

# UC3M R&D IN THE AREA OF **materials and applications**

IDENTIFICATION OF THE RESEARCH  
ACTIVITY, TECHNOLOGIES,  
PATENTS, INFRASTRUCTURES,  
AND OTHER UC3M CAPABILITIES

**uc3m**

Universidad **Carlos III** de Madrid

Vicerrectorado de Política Científica

Servicio de Apoyo al Emprendimiento y la Innovación



The Entrepreneurship and Innovation Support Service of Universidad Carlos III of Madrid (UC3M) presents UC3M potential in this "technology map" through the lines of research conducted within the framework of the National and international R&D projects, patents, and other results attained by UC3M researchers in the area of materials and applications.

The overall knowledge achieved, experience in collaborating with the industry, the existence of internally owned infrastructures and laboratories, and above all else, the multidisciplinary nature of UC3M are unique characteristics which provide an added value for the provision of a comprehensive support to innovation in institutions, large companies, and small- and medium-sized enterprises.

We would like you to learn more about the know-how at UC3M and to collaborate in new R&D&I projects.

**Entrepreneurship and Innovation Support Service,  
Universidad Carlos III de Madrid**

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December 2022

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High–Voltage Testing and Research Laboratory (LINEALT) ..... 45  
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R&D GROUP

LINES OF RESEARCH

RESEARCH PROJECTS

EXPERIENCE AND CAPABILITIES

ENGINEERING

BIOENGINEERING

**Tissue Engineering and Regenerative Medicine - Integrative Biomedicine (TERMeg-INTEGRA)**

**Group Head:**  
**Diego Velasco**

- Human tissue, particularly skin engineering
- Skin regeneration
- Redox signalling in the skin and skin diseases
- Technology for 3D bioprinting of tissues, particularly human skin:
  - development of bioprinters
  - generation of ad hoc bioinks for clinical use and in the testing of pharmaceuticals and cosmetics
- Tissue modelling in microfluidic systems (tissue-on-a-chip) for clinical use and in the testing of pharmaceuticals and cosmetics
- Cellular biomechanics

**European Projects**

- [4D-BIOMAP: Biomechanical Stimulation based on 4D Printed Magneto-Active Polymers](#)

**National Projects**

- [Method for the production of human hair follicles based on 3D bioprinting](#)

**Regional Projects (Community of Madrid)**

- [Biocompatible Magneto-Active Structures to Simulate Skin Wound Healing: an Experimental-Computational Coupled Approach](#)
- [New technologies for tissue manufacture and optimisation: the skin as a model system](#)

**Private Funding**

- [Microfluidic platform evaluation for organ-on-a-chip application](#)
- [Jiménez Díaz Foundation Research Chair on regenerative medicine and tissue bioengineering](#)

- 3D bioprinting of human tissues
- Development of bioinks for 3D bioprinting
- Tissue modelling in microfluidics systems (tissue-on-a-chip) for the analysis of pharmaceuticals, cosmetics, and chemicals.
- Mixed CIEMAT-UC3M Biomedical Engineering Unit
- Collaboration with the Sensor and Instrumentation Techniques Group (UC3M) in the area of skin healing
- Collaboration with Arcelor for the development of graphene-based bioinks
- Collaboration with the Community Blood and Tissue Centre of Asturias (*Centro Comunitario de Sangre y Tejidos de Asturias*, CCSTA) in the area of tissue engineering.
- Collaboration with the Polymer Science and Technology Institute (*Instituto de Ciencia y Tecnología de Polímeros*, ICTP- CSIC) for the development of new "smart" (sensing and actuating) dermal matrices for monitoring skin transplants

**Technological Offer (Patents)**

- Method for obtaining three-dimensional structures for tissue engineering (PCT/ES2008/000191)
- Artificial dermis and production method therefore (PCT/ES02/00087)



R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
<b>CONTINUUM MECHANICS AND STRUCTURAL ANALYSIS</b>			
<p><b><u>Lightweight Structure Dynamics</u></b></p> <p><b>Group Head:</b> David Varas, Jorge López</p>	<ul style="list-style-type: none"> <li>• Behaviour of metallic structures against impact</li> <li>• Behaviour of structures made of composite materials against impact</li> <li>• Development of material behavioural models at high strain rates</li> <li>• Analysis of the behaviour of ice under impact conditions</li> <li>• Behaviour of fuel tanks subjected to impact (HRAM)</li> <li>• Analysis of impacts of composite fragments</li> <li>• Identification and numerical and experimental characterisation of compressible anisotropic plasticity in both quasi-static regime and dynamic regime</li> <li>• Homogenisation in elastic regime, for materials with anisotropic elasticity and microstructure</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">GrapheneCore3: Graphene Flagship Core Project 3</a></li> <li>• <a href="#">BEDYN: Development of a methodology (test, measurement, analysis) to characterise the BEhaviour of composite structures under DYnamic loading</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Safe operation of tubular receptors by means of inverse thermo-elastic methods of analysis II</a></li> <li>• <a href="#">Analysis and development of auxetic protections for carbon/epoxy structures</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Elastocaloric materials for solid cooling (eCOOL-CM-UC3M)</a></li> <li>• <a href="#">Ultrasonic and iNductive nOn destructive testiNg for thermoplastic CFRP</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">FUSELAGE</a></li> <li>• <a href="#">Numerical Modelling of Self Piercing Riveting</a></li> <li>• <a href="#">Design and manufacturing Rig support for double curved panels. Simulated bird (gelatine) impact on double curved panels. Hail (parallelepiped) impact on double curved panels</a></li> </ul>	<p>Group specialising in the field relating to the behaviour of structures in a dynamic regime. The group has developed different experimental methodologies for conducting complex high- and medium-velocity impact testing. The group also has extensive experience in developing behavioural models for materials under high strain rates and simple analytical models for modelling impact phenomena.</p> <p><b>Capabilities</b></p> <ul style="list-style-type: none"> <li>• High-speed pneumatic launchers which allow propelling both rigid objects and fragments of ice or ballistic gelatine for synthetic bird tests</li> <li>• Full mechanical characterisation of structural elements at different strain rates</li> <li>• Filming of tests using high-speed cameras</li> <li>• Digital correlation of 3D images</li> <li>• Ultrasound inspection (C-SCAN)</li> </ul> <p><b>Infrastructures</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Material mechanical characterisation laboratory (LABMEC)</a></li> <li>• <a href="#">Aeronautical structure impact laboratory (IMPACTLAB)</a></li> </ul>



R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
CONTINUUM MECHANICS AND STRUCTURAL ANALYSIS			
<p><b><u>Dynamics and Fracture of Structural Elements</u></b></p> <hr/> <p><b>Group Head:</b> Ramón Zaera</p>	<ul style="list-style-type: none"> <li>• Dynamic behaviour of structural elements: experimental simulation and analysis</li> <li>• Energy-absorbing structures</li> <li>• Problems of impact on structural elements for aeronautic use</li> <li>• Protecting infrastructures and mobile platforms from impulsive loads.</li> <li>• Development of personal protections with biomechanics integration.</li> <li>• Constitutive models of materials under a high strain rate</li> <li>• Fracture and damage mechanics</li> <li>• Fracture testing under dynamic conditions</li> <li>• Optimisation of additive manufacturing techniques</li> <li>• Mechanical metamaterial design and characterisation</li> <li>• Manufacture, characterisation, and modelling of ecological composites.</li> <li>• Conceptualisation of new multifunctional structures and materials</li> <li>• Biomechanics and mechanobiology of active biological systems</li> <li>• 4D printing technologies for multifunctional materials</li> <li>• Non-local models for the analysis of materials with scale effects (micro- and nanostructures)</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">4D-BIOMAP: Biomechanical Stimulation based on 4D Printed Magneto-Active Polymers (ERC Starting Grant)</a></li> <li>• <a href="#">BEDYN: Development of a methodology (test, measurement, analysis) to characterise the BEhaviour of composite structures under DYNamic loading</a></li> <li>• <a href="#">GrapheneCore3: Graphene Flagship Core Project 3</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Experimental-computational framework for the development of metamaterial-based smart structures</a></li> <li>• <a href="#">New formulations for the identification of localised and distributed masses by means of nanobiosensors</a></li> <li>• Printed metamaterials for broadband isolation of mechanical vibrations.</li> <li>• Mechanical behaviour of thermoplastic polymers recycled in successive 3D printing processes</li> <li>• <a href="#">Experimentation and modelling of the mechanical and electrical behaviour of electroactive polymer smart structures</a></li> <li>• <a href="#">Development of lightweight, self-supporting, multi-layered metal-based shields reinforced with advanced fibres</a></li> <li>• <a href="#">Study of the behaviour of structural elements manufactured with biodegradables composites against low-velocity impact</a></li> </ul>	<p>This group has extensive experience in the analysis of mechanical behaviour against impact and fracture of mechanical and structural elements.</p> <p>The group masters experimental simulation, numerical simulation, and finite element methodologies.</p> <p>Furthermore, it also excels in the conceptualisation, characterisation, and multiphysical modelling of soft multifunctional materials and biological systems, from the cellular level to the tissue level.</p> <p>The group provides services for the industry in those areas which require knowledge of the mechanical properties of any type of material at different strain rates and temperatures, particularly under dynamic and impact conditions.</p> <p><b>Technological Offer (Patents)</b></p> <ul style="list-style-type: none"> <li>• Method and device for calculating 3D printing parameters by injection of polymer materials with rheological properties varying over time (P202230837)</li> <li>• Self-repairing conductive material) (P202230621)</li> <li>• Method for generating and controlling complex strain patterns on biological materials, magnetomechanical stimulation system for generating complex strain patterns in biological materials (EP22382103.4)</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
CONTINUUM MECHANICS AND STRUCTURAL ANALYSIS			
<p><u>Dynamics and Fracture of Structural Elements</u></p> <hr/> <p>Group Head: Ramón Zaera</p>		<p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Biocompatible Magneto-Active Structures to Simulate Skin Wound Healing: an Experimental-Computational Coupled Approach.</a></li> <li>• Simulation of the entire printing process of polymers and reinforced polymers printed by extrusion technologies</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Impact behaviour of thermoplastic polymers for aeronautical applications</li> <li>• <a href="#">Ballistic impact testing on metal shields made by means of 3D manufacturing</a></li> <li>• <a href="#">UGV material ballistic behaviour analysis</a></li> </ul>	<p><b>Infrastructures</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Material mechanical characterisation laboratory (LABMEC)</a></li> <li>• <a href="#">Structure impact laboratory (IMPACTLAB)</a></li> <li>• <a href="#">Multifunctional Structures and Biomechanics Lab (MULTIBIOSTRUCTURES)</a></li> </ul> <p><b>Related News</b></p> <ul style="list-style-type: none"> <li>• <a href="#">New Launchers for Analyzing Resistance to Impacts and Improving Armor Plating</a></li> <li>• <a href="#">R+D+i to increase aeronautical safety</a></li> <li>• <a href="#">Predicting the behaviour of an airplane upon external impact</a></li> <li>• UC3M investigators work on artificial muscles and injectable nanorobots) (Cadena SER)</li> <li>• Smart materials for mechanobiology (EU Research)</li> <li>• Novel method based on smart materials shows real-time cell damage (European Commission, CORDIS)</li> <li>• Science of Excellence in the Community of Madrid. Research Talent, Meeting our ERCs: Daniel García González) (Madr+d)</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
CONTINUUM MECHANICS AND STRUCTURAL ANALYSIS			
<p><b><u>Advanced Materials Mechanics</u></b></p> <hr/> <p><b>Group Head:</b> Enrique Barbero, Sonia Sánchez</p>	<ul style="list-style-type: none"> <li>• Analysis and modelling of laminate and sandwich structures subjected to high- and low-speed impulsive loads</li> <li>• Analysis and modelling of composite energy-absorbing structures</li> <li>• Damage tolerance study of composite structural elements subjected to different load conditions</li> <li>• Behaviour of eco-structures manufactured from natural and/or recycled and recyclable materials</li> <li>• Analysis and modelling of repairs and attachments in laminate and sandwich structures</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">BEDYN: Development of a methodology (test, measurement, analysis) to characterize the BEhaviour of composite structures under DYNamic loading</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of lightweight, self-supporting, multi-layered metal-based shields reinforced with advanced fibres</a></li> <li>• <a href="#">Study of the impact and post-impact behaviour of wind turbine blades manufactured from sandwich structures</a></li> <li>• <a href="#">Analysis and modelling of thin laminate structural adhesive repairs for the air transport sector</a></li> <li>• <a href="#">Analysis of mechanical attachments in aeronautical structures subjected to impulsive loads</a></li> <li>• <a href="#">Experimental and numerical analysis of the mechanical behaviour under dynamic conditions of structural elements manufactured from biodegradable composites</a></li> <li>• <a href="#">Analysis of the influence of damage on the dynamic response of composite wind turbine blades</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Dynamic tensile analysis on aeronautical materials</a></li> <li>• <a href="#">Analysis of the compression behaviour of A400-M aeronautical components</a></li> <li>• <a href="#">Innovation in advanced composites and optimized rear-end (ICARO)</a></li> </ul>	<p>The group specialises in the analysis and modelling of structural elements manufactured with sandwich and composite materials subjected to impulsive loads, as well as study of the damage tolerance of said elements. The group has extensive experience in the development of non-standard test methodologies.</p> <p><b>Infrastructures</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Material mechanical characterisation laboratory (LABMEC)</a></li> <li>• <a href="#">Aeronautical structure impact laboratory (ImpactLab)</a></li> </ul> <p><b><u>Group's video</u></b></p>

R&D GROUP

LINES OF RESEARCH

RESEARCH PROJECTS

EXPERIENCE AND CAPABILITIES

CONTINUUM MECHANICS AND STRUCTURAL ANALYSIS

**Nonlinear Solid Mechanics**

**Group Head:**  
José Antonio Rodríguez

- Experimental characterisation of the mechanical behaviour of metallic materials under wide ranges of strain rate and temperature, and for different stress conditions
- Development, calibration, and implementation in numerical codes of nonlinear constitutive models to describe the mechanical behaviour of metallic materials
- Experimental, analytical, and numerical study of damage, ductile fracture, and localisation processes in metallic materials subjected to complex loading conditions
- Experimental and numerical study of dynamic perforation processes of metallic structures
- Protective structure impact and fragmentation testing

**European Projects**

- [PURPOSE: Opening a new route in solid mechanics: Printed Protective Structures \(ERC Starting Grant 2017\)](#)
- [QUANTIFY: Unravelling the role of anisotropy in material failure \(MSCA-RISE\)](#)
- [OUTCOME: The outstanding challenge in solid mechanics: engineering structures subjected to extreme loading conditions \(MSCA-ITN-ETN\)](#)
- [DIAGONAL: Ductility and fracture toughness analysis of functionally graded materials \(MSCA-SE\)](#)

**National Projects**

- [A pending challenge in solid mechanics: the effect of anisotropy and porosity on mechanical strength and ductility of printed metals](#)
- [Cavitation in Continuum Media](#)
- [Perforation across the scales](#)
- [Building bridges across the scales: influence of spatial-temporal scale lengths on dynamic fracture](#)

**Private Funding**

- [The mechanics and physics of dynamic localization and fracture in heterogeneous ductile materials](#)
- [Microinertia: myth or reality?](#)

The members of NSM collaborate actively with investigators from different prestigious institutions in Europe, America, and Asia. NSM also carries out technology transfer activities and works with multitude of companies in the aerospace sector.

**[Group's video](#)**

Flyer [Technological innovation on Solid Mechanics at transportation and civilian security industries](#)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRICAL ENGINEERING			
<p><b><u>Diagnosis of Electrical Machines and Insulating Material (DIAMAT)</u></b></p> <hr/> <p><b>Group Head:</b> Juan Manuel Martínez Tarifa</p>	<ul style="list-style-type: none"> <li>Analysis of aging and characteristics of insulating materials in electrical machines and devices</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li><a href="#">Raising knowledge and developing technology for the design and deployment of high-performance power transformers immersed in biodegradable fluids - BIOTRAFO</a></li> <li><a href="#">Dielectric strength tests on low-signal cables insulation degraded by ionizing radiation</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li><a href="#">Experimentation and modelling of the mechanical and electrical behaviour of smart electroactive polymer structures</a></li> <li><a href="#">Improvement of transformer insulation systems by means of dielectric nanofluids</a></li> <li><a href="#">Management of the life cycle of biodegradable fluid-insulated transformers</a></li> <li><a href="#">Moisture dynamics in vegetable oil-insulated transformers</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li><a href="#">Supported voltage testing of dielectric sheets for lithium-ion batteries</a></li> </ul>	<p>The group specialises in the development of novel techniques for the monitoring and diagnosis of rotary electrical machine, transformer, and power cable insulation, in the analysis of the behaviour of insulating materials in electrical machines and devices, and in the performance of high-voltage tests and measurements and analysis of dielectric response (in the frequency domain). These tests can be completed and compared with the simulation results by means of finite elements.</p> <p><b>Scientific-technical Services</b></p> <ul style="list-style-type: none"> <li>Study of the aging processes in insulating materials and development of techniques for monitoring the state thereof</li> <li>Insulating material characterisation and insulation state evaluation by means of dielectric tests</li> </ul> <p><a href="#">Group's video</a></p> <p><b>Infrastructure</b></p> <ul style="list-style-type: none"> <li><a href="#">High-voltage Research and Testing Laboratory (LINEALT)</a></li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
<b>ELECTRONIC TECHNOLOGY</b>			
<p><b><u>Photonic Displays and Applications (GDAF)</u></b></p> <hr/> <p><b>Group Head:</b> José Manuel Sánchez Pena, Carmen Vázquez</p>	<ul style="list-style-type: none"> <li>• <b>Electro-optic devices and applications</b> Optical and electrical characterisation of devices (liquid crystal, electrochromic materials, etc.)</li> <li>• <b>Advanced instrumentation and sensors</b> Development of advanced instrumentation, optical fibre sensors, and the integration thereof in WDM networks</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">TRIPOD: Training and Research Involving Polymer Optical Devices</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">LC-LENS – Adjustable liquid crystal lenses</a></li> <li>• <a href="#">Nano-assembled materials for light sensing and manipulation in a wide spectral range (I): Phase-adaptive devices and meta surfaces</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">SINFOTON2-CM. Sensors and instrumentation in photonic technologies 2</a></li> </ul> <p>A new generation of photonic devices based on self-organising materials: organisation</p>	<ul style="list-style-type: none"> <li>• <b>Electro-optic devices and applications</b> This group has vast experience in characterising the optical and electrical response of a wide range of devices. The group has in-depth knowledge of the materials which form the devices, their behaviours, and their potentials in different areas of application. <ul style="list-style-type: none"> <li>· Simultaneous liquid crystal display characterisation from electrical and optical viewpoints</li> <li>· Development of intelligent light control systems for domotic buildings based on liquid crystal and electrochromic materials</li> </ul> </li> <li>• <b>Advanced instrumentation and sensors</b> This group has vast experience in the development of systems based on plastic optical fibres which are more flexible, easier to connect, and have lower associated costs. <ul style="list-style-type: none"> <li>· Intrusive self-referencing prototypes for measuring the intrinsically safe level in tanks with flammable liquids, for large tanks with slow filling and emptying and other tanks for non-corrosive liquids, which allow detecting discrete levels in smaller tanks.</li> <li>· Optical fibre-based sensors for bubble detection and measurements in fluidised beds.</li> </ul> </li> </ul> <p><b>Technological Offer (Patents)</b></p> <ul style="list-style-type: none"> <li>• High spatial resolution pyrometer (P202130347)</li> <li>• Solar simulator for the characterisation of photodetectors and solar cells (ES1249534)</li> <li>• (Liquid crystal micro lens and liquid crystal micro lens array (P201630757)</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><b><u>In-Service Materials Performance</u></b></p> <hr/> <p><b>Group Head:</b> Francisco Javier Velasco, Miguel Ángel Martínez</p>	<ul style="list-style-type: none"> <li>• Alternative materials to Portland cement: geopolymers</li> <li>• Surface treatments and adhesion: adhesives, paints, and coatings</li> <li>• Corrosion</li> <li>• Organic coatings</li> <li>• Composite materials</li> <li>• Other aspects of Behaviour of Materials In Service</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">ESSIAL: Electrical Steel Structuring, Insulating and Assembling by means of the Laser technologies</a></li> <li>• <a href="#">The inhibition synergism of some plant extracts and common inorganic inhibitors to enhance the corrosion control of the embedding steel bars in concrete - NATCON</a></li> <li>• <a href="#">KrEaTive Habitat: Technology transfer from Key Enabling Technologies (KET) to real market applications in creative industries related with the habitat industry in the SUDOE space</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of eco-efficient, low impact, and highly durable cement materials</a></li> <li>• <a href="#">Influence of corrosion and its morphology on the fatigue performance of stainless steel and carbon steel corrugated bars</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">New concepts of sustainable concretes for solar thermal energy storage</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Consulting services in the area of binding technologies</a></li> <li>• <a href="#">Consulting services in the area of adhesives</a></li> <li>• <a href="#">Study of the adhesion between glass microspheres and road signalling paints</a></li> </ul>	<p>Group with extensive experience in the field of materials, their processing, properties, and behaviour in service.</p> <p><b>Surface Treatments and Adhesion: Paints and Adhesives</b></p> <ul style="list-style-type: none"> <li>• Improvement of paint and adhesive adhesion</li> <li>• Performance and reliability of durable elastic adhesives in aggressive media and the possible use thereof in structural attachments which are resistant to vibrations and impacts</li> <li>• Verification of the mechanical characteristics in adhesive attachments using statistical techniques</li> <li>• Plasma surface treatments for improving adhesion</li> </ul> <p><b>Fault Analysis and Solutions Design</b></p> <ul style="list-style-type: none"> <li>• Optimisation of metal material manufacturing processes and chemical and thermochemical treatments</li> <li>• Optimisation of manufacturing processes by means of adhesive attachment techniques</li> <li>• Design of materials with new performance and high added value</li> </ul> <p><b>Tribology: Friction and Wear</b></p> <ul style="list-style-type: none"> <li>• Preparation of new anti-wear materials</li> <li>• Increasing composite material hardness</li> </ul>

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><u>In-Service Materials Performance</u></p> <hr/> <p>Group Head: Francisco Javier Velasco, Miguel Ángel Martínez</p>			<p><b>Corrosion</b></p> <ul style="list-style-type: none"> <li>• Corrosion control in structures made of reinforced concrete</li> <li>• Performance of new materials as concrete reinforcement</li> <li>• Anti-corrosive coating study</li> <li>• Localized corrosion of stainless steel components of in various media</li> <li>• Processing and performance optimisation of porous metals (manufactured by powder metallurgy) in aggressive environments</li> <li>• Characterisation of high-temperature direct oxidation processes</li> </ul> <p><b>Technological Offer (Patents)</b></p> <ul style="list-style-type: none"> <li>• Method for producing magnetic cork particles, particles thus obtained, and uses thereof (ES2698153)</li> </ul> <p><b>Related News</b></p> <ul style="list-style-type: none"> <li>• <a href="#">A magnetic cork allows the elimination of aquatic waste pollutants</a></li> <li>• <a href="#">The group's article on gel electrolytes in portable cells for the simple measurement of electrochemical corrosion selected as "Featured Open Access Article" in December 2019 by Corrosion (NACE)</a></li> </ul> <p><b>Equipment</b></p> <p>Cutting-edge equipment to address problems from different viewpoints: structural, mechanical, microstructural, corrosion and surface, wear, etc.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><b><u>Polymer Composites and Interphases (GMCPI)</u></b></p> <hr/> <p><b>Group Head:</b> Francisco Javier González Benito</p>	<ul style="list-style-type: none"> <li>• Design and implementation of new multifunctional nanocomposites with a thermoplastic matrix (electrical, mechanical, and thermal characterisation)</li> <li>• Solution blow spinning and electrospinning as a method for material preparation and surface modification</li> <li>• Nanoscale material characterisation.</li> <li>• Polymer and composite mixtures</li> <li>• Probe and marker fluorescence and interphases</li> <li>• Physicochemical characterisation of materials</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Preparation by solution blow spinning and characterisation of bio-compatible multifunctional thermoplastic materials constituted by submicrometric fibres</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Testing methods and techniques to characterise the mechanical properties of polymeric systems used in the coating industry</a></li> <li>• <a href="#">Study of the mechanical behaviour of materials used as intumescent paints</a></li> </ul>	<ul style="list-style-type: none"> <li>• Single matrix and multicomponent composites (interphase study)</li> <li>• Design, preparation, and characterisation of multifunctional nanocomposite materials with a thermoplastic matrix</li> </ul> <p><b>Infrastructures</b></p> <ul style="list-style-type: none"> <li>• Electron microscopy laboratory</li> <li>• Atomic force microscopy laboratory</li> <li>• Polymer characterisation laboratory</li> <li>• Material preparation laboratory</li> <li>• Materials technology laboratory</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><b><u>Polymers and Composites</u></b></p> <p><b>Group Head:</b> Juan Baselga</p>	<ul style="list-style-type: none"> <li>• Nanostructured polymers and copolymers for energy applications</li> <li>• Materials for electromagnetic shielding</li> <li>• Functionalised smart polymers for biomedical applications</li> <li>• Biosensors and bioactive materials for food use</li> <li>• Microstructured surfaces</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Nanocomposites with hierarchically structured architectures</a></li> <li>• <a href="#">Porous hierarchical nanofibres for electrochemical applications</a></li> <li>• <a href="#">Self-healing and rEsistant Asphalts for PORTs - SEAPORT</a></li> <li>• <a href="#">Advanced functional materials for application in roads and buildings-MAMCE</a></li> <li>• <a href="#">SUMMATION-Development of innovative and sustainable biological-based films with antimicrobial properties for the active packaging of food</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Cyclic polyolefins for energy applications and basis for the chemical recycling thereof for a circular economy (CICLAPNER-CM-UC3M)</a></li> </ul>	<ul style="list-style-type: none"> <li>• Polymer and copolymer synthesis</li> <li>• Nanocomposite preparation and characterisation</li> <li>• Polymer photophysics and photochemistry</li> <li>• Study of the electromagnetic properties of materials</li> <li>• Manufacturing porous carbon structures and fibres</li> <li>• Polymer and nanoparticle functionalisation</li> <li>• Study of specific interactions with DNA</li> <li>• Encapsulation of repair agents</li> <li>• Microstructured polymer materials</li> <li>• Study of the electrochemical properties of porous materials</li> </ul> <p><b>Technological Offer (Patents)</b></p> <ul style="list-style-type: none"> <li>• Materials for electromagnetic shielding. (ES2509390)</li> <li>• Nanoreinforced polymers. (ES2431492-A1)</li> <li>• Method for obtaining copper double salt nanocompounds and use thereof as a catalyst and microbicide. (P201930641 /PCT/ES2020/070439)</li> <li>• Method for manufacturing a hybrid material for conducting electrical currents 19382471.1-1103</li> <li>• Self-healing asphalt by rejuvenator-containing microcapsules activable at will by irradiation (PCT/EP2020/054868; EP 3 702 411 A1)</li> <li>• Antimicrobial composite material and the use thereof as a packaging material for fresh food (P202031251)</li> </ul>

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><u>Polymers and Composites</u></p> <hr/> <p>Group Head: Juan Baselga</p>			<p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• Mechanical, thermal, and electrical characterisation laboratory.</li> <li>• Polymer synthesis and characterisation laboratory</li> <li>• Spectroscopic characterisation laboratory</li> <li>• Optical and electron microscopy laboratory</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><b><u>Material Synthesis and Processing</u></b></p> <p><b>Group Head:</b> Alejandro Varez, Belén Levenfeld</p>	<ul style="list-style-type: none"> <li>• Injection moulding/extrusion of ceramics and metals (CIM, MIM)</li> <li>• Additive manufacturing of metals and ceramics. 3D printing (Fused Filament Manufacture)</li> <li>• Polymer mixtures. Rheological, thermal, and mechanical behaviour</li> <li>• Synthesis and structural characterisation of ceramic materials</li> <li>• Li, Na, and Ca batteries</li> <li>• Fuel cells</li> <li>• Magnetic ceramics: Ferrites</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">VIDICAT: Versatile Ionomers for Divalent Calcium baTteries</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">High-performance materials for safer batteries, and more cost-effective, symmetrical solid oxide fuel cells: development of materials and prototypes</a></li> <li>• <a href="#">Materials for lithium batteries, post-lithium batteries, and fuel cells: from laboratory to prototype</a></li> <li>• <a href="#">"Membranes based on new generation MOFs for application in H2 technology: fuel cells and electrolysers"</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">MATERYENER3-CM. Materials for energy: electric, magnetic, and superconductors.</a></li> <li>• <a href="#">Development of new solid-state lithium batteries and their electronic charging and energy management system for application in biomedical devices and unmanned aircraft DROMADER-CM</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of polymer-metal formulations for the manufacture of highly loaded 3-D printing filaments used in the additive manufacture of metal materials</a></li> <li>• <a href="#">Circular economy and nanotechnology in the process for recycling magnetic components from the automotive sector: Ecomag</a></li> </ul>	<p>A group with thirty years of experience in the field of material science and technology. In particular, the group has vast experience in (polymer and ceramic) electrolyte synthesis and characterisation for energy applications, as well as in the application and development of new binder systems for injection moulding (PIM) and powder extrusion (PEM) of metals and ceramics.</p> <p><b>Scientific-technical Services</b></p> <ul style="list-style-type: none"> <li>• Manufacture</li> <li>• Thermal characterisation</li> <li>• Heat treatments</li> <li>• Analyses</li> <li>• Structural and microstructural characterisation techniques</li> <li>• Mechanical and tribological characterisation techniques</li> <li>• Sample preparation</li> <li>• Drafting of reports</li> </ul> <p><b>Technological Offer (Patents)</b></p> <ul style="list-style-type: none"> <li>• Process of manufacturing metallic parts from metallic powder using thermostable acrylic resin as a binder (ES2167130)</li> <li>• Electrodes for rechargeable batteries) (P201630313)</li> </ul>

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><u>Material Synthesis and Processing</u></p> <hr/> <p>Group Head: Alejandro Varez, Belén Levenfeld</p>			<p><b>Infrastructures</b></p> <ul style="list-style-type: none"> <li>• Synthesis laboratory</li> <li>• Injection moulding/powder extrusion laboratory</li> <li>• Additive manufacturing (3D printing) laboratory</li> <li>• Characterisation and microstructure laboratory</li> <li>• Thermal characterisation laboratory</li> <li>• Mechanical characterisation laboratory</li> <li>• Electrical characterisation laboratory</li> <li>• Electrochemical characterisation laboratory</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><b>Powder Technology</b></p> <hr/> <p><b>Group Head:</b>  <b>José Manuel Torralba,</b>  <b>Elena Gordo,</b>  <b>Antonia Jiménez,</b>  <b>Mónica Campos</b></p>	<ul style="list-style-type: none"> <li>• <b>Special production and characterisation techniques</b> <ul style="list-style-type: none"> <li>· Spray-pyrolysis for the production of nanoparticles</li> <li>· Atomisation</li> <li>· Mechanical grinding</li> <li>· Powder injection moulding</li> <li>· Corrosion in powder metallurgy material</li> <li>· Sol-gel coatings</li> <li>· Surface treatments by diffusion to protect against corrosion, wear, and high temperature.</li> <li>· Thermodynamic and kinetic optimisation of processes</li> </ul> </li> <li>• <b>Materials</b> <ul style="list-style-type: none"> <li>· Sintered low-alloy steels</li> <li>· Sintered stainless steels</li> <li>· Sintered tool steels and Fe-based composite materials</li> <li>· Sintered Ti alloys and composite materials with a Ti matrix</li> <li>· Cu-based sintered alloys</li> <li>· Sintered Al alloys and composite materials with an Al matrix</li> <li>· Nickel-based alloys</li> </ul> </li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Powder Metallurgy Approaches for Next-Generation Bipolar Plate Materials - PERMEABLE</a></li> <li>• <a href="#">EIT Raw Materials</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of new sintered martensitic alumina-forming steels</a></li> <li>• <a href="#">Development of high added value metal components by 3D printing based on highly sustainable MIM technology for the transportation sector-3DMIM</a></li> <li>• <a href="#">Inorganic composite material processing by bonding-based additive manufacturing techniques</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">High entropy alloys for high temperature and extreme condition applications</a></li> <li>• <a href="#">ADITIMAT-CM. Additive Manufacturing: from material to application</a></li> <li>• <a href="#">Intelligent manufacturing of advanced materials for transport, energy, and healthcare</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Study for the addition of graphene and ceramic nanoparticles for the preparation of alternative hardmetals</a></li> <li>• <a href="#">Obtaining Cu-Mn master alloys in the form of gas-atomised powder</a></li> </ul> <p style="text-align: right;">+</p>	<p>This group specialises in the development of solutions in the area of powder technology/powder metallurgy, with the capability for the thermodynamic design of new alloys, development of prototypes by ingot casting, powder manufacturing and characterisation, and manufacturing by advanced consolidation techniques (including additive manufacturing, powder injection moulding, and electric field-assisted sintering techniques).</p> <ul style="list-style-type: none"> <li>• Particle synthesis and powder production</li> <li>• Coatings and surface treatments</li> <li>• Thermodynamic and kinetic simulation</li> <li>• Additive manufacturing</li> <li>• MIM and PIM</li> <li>• Material characterisation</li> <li>• Sintered materials: lightweight alloys (titanium, aluminium, magnesium), superalloys (Ni, Co), special steels</li> </ul> <p><b>Technological Offer (Patents)</b></p> <ul style="list-style-type: none"> <li>• Bipolar plate of a polymer membrane fuel cell and methods of manufacture). (PCT/ES2022/070303)</li> <li>• Procedure for obtaining a sol-gel coating, coating composition and use of the same). (ES2686890B2)</li> <li>• <a href="#">Process for manufacturing metal and/or ceramic parts using a polysaccharide-based thermoplastic binding system.</a> (Patent ES2356952)</li> </ul> <p style="text-align: right;">+</p>



R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIALS SCIENCE AND ENGINEERING AND CHEMICAL ENGINEERING			
<p><u>Powder Technology</u></p> <hr/> <p>Group Head: José Manuel Torralba, Elena Gordo, Antonia Jiménez, Mónica Campos</p>		<ul style="list-style-type: none"> <li>• <a href="#">Study of new materials with low environmental impact for 3D printing</a></li> <li>• <a href="#">Design of biodegradable Sol-Gel coatings with antimicrobial properties for the prevention and local treatment of infections on biomaterials for clinical use</a></li> <li>• <a href="#">Development of new nanomaterials optimised for the improvement of photocatalytic activity</a></li> </ul>	<ul style="list-style-type: none"> <li>• Method for obtaining metallic sponges. (ES2342815)</li> <li>• Sol-gel coating with ceramic nanoparticles for the protection of a substrate and method for obtaining same. (ES2334542)</li> </ul> <p><b>Infrastructures</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Scientific-Technological Support Laboratory for Businesses (LACTE)</a></li> </ul> <p><b>Related News</b></p> <ul style="list-style-type: none"> <li>• <a href="#">New magnetic materials for extracting energy from the sea</a></li> <li>• <a href="#">A new technique for manufacturing titanium components has been developed</a></li> </ul> <p><a href="#">Group's video</a></p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
<b>MECHANICAL ENGINEERING</b>			
<p><b><u>MACHLAB: Laboratory Machines</u></b></p> <hr/> <p><b>Group Head:</b> Cristina Castejón</p>	<ul style="list-style-type: none"> <li>• Kinematic and dynamic synthesis and analysis of machines and mechanisms</li> <li>• Vibrations and noise in machines and mechanisms, defectology</li> <li>• Instrumentation and experimental methods</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Railway rolling stock modelling and analysis for connected maintenance</a></li> <li>• <a href="#">Pattern analysis and recognition for the detection of defects in railway axles</a></li> <li>• <a href="#">System for the comprehensive monitoring of critical mechanical assemblies to improve maintenance in transport</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Condition monitoring system for the detection of cracks in railway axles (SMEPDFEF-CM-UC3M)</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of a digital twin-oriented rolling model for monitoring in agricultural vehicles</a></li> </ul>	<ul style="list-style-type: none"> <li>• Kinematic and dynamic analysis and synthesis of machines and mechanisms</li> <li>• Vibrations and noise in machines and mechanisms, defectology</li> <li>• Magnetomechanics and nanomechanics</li> <li>• Instrumentation and experimental methods</li> <li>• Rheology, tribology, and interface mechanics</li> <li>• Plant biomechanics</li> <li>• Railways</li> <li>• Security</li> <li>• Calculation, construction, and testing of electric motorcycles</li> </ul> <p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• Calculation rooms and laboratories</li> <li>• Equipment and prototypes</li> </ul> <p><a href="#">Group's video</a></p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
<b>MECHANICAL ENGINEERING</b>			
<p><b><u>MECATRAN – Experimental Mechanics, Calculations, and Transport</u></b></p> <p><b>Group Head:</b> <b>Beatriz López Boada,</b> <b>María Jesús López Boada</b></p>	<ul style="list-style-type: none"> <li>• Advanced simulation techniques in mechanical engineering</li> <li>• Calculation, construction, and testing of machines</li> <li>• Measurement and testing techniques for machines</li> <li>• Biomechanics</li> <li>• Acoustics and vibrations</li> <li>• Environmental studies, recycling, and waste management</li> <li>• Smart transport</li> <li>• Uncertainty quantification</li> </ul>	<p><b>Competitive Projects</b></p> <ul style="list-style-type: none"> <li>• New concept of an ecological tyre based on increased carcass service life and a removable tread with low environmental impact</li> <li>• <a href="#">Design and optimisation of coach and bus structures using structural adhesive attachments with dissimilar materials</a></li> <li>• <a href="#">Study of the applicability of a magneto-rheological damper in the suspension of a railway vehicle by means of the design, manufacture, and characterisation thereof</a></li> <li>• <a href="#">Design and modelling of a smart semi-active suspension system based on magneto-rheological dampers</a></li> <li>• <a href="#">Improvement of vehicle safety and comfort by means of designing a semi-active suspension system based on magneto-rheological dampers</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Technical study for optimising, assessing the containment capacity, and checking the resistance of a rolling stock restraint system on a track platform</a></li> </ul>	<p>The MECATRAN Group is made up of a group of specialists with extensive experience in a wide range of disciplines related to mechanical engineering:</p> <ul style="list-style-type: none"> <li>• Computer Aided Design (CAD) programmes</li> <li>• Data acquisition and processing programmes</li> <li>• Mechanical system dynamic simulation programmes.</li> <li>• Finite element analysis programmes</li> <li>• Experimental modal analysis programmes</li> <li>• Uncertainty quantification programmes</li> <li>• Strain gauges-based experimental techniques.</li> <li>• Scientific-technical services</li> <li>• Fatigue testing</li> <li>• Tensile testing</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
<b>MECHANICAL ENGINEERING</b>			
<p><b><u>Mechanical Simulation and Optimisation Group (SIOMECE)</u></b></p> <p><b>Group Head:</b> Belén Muñoz Abella, Lourdes Rubio</p>	<ul style="list-style-type: none"> <li>• Identification of defects in mechanical components.</li> <li>• Health Monitoring</li> <li>• Fracture and fatigue of mechanical components</li> <li>• Service behaviour of mechanical components in fatigue and fracture</li> <li>• Direct and inverse resolution of mechanical problems</li> <li>• Simulation of mechanical systems</li> <li>• Computer-aided modelling and engineering</li> <li>• Biomechanics</li> <li>• Optimisation techniques applied to mechanical engineering</li> <li>• Small mechanical and biomechanical devices design and prototyping</li> </ul>	<p><b>National Plan Projects</b></p> <ul style="list-style-type: none"> <li>• ROTACRACK: Development of simple theoretical models and commissioning of a virtual laboratory for defining a methodology for identifying fissures in rotary beams</li> <li>• VIBROCRACK: Identification of fissures in one-dimensional mechanical components by means of methods for detecting non-linearity</li> <li>• PROFISEJE: Propagation of fatigue fissures in rotary shafts</li> <li>• SHAFTCRACK: Detection and identification of fatigue fissures in rotary shafts by means of genetic algorithms</li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• Analysis of the influence of damage in the dynamic response of wind turbine blades made of a composite material.</li> <li>• Development of a non-destructive method for the detection and identification of fissures in non-rotary shafts</li> </ul>	<ul style="list-style-type: none"> <li>• Group specialising in the finite element modelling of normalised and non-normalised mechanical components, as well as in the study of their performance under service conditions</li> <li>• Experienced in the use of conventional optimisation methods and of methods such as neural networks and genetic algorithms for solving inverse problems in mechanical engineering</li> <li>• Development of research projects in the field of fracture by developing numerical and experimental models of fissured elements. These models are used for the detection and identification of fissures</li> </ul> <p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• Rotary beam test bench</li> <li>• High-throughput computer equipment</li> <li>• Rotor dynamic test bench</li> <li>• Machine for creating fissures by means of resonance</li> <li>• Static shaft and beam test bench</li> <li>• Dynamic shaft and beam test bench</li> <li>• Vibration data acquisition equipment</li> <li>• Contactless, dual axis measuring microscope</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
<b>MECHANICAL ENGINEERING</b>			
<p><b><u>Mechanical and Biomechanical Component Manufacturing and Design Technology (FABDIS)</u></b></p> <p><b>Group Head:</b> M<sup>a</sup> Henar Miguélez, José Luis Cantero</p>	<ul style="list-style-type: none"> <li>• Machining               <ul style="list-style-type: none"> <li>· Numerical modelling of machining processes</li> <li>· Definition and optimisation of processes</li> <li>· Machinability testing</li> <li>· Prototype machining</li> <li>· Use of CAD-CAE-CAM computer applications</li> <li>· Study on special materials machining</li> <li>· Ecological machining</li> </ul> </li> <li>• Additive manufacturing (metals and polymers).</li> <li>• Development of artificial intelligence tools applicable in manufacturing processes: Neural networks and machine learning.</li> <li>• Projectile impact analysis. Protection design.</li> <li>• Manufacturing-oriented design</li> <li>• Forming processes by plastic deformation               <ul style="list-style-type: none"> <li>· Numerical modelling of plastic deformation processes</li> <li>· Definition and optimisation of processes</li> <li>· High-temperature folding</li> </ul> </li> <li>• Computer-aided design, manufacturing, and engineering: CAD, CAM, CAE</li> <li>• Design of mechanical and biomechanical components</li> <li>• Genetic algorithms</li> <li>• Damage identification techniques</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Analysis of defects in fibre-reinforced laminates resulting from manufacturing processes and effect on fatigue performance</a></li> <li>• <a href="#">DIGITDRILL - Digitalisation of industrial drilling process</a></li> <li>• <a href="#">Development of a new lightweight shield by means of a combined experimental-numerical methodology</a></li> <li>• <a href="#">Drilling of CFRP/Ti hybrid components and tolerance to damage resulting from machining during service behaviour of aeronautical structural attachments</a></li> <li>• <a href="#">Modelling the drilling process of carbon fibre composite materials</a></li> <li>• Comprehensive design and additive manufacturing of patient-specific polymer implants</li> <li>• Experimental and numerical analysis of biomechanical effects in ballistic torso protection</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Drilling process improvement based on data analysis</a></li> <li>• <a href="#">Drilling process improvement based on data analysis step 2 (Drilling Digitalisation: Data analytics + AI for Drilling Process Improvement)</a></li> <li>• <a href="#">UGV material ballistic behaviour analysis</a></li> </ul>	<p>The group has over 20 years of experience in conducting research relating to machining processes and other manufacturing processes (6 years of collaboration with Airbus Getafe)</p> <p><b>Experience in manufacturing:</b></p> <ul style="list-style-type: none"> <li>• Data analytics and artificial intelligence - Smart Manufacturing (in collaboration with UC3M Smart Systems Lab.)</li> <li>• Optimisation of machining processes for low-machinability materials               <ul style="list-style-type: none"> <li>· Drilling and turning of heat-resistant alloys</li> <li>· Drilling of CRRPs and CRRPs-meta stacks</li> </ul> </li> <li>• Additive manufacturing (metals and polymers). Collaboration with UPV</li> <li>• Technologies applied to the analysis of manufacturing processes               <ul style="list-style-type: none"> <li>· Wear testing (optical microscopy and SEM-EDS)</li> <li>· Machining monitoring: shear forces, temperature, etc.</li> <li>· Numerical modelling (MEF)</li> <li>· Component damage and quality control</li> </ul> </li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
SIGNAL AND COMMUNICATIONS THEORY			
<p><b><u>Radiofrequency, Electromagnetics, Microwaves, and Antennas Group (GREMA)</u></b></p> <hr/> <p><b>Group Head:</b> Daniel Segovia</p>	<ul style="list-style-type: none"> <li>• New technologies in antenna construction: Electronic Band Gap Materials (EBGs), Frequency Selective Surfaces (FSS) and Metamaterials</li> </ul>	<p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Microwave Materials Characterisation Using Heterogeneous Systems-on-Chip for the Space Environment (MIMACUHSPACE-CM-UC3M)</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Miniaturised Antennas for Planetary Mission Probes</a></li> <li>• <a href="#">Development of multiband printed filters in microwave frequencies</a></li> </ul>	<p><b>Antenas and RF</b></p> <p>Metamaterials and sensors</p> <ul style="list-style-type: none"> <li>• Metamaterial-based passive/active circuits.</li> <li>• miniaturisation and multifrequency devices.</li> <li>• Meta-surface- and metamaterial-based active filters.</li> <li>• Metamaterial-based filters.</li> </ul> <p>Manufacturing installation</p> <ul style="list-style-type: none"> <li>• Laser circuit milling and structuring machine.</li> <li>• High-precision microwave circuit prototyping.</li> <li>• SMD (Surface Mounted Device) welding bench (up to size 0201).</li> </ul> <p><b>Technological Offer (Patents)</b></p> <ul style="list-style-type: none"> <li>• (Stacked multi-frequency antenna with metamaterials. (ES2385951)</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
SIGNAL AND COMMUNICATIONS THEORY			
<p><b><u>Radio Technologies and Applications Group</u></b></p> <p><b>Group Head:</b> Eva Rajo</p>	<ul style="list-style-type: none"> <li>Printed antennas: multiband, multimode, etc.</li> <li>Artificial surfaces, periodic structures, and metamaterials. Soft and hard surfaces</li> <li>Surface plasmons</li> <li>Transformation optics</li> <li>Lenses</li> <li>Nano-electromagnetism</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li><a href="#">Efficient antenna systems for future communication networks</a></li> <li><a href="#">New materials. Radiating devices and systems for miniaturising and improving the performance of radiofrequency heads</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li><a href="#">Antenna designs for moving SATCOM in Ka-band based on the use of metasurfaces</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li><a href="#">Transparent antenna performance demonstration device</a></li> </ul>	<p>This research group excels in the area of antennas and microwaves</p> <ul style="list-style-type: none"> <li>Microstrip Patch Antennas</li> <li>Soft surfaces</li> <li>EBG</li> <li>Reconfigurable devices</li> <li>Optimisation techniques</li> <li>Ridge gap waveguide</li> <li>Metamaterials</li> <li>Surface plasmons</li> <li>Transformation optics</li> <li>Sub-wavelength imaging</li> </ul>



R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
<b>SYSTEMS AND AUTOMATIC ENGINEERING</b>			
<p><b>Robotics Lab</b></p> <hr/> <p><b>Group Head:</b> Miguel A. Salichs, Carlos Balaguer, Luis Moreno</p>	<ul style="list-style-type: none"> <li>• Artificial muscles</li> <li>• Deformable object perception and manipulation</li> <li>• Soft robotics</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Soft intelligent articulation with reconfiguration and modularity capabilities for robotic platforms (SOFIA)</a></li> <li>• <a href="#">HumaSoft: Design and control of soft links for humanoid robots</a></li> <li>• <a href="#">Robotic inspection of the health personnel's protective suits for the treatment of patients in extreme isolation including Ebola (HORUS)</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Research for the competitive improvement of the drilling and blasting cycle in mining and underground works, by means of the conception of new engineering techniques, explosives, prototypes, and advanced tools (TUÑEL)</a></li> <li>• <a href="#">Development of a multiwire actuator with SMA fibres</a></li> <li>• <a href="#">Artificial muscles project</a></li> </ul>	<p>The Robotics Laboratory is one of the pioneers in robotics and automation both nationally and internationally.</p> <ul style="list-style-type: none"> <li>• Artificial muscles Development of electroactive polymer (EAP)-based bio-inspired intelligent materials and mechanisms.</li> <li>• Deformable object perception and manipulation Development of perception and manipulation algorithms to enable robots to help humans with tasks related to deformable objects, such as garments and textiles for laundry assistance.</li> <li>• Soft robotics Development of a new type of links to create softer humanoid robots that meet the characteristics of simplicity, accessibility and safety.</li> </ul> <p><b>Technological Offer (Patents)</b></p> <ul style="list-style-type: none"> <li>• Link for soft joint and soft joint comprising the link (ES2891180)</li> <li>• Ttool and method for the automatic remote application of strips of FRP tape with epoxy adhesive. (ES2370666)</li> </ul> <p><a href="#">Group's video</a></p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
<b>THERMAL AND FLUIDS ENGINEERING</b>			
<p><b>Fluid Mechanics</b></p> <hr/> <p><b>Group Head:</b> <b>Francisco Javier Rodríguez</b></p>	<ul style="list-style-type: none"> <li>• Combustion</li> <li>• Multiphase flows</li> <li>• Electrochemical system modelling and characterisation</li> <li>• Computational fluid mechanics</li> <li>• Heat and mass transport</li> <li>• Heat Pipes</li> <li>• Explosion dynamics</li> <li>• Evaporation of expiratory droplets and fuel</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">COmpound COatings NUrturing applications in Tissue Engineering</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Cavitation in Continuum Media</a></li> <li>• <a href="#">Dynamics of complex interphases with applications to the environment, the generation of energy and new materials - III</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Technical-economic optimisation of design and manufacturing variables for additively manufactured heat pipes</a></li> <li>• <a href="#">Study and design of cutting tools for turning obtained by 3D printing with internal cooling (ROTORNEA-CM-UC3M)</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Study of the performance of porous heat pipes obtained by means of additive manufacturing</a></li> <li>• <a href="#">Experimental characterisation of the atomisation of heating oil formulations with alternative components</a></li> </ul>	<ul style="list-style-type: none"> <li>• Sustainable combustion Technologically applicable reactive flows: hydrogen combustion, synthetic fuels, biofuels, ignition, chemical kinetics, compressibility effects, flame stabilisation and propagation.</li> <li>• Jets and blasts Structure and stability properties of jets and blasts in technologically relevant contexts</li> <li>• Multiphase flows Turbulent multiphase flows and submerged waves. Low Reynolds number flows <ul style="list-style-type: none"> <li>· Wave dynamics</li> <li>· Electrochemical system modelling and characterisation</li> <li>· Multiphase transport in porous media</li> <li>· PEM fuel cells</li> <li>· Flow batteries</li> <li>· Microfluidics</li> </ul> </li> <li>• Explosion dynamics Rapid methods for evaluating the effects of explosions on environment</li> </ul> <p><b>Infrastructures</b></p> <ul style="list-style-type: none"> <li>• Low-speed wind tunnel</li> <li>• Recirculating water channel</li> <li>• Ultrasound laboratory</li> <li>• Fuel cell</li> </ul>

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
THERMAL AND FLUIDS ENGINEERING			
<p><u>Fluid Mechanics</u></p> <p>Group Head: Francisco Javier Rodríguez</p>			<p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• High-speed cameras</li> <li>• Compact continuous wave solid-state laser</li> </ul> <p><b>Related News</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Scientific explanation of why beer overflows when clinking two bottles together</a></li> <li>• <a href="#">A scientific experiment successfully creates a wave that is frozen in time</a></li> </ul>

R&D GROUP

LINES OF RESEARCH

RESEARCH PROJECTS

EXPERIENCE AND CAPABILITIES

PHYSICS AND MATHEMATICS

MATHEMATICS

**Complex Systems Interdisciplinary Group (GISC)**

**Group Head:  
Carlos Rascón**

- Statistical mechanics and nonlinear dynamics
- Materials science and nanostructures
- Microfluidics and fluid adsorption in structured substrates
- Complex fluids and granular matter

**National Projects**

- [Order and fluctuations in complex fluids](#)
- [Emergence of Generic Scale Invariance in Dynamical Complex Systems](#)
- [Symmetry and geometry in fluctuations of spatially extensive systems away from equilibrium](#)

GISC is highly skilled in the use of the most up-to-date methodologies and the most useful tools of complexity science (statistical mechanics, stochastic processes, and other statistical methods, computer simulations, big data analysis, behavioural experiments, etc.), which allows them to solve problems present in many business and academic environments.

- Computational models for the simulation of material growth by surface techniques. It can be used to predict the morphology of the films produced based on process parameters, with impact on nanoscience and nanotechnology systems.
- Modelling of nanometre scale wetting processes and surface adsorption of liquids on structured substrates. They are relevant for the design of small-distance fluid manipulation and lubrication systems, with significant industrial and health applications.
- Mathematical models developed for the study of liquid crystals and granular matter. Said models allow predicting patterns and textures observable in both liquid crystals (constituting, for example, digital displays) and granular matter (such as, for example, mixtures of aggregates or rice grains).

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATHEMATICS			
<p><u>Complex Systems Interdisciplinary Group (GISC)</u></p> <hr/> <p>Group Head: Carlos Rascón</p>			<p><b>Related News</b></p> <ul style="list-style-type: none"> <li>• <a href="#">A mathematical equation describes the behaviour of nanofoams</a></li> <li>• <a href="#">A mathematical formula deciphers surface geometry such as cauliflower surface geometry</a></li> <li>• <a href="#">Liquid-vapor interphase continues to surprise us</a></li> </ul> <p><a href="#">Group's video</a></p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATHEMATICS			
<p><b><u>Modelling, Numerical Simulation, and Industrial Mathematics (GMSMI)</u></b></p> <hr/> <p><b>Group Head:</b> <b>Luis López Bonilla</b></p>	<ul style="list-style-type: none"> <li>• <b>Non-linear charge transport in nanostructures</b></li> <li>• Transport in quantum wells, quantum wires, and quantum dots.</li> <li>• Wigner- and Boltzmann-Poisson kinetic models. BGK collisions. Asymptotic derivation of balance equations. Numerical techniques. Wigner-BGK-Poisson kinetic models. Applications to semiconductor superlattices.</li> <li>• Spontaneous chaos in semiconductor superlattices at room temperature. Fast true random bit generators and encryption.</li> <li>• Non-linear transport in graphene and carbon nanotubes.</li> <li>• <b>Multiscale modelling of materials</b></li> <li>• Discrete models for two- and three-dimensional dislocations and cracks in crystals with cubic and hexagonal symmetry.</li> <li>• Hybrid multiscale numerical models for the diagnosis and optimal structural design of materials</li> <li>• Multiscale descriptions of heteroepitaxial growth taking into account the substrate strain field.</li> <li>• Inverse problems and imaging techniques for crack detection schemes and automatic control of the epitaxial growth process.</li> </ul>	<ul style="list-style-type: none"> <li>• National Projects</li> <li>• <a href="#">Mathematical and technical models for cellular aggregates</a></li> <li>• <a href="#">Hybrid models for nano- and biosystems</a></li> <li>• <a href="#">Collective and stochastic behaviour in nano- and biomaterials</a></li> </ul>	<ul style="list-style-type: none"> <li>• GMSMI possesses considerable hardware and software which allow it to carry out numerical simulation projects. It also capable of carrying out supercomputing projects through collaboration with CIEMAT that provides access to the 160-processor SGI Origin 3800 computer for parallel compressing.</li> <li>• Nanotechnology and Computational Materials Science:</li> <li>• Modelling and numerical simulation of electron transport in semiconductor nanostructures subject to intense fields</li> <li>• Modelling of new magnetic and superconductor materials</li> <li>• Modelling of dislocations, fissures, and other defects in computational materials science</li> <li>• <a href="#">Group's video</a></li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
PHYSICS			
<p><b><u>Advanced Materials for Solar Energy Applications</u></b></p> <p><b>Group Head:</b> <b>Beatriz Galiana</b></p>	<ul style="list-style-type: none"> <li>• Solid state physics</li> <li>• Integration of fluorescent materials in solar cells</li> <li>• Quantum efficiency measurements of photovoltaic devices</li> <li>• Modelling of optical and electrical properties of nanostructures and thin films</li> <li>• Sputtering growth of fluorescent and photoactive materials</li> <li>• Synthesis of fluorescent and photoactive nanoparticles</li> <li>• Transmission and scanning electron microscopy</li> <li>• Atomic force microscopy in tapping and conductive modes</li> <li>• Electrical properties of thin layers</li> <li>• Solar cell design and modelling</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Analysis and development of materials for integration into III-V nanowire-based solar cell</a></li> <li>• <a href="#">Development and irradiation of high-entropy alloys, copper-based materials, and nanostructured ODS steels for fusion reactors</a></li> </ul> <p><b>Regional Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of the multidisciplinary R&amp;D activities programme for the Fusion Technology Centre (TechnoFusion)</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Simulation modernisation: visualisation of slow targets (MS-VOL)</a></li> </ul>	<p>This group which specialises in the area of applied physics includes experts in solar cells, thin film (MBE, MOVPE; sputtering), advanced materials characterisation (TEM, AFM, PL, etc.), modelling of semiconductor materials, and study of rare earth-based luminescent materials.</p> <p><b>Equipment</b></p> <p>TEM, sputtering equipment with two magnetrons (co-sputtering), C-AFM, optical measurement laboratory, quantum efficiency equipment, spectrophotometer.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
PHYSICS			
<p><b><u>Nanostructured and Multifunctional Materials</u></b></p> <p><b>Group Head:</b> Miguel Ángel Monge</p>	<ul style="list-style-type: none"> <li>• Biological materials</li> <li>• Development of new materials</li> <li>• Ceramic materials</li> <li>• Nanostructured materials</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Production and evaluation of tungsten alloys, copper alloys, and ultra-fine grain steel reinforced by oxide dispersion for melting applications</a></li> <li>• <a href="#">Development and irradiation of high-entropy alloys, copper-based materials, and nanostructured ODSs steels for fusion reactors</a></li> <li>• <a href="#">Processing, characterisation, and irradiation of nanostructured Cu, W-Cu alloys, and ODS steels for fusion reactors</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of the multidisciplinary R&amp;D activities programme for the Fusion Technology Centre (TechnoFusion)</a></li> <li>• <a href="#">Physical and biological characterisation of composites made of Y2O3 nanoparticle-reinforced hydroxyapatite produced by slip casting</a></li> <li>• <a href="#">Advanced structural materials</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of ODS Fe-Cr alloys for fusion applications</a></li> </ul>	<ul style="list-style-type: none"> <li>• Materials for fusion Processing and characterisation of: <ul style="list-style-type: none"> <li>· W alloys</li> <li>· Cu alloys</li> <li>· Steels</li> </ul> </li> <li>• Lightweight materials Processing and characterisation of Al and Ti</li> </ul> <p><b>Infrastructure</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Nanostructured and multifunctional materials laboratory (LMNM)</a></li> </ul>



R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
PHYSICS			
<p><b>Plasma Physics</b></p> <hr/> <p><b>Group Head:</b> <b>Luis García Gonzalo</b></p>	<ul style="list-style-type: none"> <li>• Turbulence and transport in fusion plasmas</li> <li>• Runaway electron study</li> <li>• MHD stability</li> <li>• Design of magnetic confinement fusion devices</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">EUROfusion-Europe: Implementation of activities described in the Roadmap to Fusion during Horizon Europe through a joint programme of the members of the EUROfusion consortium</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of codes and models for the study of problems in two critical areas for ITER tokamak: plasma edge modelling and disruption mitigation</a></li> <li>• <a href="#">Study of the impact of three-dimensional magnetic perturbations on the transport and stability properties of tokamaks and stellarators</a></li> <li>• <a href="#">Runaway electron generation, control, and dissipation during disruptions: implications for ITER</a></li> <li>• <a href="#">Study and control of turbulent transport in magnetically confined plasmas</a></li> </ul>	<p>This group specialises in magnetic confinement-controlled thermonuclear fusion. The group has extensive experience in solving problems relating to the design of fusion devices, the study of turbulent transport of plasma, and the design of runaway electron control mechanisms to avoid possible damage from these high-speed particles in the reactor. To that end, the group uses sophisticated mathematical and computational tools.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
PHYSICS			
<p><b><u>Remote Sensing Sensors and Infrared Imaging Laboratory (LIR-InfraRed LAB)</u></b></p> <hr/> <p><b>Group Head:</b> Antonio J. of Castro González</p>	<ul style="list-style-type: none"> <li>• Spectral analysis</li> <li>• Thermography and Radiometry</li> <li>• Non-invasive analysis</li> <li>• Simulation and design</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">HITCOMP: High Temperature Characterisation and Modelling of Thermoplastic Composites</a></li> </ul> <p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">CFRP under fire load</a></li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Monitoring, analysis, and testing activities for the simulation of high temperature events on composite structure for CERTERIN WP9</a></li> <li>• <a href="#">Monitoring, analysis activities for the simulation of fire events on composite structure</a></li> <li>• <a href="#">Characterisation of thermo-mechanical behaviour of composites in fire and empirical determination of their properties</a></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Spectral analysis</b> Infrared radiation-matter interaction analysis.</li> <li>• <b>Thermography and radiometry</b> Contactless remote measurement of the temperature of an object</li> <li>• <b>Non-invasive analysis</b> Contactless non-destructive analysis by means of infrared technology (NDT-IR). Applications: <ul style="list-style-type: none"> <li>· Design and development of specific IR thermography systems for the characterisation of the internal structure of materials</li> <li>· Preventive analysis of anomalies</li> <li>· Health monitoring</li> <li>· Behavioural modelling based on experimental data</li> </ul> Development of IR thermography techniques for empirical determination of the thermal parameters of materials (diffusivity, conductivity, specific heat, etc.).</li> <li>• <b>Simulation and design</b> Software tools to simulate the thermal behaviour of a material subjected to high temperatures.</li> <li>• <b>3DFireSimulator (3DFS)</b> Software for the virtual analysis of the thermal behaviour of materials subjected to fire.</li> </ul> <p><a href="#">Group's video</a></p> <p><b>Infrastructure</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Thermography and infrared imaging laboratory (LATIR)</a></li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
PHYSICS			
<p><b><u>Semiconductor Nanostructures</u></b></p> <p><b>Group Head: Rosa María de la Cruz Fernández</b></p>	<ul style="list-style-type: none"> <li>• Semiconductor nanostructures: wells, wires, and quantum dots</li> <li>• Theory (numerical simulation)</li> <li>• Optical properties (reflectance, transmittance, and absorbance) in semiconductor nanostructures with applications in solar cells</li> <li>• Lattice vibrations (phonons): study of the electron-phonon interaction mechanism</li> <li>• Growth mechanisms: modelling and prediction of physical magnitudes related to growth control and characterisation of the same laboratory level</li> <li>• Electron and spin transport: simulation and theoretical design of optoelectronic devices based on electron and spin transport</li> </ul>	<p><b>National Projects</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Analysis and development of materials for integration into III-V nanowire-based solar cell</a></li> </ul> <p><b>Regional Projects (Community of Madrid)</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Development of the multidisciplinary R&amp;D activities programme for the Fusion Technology Centre (TechnoFusion)</a></li> </ul>	<ul style="list-style-type: none"> <li>• Theory, modelling, and simulation in:             <ul style="list-style-type: none"> <li>· Optical properties in semiconductor nanostructures (quantum dots, nanoshells, etc.). Semiconductor nanostructures applicable in solar cells.</li> <li>· Growth mechanisms (coherent and incoherent) in semiconductor quantum dots</li> <li>· Polarons in semiconductor nanostructures</li> </ul> </li> </ul>

R&D GROUP

DESCRIPTION

PURPOSES

RESEARCH INSTITUTES

RESEARCH INSTITUTES

**"Álvaro  
 Alonso Barba"  
 Technological  
 Institute  
 Chemistry and  
 Materials**

**Contact:  
 María José Cano**

The **Álvaro Alonso Barba Technological Institute of Chemistry and Materials** of University Carlos III of Madrid was founded at the end of 1999 as a dynamic instrument for technological research and development in materials.

This Institute houses research professors from different areas and departments of the university and has maintained a stable activity since its inception.

The Institute was established based on inclusiveness to encourage the creation of multidisciplinary groups capable of leading innovative research projects and specific programmes for the training of specialists in cutting-edge technologies. Another objective of the Institute is to provide an effective response to the industrial demand for scientific and technological consultancy in the fields of competence.

- Creation of multidisciplinary scientific teams that generate adequate knowledge of the problems related to chemistry and materials and the contribution to the international scientific world of solutions to these problems.
- Securing and channelling scientific and technological projects related to the area of chemistry and materials.
- Comprehensible and sustained dissemination of this knowledge and solutions to contribute to the training and dissemination of (and with) scientists in the Institute's field of work.
- Creation of a communication and exchange channel with international institutions and specialists (especially Latin American) coinciding with the object of scientific study of the Institute.

R&D GROUP

DESCRIPTION

SERVICES AND EQUIPMENT

LABORATORIES

LABORATORIES

**Scientific-  
Technological  
Support  
Laboratory  
for Businesses  
(LACTE)**

**Contact:  
Elisa M<sup>a</sup> Ruiz  
Navas**

Laboratory L.A.C.T.E. was founded with the purpose of collaborating with companies within the Community of Madrid in the sector of materials science.

The laboratory is currently involved in the ADITIMAT-CM (S2018/NMT-4411) R&D Programme which is spearheaded by the Community of Madrid and focuses on additive manufacturing.

Previously, it has participated in the MULTIMAT-CHALLENGE-CM (S2013/MIT-2862) R&D Programme focusing on the development of multifunctional materials for the challenges facing society, and the ESTRUMAT (S2009/MAT-1585) R&D Programme for the development of advanced structured materials, both spearheaded by the Community of Madrid.

This laboratory is part of the Community of Madrid Laboratory and Infrastructure Network (REDLAB).

It has collaborated with many companies within the Community of Madrid, the rest of the Spanish territory, as well as internationally.

**Services**

- Services for the analysis, characterisation, and measurement of the properties of materials
- Design of materials and optimisation of production processes by means of powder metallurgical techniques (which is the distinguishing feature of LACTE)
- Chemical and thermochemical treatments for metallic materials.
- Behaviour in service and design of new materials with improved performance and high added value or under severe conditions of wear and electrochemical oxidation/corrosion

**Equipment**

LACTE has used its equipment in different areas of work such as:

- Thermodynamic and kinetic simulation software: Software Thermocalc Windows (TCW) and DICTRA
- High-energy milling equipment
- Laser particle size analyser for dry and suspended conditions
- C, O, S content analyser (LECO)
- Low-temperature TGA-DSC differential thermal analyser (STA 6000 Simultaneous Thermal Analyzer)
- Controlled atmosphere furnaces
- Hot extrusion equipment (up to 550°C)
- High-temperature contact angle measuring device DSAHT (up to 1700°C)
- UTM-Bruker tribometer
- Electrochemical characterisation equipment
- Equipment for obtaining coatings by sol-gel technology
- Equipment for rheological characterisation of polymers with and without metallic/ceramic fillers
- Equipment for the injection of polymers with and without metallic/ceramic fillers
- 3D printer from pellets (Tumaker- IT3D)

R&D GROUP	DESCRIPTION	SERVICES AND EQUIPMENT
LABORATORIES		
<p><b><u>Material Mechanical Characterisation Laboratory (LABMEC)</u></b></p> <hr/> <p><b>Contact:</b>            Sonia Sánchez</p>	<p>LabMec (Material Mechanical Characterisation Laboratory), which has specific experience in the area of dynamic and impact testing, provides services for characterising the mechanical behaviour of structural elements or materials at different strain rates and temperatures.</p> <p>This laboratory is part of the Community of Madrid Laboratory and Infrastructure Network (REDLAB).</p>	<p>This laboratory is in possession of a wide range of mechanical testing apparatuses, with some being the only ones found in Spain. These apparatuses include:</p> <ul style="list-style-type: none"> <li>• Universal servohydraulic machine</li> <li>• Instrumented Charpy pendulum</li> <li>• Instrumented drop weight tower</li> <li>• Hopkinson tensile bar</li> <li>• Gas cannon</li> </ul>

R&D GROUP	DESCRIPTION	SERVICES AND EQUIPMENT
LABORATORIES		
<p><b>Biomass Fuel Testing Laboratory (BIOLAB)</b></p> <hr/> <p><b>Contact:</b> Antonio Soria</p>	<p>The purpose of BIOLAB is to provide services for the physical, physicochemical, and energy characterisation of biomass in order to determine its properties and quality as fuel.</p> <p>This laboratory is part of the Community of Madrid Laboratory and Infrastructure Network (REDLAB).</p>	<p><b>Types of tests (Product: Fuels)</b></p> <ul style="list-style-type: none"> <li>• Environmental Characterisation of effluents from thermal processes (combustion and gasification); Thermogravimetric analysis</li> <li>• Physical Apparent density, combustion index, disintegration resistance index</li> <li>• Mechanical Determination of battery density Determination of grain size distribution</li> <li>• Chemical Determination of total carbon, hydrogen, and nitrogen content Determination of sulphur and chlorine content Determination of calorific value Determination of moisture, volatile substance, and ash contents Determination of the degree of sintering/fusibility of ashes</li> </ul> <p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• Elemental analyser</li> <li>• Thermogravimetric analyser</li> <li>• Calorimetric pump</li> </ul>

R&D GROUP	DESCRIPTION	SERVICES AND EQUIPMENT
LABORATORIES		
<p><b><u>High-Voltage Testing and Research Laboratory (LINEALT)</u></b></p> <hr/> <p><b>Contact:</b>  <b>Juan Manuel Martínez Tarifa</b></p>	<p>Since its inception in the year 2000, the High-Voltage Research and Testing Laboratory (LINEALT) has been working on the analysis and characterisation of insulating materials and systems (solid, polymeric, paper-oil systems, etc.), as well as on the application and development of various high-voltage measurement and testing techniques (DC and AC applied voltage up to 100 kV RMS, impulse testing, ageing testing, partial discharge measurements, capacity and loss factor measurements, etc.).</p> <p>The laboratory also incorporates advanced testing, measurement, and diagnostic techniques, such as dielectric spectroscopy, frequency response analysis, space charge measurement, infrared thermography, etc., or more conventional techniques such as insulation resistance/polarisation index and impulse testing. Some of these measurements can be performed in the field.</p> <p>The LINEALT Laboratory regularly maintains collaborative relationships with electric utility companies, manufacturers and users of electrical equipment and appliances through R&amp;D activities, contract research, ongoing training, or technical consultancy. This laboratory is part of the Community of Madrid Laboratory and Infrastructure Network (REDLAB).</p>	<p><b>Types of tests (Procedure: UNE-CEI-EN Standard)</b></p> <ul style="list-style-type: none"> <li>• Insulation testing</li> <li>• Partial discharge measurements</li> <li>• Dielectric strength and supported voltage testing.</li> <li>• Capacitance and tg delta measurements</li> <li>• Surface and volumetric resistivity measurements.</li> </ul> <p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• AC high-voltage generator</li> <li>• 140 kV DC high-voltage generator</li> <li>• Impulse and switching voltage generator, up to 140 kVp</li> <li>• Partial discharge measurement and analysis systems</li> <li>• Automatic bridge for measuring C and tg delta</li> <li>• Cumulative space charge measuring device</li> <li>• Equipment for non-conventional partial discharge measurements</li> </ul>



R&D GROUP	DESCRIPTION	EQUIPMENT
<b>LABORATORIES</b>		
<p><b><u>Nanostructured and Multifunctional Materials Laboratory (LMNM)</u></b></p> <hr/> <p><b>Contact:</b> <b>Miguel Ángel Monge</b></p>	<p>The Nanostructured and Multifunctional Materials Laboratory (LMNM) focuses its research on the field of materials physics with applications in the nuclear sector and the development of new biomaterials.</p> <p>The laboratory's activity is centred on the design, pilot-scale production, and study of the mechanical properties and microstructure of low induced activation structural alloys that are resistant to irradiation and high temperatures, as well as coating materials. The most significant of such alloys include, among others, those consisting of V, Ti, W, reduced activation steels reinforced by means of a nanometric oxide distribution (ODS), and EUROFER 97 which is the European reference steel for fusion applications. The laboratory has also worked extensively on ceramic materials with potential fusion applications (MgO, Al<sub>2</sub>O<sub>3</sub>, and Zr<sub>2</sub>O<sub>3</sub>), due to their mechanical characteristics, optical properties, and semiconducting properties at high temperatures. In the field of biomaterials, the laboratory focuses on the development of Ti-based nanostructured alloys and the production of hydroxyapatite-based nanostructured ceramic materials. Given its extensive experience in the production and characterisation of nanostructured materials, the LMNM provides consultancy services and offers the possibility of carrying out research and development projects in these areas of knowledge.</p> <p>This laboratory is part of the Community of Madrid Laboratory and Infrastructure Network (REDLAB).</p>	<p><b>Types of tests</b></p> <ul style="list-style-type: none"> <li>• Mechanical <ul style="list-style-type: none"> <li>Characterisation of mechanical properties</li> <li>Wear and tribology</li> <li>Hardness and fracture toughness</li> <li>Creep</li> </ul> </li> <li>• Physical <ul style="list-style-type: none"> <li>Surface composition</li> <li>Optical properties</li> </ul> </li> <li>• Electrical <ul style="list-style-type: none"> <li>Electrical characterisation</li> </ul> </li> <li>• Microscopy <ul style="list-style-type: none"> <li>Microstructural characterisation</li> <li>Topography and surface study</li> </ul> </li> <li>• Non-destructive testing <ul style="list-style-type: none"> <li>Determination of thermal conductivity</li> <li>Microstructural study of defects</li> <li>Elastic constant measurement</li> <li>Density measurement</li> </ul> </li> </ul> <p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• Hot isostatic HIP consolidation (Hot Isostatic Pressing)</li> <li>• Arc melting furnace</li> <li>• Vacuum and controlled-atmosphere furnaces</li> <li>• Planetary and attrition mills</li> <li>• Hot angular extrusion machine up to 700°C (ECAE)</li> <li>• Mechanical tensile and compression testing machine</li> <li>• Creep and flexure testing machine up to 650 °C and 25 kN</li> </ul>

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R&D GROUP	DESCRIPTION	EQUIPMENT
LABORATORIES		
<p><u>Nanostructured and Multifunctional Materials Laboratory (LMNM)</u></p> <hr/> <p>Contact: Miguel Ángel Monge</p>		<ul style="list-style-type: none"> <li>• Nanoindenter and microindenter</li> <li>• Grindosonic</li> <li>• Atomic force microscope AFM</li> <li>• SThm by means of AFM</li> <li>• Optical microscopy</li> <li>• Positron annihilation lifetime spectrometer</li> <li>• Positron annihilation coincidence Doppler spectrometer</li> <li>• Pycnometer</li> <li>• Absorption and luminescence spectrometers</li> <li>• AGILEN 4294-A complex impedance spectrometer</li> <li>• Hot angular extrusion machine up to 700 °C (ECAE)</li> <li>• Pin-On Disk tribometer with potentiostat</li> <li>• XPS surface characterisation</li> </ul>

R&D GROUP	DESCRIPTION	SERVICES AND EQUIPMENT
LABORATORIES		
<p><b><u>Transmission Electron Microscopy Laboratory (LABMET)</u></b></p> <hr/> <p><b>Contact:</b> Beatriz Galiana</p>	<p>The Transmission Electron Microscopy Laboratory (LABMET) is in possession of a Tecani 20 FEG electron microscope equipped with an X-ray detector, a STEM module, and a HAAD high-angle dark field detector for atomic number contrast. The suitable selection of contrast conditions allows studying materials with a resolution of 0.2 nm, determining the crystalline structure, chemical composition, and the content and distribution of defects.</p> <p>This laboratory is part of the Community of Madrid Laboratory and Infrastructure Network (REDLAB).</p>	<p><b>Types of tests</b></p> <ul style="list-style-type: none"> <li>• Microscopy</li> </ul> <p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• FEG transmission electron microscope</li> <li>• EDX, X-ray spectrometer</li> <li>• Concave grinder, Dimpler</li> <li>• Ion bombardment grinder, Ion mill</li> <li>• Ultrasonic cutter</li> </ul>

R&D GROUP	DESCRIPTION	SERVICES AND EQUIPMENT
LABORATORIES		
<p><b><u>Thermography and Infrared Imaging Laboratory (LATIR)</u></b></p> <hr/> <p><b>Contact:</b>  <b>Fernando López</b></p>	<p>LATIR specialises in the use of infrared imaging (IR) and thermography for Tecless and Shutterless calibration of infrared imaging systems, combustion analysis, optimisation of remote temperature measurement processes, gas detection, plume IR emission, etc., developing specific applications for the automotive, aeronautics, defence, energy, environmental, fire safety industries, etc.</p>	<p><b>Types of tests</b></p> <ul style="list-style-type: none"> <li>• Non-destructive testing           <ul style="list-style-type: none"> <li>Leak detection</li> <li>Determination of leak-tightness</li> <li>Determination of thermal non-uniformity</li> </ul> </li> <li>• Physical           <ul style="list-style-type: none"> <li>Determination of Infrared signature</li> </ul> </li> <li>• Fuego           <ul style="list-style-type: none"> <li>Determination of material strength in fire test</li> <li>Structure and flame propagation</li> </ul> </li> <li>• Environmental           <ul style="list-style-type: none"> <li>Study of the emission of pollutant gases</li> </ul> </li> <li>• Behavioural testing           <ul style="list-style-type: none"> <li>Performance, yield, and durability test</li> </ul> </li> </ul> <p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• Cavity black body</li> <li>• Black body with an extensive area – 100 mm</li> <li>• InSb IR camera</li> <li>• MCT multispectral IR system</li> <li>• FTIR spectroradiometer</li> <li>• Hyperspectral eMWIR imaging system</li> <li>• Climatic chamber</li> <li>• BB-4A-230VAC black body. OMEGA</li> <li>• Absolute/differential black body with an extensive area – 150 mm</li> <li>• FTIR spectrophotometer</li> </ul>

R&D GROUP

DESCRIPTION

SERVICES AND EQUIPMENT

APPLIED R+D+I LABORATORIES IN THE SCIENCE PARK

**Aeronautical  
Structures Impact  
Laboratory  
(IMPACTLAB)**

**Contact:**  
**José Antonio  
Loya, Jorge López  
Puente**

The Aeronautical Structures Impact Laboratory is formed by a team of qualified professionals with extensive experience in providing innovative solutions to the industry, related to the mechanical behaviour of components and the calculation of structural elements.

It has facilities for carrying out mechanical tests (with specific experience in the field of dynamic and impact testing) in a wide range of strain rates and temperatures. The laboratory has 6 pneumatic launchers (of different calibres, from 7 mm to 500 mm) to perform high-velocity impact testing (up to 1000 m/s) in a wide range of energies (up to 300 KJ). It also has extensive experience in the modelling of solid mechanics problems using self-developed tools and commercial numerical codes.

This laboratory is located within the facilities of the UC3M Science Park.

**Services**

- Experimental high-velocity impact testing on aeronautical structures (using ice projectiles, bird projectiles, metal fragment projectiles, etc.)
- Analysis of the impact behaviour of aeronautical and aerospace structural elements
- Development of specific methodologies for the study of damage tolerance under different loading conditions of aeronautical and aerospace structures manufactured with composite materials.
- Safety and defence of mobile systems subjected to impact loads.
- Analysis and modelling of lightweight structures subjected to impact loads.
- Conducting energy absorption tests.

*Co-funding:*

Activity of the Project "UC3M Plan for Promoting Innovation and R&D Result Transfer in the Production Sector of the Community of Madrid with Priority in the Southern Metropolitan Area" with Ref.: OI2018/PC-UC3M-5152 and the acronym PC-UC3M. This project was awarded in the 2018 Call for Grants for fostering technological innovation and promoting technology transfer to the production sector comprised within the priorities of the Regional Research and Innovation Strategy for Smart Specialization (RIS3) of the Community of Madrid through technological innovation coordinating entities. It is co-funded by the European Regional Development Fund which provides 25% of the funding and by the Community of Madrid which provides another 25% within the framework of the FEDER 2014-2020 operational program.



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