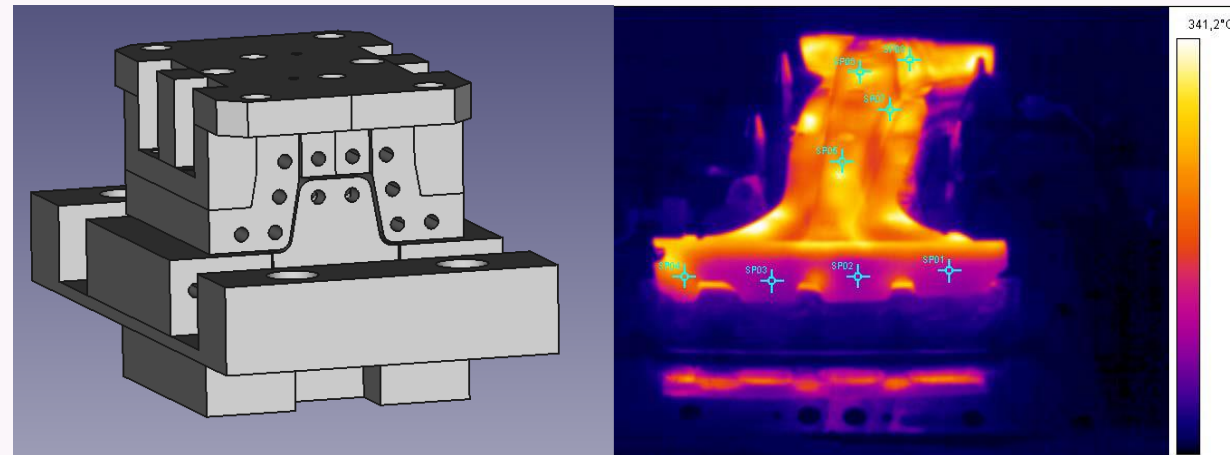
The goal is to reduce vehicle chassis weight compared to the current solutions, taking into account eco-design and circular economy aspects.



<https://fatigue4light.eu/>

New Processes for Advanced Materials research line

Advanced Solutions for LIGHTWEIGHTING and high MATERIALS PERFORMANCE



- 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: production and characterization
- Atomisation

New Processes for Advanced Materials research line

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

Noteworthy projects

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INNOESTAMP

Innovation in PVD coatings for Press Hardening Applications

The aim of INNOESTAMP is to develop and demonstrate a Physical Vapor Deposition (PVD)-based surface treatment solution able to enhance the performance of tooling for press hardening of steel sheet.

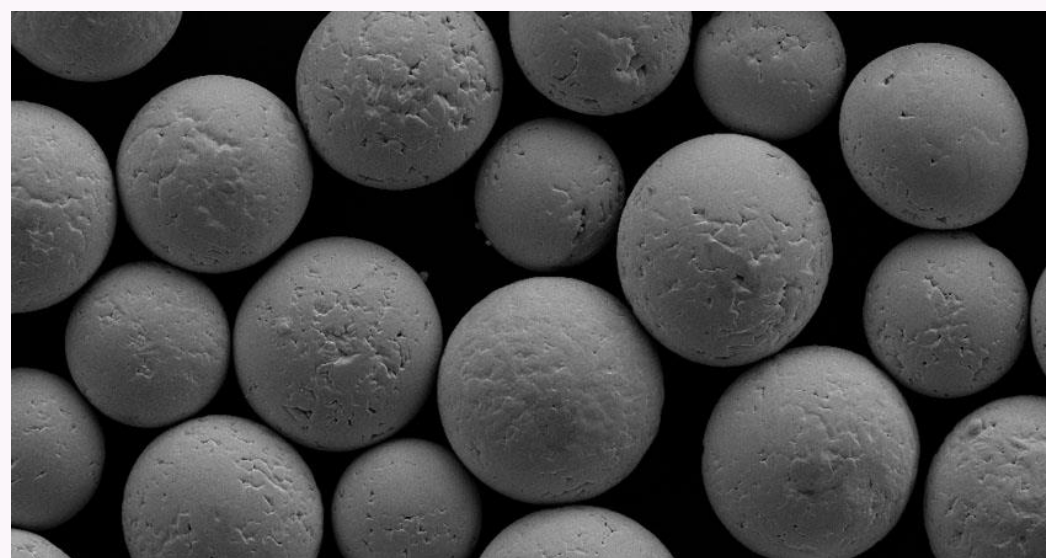
These solutions are demonstrated in a press hardening pilot line, set up and validated during the project to be representative of conditions in the industrial environment.



Advanced manufacture of powder materials for industrial applications

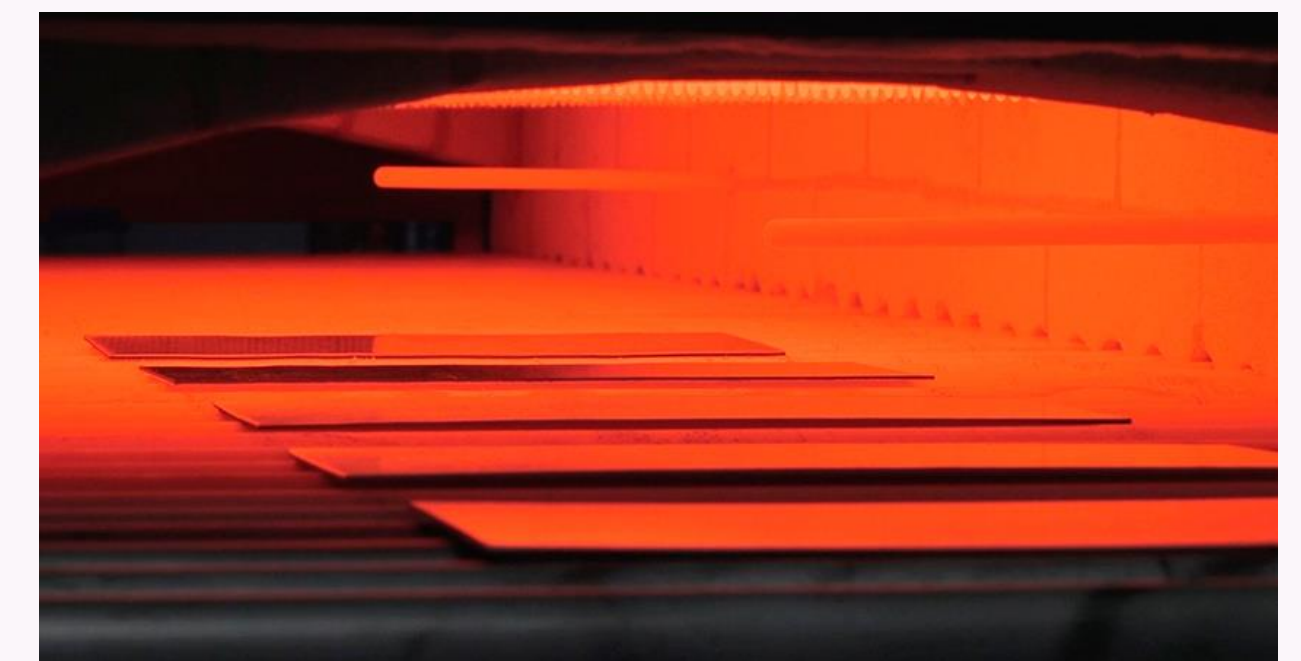
The FAMPAI project develops and manufactures, with advanced processes, powdered materials of a metallic, intermetallic and ceramic nature, with a crystalline, amorphous structure, for industrial applications. The project focuses on shaping pieces by means of powder metallurgy and on the treatment and functionalisation of surfaces by means of coatings deposited by projection.

<https://industriesdelfutur.cat/en/portfolio/fampai>



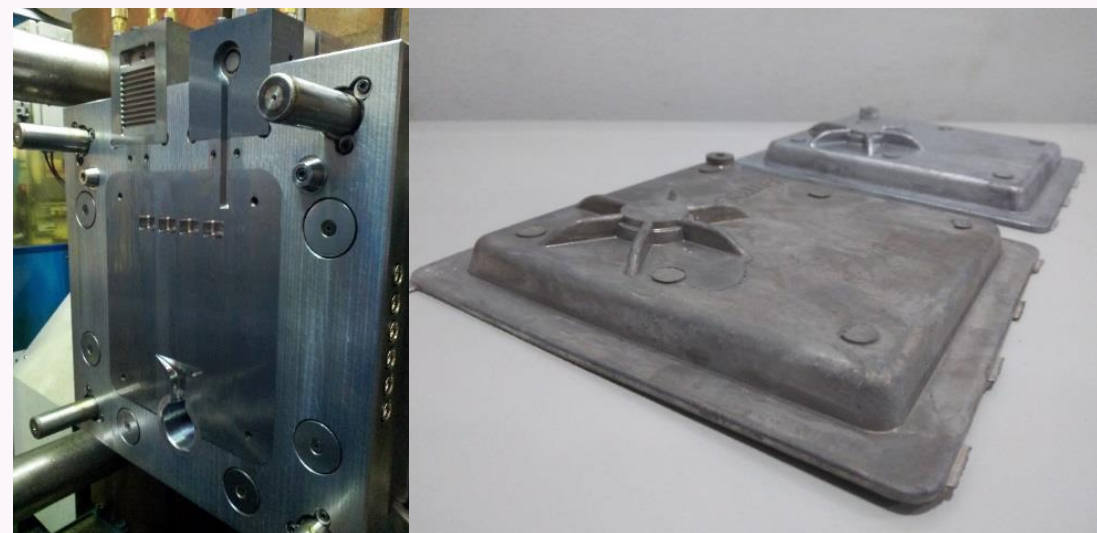
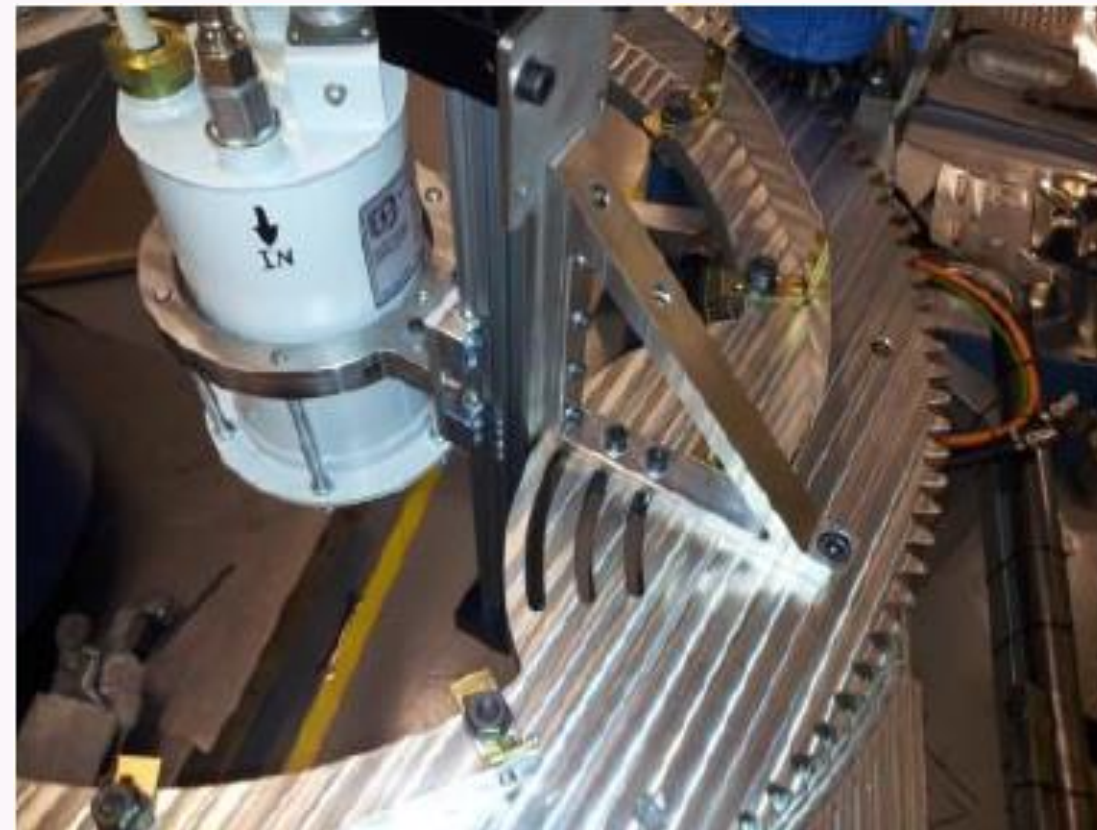
Advanced metallurgical and micromechanical modelling to deploy the microstructural tailoring potential of press hardening

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.



Light Alloys Casting research line

Advanced Solutions for LIGHTWEIGHTING and high MATERIALS PERFORMANCE



- **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.
- **High Pressure Die Casting Facilities:** Complete HPDC cell with state of the art vacuum equipment, versatile testing die for VPDC, extended experience in VPDC process, component post-processing, heat treatment and characterization.
- **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.
- **Fabrication of hollow parts with salt core technology:** Production of salt cores with HPDC process, production of parts with complex cavities in aluminium, plastic and composite with the salt core, salt core process removal.

Light Alloys Casting research line

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

Noteworthy projects

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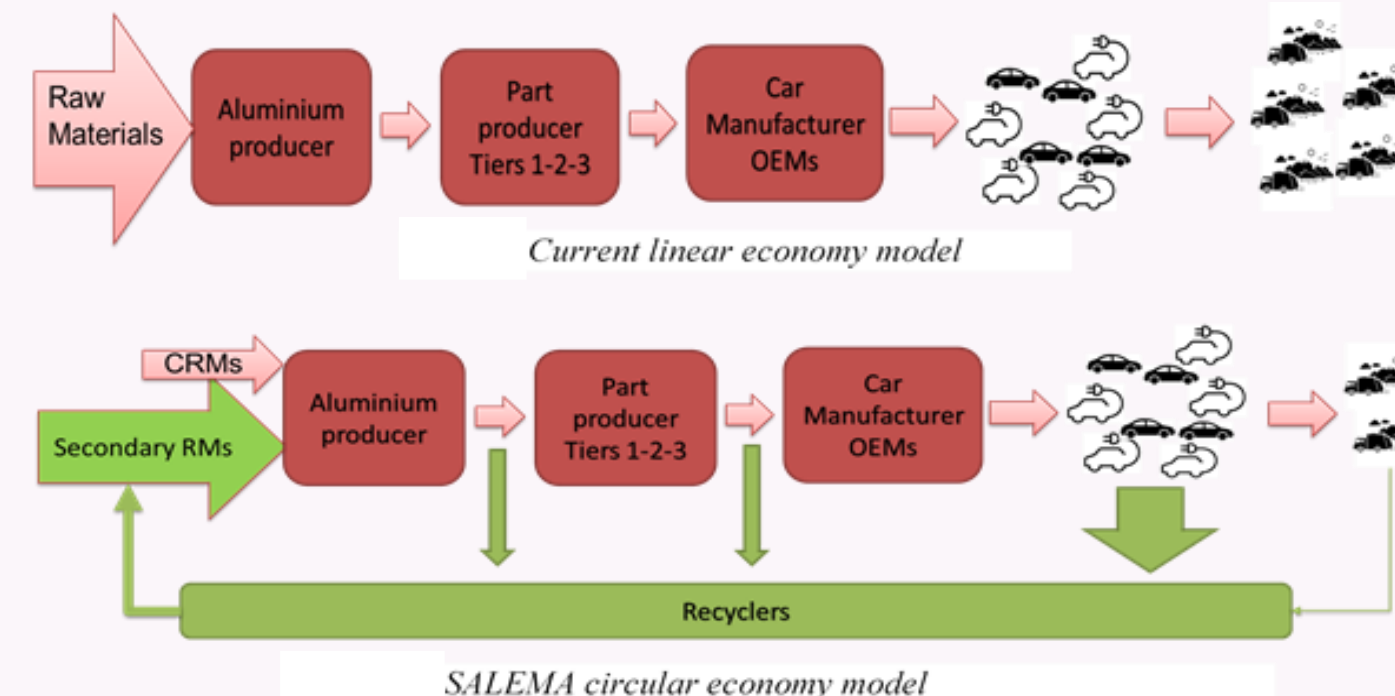
Development of a degassing technology for industrial manufacturing of light alloy components

CERORSOM develops an innovative degassing technology based on the ultrasonic treatment of light metals to demonstrate, for the first time on an industrial scale, that ultrasonic degassing technology can be an efficient resource and environmentally friendly method to be used effectively in industrial conditions.



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.

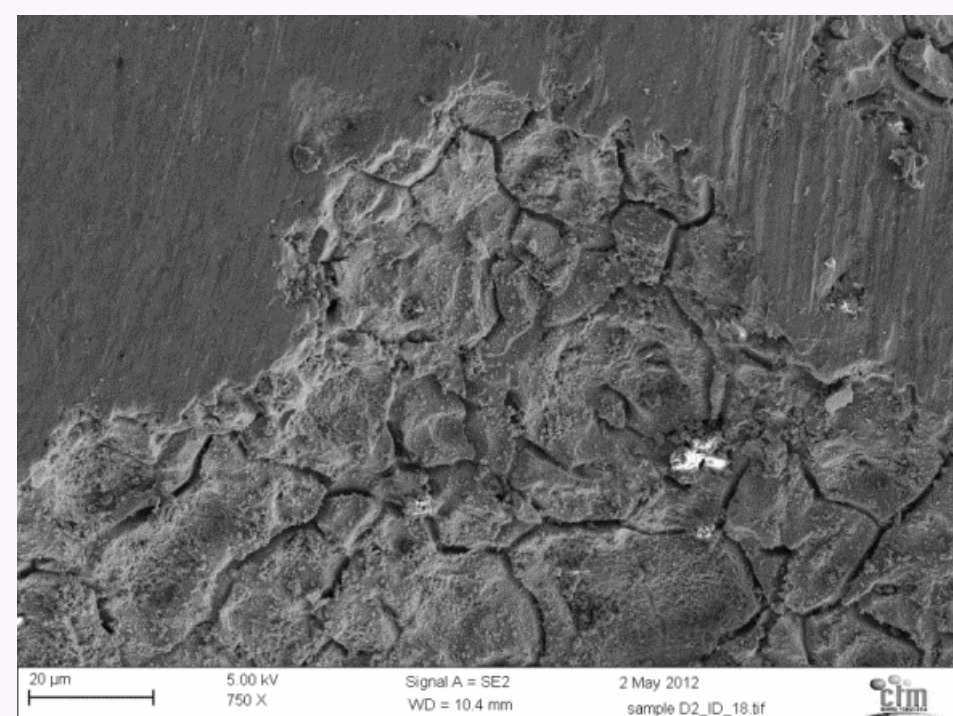
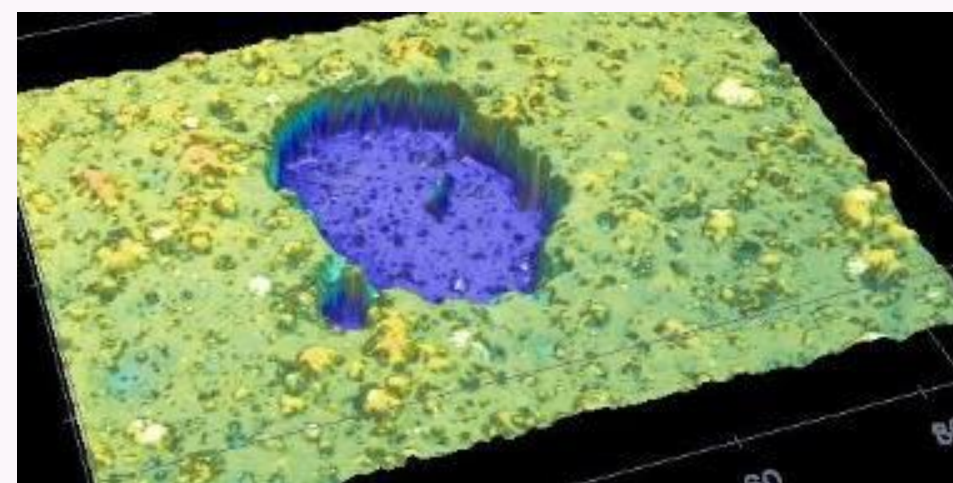
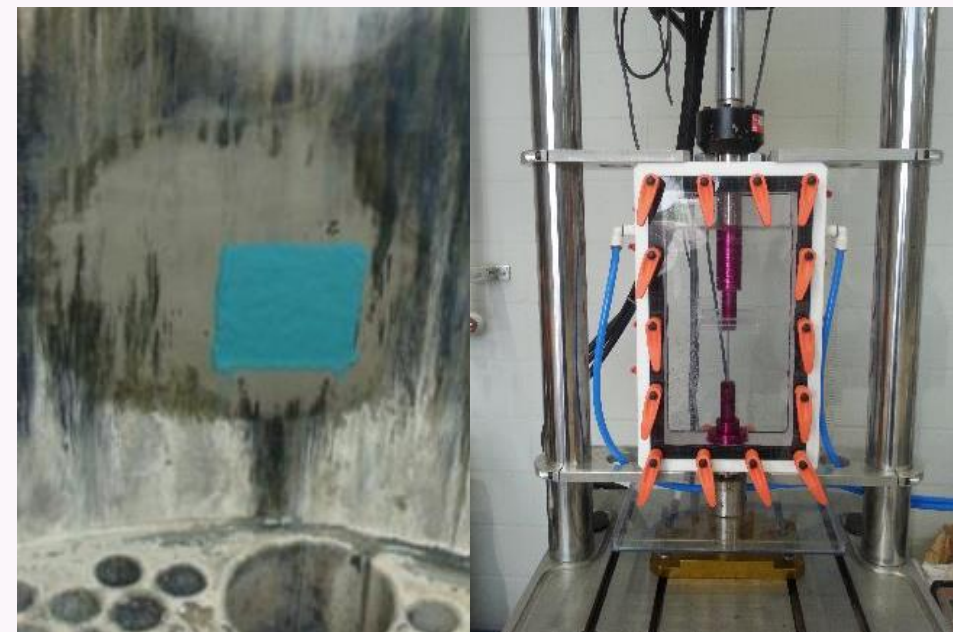


Retrofitting equipment for efficient use of Variable feedstock in metal making processes

The REVAMP has the objective to cope with the increasing variability and to ensure an efficient use of the feedstock in terms of materials and energy. Eurecat is involved in the research of the effect of impurities and metal treatment in aluminium alloys and the development of a tool to optimize the selection of recycled aluminium with variable composition and quality.

<http://revamp-project.eu/>





- 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

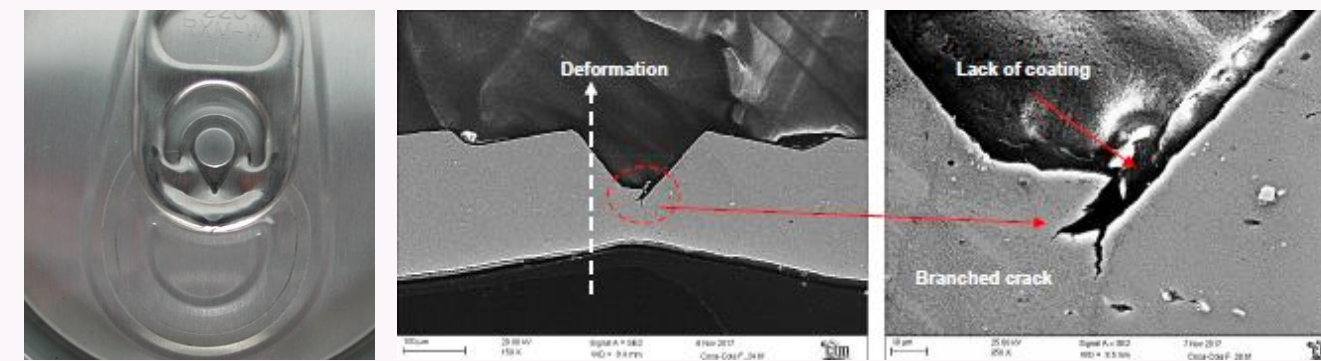
Corrosion in the food industry

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



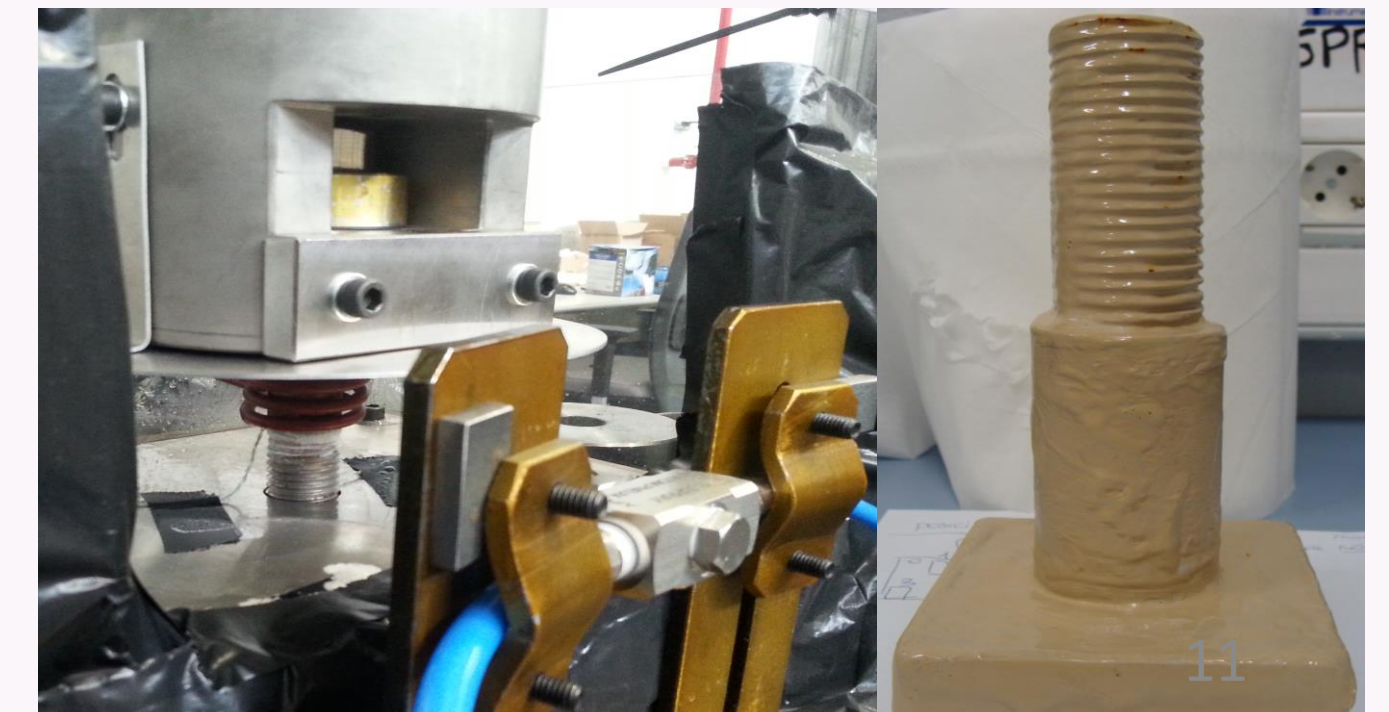
Uncontrolled can opening



Off-Shore

Stress Corrosion Cracking and Corrosion Fatigue

Materials for off-shore structures are under high environmental stresses but also mechanical stress. New materials and components are being developed constantly. EURECAT can carry out specific tests to determine the mechanical resistance of new components or materials in aggressive environments, such as off-shore.





- 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.



HARSHWORK

Optimizing raw material handling and processing under harsh working conditions

The European project HARSHWORK develops a technology to improve the efficiency in the handling and processing of raw materials such as copper or nickel, where the impact and wear of industrial components is very high. HARSHWORK will increase the competitiveness of mining companies and manufacturers of industrial equipment for this sector, as well as steel manufacturers and companies in the recycling sector.

<https://eitrawmaterials.eu/project/harshwork/>



ALUTOOL

New cutting-edge technologies development to produce high-added-value functional surfaces for aluminum stamping sector

ALUTOOL project develops dies with special characteristics to form and cut aluminium parts for vehicles and aluminium sheet materials with optimised characteristics, in order to improve the part manufacturing process. In parallel, new, advanced surface treatment processes and specific lubricants will be created for drawing and cutting aluminium parts for vehicles



Advanced machining and roughness prediction strategies for optimal surface integrity

The AVINT project aims to develop an application to predict the roughness and surface finish of machined pieces with an optimal surface integrity. In addition, in the framework of the project new products and pieces with added value are obtained, such as machining tools, coatings and lubricants/cooling agents.

<https://industriesdelfutur.cat/en/portfolio/avint/>



Surface Technology & Coatings research line

Customized FUNCTIONAL SURFACES for harsh environments

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- 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

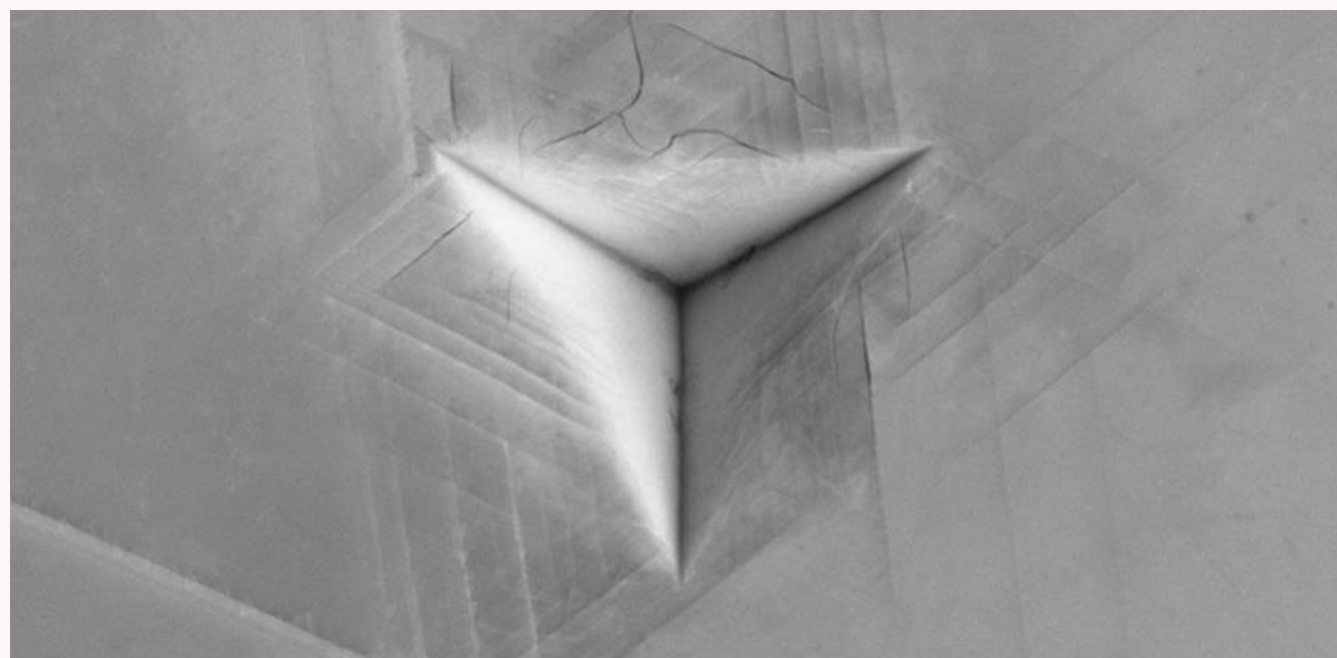
Noteworthy projects

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DEMANDING

Development and understanding of new ion implantation processes of hard materials substrates and PVD AlCrSiN - based hard coatings

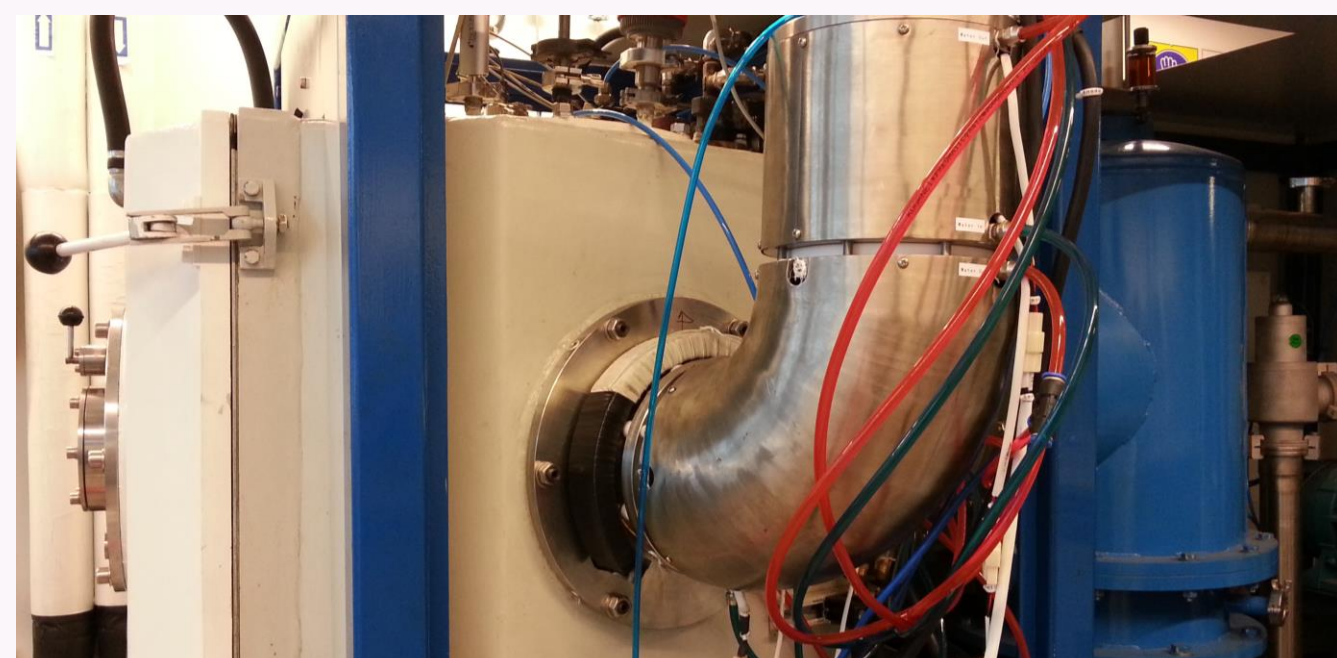
The project aims to improve the properties of these materials, such as mechanical (hardness and fracture toughness), tribological (friction and wear resistance), chemical (corrosion resistance) and thermal (oxidation resistance) for its application in the metal-mechanical industry.



REDUCA

Innovation in advanced hard coatings obtained by PVD cathodic arc technology for applications in the metal-mechanical industry

The project focuses on the development of thick TiAlN hard coatings (gradient nanostructured layers) and of ultra-hard coatings of amorphous, diamond-like carbon (DLC). It will therefore be necessary to design and implement new and advanced concepts in coatings technology based on high-vacuum plasma.

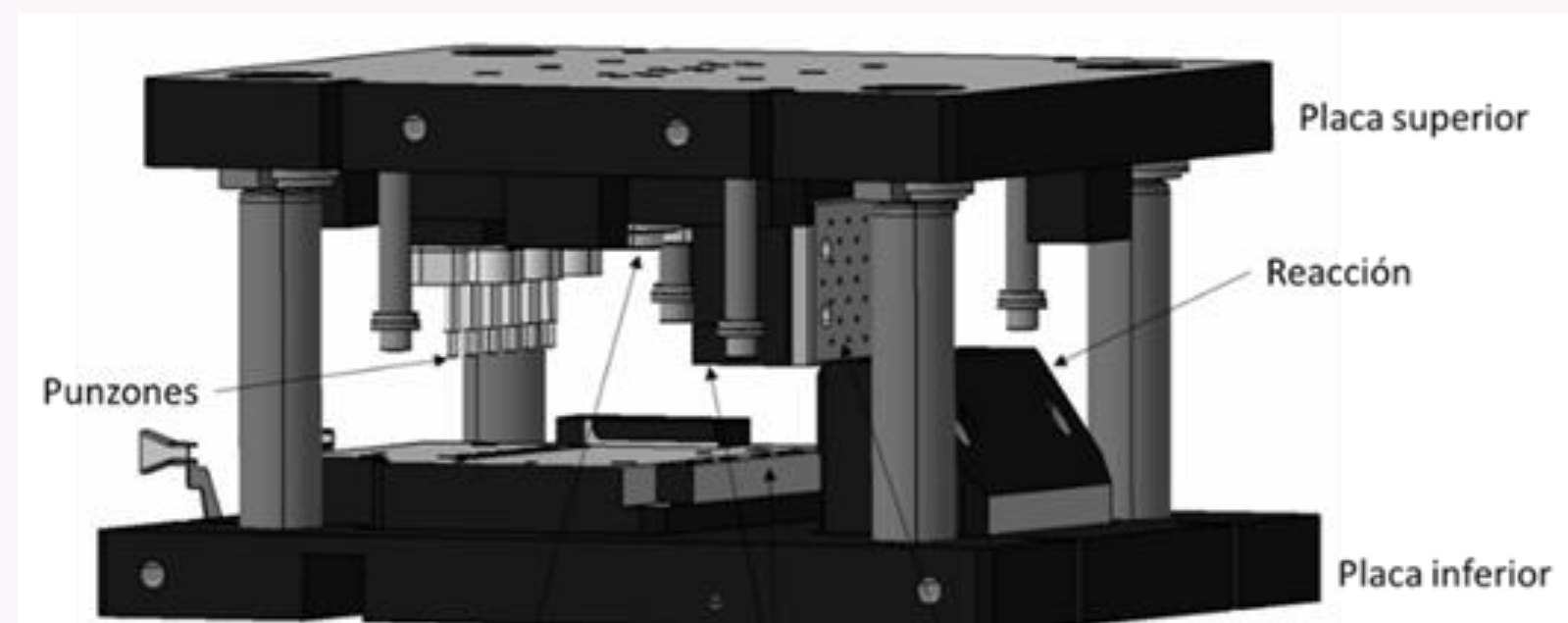
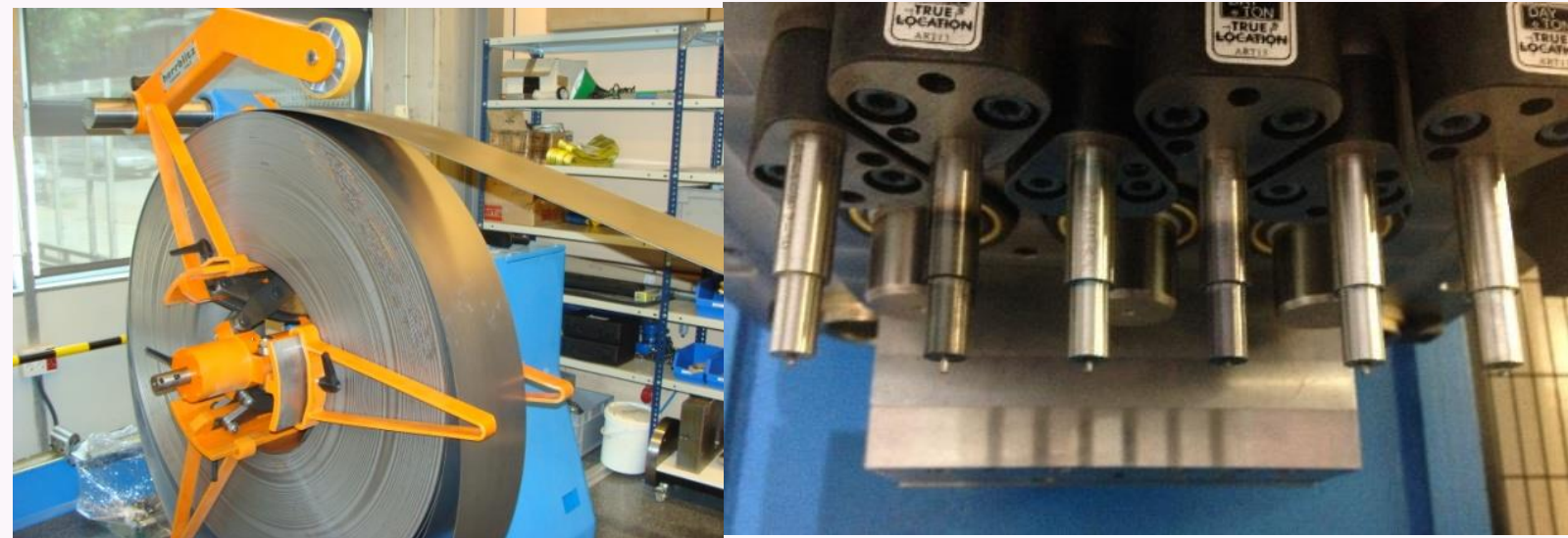


Innovation in advanced coatings for biomedical applications obtained by means of vacuum plasma assisted deposition techniques

The BIOPLASMA project develops advanced and innovative coatings for biomedical applications, such as prosthesis or implants, with the aim to improve the biological response of these components, eliminating the clinical and surgical complications derived from both chemical and mechanical lack of biocompatibility and biostability.



- **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,
 - Potentionstat studies
 - Biocorrosion
 - Tests tailored to customer specification



- Equipment

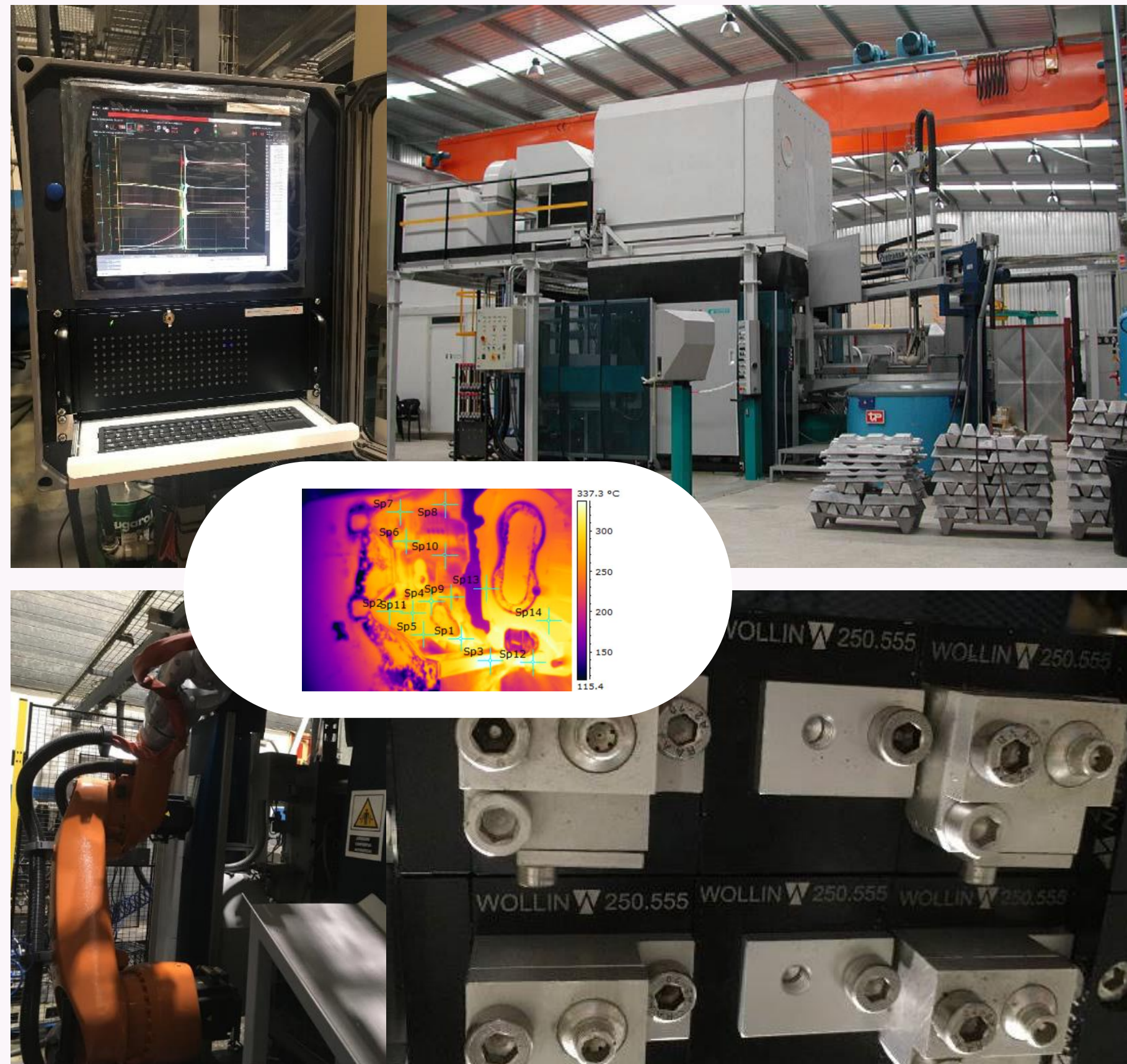
- Mechanical (100 t) and hydraulic (150 t) presses
- Continuous roller hearth furnace, up to 400 x 300 mm blanks
- Batch furnaces
- Measurement and imaging equipment, incl. thermal imaging

- 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

- KUKA robot with WOLLIN nozzles
- ProVac Vacuum unit
- MK vacuum density-tester
- CastQuality equipment from Electronics GmbH
- Sensorized machine and die
- Thermal imaging camera

- 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

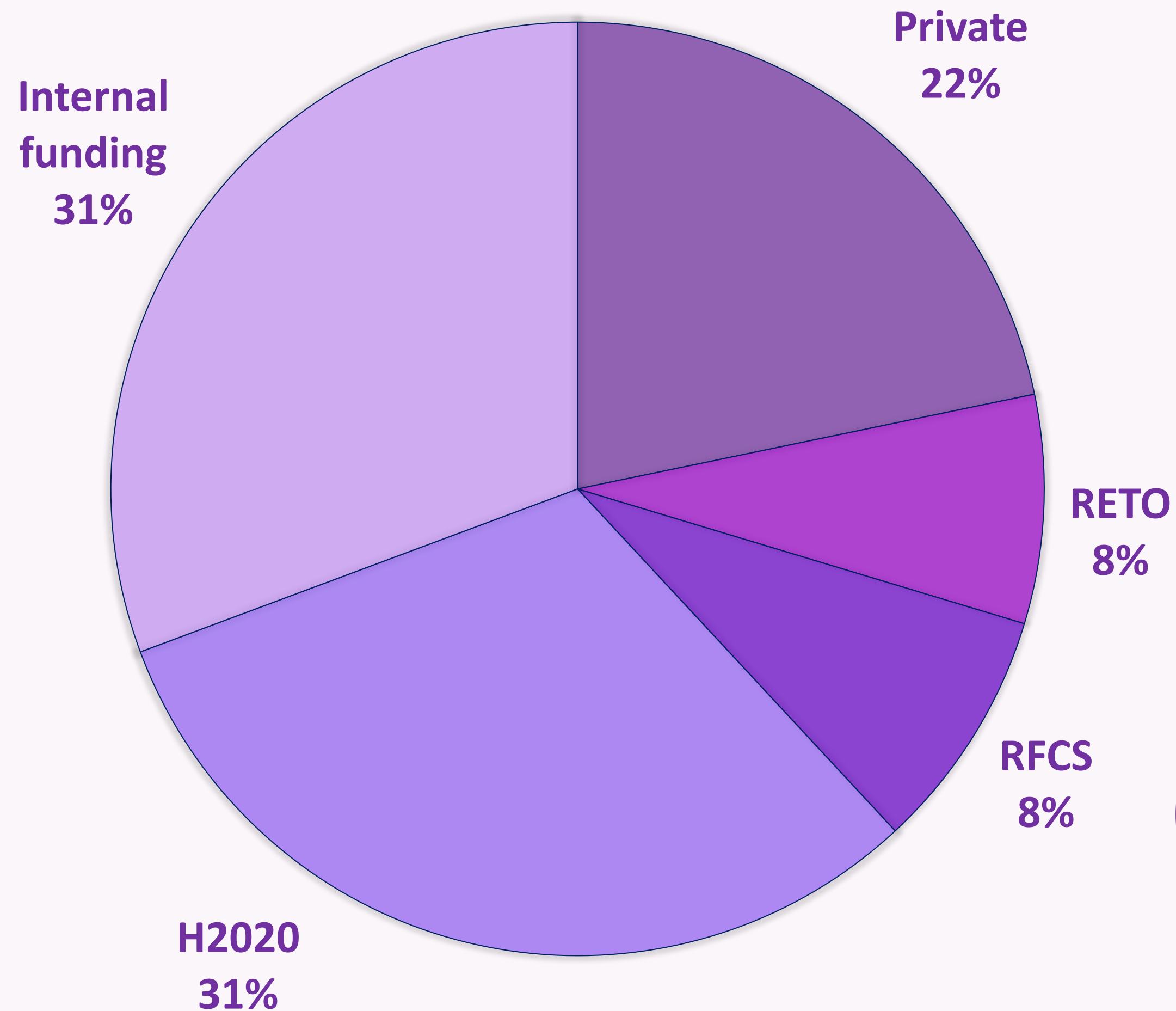
- Industrial PVD reactor
- Lab-scale PVD reactor

- 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 2021

- 7 H2020
- 6 RFCS
- 1 EIT Raw Materials
- 8 RETO
- 3 RIS3CAT
- + 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!



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