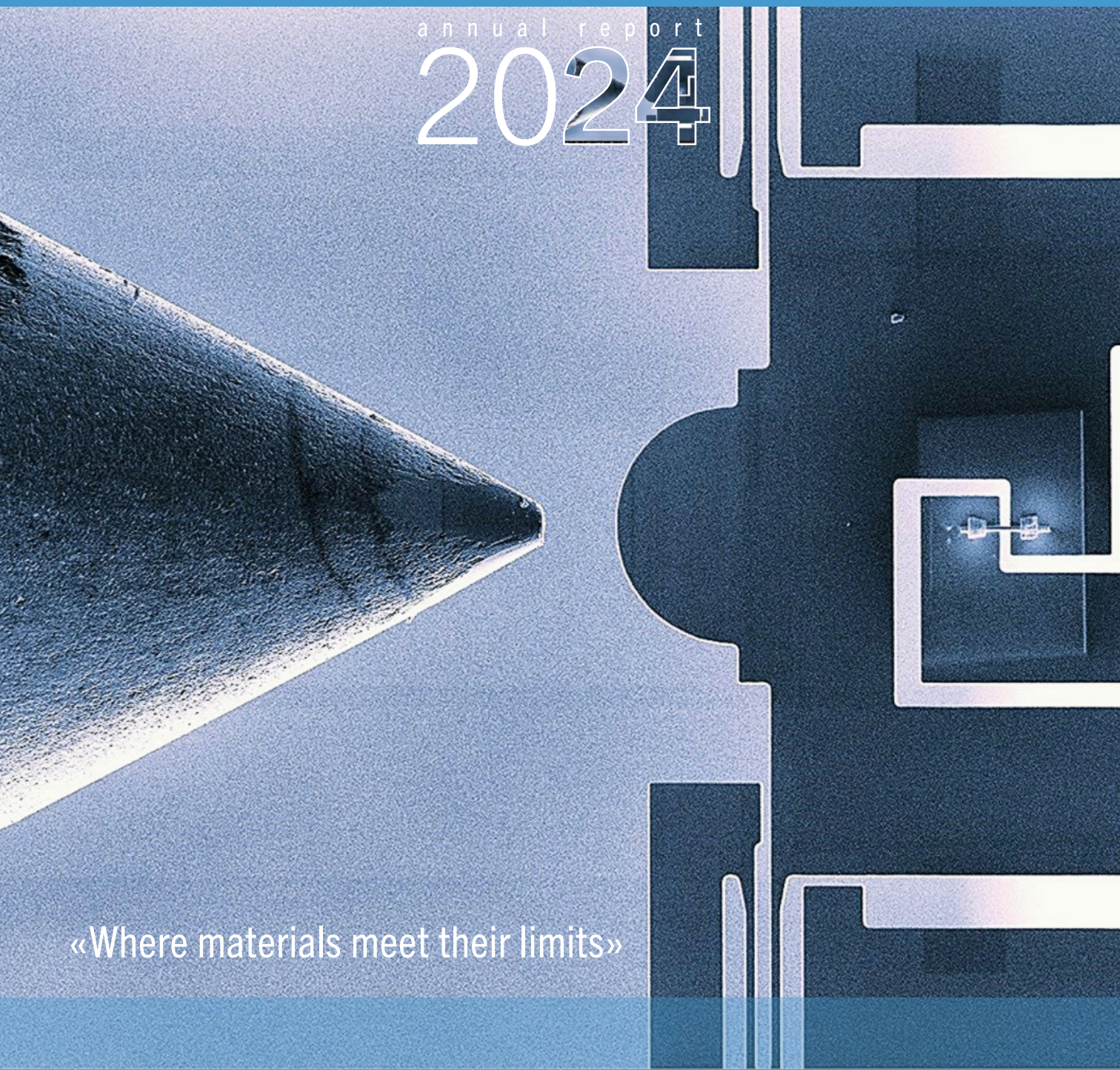
institute imdea materials

www.materials.imdea.org

annual report

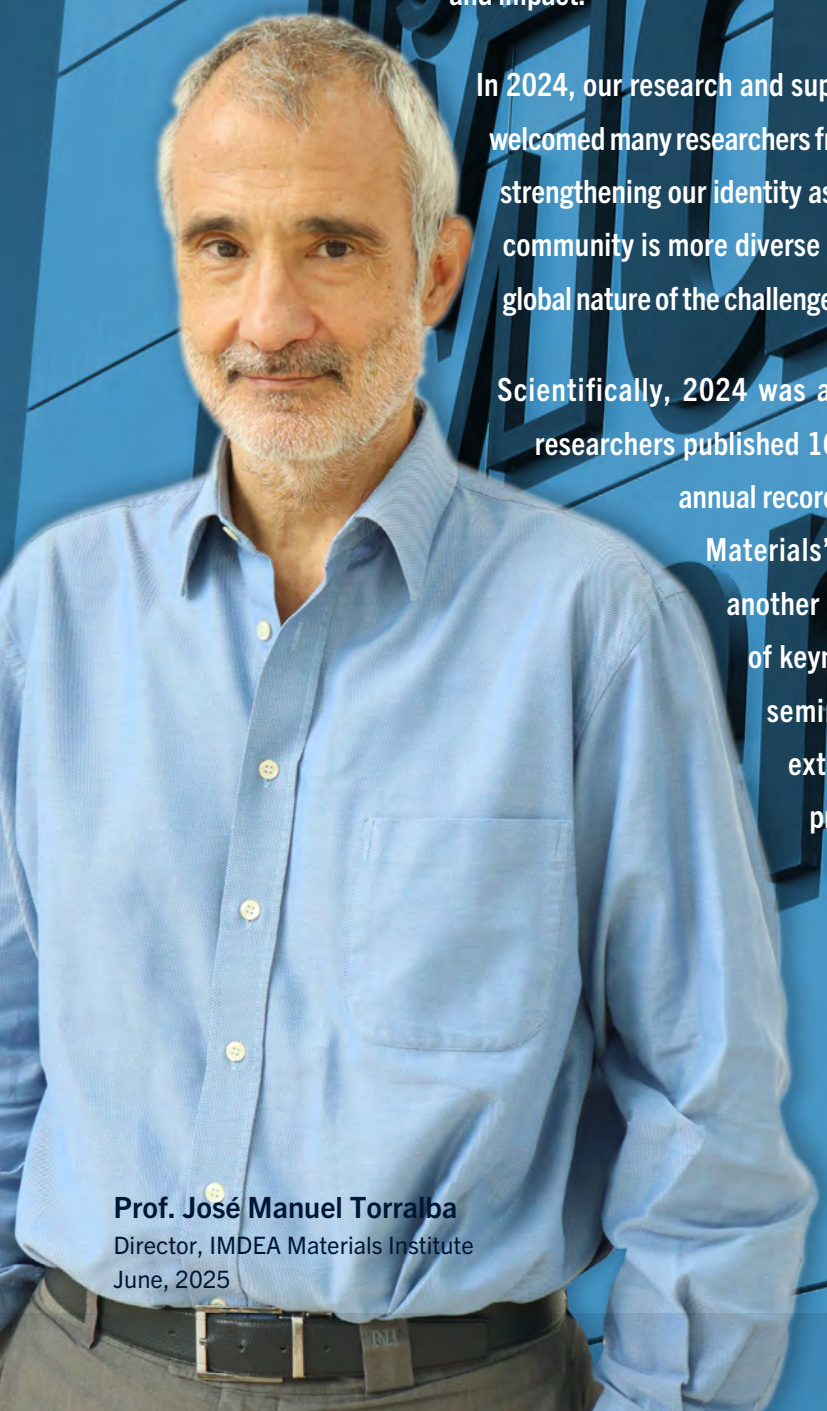
2024



«Where materials meet their limits»

WORDS FROM THE DIRECTOR...

It is my pleasure once again to introduce the IMDEA Materials Annual Report and reflect on another exceptional year for the Institute. Since stepping into this role in 2021, I have had the privilege of watching IMDEA Materials continue its remarkable growth - not only in size, but in scientific output, talent attraction, and impact.



In 2024, our research and support staff grew to more than 160, and we welcomed many researchers from new countries and backgrounds, further strengthening our identity as an international centre of excellence. Our community is more diverse and dynamic than ever, a reflection of the global nature of the challenges we are tackling through materials science.

Scientifically, 2024 was a record-setting year. IMDEA Materials researchers published 168 articles in SCI-indexed journals: a new annual record for the institute. Not only that, but IMDEA Materials' publications received 9,356 citations, another record. Our researchers delivered dozens of keynote addresses, presentations and invited seminars around the world, while I was also extremely proud to see 11 of our talented predoctoral researchers successfully defend their doctoral theses.

Equally important is how this research is being recognised and supported. In 2024, we secured 26 new projects, including 13 European, 6 national and regional, and 7 industrial projects. Among these, the €9 million IRIDISCENTE project, co-coordinated by IMDEA Materials and

Prof. José Manuel Torralba
Director, IMDEA Materials Institute
June, 2025

ArcelorMittal, stands out as the largest ever led by the Institute.

We also strengthened our position as one of Spain's leading talent-attracting centres, earning 8 MSCA postdoctoral fellowships, the fourth most of any Spanish institution. We also added four new national and regional fellowships, including one Ramón y Cajal and two Juan de la Cierva grants.

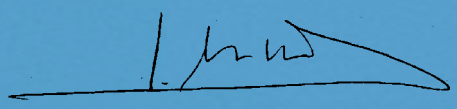
In terms of European research, we were proud to be recognised as one of the top five Horizon Europe project coordinators in the Madrid region (2021–2023), as noted by the Ministry of Science, Innovation and Universities.

Our growth has also been structural and strategic. In 2024, we launched two new research groups. These were our Catalysis and Energy Materials (CEM) group, led by Prof. Harun Tüysüz, focusing on next-generation materials for sustainable energy applications, and our Biometals, Coatings and Devices (BCD) group, led by Dr. Mónica Echeverry Rendón, working on advanced biomedical materials and coatings.

We also continue to cultivate industrial collaborations. Notably, we announced a new strategic partnership with ArcelorMittal, reinforcing our commitment to bridging fundamental research with real-world applications. And we hosted a number of high-level scientific events and seminars, further establishing ourselves as a key node in the global materials science network. I also take this opportunity to publicly renew our commitment to following our code of ethics and promoting a culture of compliance.

Finally, I want to acknowledge the people behind these achievements. Our principal investigators, researchers, technicians, and administrative staff continue to drive this Institute forward with their talent and dedication. Each one contributes to our shared mission of developing materials that improve society, be it through more efficient energy systems, better healthcare, or more sustainable technologies.

Thank you all for being part of this journey. I look forward to everything we will continue to accomplish together in 2025.



annual report 2024

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cover picture

Fiberglass Testing

SEM image of an in-situ micromechanical test, showing a push-to-pull device (right-hand side) with the glass fiber to be tested mounted on the gap in the centre and a diamond tip used to apply a force on the device (left-hand side).

Miguel Monclús

Senior Research Associate, IMDEA Materials Institute.

contents

About us

IMDEA Materials Institute is one of seven Madrid Institutes for Advanced Studies (IMDEA Institutes) based in the Madrid Region.

Founded as research centres of excellence at the initiative of the regional government in 2006 and 2007, these seven institutes are focused on strategic areas for society from a business, scientific and technological point of view: water, food, energy, nanoscience, networks, software and materials.

Their objective? To encourage excellent R+D+I and create an efficient science and technology development model while collaborating with the industrial sector.

IMDEA Materials Institute's goal is to carry out research at the forefront of Materials Science and Engineering, to attract talent from around the world, and to collaborate with companies to transfer fundamental and applied knowledge into valuable technology.

IMDEA Material's Four Seasons
Inspired by Vivaldi's The Four Seasons, IMDEA Materials Institute is presented through the four stages of the year: spring, summer, autumn, and winter.
Javier García Molleja
1st Place, IMDEA Materials Institute Imaging Contest, 2025, Open Subject Category.

Our…

…mission

Research of excellence in Materials Science to tackle the challenges facing society and to foster the Madrid region's sustainable development.

…vision

To continue enhancing IMDEA Materials' reputation as a leading research institute, one which is internationally recognised for its excellence in Materials Science and its contributions to the positive transformation of society.

…facilities

IMDEA Materials Institute is located in the Scientific and Technological Park of the Technical University of Madrid in Tecnogetafe, Madrid, Spain. Our 2,640 m^2 of state-of-the-art laboratories offer a unique combination of materials modelling, simulation and processing. The Institute hosts a 200-person multicultural and multidisciplinary team including their integration in labs and research centres throughout the world. IMDEA Materials also hosts visiting spaces for international conferences and meetings.

…technology

Metals, composites, polymers, 3D printing, multiscale modelling and materials simulation, nanostructured materials, multiscale experimental characterisation, greener processes, fire retardants, electrochemistry, biomaterials and cell culture, and more.

...SECTORS AND AREAS OF APPLICATION

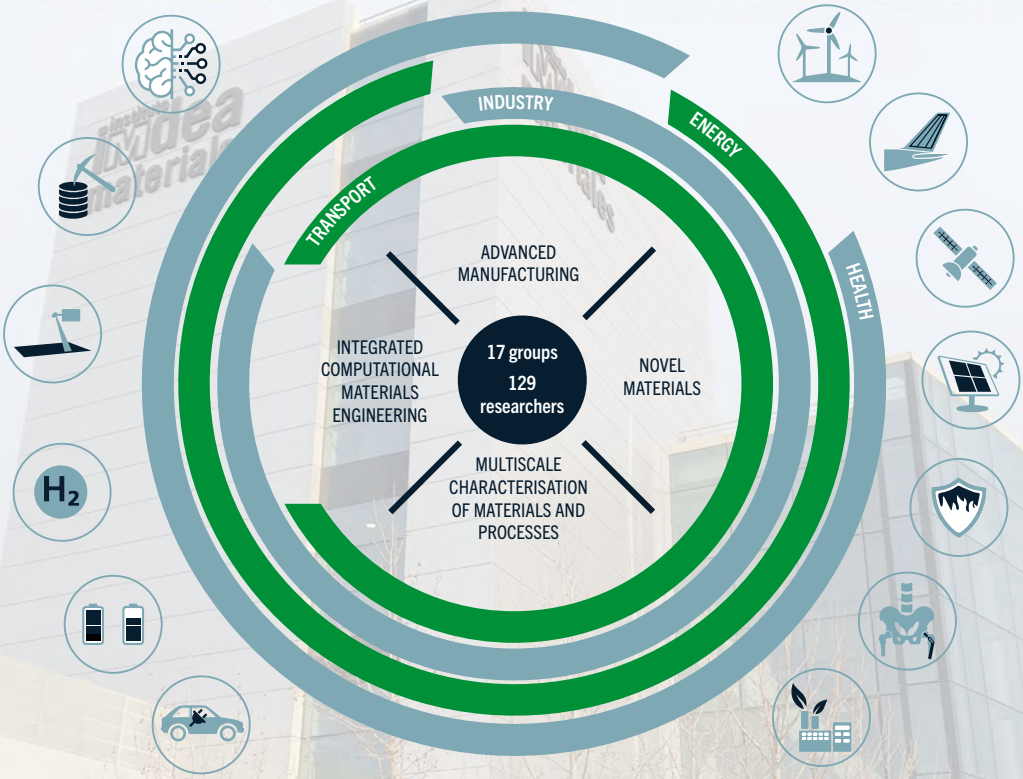
Research programmes: fundamental and applied

TALENT

- Novel Materials
- Integrated Computational Materials Engineering
- Multiscale Characterisation of Materials and Processes
- Advanced Manufacturing

Strategic Partners: ITP Aero, AIRBUS, HEXCEL, RENISHAW apply innovation, hp, ArcelorMittal, REPSOL, Tolsa, ANTOLIN

Global challenges



...people

In 2024, IMDEA Materials Institute continued to grow. Our number of predoctoral and postdoctoral researchers increased from 88 to 112, our principal investigators (PIs) from 16 to 17, and our support staff from 33 to 36. This growth reflects the success of our strategy to strengthen human resources and foster a culture of scientific excellence.

Our staff remains our most valuable asset, and we are committed to providing a supportive and stimulating work environment for those who share our mission of advancing knowledge.

With this in mind, two major initiatives stand out from 2024. First, IMDEA Materials secured a *"Preparation and Management of European Projects and Facilitating the Attraction of International Talent" (OCPI)* grant from the Spanish Ministry of Science, Innovation, and Universities. This grant strengthens our capacity to participate in Horizon Europe projects and enhances our ability to attract, incorporate, and retain international research talent, supporting our broader goal of fostering global collaboration.

Secondly, we launched the *Junior Principal Investigator (Junior PI) program,* enabling postdoctoral researchers with competitive talent grants to lead their own research groups. Our first Junior PI, Dr. Mónica Echeverry Rendón, who was also awarded a César Nombela talent attraction grant by the Community of Madrid in 2024, has already established the Biometals, Coatings, and Devices Group, focused on advanced research in biometals, coatings, and medical devices. Her appointment marks an exciting step in our commitment to supporting female researchers and providing a platform for leadership and innovation.

As part of our commitment to equality, meanwhile, we continue to implement our Gender Equality Plan to ensure equal opportunities for all staff. Our Transversal Training Programme also supports personal and professional growth in areas such as time and stress management, entrepreneurship, and career development.

These initiatives reflect IMDEA Materials' continued dedication to building a talented, diverse, and international research team. Our success is driven by the dedication and enthusiasm of our staff, and we remain committed to creating an environment where everyone can thrive.

Rosa Bazán
HR Manager

55%
Foreign Researchers

129
Researchers

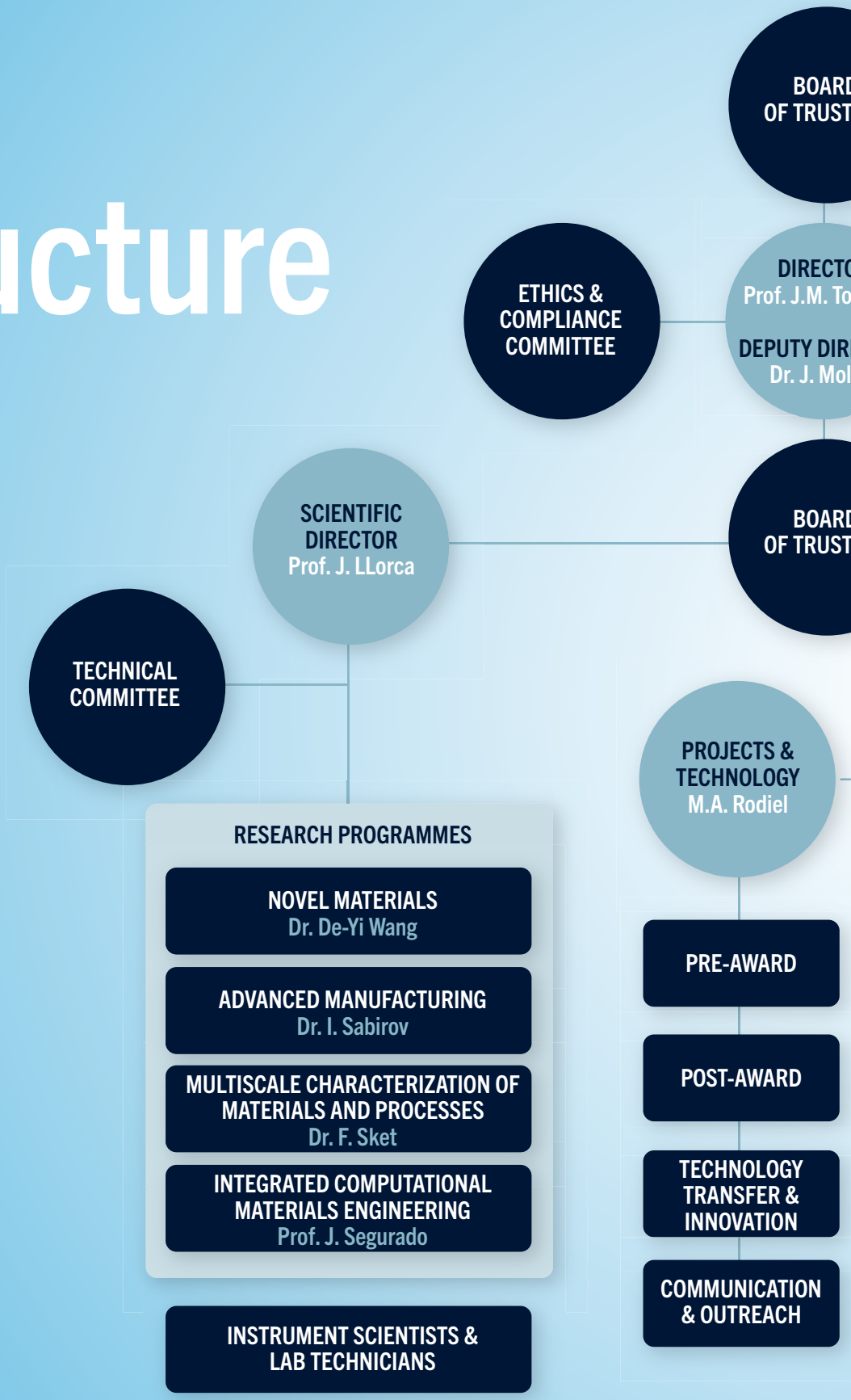
45%
PHDS

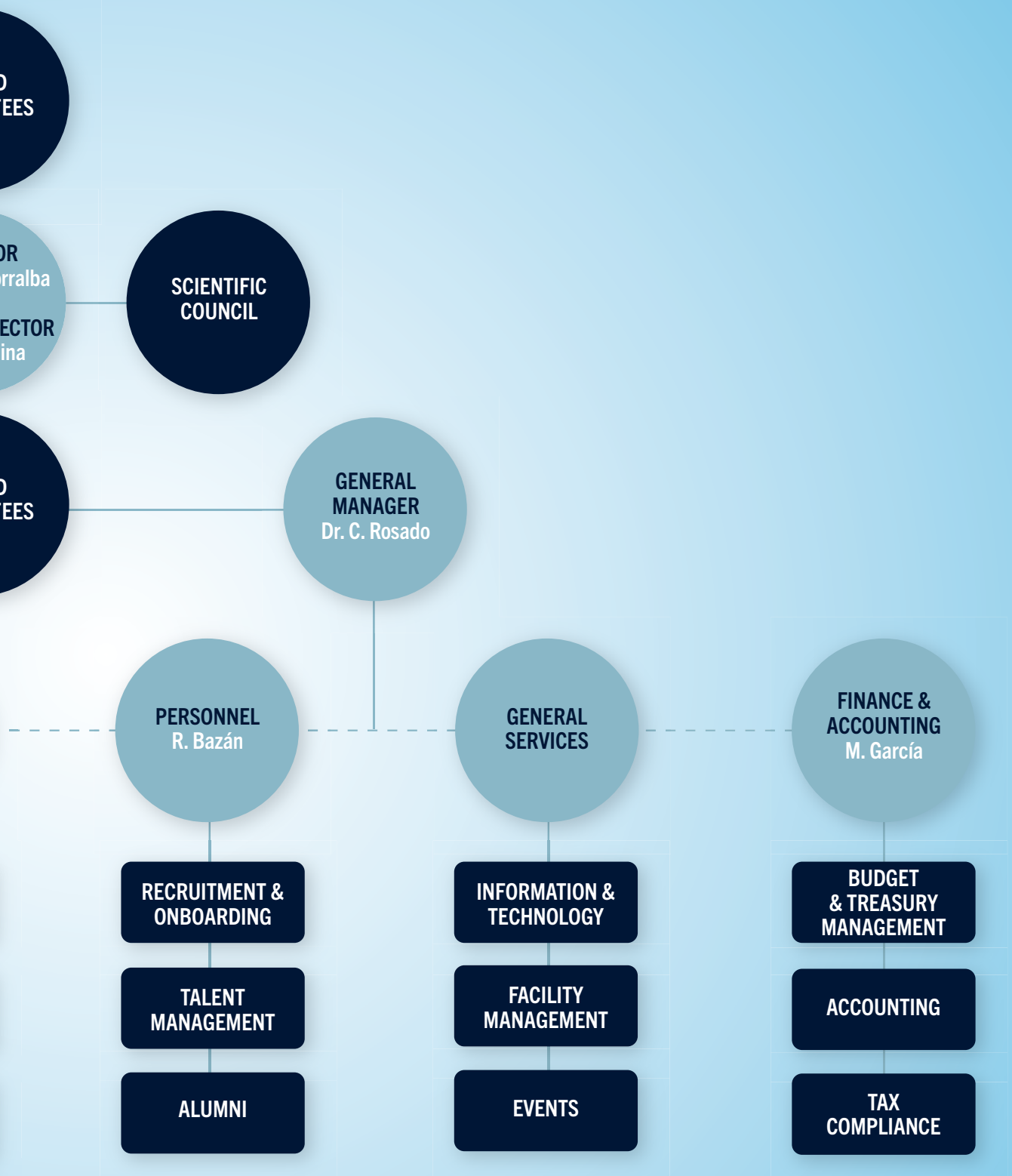
26
Nationalities

36%
Female researchers

17
Research groups

our structure

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our structure

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in figures

human resources

talent

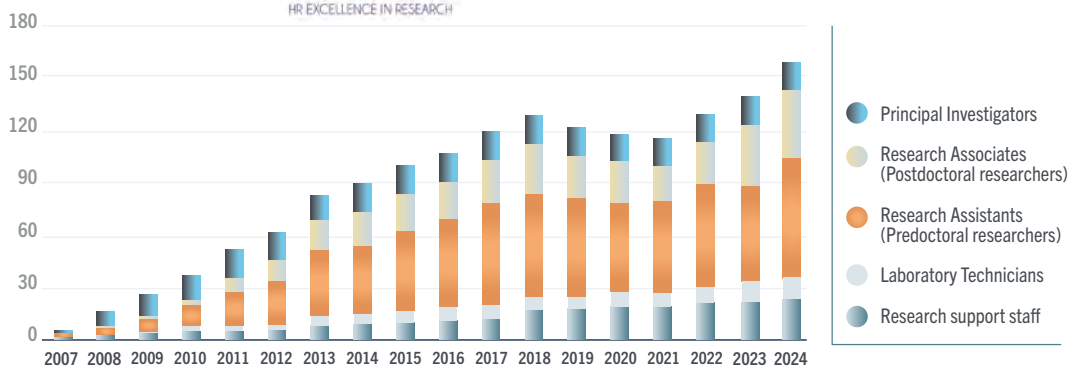
Talent attraction has been the key to the Institute's **success**.

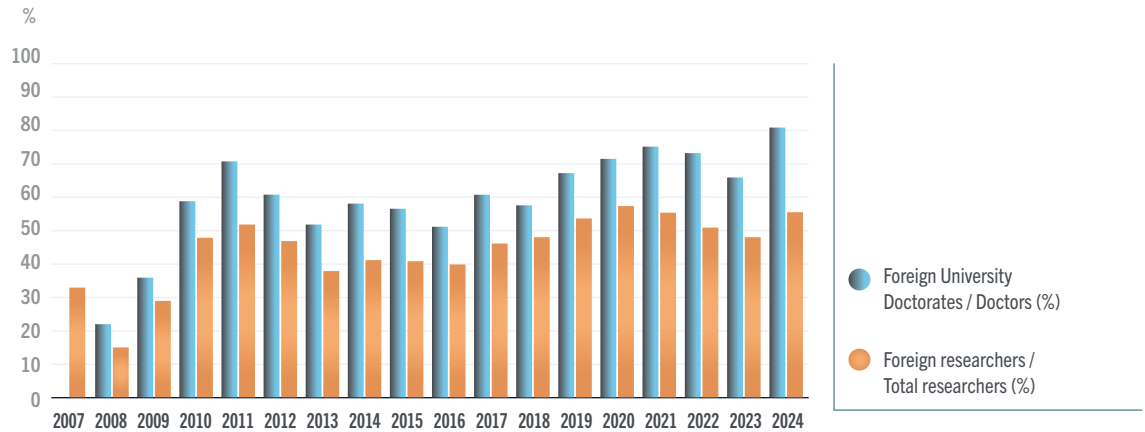
An open and transparent selection process along with regular evaluations performed by an independed Scientific Council ensures the excellence of our Principal Investigators.

IMDEA Materials has created a **multidisciplinary and international working environment** to attract and maintain talented researchers from all over the world.

Career development at IMDEA Materials is acknowledged by the EU's HR Excellence in Research seal.

HR EXCELLENCE IN RESEARCH





Technology and knowledge transfer to society through **talent transfer**

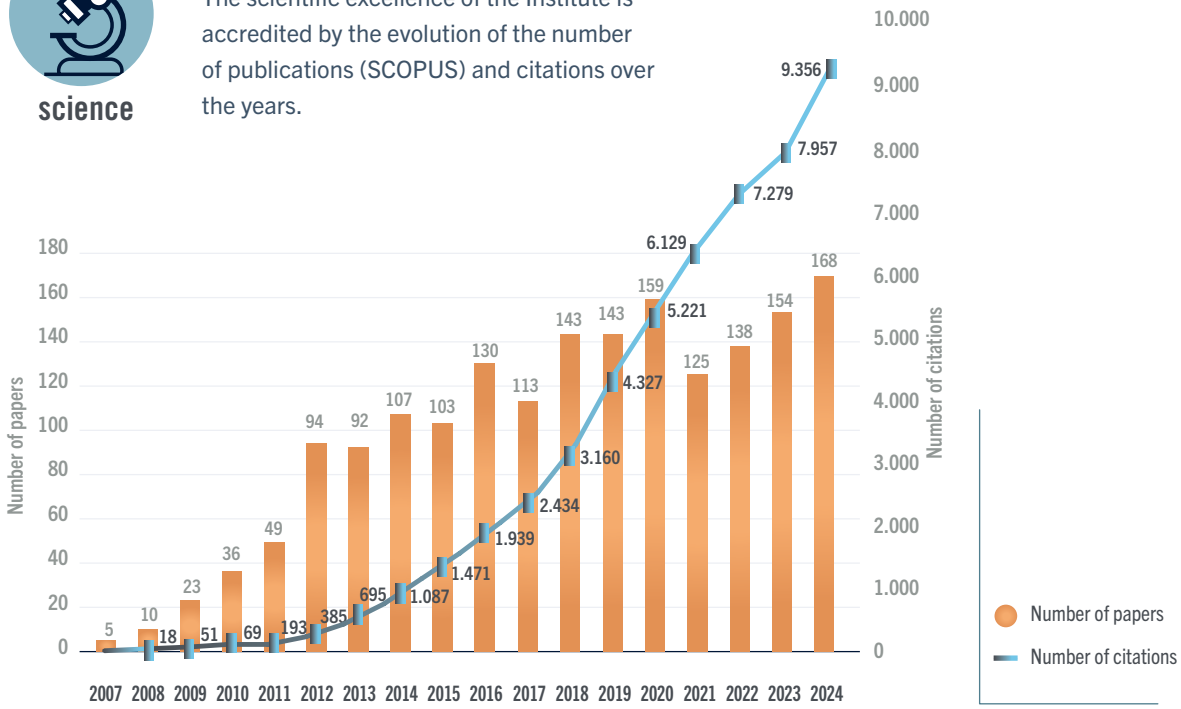
111 Defended PhD theses since 2007

66 Ongoing PhD theses

scientific results

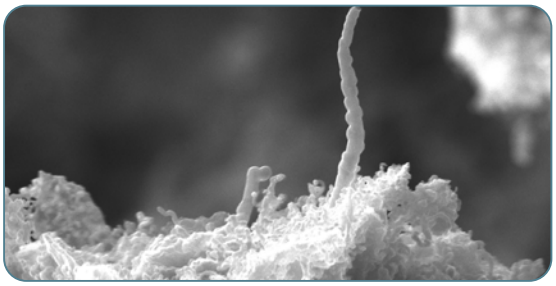
science

The scientific excellence of the Institute is accredited by the evolution of the number of publications (SCOPUS) and citations over the years.



2024

Photograph taken by: Miguel Monclús



Photograph taken by: Jimena de la Vega

29 Keynote/ invited talks

168 Papers (SCOPUS)

9.356 Citations (SCOPUS)

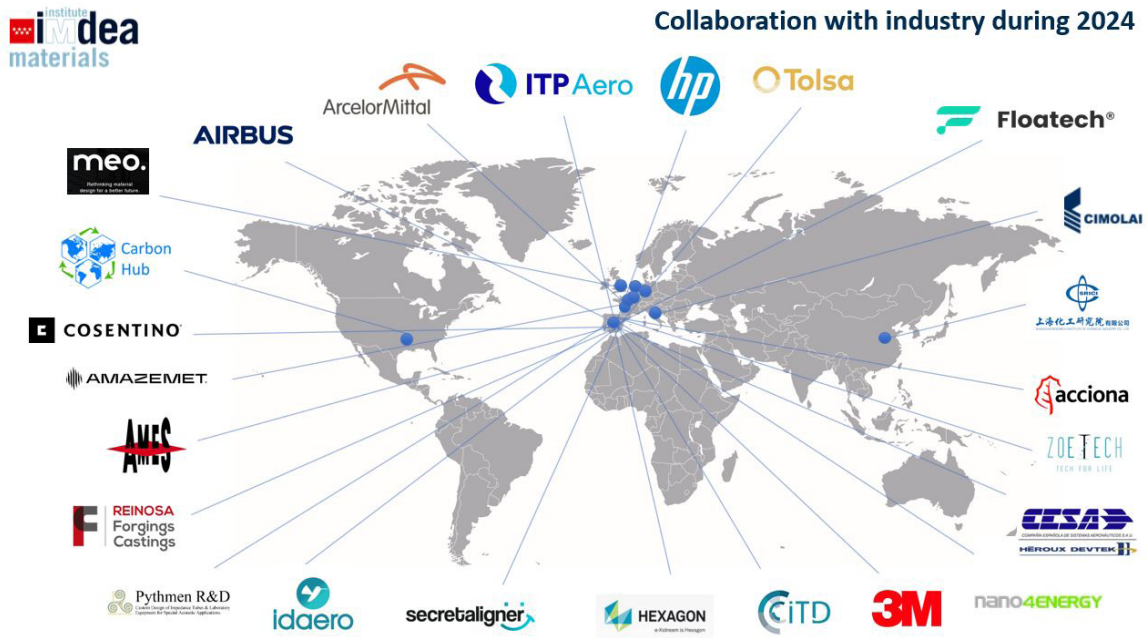
28 Invited seminars and lectures

technology transfer and innovation

transfer

As part of our strategic plan 2020-2024, IMDEA Materials Institute has created a Technology Transfer and Innovation Office (TTIO), with the ultimate goal of fostering the output from our research results in terms of exploitation and commercialisation, maximising the impact of the Institute's activities on society.

Companies which had active collaborations with the IMDEA Materials Institute in 2024:



Performance indicators in 2024

21 Contracts with industry

2 Industrial doctorates

5 Patent applications

2 Patents granted

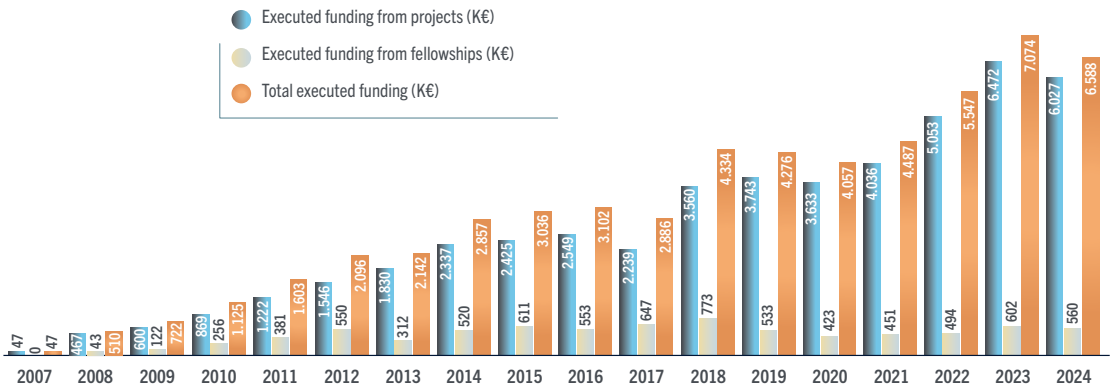
17 Active patent families

11 Software/code licenses

1 **Active spin-offs:** (FLOATECH, S.L.)
Floatech®

projects and fellowships

Research activities are performed in the framework of R&D projects and fellowships, which are funded either by regional/national/ international agencies or through direct contracts with companies.



2024

- **International projects** 41%
- **National projects** 20%
- **Regional projects** 11%
- **Contracts with industry** 28%

84
R&D projects

2
Active ERC projects

2
Active FET-OPEN / EIC Pathfinder Open projects

facilities

talent science transfer

All Facilities by Research Area

Synthesis, Processing and Integration of Materials

Metallic alloys

– Bulk processing techniques: induction casting and arc melting.
– GLEEBLE 3800 thermo-mechanical simulator equipped with tools for physical simulation of casting, rolling, forging, welding, sintering and controlled heat treatments.
– Powders manufactured by gas atomisation and mechanical milling.
– Selective laser melting technology for the additive manufacturing of metals.

Polymer-based composites and nanocomposites

– Liquid moulding processing: RTM (Resin Transfer Moulding), Instrumented resin transfer moulding for digital twin deployment, V(Vacuum infusion), RI(Resin Film Infusion), prepeg lamination using vacuum bagging of autoclave and out-of-autoclave prepregs (OoA) or laminate hot-press moulding (< 400 ºC).
– Semi-industrial equipment for compounding (microcompounder and twin-two screw extruder) and injection moulding (industrial injector and mini-injector machine) of thermoplastics, integration of advanced nano-fillers, filament maker for 3D printing (3devo) and melt flow index.
– 3D printing with polymers and composites: capabilities include pure polymers, polymers with particles, short fibre, and continuous fibre reinforcements (metal, carbon, glass, etc.); equipment includes continuous metal filament printers and resin bath (SLA - stereolithography) printers.

Nanomaterials

– Synthesis and chemical modification of nanocarbons, inorganic materials, nanocomposites, semiconductors, thin films, zeolites and other nanomaterials.
– Evaporator equipment in controlled atmosphere environments, high-pressure reactors and in-house chemical vapour deposition systems.

Energy storage and conversion devices

– Synthesis and characterisation of nanostructured electrode materials for energy storage.
– Fabrication of composite electrodes and integration in rechargeable batteries (Li-ion, Li-O_2, Na-ion, Li–S, Mg-air, etc.).
– Fabrication and testing of nanocarbon-based electrodes and their integration with liquid and solid electrolytes (from low-range <g=100Ωcm^2 flexible supercapacitors.
– Integration to form large-area, multifunctional composite structures.
– Fabrication (solvent-based deposition), physical vapour deposition, high-pressure sintering ovens and hot plates and characterisation.
– 3D printing devices for electrolytes and in situ XRD device for battery applications.

Microstructural and Chemical Characterisation

– 3D Microscopy at different length-scales, including X-ray tomography, X-ray diffraction, 3D-SEM, 3D-EDS and 3D-EBSD in the FIB, and 3D-TEM and 3D-EDS in the TEM.
– In-situ thermo-mechanical testing of miniaturised samples in the X-ray tomography system, as well as in the SEM and TEM.
– In-situ processing studies in the X-ray tomography system, such as casting, infiltration and curing of polymer-based materials.
– Raman spectrophotometer and Gel permeation chromatography.
– Particle size analyser, freeze dryer and in-situ thermal studies of polymers in the X-ray diffractometer.
– In-situ thermal studies of polymers in X-ray diffractometer (SAXS/WAXS).
– C-scan ultrasound non-destructive inspection system.
– High-resolution X-ray tomography allowing for the installation of in-situ devices for testing and the added ability to perform diffraction contrast tomography (laboratory-based DCT).

Mechanical Properties

– Mechanical materials testing, using electromechanical and hydraulic machines (quasi-static, dynamic and impact testing over a range of temperatures).
– Mechanical property characterisation at multiple length scales, including nanoindentation, microcompression, microtensile testing and microfracture mechanics.

Biomaterials and Cell Culture

– Confocal, fluorescence, and brightfield microscopes.
– PCR instrument, multi-plate reader, ultrasonic processor, lyophilizer, autoclave, Spectrofluorometer and dynamic light scattering equipment.
– Microfluidic system, gel electrophoresis and blotting system.
– Liquid nitrogen tank for cold storage and -80ºC freezer.
– Prusa Mini 3D printer and Phrozen Sonic Mini 8K resin 3D printer.
– Bio-safety cabinets, benchtop and CO2 incubators.
– Centrifuge, microcentrifuges, vortex mixers, pipet controllers, hot plate stirrers, dry block heaters, UV lamps, pH meter, balance and thermostatic water baths.
– Bioreactor TC-3F deformation system Ebers.
– Histology area: Microtome, cryostat, staining station and paraffin embedding station.
– Chemical fume hood.
– Orbital shaker and rotary laboratory shaker.

Functional Properties

Fire resistance

– Rapid laboratory scale tests for screening (micro-scale combustion calorimetry and oxygen index).
– Dual cone calorimetry and UL94 Horizontal/Vertical Flame Chamber.
– Fire-grit torch test.

Thermal

– DSC, TGA and Hot Disk Thermal Conductivity analyser.
– Thermal mechanical analysis (DMA and Rheology).
– Pushrod Dilatometer to measure dimensional changes.

Electrochemical

– Electrochemical characterisation of energy storage devices (Li-ion, Li–S, Li–O_2, Na-ion and hybrid batteries).
– Simultaneous testing for 100 batteries can be performed using multichannel battery testers.
– Galvanostatic/potentiostatic cycling at various current densities.
– Single channel ZIVE SP1 electrochemical workstation for cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) study of batteries.
– LCR equipment to quantify dielectric properties in composites.

Simulation

– Simulation techniques at different scales (electronic, atomistic, mesoscopic and continuum), to design or improve materials and components by means of virtual testing and processing.
– High performance computer cluster (600+ Intel Xeon CPU cores and NVIDIA GPU acceleration) leading to a computational power of 50 Tflop/s.
– In-house developed simulation tools (including Iris, Mousse, FFT-MAD, CAPSUL, phase-field simulations, etc.) as well as commercial and open source software tools for modelling and simulation in Materials Science and Engineering (ThermoCalc, Abaqus, Eirene/S, LIGS, DynaPamCrash, LAMMPS, VASP, etc.).

Microlandscape
Polarised picture of metallic satellites, with a non-polarised round cut of another sample with dendrite-looking tree overlay.
Teresa Nieto
Joint 1st Place, IMDEA Materials Institute Imaging Contest, 2025, Art in Science Category.

research programmes

In 2024, IMDEA Materials Institute was organised into 17 research groups focused on distinct but interrelated areas in the field of Materials Science and Engineering. Each of these groups is led by one staff researcher, or Principal Investigator, who is in charge of coordinating and supervising a team of post and predoctoral researchers.

The research groups, as key units of the institute, develop research projects and collaborations to drive the frontier of science and knowledge of their field forward and to transfer knowledge into valuable technology. The Institute's two newest research groups, **Catalysis and Energy Materials**, headed by Prof. Harun Tüysüz. and **Biometals, Coatings and Devices**, led by Dr. Mónica Echeverry Rendon, have further extended the scope of IMDEA Materials' materials science research.

As a result of the high degree of internal collaboration within the Institute, and to take advantage of that fact, our research groups are divided between four Research Programmes: Advanced Manufacturing, Integrated Computational Materials Engineering, Multiscale Characterisation of Materials and Processes and Novel Materials.

Driven by the talent of the researchers involved, each of these programmes combines cutting-edge fundamental-oriented research in topics at the frontiers of knowledge with applied research encompassing the midterm interests of our industrial partners to provide long-term leadership. As of 2024, the leaders of our Research Programmes were: Dr. Ilchat Sabirov, Prof. Javier Segurado, Dr. Federico Sket and Prof. De-Yi Wang.

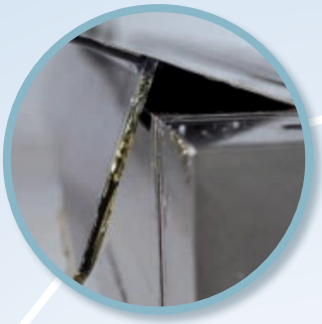
Novel Materials

Integrated Computational Materials Engineering

Advanced Manufacturing

Multiscale Characterisation of Materials and Processes

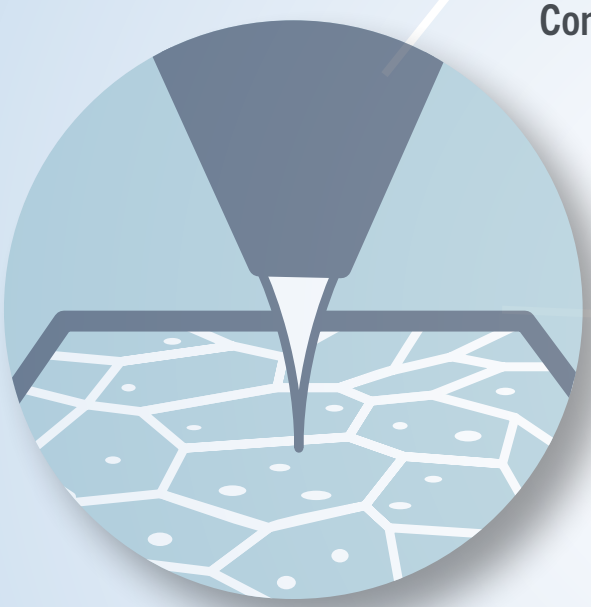
programme Advanced Manufacturing



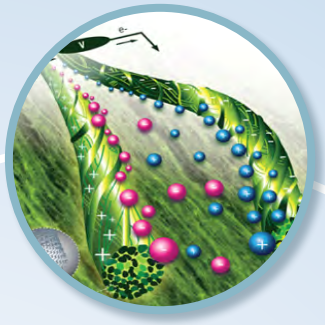
Structural Composites

Goal and vision

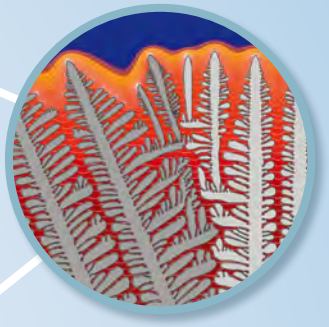
The Advanced Manufacturing programme is highly interdisciplinary in nature, spanning the alloy, biomaterial, polymer, composite, nanostructured materials, and energy material fields, and involving both experimental and computational efforts. This programme's objective is to improve quality, productivity, cost efficiency and sustainability in current manufacturing paradigms, as well as conceiving and developing novel hybrid manufacturing techniques to enable the commercial realisation of emerging products in the transport, biomedical, energy, automotive and other industrial sectors.



In this context, innovation and development rely on a deep understanding of the physical and chemical phenomena influencing manufacturing processes. A key part of this programme involves the creation and development of models based on Artificial Intelligence (AI) to predict the optimum manufacturing routes and quality of the manufactured products, as well as the modelling of tool-material interactions. The resulting fundamental knowledge is supplemented by state-of-the-art characterisation techniques needed to monitor the manufactured product quality, including micro(structure) and mechanical and functional properties.

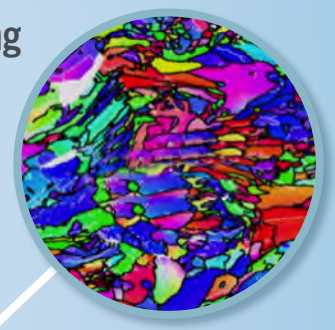


Multifunctional Nanocomposites

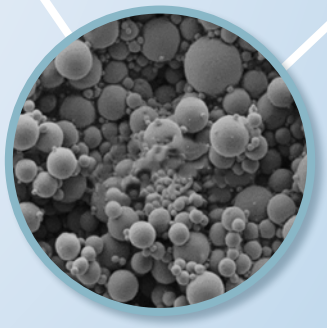


Modelling and Simulation of Materials Processing

Physical Simulation



Sustainable Metallurgy



Sustainable Powder Metallurgy

Main research lines

Industry 4.0

- Virtual testing of structural composites and analysis of the effect of manufacturing defects on structural performance.
- Virtual processing of structural composites including hot-forming and out-of-autoclave (injection, infusion, compression moulding). Surrogate and reduced order models for manufacturing based on Multiphysics simulations.
- AI techniques applied to manufacturing. Digital twins for manufacturing processes. Smart detection of defects by sensors including the active control of manufacturing systems.
- Structural health monitoring (SHM) through sensors integrated with Carbon Nanotube (CNT) yarn and AI-based automated damage detection models.
- AI-guided materials design and chemical process.
- Electric-current-assisted curing for bonding and repairs.
- Multifunctional composites for structural and energy storage applications.
- High-throughput computational thermodynamics for multicomponent alloy screening.

Nanostructured materials, electrodes and devices

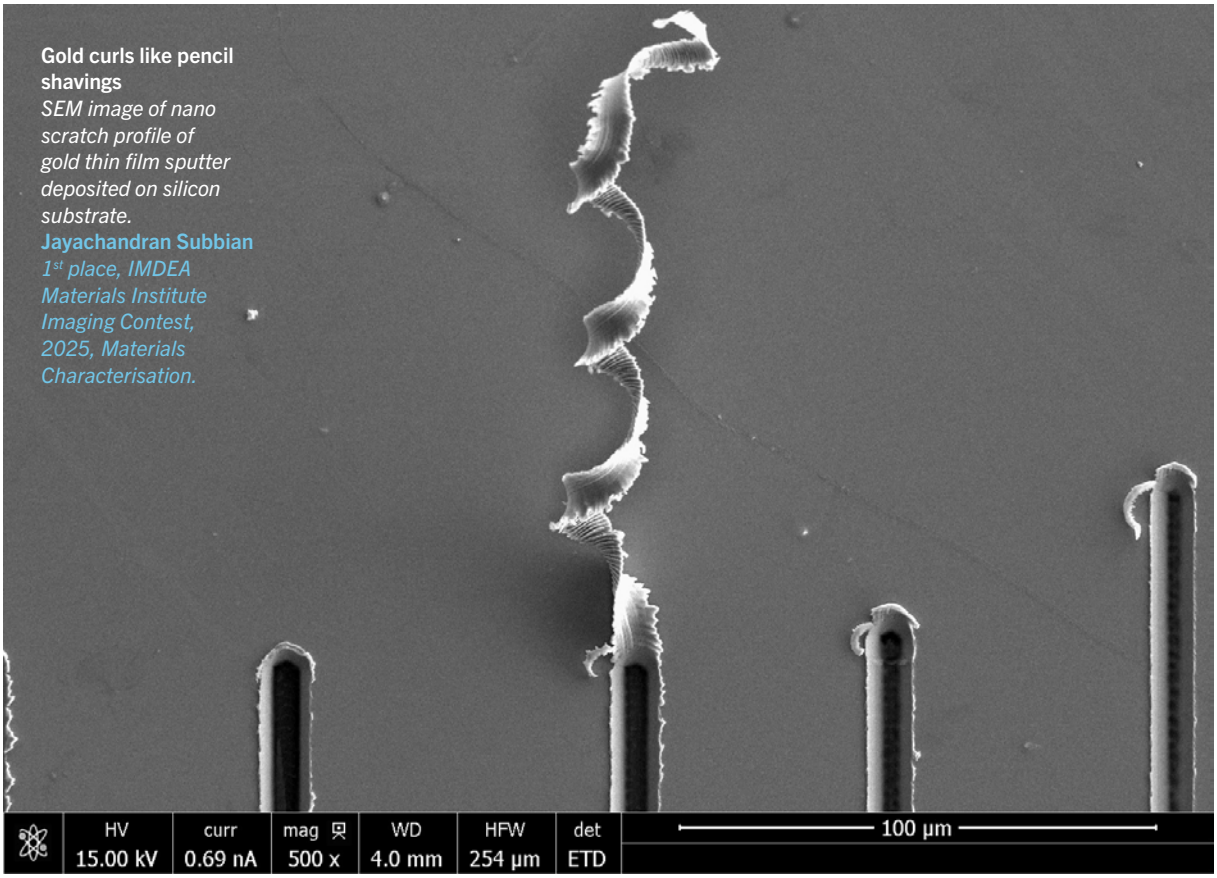
- Gas-phase assembly of continuous sheet and fibres of carbon nanotubes and inorganic nanowires (Si, SiC, MOx).
- Integration of these nanomaterials into electrodes and composite materials.
- Preparation of stable dispersions of nanowires for wet-processing of optoelectronic devices.

Liquid and solid-state processing

- Rapid alloy prototyping and manufacturing of bulk alloy libraries for the fast assessment of properties.
- Optimisation of casting processes.
- Development of novel thermomechanical processes and powder metallurgy routes via mechanical alloying and gas atomisation in non-oxidation conditions.
- Consolidation by field-assisted sintering and conventional press and sintering.
- Powder Injection Moulding.
- High-throughput computational thermodynamics for alloy design
- Multiscale modelling (e.g. phase-field) of microstructure formation and evolution during solidification and solid-state processing

3D printing

- Metallic materials, including powder design, fabrication and characterisation.
- Composites, polymers, recycled fibres and hybrids.
- PLA composite materials reinforced with Mg, Zn or CaPs nanoparticles and continuous metallic wires.
- Development of functional thermoplastic filaments (flame retardant, thermal conductive, biodegradable, reinforced, electrically conductive, etc.) for 3D printing.
- Data-driven design of 3D-printed metamaterials.
- Custom-made implants using new biocompatible alloys.
- Stereolithography, including resin synthesis and characterisation.
- Extrusion-based 3D printing of biomaterials and bioprinting.
- Predictive simulation.
- In-situ monitoring.

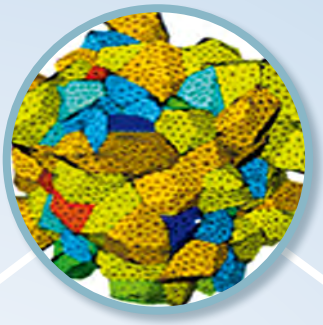


Gold curls like pencil shavings
SEM image of nano scratch profile of gold thin film sputter deposited on silicon substrate.
Jayachandran Subbian
1st place, IMDEA Materials Institute Imaging Contest, 2025, Materials Characterisation.

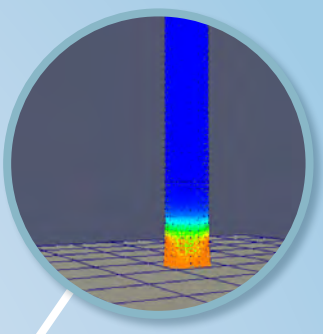
programme
Integrated Computational Materials Engineering

Goal and vision

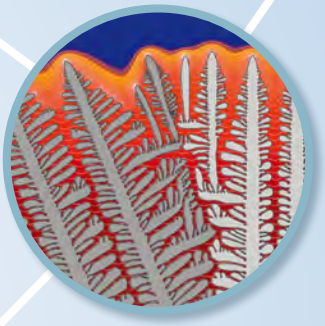
The Integrated Computational Materials Engineering (ICME) research programme is aimed at integrating all available simulation tools into multiscale modelling strategies, capable of simulating the processing and behaviour of engineering materials. In this way, new materials can be designed, tested and optimised before manufacture in the laboratory. The programme's focus is on materials engineering, i.e. understanding how material microstructures develop during processing (virtual processing), the relationship between microstructure and behaviour (virtual testing), and how to optimise materials for a given application (virtual design). Moreover, experiments are also an integral part of the research programme for model calibration and validation at different length and time scales. The expertise of the programme's researchers covers a wide range of simulation techniques at different scales (electronic, atomistic, mesoscopic and continuum) and is supported by high-performance computer clusters with GPUs.



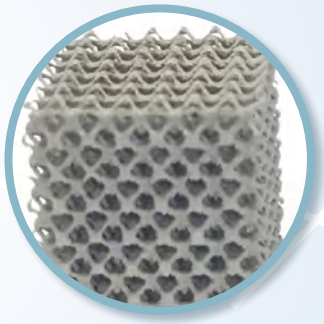
Multiscale Materials Modelling



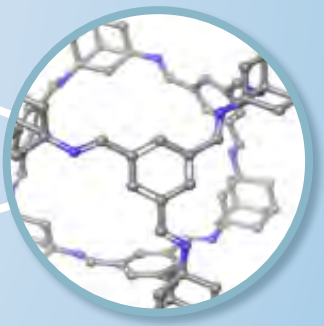
Computational Solid Mechanics



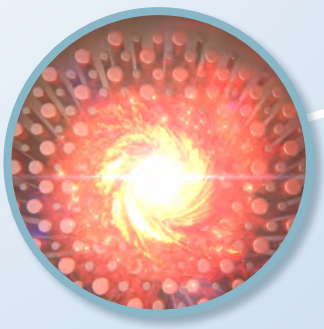
Modelling and Simulation of Materials Processing



Bio/Chemo/Mechanics of Materials



Computational and Data-Driven Materials Discovery



Acoustic and Mechanical Metamaterials

Main research lines

Virtual materials design, including virtual processing and virtual testing

- Virtual material discovery for functional applications using DFT, cluster expansion and atomistic approaches combined with AI.
- **Virtual processing:** Integration of modelling tools (atomistic, computational thermodynamics and kinetics, phase-field and cellular automata) to simulate microstructure formation and evolution during processing.
- **Virtual testing of metallic alloys:** Development of microstructural-based constitutive models to predict the mechanical behaviour of single crystals. Simulation of the mechanical response of polycrystalline metals by means of FFT and FEM-based homogenisation.
- **Virtual testing of composites:** Implementation of the constitute models in finite element codes to simulate the mechanical behaviour of structural components.
- **Smart manufacturing:** Multiphysics models of autoclave and out-of-autoclave curing of composite materials accounting for porosity evolution during the process. Simulation-based smart manufacturing processes. Sensoring and process control.
- These approaches are applied to several materials, in particular
  - Metallic alloys for engineering and biological applications
  - Multifunctional composite materials and structures.
  - Materials for catalysis.

Materials modelling at different length and time scales

- First-principles calculations.
- Molecular mechanics and molecular dynamics.
- Dislocation dynamics.
- Object and lattice Kinetic Monte Carlo.
- Computational thermodynamics and kinetics.
- Phase-field.
- Finite Element solvers for Multiphysics problems.
- Fast Fourier based solvers for Multiphysics problems.

Multiscale materials modelling

- Bottom-up approaches (scale bridging).
- Development of modular multi-scale tools.
- High-throughput screen integration.
- Concurrent models.
- Mean-field homogenisation.
- Computational homogenisation including FEM and Fast Fourier Transform – FFT-based solvers.
- Surrogate models of micromechanical models based on AI.

Modelling and simulation strategies for different applications

- Material informatics for large material dataset analysis.
- Modelling and simulation of H_2 embrittlement in metallic tanks and pipes.
- Study of H_2 diffusion mechanisms in metals.
- Discovery of new catalysts for H_2 production and fuel cells.
- Discovery of new catalysts for CO_2 reduction reaction.
- Modelling and simulation of multiscale transport phenomena (application to advanced materials for batteries).
- Virtual design and testing of mechanical metamaterials and architectured metamaterials.
- Simulation of the additive manufacturing process in metals including macroscopic simulation of the thermomechanical process by Multiphysics finite element models, microstructure evolution through phase field and prediction of mechanical response using polycrystalline homogenisation.
- Modelling and simulation of elastic waves and sound propagation in complex additive-manufactured media.
- Exploring new physical phenomena in the wave-based and elastostatic context.

Computational and data-driven materials discovery

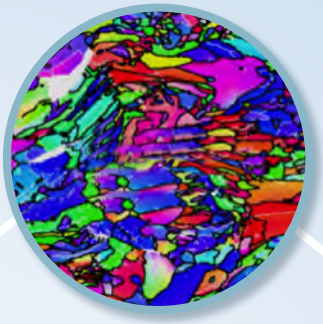
- Discovery of porous materials for energy applications (CO_2 capture and methane storage).
- Design of ionic liquids.
- Materials discovery: structures with high H_2 working capacity and H_2 adsorption-desorption performance.
- Design of Metal-Organic Frameworks (MOFs) for separation of gases for anaesthesia (Xe/Kr).

Abstract Science at IMDEA Materials
An image that represents, in an abstract and colourful way, what we do at IMDEA Materials. Generated using an artificial intelligence model with a prompt describing the centre and its activities.
Javier García Pérez
1st Place, IMDEA Materials Imaging Contest, 2025, Public Choice Category.

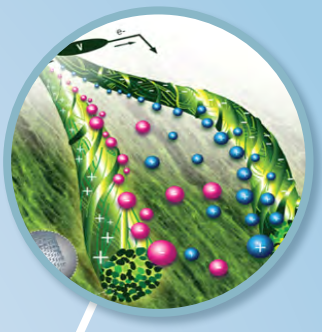
programme
Multiscale Characterisation of Materials and Processes

Goal and vision

Progress in the development of new materials and processing methods can only come from a thorough understanding of the microstructure of the material in focus, its evolution during either processing or service operation, and its influence on the relevant properties for the purpose it was designed. Since the microstructural features that determine material behaviour usually span several length scales (for instance, from macroscopic defect distribution to nanometre scale precipitates in the case of metallic alloys), this understanding can only come from advanced 4D characterisation techniques, capable of determining the evolution of the 3D microstructure over time at different length scales; hence the term 4D. This is precisely the objective of this programme: to understand microstructure/defect distribution and evolution in advanced materials during processing and service using advanced characterisation techniques.



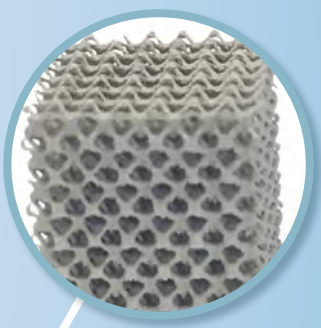
Sustainable Metallurgy



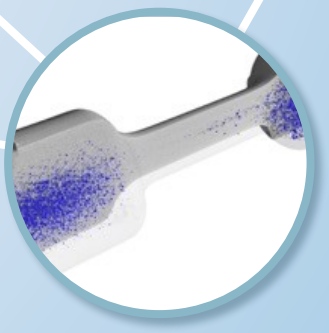
Multifunctional Nanocomposites

Nanomechanics y Micromechanics

Structural Composites



Bio/Chemo/Mechanics of Materials



X-Ray Characterisation of Materials

Main research lines

Advanced material characterisation, including microstructural, chemical and crystallographic information across several length scales and using different techniques

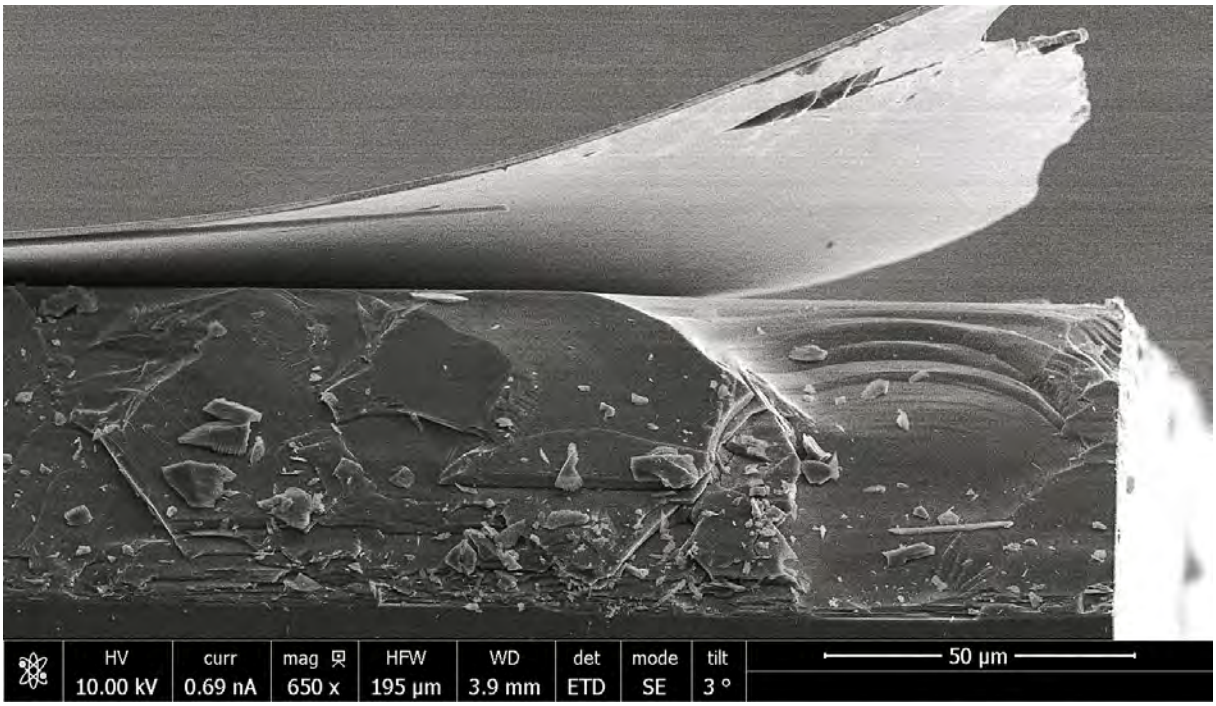
- Multiscale characterisation with optical and electron microscopy, X-rays, atomic force microscopy, Raman spectroscopy and ultrasonic inspection. Some of the equipment used for this is:
  - FIB-FEG-SEM, including 3D-EDS and 3D-EBSD. In-situ stages for thermomechanical testing;
  - FEG-TEM including 3D-STEM and 3D-EDS with in-situ stage for mechanical testing;
  - X-ray Tomograph (XCT) with in-situ stage for thermomechanical testing, furnaces for thermal treatments and observation of chemical reactions, in-situ composite curing and in-situ composite infiltration;
  - Diffraction Contrast Tomography (DCT). This new technique at IMDEA allows us to obtain tomography from the diffracted beam in crystalline samples, thus revealing the 3D orientation and size of grains within specimens.
  - X-ray Diffractometer (XRD) equipped for residual stresses and texture determination, reflectometry analysis, Cu and Cr radiation, linear detector and an in-situ furnace;
  - Raman micro-spectrometer 5x, 20x, 50x, 100x microscope objectives, 532 nm Nd:YAG laser (50W) and diffraction grating of 1800 l/mm, 100 nm resolution;
  - Small angle X-ray scattering and Wide angle X-ray scattering (SAXS/WAXS) for the study of crystallisation in polymers, chemical composition or phase composition of a film, film texture (preferred alignment of crystallites), crystallite size and presence of film stress.
- Characterisation of a broad range of materials e.g. biomaterials, plastics, metal matrix composites, fibre-reinforced composites, metals, nanomaterials, etc.
- Use of large facilities such as neutron or synchrotron radiation facilities for characterisation.
- Development of new methodologies (e.g. hardware for in-situ testing and software tools) for material characterisation and analysis while also applying artificial intelligence methods.
- Correlative studies of materials, i.e. combining insights from different techniques.

4D characterisation: in-situ multiscale characterisation of processes

- Thermo-mechanical testing across several length scales: tension, compression, fatigue, creep, etc. in the Scanning Electron Microscope (SEM) and X-ray tomograph.
- Properties and deformation mechanisms of small volumes by nanomechanical testing in the scanning and Transmission Electron Microscopes (TEM): properties of metallic phases, interfaces, nanoparticles, carbon-based nanomaterials (carbon nanotubes, graphene, etc.).
- Elevated temperature nanomechanical testing.
- 4D characterisation of processes by X-ray tomography and X-ray diffraction: eg. metallic alloy solidification, metallic alloy phase formation and chemical reactions, infiltration and resin flow in composites, composite curing, etc.

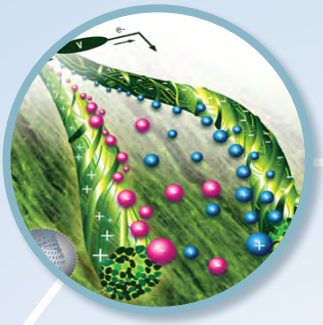
Cross-correlation between experiments and multiscale simulations (molecular dynamics, dislocation dynamics, crystal plasticity, finite elements, etc.)

- Digital modelling from 3D structures.
- Integration of experimental statistical measurements into models.
- Experimental confirmation of modelling results.
- Experimental design based on models.



Surf the wave
Ni3Fe thin film of 250 nm of thickness detached from its substrate.
Jorge Redondo

programme Novel Materials



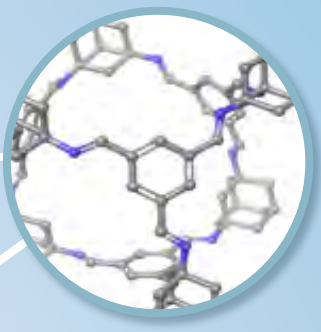
Multifunctional Nanocomposites

Catalysis and Energy Materials

Goal and vision

The Novel Materials programme combines expertise in design and synthesis of nano and molecular building blocks with their integration into macroscopic materials and devices. The aim? Firstly, to develop solutions for high-performance structural composites with enhanced multifunctional capabilities such as thermal, electrical and fire resistance. Secondly, to explore the processing structure-property relationships in metallic alloys with particular emphasis on the role of microstructure on the mechanical response at all length scales. Formed by chemists, physicists and engineers (chemistry, materials, mechanical and aeronautical), this interdisciplinary research group carries out both fundamental and applied research via close collaboration with companies in the transport, aerospace, energy, safety and biomedical sectors. The programme's research facilities include state-of-the-art equipment for synthesis, processing, manufacturing, structural/materials characterisation and material properties.

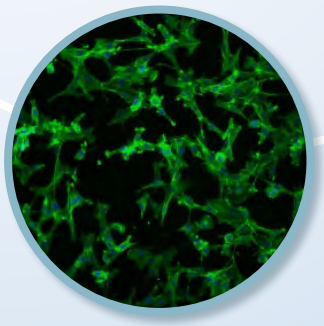
High Performance Polymer Nanocomposites



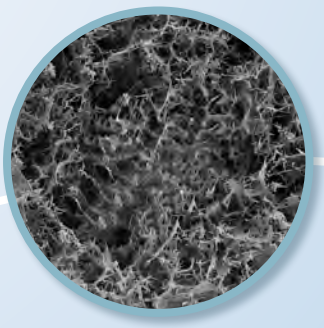
Accelerated Materials Discovery

Nanomechanics and Micromechanics

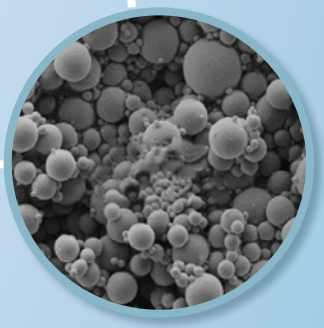
Structural Composites



Biometals, Coatings and Devices



Biomaterials and Regenerative Medicine



Sustainable Powder Metallurgy

Main research lines

Synthesis and integration of nanomaterials (nanotubes, nanofibers, MXene, 2D nanofillers, etc.)

- Nanocarbon/semiconductor hybrids synthesis for photo and electrocatalysis, interaction of nanocarbons with liquid molecules, polyelectrolytes and inorganic salts.
- Inorganic nanowire synthesis and assembly as macroscopic yarns and fabrics.
- Sensors: triboelectric, thermoresistive chemical, piezoresistive and piezoelectric.
- Hierarchical materials: nanoscale to macroscale materials design, nano-reinforced materials, composite materials with enhanced electrical and thermal conductivity.
- Electrospinning for polymeric nano-membranes.

Synthesis and properties of polymer-based multifunctional nanocomposites

- Sustainable materials: bio-based nanocarriers, novel guest-host nanomaterials, nano-cross linkers, multifunctional polymer nanocomposites, renewable and recyclable polymeric materials, biodegradable polymers, carbon fibre reinforcement, etc.
- Fire retardant materials through nanodesign: multifunctional nanomaterials to increase fire retardancy: layered double hydroxides, Metal-Organic Frameworks, sepiolite, molybdenum disulphide, nanocarbon, nano metal hydroxide, graphene, cellulose nanocrystal, etc.
- Energy storage and energy saving materials, PCMs for thermal management.

Materials for the hydrogen economy

- High-throughput design and synthesis (magnetron sputtering) of novel catalysts for green hydrogen production and hydrogen energy generation via elastic strain engineering.
- Development of new metallic alloys for hydrogen embrittlement conditions.

Metallic materials

- Advanced high-strength steels combining enhanced mechanical and in-use properties.
- High-alloy steels, superalloys and high entropy alloys.
- Analysis of chemistry-processing-microstructure-properties relationship on macro- and microscales, emphasising strength, ductility, fatigue and fracture resistance.
- Study of solidification-microstructure relationships using traditional (vacuum induction melting, vacuum arc melting, gravity and tilt casting, directional solidification) and advanced (centrifugal and suction casting, vacuum melt atomisation) techniques.
- Rapid phase screening, crystal structures, properties, microstructure and kinetics in bulk materials by the Kinetic Diffusion Multiple Technique.
- Multiscale functional coating layer deposition via blade casting, spin coating, spray coating, electrospining, etc.
- Structural-mechanical property relationships for lightweight porous metal structures.

Structural composites

- Structural composites manufacturing by liquid moulding (resin transfer moulding and vacuum infusion) and autoclave consolidation. Additive manufacturing of fibre-reinforced composites.
- Material design for damage tolerance and impact resistance, including multimaterial integration.
- Hierarchical integration of nano filler reinforcements for damage tolerant, electrical, lightning impact applications.
- Recycling techniques for polymer-based composites.

Materials for extreme conditions

- Impact, high temperature, mechanical, fire and predictive simulation.
- Prediction and prevention strategy for metal- and polymer-based composite materials under simultaneously extreme conditions such as high-temperature behaviour and structural loading.
- Alloys to be used in high-temperature and corrosive environments.

Materials for Lithium-Ion Batteries (LIBs)

- Nanostructured silicon anodes.
- Carbon nanotube fabrics for hybrid electrodes and metal-free current collectors.
- Electrode development (defect-engineered, fire-retardant, flame-resistant all solid-state polymers, etc.).
- AI-accelerated electrolyte composition optimisation.
- Flexible and structural batteries.

Materials for post LIBs

- Fire-retardant electrolytes.
- AI-accelerated electrolyte composition optimisation.
- New electrodes and interfacial strategies for Zinc-ion batteries.

Lightweight materials

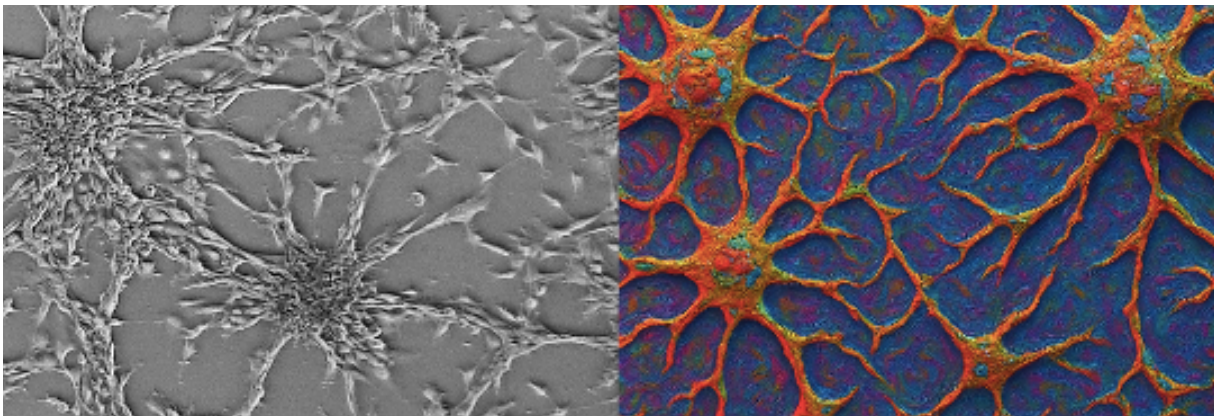
- Composite materials, alloys, hybrids, sandwich-structured fire retardants, porous polymers, polymer-based aerogels and reversible crosslinking.

Green materials approaches

- Bio-based polymers fibres and additives as well as biobased thermal energy storage/phase change materials.
- Reprocessable composites.
- Valorisation of by-products in hydrogen production.
- Advanced alloy development avoiding the use of critical materials.

Regenerative engineering and medical treatments

- Bioresorbable metallic and composite scaffolds for bone regeneration and biodegradable cardiovascular metallic stents, both via 3D printing.
- New materials for tissue engineering and regenerative medicine.
- Materials and devices for organs-on-chips, spheroid/organoid generation, and in vitro tissue models.
- Degradable metal nanoparticles for biomedical applications (anticancer or antibacterial activity).
- Molecule-based material biofunctionalisation and surface modification for improved performance.
- Mechanotransduction.



Biology Unplugged
U87 cell line as a model to study TTF against glioblastoma, real image (Inverted Optical Microscope vs. AI-Generated Image).
Mónica Echeverry Rendón
1st Place, IMDEA Materials Institute Imaging Contest, 2025, Simulation, Computational and AI-Generated Category.

2024 Activity Highlights

Our Impact and Influence

Leader in MSCA PF Fellowships in Spain for third consecutive year

IMDEA Materials Institute has once again confirmed its role as a national leader in talent attraction, ranking third in Spain in the 2024 Marie Skłodowska-Curie Actions Postdoctoral Fellowships (MSCA PF) call, with eight awarded projects. The institute's success rate of nearly 40% also significantly outpaces the European average of 16%. Topics covered include carbon capture, fire-retardant materials, additive manufacturing, and alloy optimisation. This marks the third year in a row IMDEA Materials has held a position among Spain's MSCA leaders and 2024 saw the institute ranked behind only the much larger CSIC and the University of Barcelona.

IMDEA Materials highlighted among Madrid's leading Horizon Europe centres

According to the Spanish Ministry of Science, Innovation and Universities, IMDEA Materials Institute was among the top five institutions in the Community of Madrid from 2021 to 2023 in coordinating Horizon Europe projects. In that 3-year period, IMDEA Materials coordinated 15 of these prestigious projects, behind only CSIC and public universities, the Technical University of Madrid, the Carlos III University of Madrid and the Complutense University of Madrid.

Top of the Class: Stanford ranks IMDEA scientists among world's best

Stanford University's prestigious ranking of the world's top 2% scientists again included multiple IMDEA Materials researchers. Prof. Javier LLorca, the Institute's Scientific Director, is now among the top 200 scientists globally in materials science. Other recognised researchers include Profs. José Manuel Torralba, Carlos González, Javier Segurado, Harun Tüysüz and De-Yi Wang, and Drs. Mará Teresa Pérez Prado, Johan Christensen, Ilchat Sabirov, Maciej Haranczyk. Prof. Wang was the most significant mover from the 2023 rankings, jumping nearly 20,000 positions.

Our Scientific Leadership

Catalysing green hydrogen and chemical recycling with new research group

The institute's newly launched Catalysis and Energy Materials (CEM) group, led by Prof. Harun Tüysüz, brings expertise in this cutting-edge field from Germany's Max-Planck Institute to IMDEA Materials. The group focuses on the development of next-generation photo- and electro-catalysts for processes such as water electrolysis and chemical recycling. Their CHOSEN-CAT project was ranked number one in the Spanish ATRAE programme funding call. The group's work is a cornerstone of IMDEA's mission to advance sustainable energy solutions.

Junior PI Programme empowers next-generation leaders

In a first for the institute, IMDEA Materials launched its Junior Principal Investigator (PI) programme, enabling early-career researchers to form and lead their own research groups. Dr. Mónica Echeverry Rendón, an accomplished scientist with international experience, became the programme's first participant after earning a "César Nombela" talent attraction grant from the Community of Madrid. This initiative is part of the Institute's long-term commitment to nurturing young talent and fostering scientific independence.

Centre of Events

IMDEA Materials hosted a number of major events during 2024 including the inaugural Workshop on Additive Biofabrication (WAB2024) organised by several of the Institute's researchers. The institute was also the first member of the Spanish Composites Materials Association (AEMAC) to host the association's biannual meeting, as well as the MATERPLAT General Assembly, ACAMI's Materials Workshop for a Better Defense, along with numerous expert seminars.

EMMC19: From uncertainty to resounding success

The 19th European Mechanics of Materials Conference (EMMC19), organised by IMDEA Materials and the Technical University of Madrid (UPM), attracted over 550 attendees and marked one of the largest events in the Institute's history. IMDEA researchers played a key organisational and scientific role, with more than 20 speaking or volunteering, and several leading symposia. Two of the Institute's Principal Investigators, Profs. Carlos González and Javier Segurado organised the event, while Deputy Director Dr. Jon Molina delivered one of three plenary lectures. The success of EMMC19 further consolidates the Institute's growing stature in the field of mechanics of materials.

New Strategic Partnerships

New Strategic Agreement with ArcelorMittal

In 2024, IMDEA Materials and ArcelorMittal signed a strategic agreement to reinforce their long-standing collaboration. The goal is to accelerate the development of sustainable materials technologies through shared talent and knowledge. Several IMDEA PhD graduates already contribute to ArcelorMittal's innovation efforts, and the new agreement formalises a commitment to deepening research-industry collaboration to meet critical challenges like decarbonisation and AI integration in steelmaking.

IRIDISCENTE: Advancing Sustainable Steel Design

IRIDISCENTE is the largest coordinated project in the Institute's history, with a budget exceeding €9 million. Co-led by IMDEA Materials and ArcelorMittal, the initiative seeks to revolutionise steel production through artificial intelligence and sustainable design practices. Funded under Spain's TRANSMISIONES programme, IRIDISCENTE aims to reduce emissions and resource use by improving alloy development and process efficiency. The project includes a data space for intelligent material design, drawing from physical models of alloy properties and microstructures.

principal investigators

Senior Researchers

Prof. José Manuel Torralba

Director. Sustainable Powder Metallurgy

Ph.D. in Metallurgy from the Technical University of Madrid, Spain. Ph.D. in Armament Engineering from the Technical School of Elche, Spain. Professor of Materials Science and Engineering, Carlos III University of Madrid. Permanent Member of the Spanish Royal Academy of Engineering.

Research Interests

Powder metallurgy, powder development, characterisation and advanced consolidation methods (field assisted sintering, metal injection moulding, additive manufacturing, etc.) He has worked with most families of materials in powder metallurgy, such as low-alloyed steels, special steels, hardmetals, superalloys, light alloys, metal matrix composites, High Entropy Alloys, etc.

Prof. Jon M. Molina-Aldareguia

Deputy Director. Micromechanics and Nanomechanics

Ph.D. in Materials Engineering from the University of Cambridge, UK.

Research Interests

Micro- and nano-mechanical testing including the implementation of these tests in extreme conditions (high temperatures) and/or in situ inside electron microscopes. Electron microscopy analysis of advanced structural materials, microstructural and mechanical characterisation of thin-films and developing an understanding of the processing-microstructure-property relationships in a wide range of structural materials.

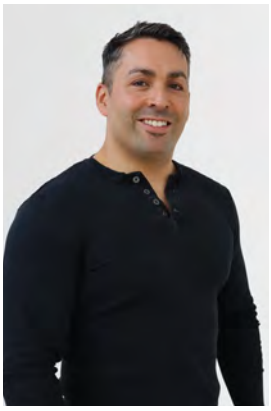
Prof. Javier LLorca

Scientific Director, Bio/Chemo/Mechanics of Materials

Ph.D. in Materials Science from the Technical University of Madrid, Spain. Professor of Materials Science, Technical University of Madrid, Spain.

Research Interests

Development of new materials for engineering applications in transport, energy and health. Establishing the processing-structure-properties relationships of materials by means of computational tools and multiscale modelling strategies as well as in situ and in operando characterisation techniques. Particular emphasis is given to the interaction between biological, chemical and mechanical processes. This information is used to design new materials that are manufactured by means of advanced processing techniques (including additive manufacturing of metallic alloys, polymers and composites, magnetron sputtering, etc.).



Dr. Johan Christensen

Senior Researcher, Acoustic and Mechanical Metamaterials.

Ph.D. in Condensed Matter Physics from the Autonomous University of Madrid, Spain.

Research Interests

Theoretical descriptions of numerical modelling of metamaterials and topological insulators. The exploration of novel material properties and physical effects, both in the context of wave propagation, as well as topology-induced deformations and wave guiding. The driving force of this research is to both nurture fundamental science and target technological implications.

Prof. Carlos González

Senior Researcher, Structural Composites

Ph.D. in Materials Science from the Technical University of Madrid, Spain. Professor of Materials Science, Technical University of Madrid, Spain.

Research Interests

Materials processing, characterisation and modelling from a theoretical and numerical perspective of the mechanical performance of advanced structural materials with a particular emphasis on polymeric-matrix composites. The development of physically-based constitutive models including multiscale strategies for virtual testing as well as virtual processing for manufacturing optimisation.

Dr. Maciej Haranczyk

Senior Researcher.
Accelerated Materials Discovery

Ph.D. in Chemistry from the University of Gdansk, Poland.

Research Interests

Computational and data-driven approaches to materials discovery and design. Development of novel methodologies integrating laboratory automation, materials informatics, and machine learning. Application of these tools to the design of materials for clean and energy-efficient technologies.

Dr. María Teresa Pérez-Prado

Senior Researcher.
Sustainable Metallurgy

Ph.D. in Materials Science from the Complutense University of Madrid, Spain.

Research Interests

The development of advanced materials for a more sustainable planet. Her expertise includes a focus on linking the composition, processing, microstructure, and properties of metals to optimise alloy design for advanced manufacturing, sustainable transport, energy and biomedical applications.

Dr. Srdjan Milenkovic

Senior Researcher.
Solidification Processing and Engineering

Ph.D. in Materials Science from the State University of Campinas, Brazil.

Research Interests

Advanced solidification processing techniques (centrifugal and suction casting, reactive filtration) with a special emphasis on small-scale gas atomisation of powders for additive manufacturing and the development of novel high-throughput casting methods for accelerated material discovery by means of materials libraries. Alloy development, and the study of processing-structure-property relationships of Ni-based superalloys, intermetallic compounds, eutectic allots and other advanced materials for high-temperature applications.

Prof. Ignacio Romero

Senior Researcher,
Computational Solid Mechanics

Ph.D. in Civil Engineering from the University of California Berkeley, USA.

Research Interests

Numerical methods for nonlinear mechanics of solids, fluids, and structures. Development of time integration methods for Hamiltonian and coupled problems, models and numerical methods for nonlinear beams and shells, improved finite elements for solid mechanics, error estimators in nonlinear dynamics and multiscale methods for materials modelling.

Dr. Ilchat Sabirov

Senior Researcher, Physical Simulation

Ph.D. in Metallurgy from the University of Leoben, Austria.

Research Interests

The physical simulation of metal manufacturing processes and their optimisation. The study of the effect of alloy composition and process parameters on the microstructure and properties of metallic materials. The development of novel tools for the physical simulation of emerging metal manufacturing processes, as well as the development of unique thermo-mechanical processing routes to optimise metallic material performance.

Prof. Javier Segurado

Senior Researcher, Multiscale Materials Modelling

Ph.D. in Materials Engineering from the Technical University of Madrid, Spain. Associate Professor of Materials Science, Technical University of Madrid, Spain.

Research Interests

Multiscale materials modelling of metals, composites, foams and lattice materials.
Development of models and simulation tools at different length scales, including molecular dynamics, kinetic Monte Carlo, discrete and continuous dislocation dynamics, single-crystal plasticity models. Development of computational homogenization techniques for multiphysyical problems, including FFT based solvers. Simulation of Fracture and damage of heterogeneous materials. Simulation of wave propagation in heterogeneous materials.

Dr. Federico Sket

Senior Researcher. In-situ processing and mechanical characterisation of materials

Ph.D. in Materials Engineering from the Max-Planck Institute for Iron Research, Germany.

Research Interests

The microstructural evolution of metal alloys and fibre-reinforced composities for engineering applications using advanced laboratory and synchrotron X-ray tomography as well as X-ray diffraction. The processing of composite materials and the relationship between processing conditions and microstructural properties, as well as the development of in-situ devices (based on in-situ X-ray microtomography and X-ray diffraction) for testing mechanical properties and processing using X-rays. The incorporation of experimental results in the development of physically-based models to optimise materials processing and their properties.

Dr. Damien Tourret

Senior Researcher, Modelling and Simulation of Materials Processing

Ph.D. in Materials Science and Engineering from Mines ParisTech, France.

Research Interests

Theory, modelling, and simulation of microstructure selection, formation, and evolution in advanced materials (e.g. metallic alloys and nanostructures). Solidification processing (e.g. casting, welding, additive manufacturing), crystal growth, and phase transformations in metals and alloys. Multiscale modelling - combining atomistics, phase-field, and macroscopic thermomechanical approaches. High-performance computing (e.g. parallelisation on graphics processing units), non-equilibrium (e.g. rapid) solidification, and in-situ imaging of solidification experiments.

Prof. Harun Tüysüz

Senior Researcher. Catalysis and Energy Materials

Ph.D. in Chemistry from the Max-Planck-Institut für Kohlenforschung, Germany.

Research Interests

Designing and developing functional halide perovskite structures for solar energy conversion, as well as tailoring nanoscale materials for catalytic transformations such as water electrolysis for green hydrogen generation, thermocatalytic CO2 conversion, and catalytic plastic recycling. The motivation behind the research line is to advance understanding of the structure-activity relationships in the field of heterogeneous catalysis and materials science. One of our main strategies involves developing sustainable synthetic and catalytic processes by precisely controlling the key physicochemical properties of advanced energy materials at the atomic and nanoscale, using both top-down and bottom-up approaches.

Dr. Juan José Vilatela

Senior Researcher. Multifunctional Nanocomposites

Ph.D. in Materials Science from the University of Cambridge, United Kingdom.

Research Interests

The development of synthesis methods for the assembly of 1D nanomaterials intro macroscopic nanotextiles with high-performance properties for structural and energy applications. This work is focused on multiscale models of network materials to overcome the limits of traditional materials, expanding floating catalyst Chemical Vapor Deposition (CVD) synthesis to multiple chemistries, and supporting the industrialisation of nanomaterials through scalable manufacture and integration in components as battery electrodes, as well as structural composite reinforcement, among other applications.

Prof. De-Yi Wang

Senior Researcher. High Performance Polymers and Fire Retardants

Ph.D. in Polymer Chemistry and Physics from Sichuan University, China.

Research Interests

Application-oriented fundamental problems in sustainable polymers and fire-safe materials. His main research lines include Flame Retardant Materials, Fire-safe Energy Storage Materials, Bio-based Materials and Phase Change Materials, etc.

Researchers

Dr. Jennifer Patterson

Researcher. Biomaterials and Regenerative Medicine

Ph.D. in Bioengineering from the University of Washington, USA.

Research Interests

The synthesis of novel biomaterials with a particular focus on hydrogels, as well as the processing of biomaterials into complex 3D structures and the characterisation of their physical and chemical properties. The evaluation of cytocompatibility and biological functionality in vitro, preclinical evaluation in small animal models in vivo, tissue engineering applications and the development of 3D in vitro tissue models and organ-on-chip devices.

Junior Researchers

Dr. Mónica Echeverry Rendón

Junior Researcher.
Biometals, Coatings and Devices

Ph.D. in Materials Science from the University of Antioquia, Colombia and a Ph.D. in Medical Science from the University of Groningen, the Netherlands.

Research Interests

The development and evaluation of materials in biomedical engineering, with a strong emphasis on personalised medicine. This involves designing medical solutions, such as materials, implants, or biomedical devices, that are tailored to the unique physiological and clinical needs of individual patients. Central to this approach is the careful selection of suitable materials, including alloys, composites, or multimaterials, along with the identification of optimal manufacturing techniques. The overarching goal is to generate foundational knowledge that enables the design of innovative materials with superior biological performance. This is achieved through precise control over material composition, degradation behaviour, and interactions with biological tissues, often enhanced by the application of advanced surface coatings.

Inside the Red Glow

Sputtering of TiAlBN coating on the silicon substrate. The image shows the heating of the substrate before the deposition process

Jayachandran Subbian

Joint 1st Place, IMDEA Materials Institute Imaging Contest, 2025, Art in Science Category.

annex

1. R&D projects and contracts

1.1. European R&D Projects (European Commission)

Title/Acronym: European database for multiscale modelling of radiation damage/ ENTENTE
Partners: Centre for Energy, Environmental and Technological Research (CIEMAT, coordinator), IMDEA Materials Institute, Bay Zoltan Nonprofit Ltd. for Applied Research (BZN), the French Alternative Energies and Atomic Energy Commission (CEA), French National Centre for Scientific Research (CNRS), Electricité de France (EDF), Framatome, Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute for Radiological Protection and Nuclear Safety (IRSN), KTH Royal Institute of Technology in Stockholm, University of Cantabria, National Nuclear Laboratory Limited (NNL), Phimeca, Belgian Nuclear Research Centre (SCK CEN), University of Warwick, University of Bristol, Materials Performance Centre of the University of Manchester, University of Alicante, Polytechnic University of Catalonia – BarcelonaTech, Technical University of Madrid, Culham Centre for Fusion Energy, UJV Rez, VTT Technical Research Centre of Finland, State Enterprise State Scientific and Technical Center for Nuclear and Radiation Safety (SSTC), Chalmers University of Technology and Central Research Institute of Electric Power Industry (CRIEPI)
Period: 2020-2024
Funding Institution/Programme: European Commission/EURATOM
Principal Investigators: Prof. J.M. Molina Aldareguía

Title/Acronym: Multi-scale optimisation for additive manufacturing of fatigue resistant shock-absorbing metamaterials/MOAMMM
Partners: University of Liège (coordinator), IMDEA Materials Institute, KU Leuven, Johannes Kepler University Linz and CIRP
Period: 2020-2024
Funding Institution/Programme: European Commission/Horizon 2020 Programme – FET Open
Principal Investigators: Prof. J. Segurado

Title/Acronym: Design of lightweight steels for industrial applications / DELIGHTED
Partners: IMDEA Materials Institute (coordinator), Universiteit Gent, Onderzoekscentrum Voor Aanwending Van Staal NV, Politecnico di Milano, Max Planck Institut fur Eisenforschung GmbH
Period: 2020-2024
Funding Institution/Programme: European Commission/Research Fund for Coal and Steel (RFCS)
Principal Investigator: Dr. I. Sabirov

Title/Acronym: Digital method for improved manufacturing of next-generation multifunctional airframe parts/DOMMINIO
Partners: AIMEN (coordinator), IMDEA Materials Institute, Tortech Nano Fibers, IRES, the National Technical University of Athens, Aciturri Engineering, IPC, BAE Systems, EASN, ESI Group, Arts et Métiers, INCAS and Dasel
Period: 2021-2024
Funding Institution/Programme: European Commission/Horizon 2020 Programme - Societal Challenges - Smart, Green and Integrated Transport
Principal Investigators: Prof. C. González and Dr. J.J. Vilatela

Title/Acronym: Additive manufacturing of amorphous metals for soft magnetics/ AM2SOFTMAG
Partners: Saarland University, IMDEA Materials Institute, the Italian National Institute of Metrology Research and Heraeus
Period: 2022-2026
Funding Institution/Programme: European Commission/Horizon Europe Programme – EIC Pathfinder Open
Principal Investigator: Dr. M.T. Pérez Prado

Title/Acronym: Smart 4D biodegradable metallic shape-shifting implants for dynamic tissue restoration/BIOMET4D
Partners: IMDEA Materials Institute (coordinator), the Technical University of Madrid, Aerosint, Meotec, the University Hospital Cologne, the National University of Ireland Galway and the Gregorio Marañón Hospital Biomedical Research Foundation
Period: 2022-2026
Funding Institution/Programme: European Commission/Horizon Europe Programme – EIC Pathfinder Open
Principal Investigator: Dr. J. Patterson

Title/Acronym: Resource-efficient steel construction using additive manufacturing/ CONSTRUCTADD
Partners: Milan Polytechnic University (coordinator), IMDEA Materials Institute, RWTH Aachen University, the University of Pisa, Prima Industrie, Vallourec, Mimete, Cimolai, ArcelorMittal, BLM and DNV Netherlands
Period: 2022-2026
Funding Institution/Programme: European Commission/Research Fund for Coal and Steel (RFCS)
Principal Investigator: Dr. I. Sabirov

Title/Acronym: Mechanics of Nanoporous W under irradiation/MENAWIR
Partners: IMDEA Materials Institute
Period: 2022-2024

Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. C. Ruestes; Supervisor: Prof. J. Segurado

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Title/Acronym: Universal processing route for high-performance nanostructured yarns/ UNIYARNS
Partners: IMDEA Materials Institute
Period: 2022-2027
Funding Institution/Programme: European Commission/Horizon Europe Programme – ERC Consolidator Grant
Principal Investigator: Dr. J.J. Vilatela

Title/Acronym: AI-powered characterisation and modelling for green steel technology/ AID4GREENEST
Partners: IMDEA Materials Institute (coordinator), Ghent University, the University of Oulu, the University of Liège, Fraunhofer Institute, Ocas NV, the Spanish Association for Standardisation-UNE, ePotentia and EurA AG
Period: 2023-2026
Funding Institution/Programme: European Commission/Horizon Europe Programme – Cluster 4
Principal Investigator: Dr. I. Sabirov

Title/Acronym: Digital laser production: digital twins of laser processing for multi-capability manufacturing of complex components and certification/DILAPRO
Partners: The Danish Technological Institute (coordinator), IMDEA Materials Institute, the Centre of Metallurgy Research ASBL, Dublin City University, the Technical University of Denmark, the European Federation for Welding, Joining and Cutting, Fieldmade AS, Prima Additive SRL, Welltec AS, Pepite SA and Amiquam SA
Period: 2023-2026
Funding Institution/Programme: European Commission/Horizon Europe Programme – Cluster 4
Principal Investigator: Dr. I. Sabirov

Title/Acronym: Electrode assembly from floating nanowires for sustainable next generation batteries/ELECTROFLOAT
Partners: IMDEA Materials Institute
Period: 2023-2024
Funding Institution/Programme: European Commission/Horizon 2020 Programme – ERC Proof of Concept
Principal Investigator: Dr. J.J. Vilatela

Title/Acronym: Hierarchical porous PEEK via combined physical foaming and additive manufacturing: bringing circularity to advanced engineering materials/HIPPEEK
Partners: IMDEA Materials Institute
Period: 2023-2025
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. L. Doyle; Supervisor: Prof. C. González

Title/Acronym: High-throughput discovery of catalysts for the Hydrogen economy through machine learning/HIGHHYDROGENML
Partners: IMDEA Materials Institute
Period: 2023-2025
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. V. Vassilev Galindo; Supervisor: Prof. J. Llorca

Title/Acronym: Hybrid-electric regional architecture/HERA
Partners: Leonardo SpA, Airbus Defence and Space SA, the Italian Aerospace Research Center, the German Aerospace Center – DLR, Dream Innovation SRL, EASN, Fraunhofer Institute, GE AVIO SRL, HIT09 SRL, Aertec Solutions SL, Collins Aerospace, Honeywell International SRO, Israel Aerospace Industries LTD, INCAS - National Institute for Aerospace Research "Elie Carafoli", MTU Aero Engines AG, the Netherlands Aerospace Centre – NLR, ONETA The French Aerospace Lab, PIAGGIO Aero Industries SPA, Torino Polytechnic University, Rolls-Royce Deutschland LTD, Siemens Industry Software NV, the Technical University of Delft, the University of Naples Federico II, the Technical University of Madrid, Patras University, SAFRAN SA, the Warsaw Institute of Aviation, INEGI, Almadesign, Aernnova Aerospace SA, ISQ, THALES AVS France SAS, Protom Group SpA, Aeromechs SRL, Unified International, ISAE-SUPAERO and the Milan Polytechnic University
Period: 2023-2026
Funding Institution/Programme: European Commission/Horizon Europe Programme – Clean Aviation
Principal Investigator: Prof. I. Romero

Title/Acronym: Hydrogen storage and carriage as opportunity for renewable energy transition/HYSCORE
Partners: RWTH Aachen University (coordinator), IMDEA Materials Institute, Ghent University, Aalto University, Corinth Pipeworks SA, OTH Regensburg, the University of Thessaly and Serimax
Period: 2023-2026
Funding Institution/Programme: European Commission/Research Fund for Coal and Steel (RFCS)
Principal Investigator: Dr. I. Sabirov

Title/Acronym: Metals against Leishmaniasis/METALEISH
Partners: IMDEA Materials Institute
Period: 2023-2025
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. B. Gomes; Supervisor: Prof. J. LLorca

Title/Acronym: Multiscale-multiphysics modelling of Ti alloy medical implants based on additive manufacturing technology/M3TIAM
Partners: IMDEA Materials Institute
Period: 2023-2025
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. A. Boccardo; Supervisor: Dr. D. Tourret

Title/Acronym: Toward desirable metal organic framework mixed matrix materials through machine learning-guided interface design/M4MID
Partners: IMDEA Materials Institute
Period: 2023-2025
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. P. Vo; Supervisor: Dr. M. Haranczyk

Title/Acronym: Dynamic coil-shaped polylactic acid-reinforced extracellular matrix-derived scaffold with oriented pores for articular cartilage tissue engineering/RECOIL3D
Partners: IMDEA Materials Institute
Period: 2023-2025
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. P. Díaz Payno; Supervisor: Dr. J. Patterson

Title/Acronym: Smart electrolyte with inherent flame-retardancy for next generation fire-safe lithium-ion batteries/SMARTBATT
Partners: IMDEA Materials Institute
Period: 2023-2025
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. A. Ghosh; Supervisor: Prof. D.Y. Wang

Title/Acronym: 3D printing of pyrolytic and graphitic carbon/3D-Carbon
Partners: IMDEA Materials Institute
Period: 2023-2025

Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. M. Islam; Supervisor: Prof. D.Y. Wang

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Title/Acronym: Additive manufacturing and advanced materials competence centre in Cyprus/AM2C3
Partners: University of Cyprus (coordinator), IMDEA Materials Institute and the Swiss Federal Laboratories for Materials Science and Technology
Period: 2024-2027
Funding Institution/Programme: European Commission/Horizon Europe – Widening
Principal Investigator: Dr. M.T. Pérez Prado

Title/Acronym: Bioabsorbable metallic endovascular medical devices doctoral network/ BIOMEND
Partners: The University of Galway (coordinator), IMDEA Materials Institute, the Technical University of Madrid and RWTH Aachen University
Period: 2024-2027
Funding Institution/Programme: European Commission/Horizon Europe/MSCA Doctoral Networks - Industrial Doctorates
Principal Investigator: Prof. J. LLorca

Title/Acronym: Enhancing bioavailability of beneficial polyphenolic compounds in food via advanced materials engineering/BIOCOMAT
Partners: IMDEA Materials Institute and the Institute of Polymer Science and Technology
Period: 2024-2026
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. S. Lachowicz Wiśniewska; Supervisor: Dr. M. Haranczyk

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Title/Acronym: Integrating multiscale modelling of metal printing with advanced calibration and characterisation techniques/IMMMPACCT
Partners: IMDEA Materials Institute
Period: 2024-2026
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. V. Lampitella; Supervisor: Dr. D. Tourret

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Title/Acronym: Novel magnesium alloy for bone tissue engineering manufactured by selective laser melting/MACS
Partners: IMDEA Materials Institute and the Warsaw University of Technology
Period: 2024-2026

Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. M. Sabbaghian; Supervisor: Prof. J. LLorca

Title/Acronym: Microstructure-informed numerical framework for predicting the response of TBC system/MIM-TBC
Partners: IMDEA Materials Institute
Period: 2024-2026
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. M. Jalili; Supervisor: Prof. J. Segurado

Title/Acronym: Non-corrosive polymer electrolyte with preferential AL3+ transport for rechargeable aluminium batteries/NC-PEPA
Partners: IMDEA Materials Institute
Period: 2024-2026
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. Z. Ali Zafar; Supervisor: Dr. J.J. Vilatela

Title/Acronym: Phase diagram of multiprincipal element alloys/PD-MPEA
Partners: IMDEA Materials Institute
Period: 2024-2026
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. C. Shi; Supervisor: Prof. J. LLorca

Title/Acronym: Year-round, fire-safe, and sustainable solar management materials/ SOLAR-MATER
Partners: IMDEA Materials Institute
Period: 2024-2026
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. W. Cai; Supervisor: Prof. D.Y. Wang

Title/Acronym: Development and characterisation of ultrafine hierarchically structured eutectic Ti-Fe-based alloys using additive manufacturing and advanced tomographic techniques/UTIFE
Partners: IMDEA Materials Institute
Period: 2024-2026
Funding Institution/Programme: European Commission/Horizon Europe - MSCA Postdoctoral Fellowships
Principal Investigator: Dr. J. Ballor; Supervisor: Dr. F. Sket

Title/Acronym: Forming catalysts: a basic principle of deep chemistry, life chemistry and life (VW-LIFE)
Partners: IMDEA Materials Institute
Period: 2024-2027
Funding Institution/Programme: Volkswagen Stiftung/Volkswagen Foundation – Cooperation Projects
Principal Investigator: Prof. H. Tüysüz

1.2. Other International R&D Projects

Title/Acronym: Metamaterial fibres of intercalated bundles/METACALATED
Partners: IMDEA Materials Institute
Period: 2023-2026
Funding Institution/Programme: US Air Force Office of Scientific Research (AFOSR)
Principal Investigators: Drs. J.J. Vilatela and J. Christensen

1.3. National R&D Projects

Title/Acronym: Excellence Unit María de Maeztu/MdM 2018
Partners: IMDEA Materials Institute
Period: 2019-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Severo Ochoa - María de Maeztu
Principal Investigator: Prof. J. Llorca

Title/Acronym: Biobased, self-reinforced and flame-resistant all-solid-state polymer electrolytes for new generation fire-safe battery/BIOFIRESAFE
Partners: IMDEA Materials Institute
Period: 2021-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Research Challenges
Principal Investigator: Prof. D.Y. Wang

Title/Acronym: High-throughput strategies for the discovery of new catalysts for the hydrogen economy through elastic strain engineering/CATBYESE
Partners: IMDEA Materials Institute
Period: 2022-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Green and Digital Transition
Principal Investigator: Prof. J. Llorca

Title/Acronym: Design of master alloys for sintered steels/DAMAS
Partners: AMES (coordinator), IMDEA Materials Institute and the Carlos III University of Madrid
Period: 2022-2025
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Public-Private Collaboration
Principal Investigator: Dr. D. Tourret and Prof. J.M. Torralba

Title/Acronym: Biobased flame retardant system for sustainable polymers: molecule design, digital synthesis, digital analysis, data-driven approach/DIGIBIOFAM
Partners: IMDEA Materials Institute
Period: 2022-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Green and Digital Transition
Principal Investigator: Prof. D.Y. Wang and Dr. M. Haranczyk

Title/Acronym: Implantable device for brain tumour treatment using electrical fields/DITTCE
Partners: The Technical University of Madrid (coordinator), IMDEA Materials Institute, the Institute of Health Carlos III, the Niño Jesús Hospital Biomedical Research Foundation, La Princesa University Hospital Biomedical Research Foundation and Insyte
Period: 2022-2025
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Strategic Lines
Principal Investigator: Dr. M. Echeverry Rendón and Prof. J. Llorca.

Title/Acronym: Nanostructure network electrodes to realise the high energy density 3b/4a battery/MAT4BAT
Partners: IMDEA Materials Institute
Period: 2022-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Green and Digital Transition
Principal Investigator: Dr. J.J. Vilatela

Title/Acronym: Micro/macro-modelling of solidification in additive manufacturing/MIMMOSA
Partners: IMDEA Materials Institute
Period: 2022-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/International joint programming actions (seal of excellence European Commission/Horizon 2020 Programme – Marie Skłodowska-Curie Actions – IF)
Principal Investigator: Dr. R. Tavakoli; Supervisor: Dr. D. Tourret

Title/Acronym: Consolidation and study of behaviour under hydrogen/NATURE
Partners: The Carlos III University of Madrid (coordinator), IMDEA Materials Institute and the Technical University of Madrid
Period: 2022-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Green and Digital Transition
Principal Investigator: Dr. D. Tourret

Title/Acronym: Porous metal genomics for tailoring mechanical properties of light-weight 3D-printed architectures/PORMETALOMICS
Partners: IMDEA Materials Institute (coordinator), the Institute of Mathematics of the Polish Academy of Sciences and Technion
Period: 2022-2025
Funding Institution/Programme: Spanish Ministry of Science and Innovation - European Commission/M-ERA.NET
Principal Investigator: Dr. M. Haranczyk

Title/Acronym: Synthesis and assembly of long metal oxide nanowires for energy/ SALMONE
Partners: IMDEA Materials Institute
Period: 2022-2026
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Knowledge Generation
Principal Investigator: Drs. J.J. Vilatela and D. Tourret

Title/Acronym: The introduction of geometrical gradients in Zn based scaffolds by laser powder bed fusion/BIOFUN3D
Partners: Technical University of Madrid and IMDEA Materials Institute
Period: 2023-2026
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Knowledge Generation
Principal Investigator: Dr. F. Sket

Title/Acronym: Advanced materials and nanomaterials Spanish technological platform 2023-2024 /MATERPLAT 2023-2024
Partners: IMDEA Materials Institute (Technical Secretariat)
Period: 2023-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/ Technological Platforms
Coordinator: M.Á. Rodiel

Title/Acronym: No dissipation in sonic flatlands/NODISONICS
Partners: IMDEA Materials Institute
Period: 2023-2025
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Research consolidation
Principal Investigator: Dr. J. Christensen

Title/Acronym: European Project Office IMDEA Materials Institute 2023-2024/OPE - IMDEA Materials 2023-2024
Partners: IMDEA Materials Institute
Period: 2023-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/ Preparation and management of European projects
Coordinator: M.Á. Rodiel

Title/Acronym: 4D printing of smart materials for sustainable mobility/PRIORITY
Partners: IMDEA Materials Institute
Period: 2023-2024
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Knowledge Generation
Principal Investigator: Dr. M.T. Pérez Prado and Dr. Srdjan Milenkovic

Title/Acronym: New generation of parts for sustainable mass production by 3D-Metal Jet with improved quality and reliable manufacturing process/3D-METJET
Partners: HP Printing and Computing Solutions (Coordinator), IMDEA Materials Institute and AMES
Period: 2023-2026
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Public-Private Collaboration
Principal Investigator: Dr. F. Sket and Prof. J.M. Torralba

Title/Acronym: Synergistic solutions to enhancing fire-safety on battery systems for e-mobility/BAT4FIRE
Partners: Tolsa (coordinator) and IMDEA Materials Institute
Period: 2024-2027
Funding Institution/Programme: Spanish Ministry of Science, Innovation and Universities/State Research Agency
Principal Investigator: Prof. D.Y. Wang and Dr. M. Haranczyk

Title/Acronym: Nanostructured halide perovskites for solar energy conversion and acceleration of catalytic transformations/CHOSEN-CAT
Partners: IMDEA Materials Institute

Period: 2024-2027
Funding Institution/Programme: Spanish Ministry of Science, Innovation and Universities/ATRAE
Principal Investigator: Prof. H. Tüysüz

Title/Acronym: Artificial intelligence for the sustainable design of efficiency alloys and processes/IRIDISCENTE
Partners: ArcelorMittal (co-coordinator), IMDEA Materials Institute (co-coordinator), Renishaw Ibérica, the Carlos III University of Madrid, AIMEN Technology Centre, Mimtech ALFA, Idaero Solutions, the University of Burgos, The Next Pangea, Blesol Tech and AENIUM Engineering
Period: 2024-2027
Funding Institution/Programme: Spanish Ministry of Science and Innovation/State Research Agency
Principal Investigator: Prof. J.M. Torralba

Title/Acronym: Enabling technologies for the implementation of artificial intelligence in the value chain of additive manufacturing of new metal alloys/METALIA
Partners: Egile (co-coordinator), CATEC (co-coordinator), IMDEA Materials Institute, Leitat, the Technical University of Madrid, Grupo Sevilla Control, Cubicoff, BitMetrics and DLyte
Period: 2024-2027
Funding Institution/Programme: Spanish Ministry of Science, Innovation and Universities/State Research Agency
Principal Investigator: Dr. F. Sket and Prof. J.M. Molina Aldareguía

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Title/Acronym: Oficina de Captación de Personal de Investigación Instituto IMDEA Materiales 2024-2025 (OCPI IMDEA Materials)
Partners: IMDEA Materials Institute
Period: 2024-2025
Funding Institution/Programme: Spanish Ministry of Science, Innovation and Universities/Preparation and management of EU projects and attraction of international talent
Coordinator: R. Bazán

Title/Acronym: Accelerated development of sustainable nanocomposites through laboratory automation and machine learning/SUSCOMPAUTO
Partners: IMDEA Materials Institute
Period: 2024-2027
Funding Institution/Programme: Spanish Ministry of Science and Innovation/Knowledge Generation
Principal Investigator: Dr. M. Haranczyk and Prof. D.Y. Wang.

1.4. Regional R&D Projects

Title/Acronym: Metamaterial printing using shape memory alloys and functional gradients for a new generation of smart implants/i-MPLANTS-CM
Partners: The Technical University of Madrid and IMDEA Materials Institute
Period: 2021-2024
Funding Institution/Programme: Regional Government of Madrid/Synergy projects
Principal Investigator: Prof. J.M. Molina Aldareguía

Title/Acronym: Design and scaling of new hard coatings deposited by HiPIMS for high-speed milling/ HIPDUR
Partners: NANO4ENERGY and IMDEA Materials Institute
Period: 2022-2025
Funding Institution/Programme: Regional Government of Madrid/Industrial Doctorate
Principal Investigator and Supervisor: Dr. M. Monclús; Doctoral Researcher: A. García

Title/Acronym: Two-dimensional disruptive materials for the new technological transformation/MAD2D
Partners: The Complutense University of Madrid (coordinator), IMDEA Materials Institute, IMDEA Energy Institute, the Autonomous University of Madrid and the Technical University of Madrid
Period: 2022-2025
Funding Institution/Programme: Spanish Ministry of Science and Innovation - Regional Government of Madrid/Complementary R&D&I plans-REACT EU resources
Principal Investigators: Prof. J. LLorca and Drs. J.J. Vilatela and M. Haranczyk

Title/Acronym: Bioengineering of skeletal muscle satellite cells as a new strategy for cardiomyocyte differentiation and cardiac regeneration/CARDIOBOOST
Partners: CNIC (coordinator), IMDEA Materials Institute, the Complutense University of Madrid, IIBM-CSIC and CBM Severo Ochoa
Period: 2023-2026
Funding Institution/Programme: Regional Government of Madrid/Biomedicine
Principal Investigator: Dr. J. Patterson

Title/Acronym: Software for 3D printing of efficient electric motors/SOFTWARE IMPR 3D
Partners: IMDEA Materials Institute
Period: 2024-2024
Funding Institution/Programme: Madri+d Foundation for Knowledge/DeepTech Madrid
Principal Investigador: Dr. M.T. Pérez Prado

Title/Acronym: Development of biomaterials for processable transparent aligners by thermoforming and 3D printing/3DALIGNER
Partners: IMDEA Materials Institute and Secret Aligner SL
Period: 2023 - 2026
Funding Institution/Programme: Regional Government of Madrid/Industrial Doctorate
Principal Investigator: Dr. J. P. Fernández; Doctoral Researcher: J.I. Delgado

1.5. Privately-funded R&D Projects

Title/Acronym: Fire-retardant polyether polyol-based Pu flexible foam and its burning behaviors/FIREPOLYOL
Company: Shanghai Research Institute of Chemical Industry
Period: 2024-2025
Principal Investigator: Prof. D.Y. Wang

Title/Acronym: Advanced air mobility research: hydrogen-powered electric vertical take-off air vehicle/IFOH2EVTOL
Company: Pythmen R&D - European Business and Innovation Centre of Cartagena (CEEIC)
Period: 2024-2025
Principal Investigator: Dr. J. Christensen

Title/Acronym: IMDEA Materiales-ITP Aero collaboration in the development of advanced materials for aeronautical applications/FCAS 2024
Company: ITP Aero
Period: 2024
Principal Investigator: Prof. J.M. Molina Aldareguía, Dr. D. Tourret.

Title/Acronym: Development of ultrasound inspection capabilities enhanced by artificial intelligence and X-ray computed tomography for defect analysis in composite materials/ PEGASO 3
Company: Airbus
Period: 2024-2025
Principal Investigator: Dr. F. Sket

Title/Acronym: Advancing si-CNT composites for lithium-ion batteries / CHUB-BAT
Company: RICE University
Period: 2024-2024
Principal Investigator: Dr. J.J. Vilatela

Title/Acronym: Re-silestone – next resilient agglomerated stone/THERMOSTONE
Company: Cosentino Research and Development
Period: 2024-2024
Principal Investigator: Prof. D.Y. Wang

Title/Acronym: Novel flame retardant polymer materials
Partners: IMDEA Materials Institute
Period: 2024-2025
Funding Institution/Programme: German Industrial Company
Principal Investigator: Prof. D.Y. Wang

Title/Acronym: Toughness, damage tolerance and recyclability of thermoplastic CNT fabric composites/ CHUB-COMP
Company: RICE University
Period: 2023-2024
Principal Investigator: Dr. J.J. Vilatela

Title/Acronym: Circular economy in the thermoset composites industry/EOCENE
Company: Acciona Construccion SA
Period: 2023-2024
Principal Investigator: Dr. J.P. Fernández Blázquez

Title/Acronym: Research into intelligent electrical control and actuation systems through the development of health monitoring technologies for sustainable aviation/I-SISTEHMA
Company: Compañía Española de Sistemas Aeronáuticos SA - Heroux Devtek
Period: 2023-2024
Principal Investigator: Dr. J.J. Vilatela

Title/Acronym: Multi-material additive manufacturing of multi-functional moulds for out-of-autoclave infusion processes/FAUNO
Company: Idaero Solutions
Period: 2023-2025
Principal Investigator: Prof. I. Romero

Title/Acronym: Development of ultrasound inspection capabilities enhanced by artificial intelligence and X-ray computed tomography for defect analysis in composite materials/ PEGASO 2
Company: Airbus
Period: 2023-2024
Principal Investigator: Dr. F. Sket

Title/Acronym: Smart, adaptive and sustainable technologies for agile and zero-defect manufacturing of composite materials by resin transfer process/SM@RTM-CITD
Company: CITD, Engineering & Technologies, S.L.
Period: 2023-2024
Principal Investigators: Prof. C. González

Title/Acronym: Industrial technologies for sustainable and competitive aeronautics/ TIANA
Company: Acciona Construccion SA
Period: 2023-2025
Principal Investigator: Dr. J.P. Fernández Blázquez

Title/Acronym: Development of biomedical device to support venous lymphatic return/ RETOVEN
Company: ZOETECH SL
Period: 2023-2024
Principal Investigator: Prof. D.Y. Wang

Title/Acronym: Development of biomaterials for processable transparent aligners by thermoforming and 3D printing/3DALIGNER
Company: Secret Aligner SL
Period: 2023-2025
Principal Investigator: Dr. J.P. Fernández Blázquez

Title/Acronym: Computerised tomography/XCTVSUS Airbus
Company: Airbus
Period: 2022-2024
Principal Investigador: Dr. F. Sket

Title/Acronym: Smart, adaptive and sustainable technologies for agile and zero-defect manufacturing of composite materials by resin transfer process/SM@RTM-IDAERO
Company: Idaero Solutions
Period: 2022-2024
Principal Investigators: Prof. C. González

Title/Acronym: Design and scaling of new hard coatings deposited by HiPIMS for high-speed milling/ HIPDUR
Company: NANO4ENERGY
Period: 2022-2025
Principal Investigator: Dr. M. Monclús

Title/Acronym: Advice for Shanghai Research Institute of Chemical Technology/ CONSULT
Company: Shanghai Research Institute of Chemical Technology
Period: 2022-2024
Principal Investigator: Prof. D.Y. Wang

Title/Acronym: Optimisation of the processing route of polyurethane-coated composite material/NEOTAIL
Company: 3M España
Period: 2021-2024
Principal Investigator: Prof. C. González

2. Fellowships

2.1. International Fellowships

Recipient: X. Ao
Programme: China Scholarship Council Fellowships
Project: *Fire behaviour of composite materials*
Period: 2020-2024
Funding Institution: China Scholarship Council

Recipient: Q. Chen
Programme: China Scholarship Council Fellowships
Project: *Biobased flame-retardant polymer electrolytes for lithium-ion batteries*
Period: 2022-2026
Funding Institution: China Scholarship Council

Recipient: S. Du
Programme: China Scholarship Council Fellowships
Project: *Marine-derived chitosan-based thermosensitive hydrogels and their applications in anti-ageing*
Period: 2021-2025
Funding Institution: China Scholarship Council

Recipient: J.C. He
Programme: China Scholarship Council Fellowships
Project: *Multiscale simulation of fatigue*
Period: 2024-2025
Funding Institution: China Scholarship Council

Recipient: Y. Hu
Programme: China Scholarship Council Fellowships
Project: *Advanced fundamental metamaterials related phenomena*
Period: 2023-2025
Funding Institution: China Scholarship Council

Recipient: J. Huang
Programme: China Scholarship Council Fellowships
Project: *3D-printed dual elastic biomimetic scaffolds for articular cartilage regeneration*
Period: 2024-2028
Funding Institution: China Scholarship Council

Recipient: Y. Li
Programme: China Scholarship Council Fellowships
Project: *The characterisation of Mg-Zn multimaterial components for different engineering applications*
Period: 2024-2028
Funding Institution: China Scholarship Council

Recipient: X. Li
Programme: China Scholarship Council Fellowships
Project: *Fire behaviours of composite materials*
Period: 2019-2024
Funding Institution: China Scholarship Council

Recipient: Yunhuan Liu
Programme: China Scholarship Council Fellowships
Project: *Functional flame-retardant coating*
Period: 2023-2027
Funding Institution: China Scholarship Council

Recipient: Yuyao Liu
Programme: China Scholarship Council Fellowships
Project: *New-generation biodegradable polymers in tissue engineering*
Period: 2021-2025
Funding Institution: China Scholarship Council

Recipient: S. Tang
Programme: China Scholarship Council Fellowships
Project: *Novel biomaterials development for tissue engineering and regenerative medicine*
Period: 2024-2028
Funding Institution: China Scholarship Council

Recipient: K. Tian
Programme: China Scholarship Council Fellowships
Project: *Development of autonomous laboratory for discovery and processing of multifunctional nanocomposites*
Period: 2024-2028
Funding Institution: China Scholarship Council

Recipient: X. Xu
Programme: China Scholarship Council Fellowships
Project: *Study of bio-based flame retardant via organo-inorganic hybridisation at the molecular level*
Period: 2023-2027
Funding Institution: China Scholarship Council

Recipient: R. Yang
Programme: China Scholarship Council Fellowships
Project: *Functional wood-based aerogel with enhanced flame*
Period: 2024-2026
Funding Institution: China Scholarship Council

Recipient: W. Ye
Programme: China Scholarship Council Fellowships
Project: *New generation environmentally friendly halogen-free flame retardant with a combination of N-substituted alkoxy hindered amines*
Period: 2021-2025
Funding Institution: China Scholarship Council

Recipient: J. Zhang
Programme: China Scholarship Council Fellowships
Project: *Topological effects in mechanical metamaterials with a generalised constitute*
Period: 2022-2026
Funding Institution: China Scholarship Council

Recipient: M. Zhang
Programme: China Scholarship Council Fellowships
Project: *New-generation fire retardant materials for lithium-ion batteries*
Period: 2021-2025
Funding Institution: China Scholarship Council

2.2. National Fellowships

Dr. F. Sket
Programme: Ramón y Cajal
Period: 2020-2025
Funding Institution: Spanish Ministry of Science, Innovation and Universities

Dr. D. Tourret
Programme: Ramón y Cajal
Period: 2021-2026
Funding Institution: Spanish Ministry of Science, Innovation and Universities

Dr. P.J. Navarrete Segado
Programme: Juan de la Cierva
Period: 2023-2024
Funding Institution: Spanish Ministry of Science, Innovation and Universities

Dr. Y. Yang
Programme: Juan de la Cierva
Period: 2024-2026
Funding Institution: Spanish Ministry of Science, Innovation and Universities

C. Martínez Alonso
Programme: Training University Lecturers (FPU)
Period: 2020-2024
Funding Institution: Spanish Ministry of Science, Innovation and Universities

M. Castillón
Programme: Predoctoral Fellowships
Period: 2021-2025
Funding Institution: Spanish Ministry of Science, Innovation and Universities

O. Contreras
Programme: Predoctoral Fellowships
Period: 2020-2024
Funding Institution: Spanish Ministry of Science, Innovation and Universities

J. García Pérez
Programme: Predoctoral Fellowships
Period: 2021-2025
Funding Institution: Spanish Ministry of Science, Innovation and Universities

E. Kazemi
Programme: Predoctoral Fellowships
Period: 2020-2024
Funding Institution: Spanish Ministry of Science, Innovation and Universities

M.D. Martín Alonso
Programme: Predoctoral Fellowships
Period: 2021-2025
Funding Institution: Spanish Ministry of Science, Innovation and Universities

B. Ozdemir
Programme: Predoctoral Fellowships
Period: 2022-2026
Funding Institution: Spanish Ministry of Science, Innovation and Universities

A. Pascual
Programme: Predoctoral Fellowships
Period: 2023-2027
Funding Institution: Spanish Ministry of Science, Innovation and Universities

J. Redondo
Programme: Predoctoral Fellowships
Period: 2022-2026
Funding Institution: Spanish Ministry of Science, Innovation and Universities

I. Rodríguez
Programme: Predoctoral Fellowships
Period: 2021-2025
Funding Institution: Spanish Ministry of Science, Innovation and Universities

2.3. Regional Fellowships

Dr. M. Echeverry Rendón
Programme: Talento César Nombela
Period: 2024-2029
Funding Institution: Madrid Regional Government

A. Vicente
Programme: Youth Employment Programme
Period: 2022-2024
Funding Institution: Madrid Regional Government

Á. de la Camacha Díaz
Programme: PIPF[1]
Period: 2024-2028
Funding Institution: Madrid Regional Government

M. Hernández del Valle
Programme: PIPF
Period: 2023-2027
Funding Institution: Madrid Regional Government

J. León Ramos
Programme: PIPF
Period: 2023-2027
Funding Institution: Madrid Regional Government

B. Limones Ahijón
Programme: PIPF
Period: 2023-2027
Funding Institution: Madrid Regional Government

N. Mollaei
Programme: PIPF
Period: 2024-2027
Funding Institution: Madrid Regional Government

G. Ortiz
Programme: PIPF
Period: 2023-2027
Funding Institution: Madrid Regional Government

[1] *Ayudas de Personal Investigador Predoctoral en Formación*

3. Scientific results

3.1. Publications

1. Ali W.; González C.; Kopp A.; LLorca J. *Bioabsorbable composite laminates of poly-lactic acid reinforced with surface-modified Mg wires for orthopedic implant applications*. **Advanced Engineering Materials**. 2024
2. Sadanand S.; Rodríguez Sánchez M.; Ghavimi A.; Busch R.; Sharangi P.; Tiberto P.M.; Ferrara E.; Barrera G.; Thorsson L.; Wachter H.J.; Gallino I.; Pérez Prado M.T. *Laser powder bed fusion of a nanocrystalline Finemet Fe-based alloy for soft magnetic applications.* **Journal of Laser Applications**. 2024
3. Ribeiro B.L.; Monclús M.A.; Barbosa M.; Torralba J.M.; Malheiros L.F.; Santos R.F.; Sequeiros E.W. *High-throughput screening of MoNbTaW-based refractory High-Entropy Alloys through Direct Energy Deposition in-situ alloying*. **Materials Characterization**. 2024
4. He L.; Cao Y.; Qu H.M.; Zhang Y.K.; Bi Q.Q.; Wang D.Y. *Advances in flame retardancy of asphalt pavement: A review*. **Advanced Industrial and Engineering Polymer Research**. 2024
5. Shi X.H.; Jing C.Y.; Luo H.; Shi H.; Wang D.Y. *A flame retardant coating based on amino acid and phytic acid for cotton fabrics.* **Polymer Degradation and Stability**. 2024
6. Han Z.; Song X.; Chen Z.; Pan Y.T.; Lai X.; Wang D.Y.; Yang R. *Half etching of ZIF-67 towards open hollow nanostructure with boosted absorption ability for toxic smoke and fume in epoxy composites*. **Sustainable Materials and Technologies**. 2024
7. Merugu S.; Kearney L.T.; Keum J.K.; Naskar A.K.; Ansary J.; Herbert A.; Islam M.; Mondal K.; Gupta A. *Investigating permselectivity in PVDF Mixed Matrix Membranes using experimental optimization, machine learning segmentation, and statistical forecasting*. **ACS Omega**. 2024
8. Kazemi Khasragh E.; González C.; Haranczyk M. *Toward diverse polymer property prediction using transfer learning*. **Computational Materials Science**. 2024
9. Hu S.L.; Li Y.M.; Fang H.P.; Deng Y.; Wang D.Y. *Organic-inorganic hybrid modified the halloysite nanotube: Toward vinyl ester resin composites with enhanced flame retardance and mechanical property*. **Colloids and Surfaces A: Physicochemical and Engineering Aspects**. 2024
10. Martínez Alonso C.; LLorca J. *Applicability of the d-Band model to predict the influence of elastic strains on the adsorption energy of different adsorbates onto Pt and PtO2 surfaces*. **ACS Omega**. 2024
11. Ghosh A.; Kaur S.; Verma G.; Dolle C.; Azmi R.; Heissler S.; Eggeler Y.M.; Mondal K.; Mager D.; Gupta A.; Korvink J.G.; Wang D.Y.; Sharma A.; Islam M. *Enhanced performance of laser-induced graphene supercapacitors via integration with candle-soot nanoparticles*. **ACS Applied Materials and Interfaces**. 2024
12. Shi X.H.; Xie W.M.; Shi H.; Wu S.J.; Liu Q.Y.; Wang D.Y. *Preparation of phosphorus-containing organic-hybrid layered double hydroxide as a flame retardant for thermoplastic polyurethane.* **Applied Clay Science**. 2024
13. Andrés E.M.; Romero I. *A variational method for the simulation of hydrogen diffusion in metals*. **Mechanics of Materials**. 2024
14. Kumar A.; Gil Sepulcre M.; Lee J.; Bui V.Q.; Wang Y.; Rüdiger O.; Kim M.G.; DeBeer S.; Tüysüz H. Iridium single-atom-ensembles stabilized on Mn-substituted spinel oxide for durable acidic water electrolysis. **Advanced Materials**. 2024
15. Bi Q.Q.; Li Y.M.; He L.; Wang D.Y. *Bio-derived modified halloysite nanotubes as eco-friendly flame retardants to endow epoxy with high thermal stability, mechanical performance and flame retardancy*. **Chemical Engineering Journal.** 2024

16. Song K.; Bi X.; Wang D.; Pan Y.T.; Xie M.; He J.; Wang D.Y.; Yang R. *Porous liquids assisted in-situ generated Co-LDH@MOF heterostructure with abundant defects for flame retardant and mechanical enhancement in polyurea composites*. **Chemical Engineering Journal**. 2024
17. Cobian L.; Maire E.; Adrien J.; Freitas U.; Fernández Blázquez J.P.; Monclús M.A.; Segurado J. *Effect of sample dimensions on the stiffness of PA12 Lattice materials fabricated using powder bed fusion*. **Additive Manufacturing**. 2024
18. Zhang L.; Ge Y.; Guan Y.J.; Chen F.; Han N.; Chen Q.; Pan Y.; Jia D.; Yuan S.Q.; Sun H.X.; Christensen J.; Chen H.; Yang Y. *Nonreciprocal acoustic devices with asymmetric peierls phases*. **Physical Review Letters**. 2024
19. Halder R.; Sahoo S.; Benzing J.T.; Saville A.I.; Rollett A.D. *Variant selection and macrozone in Ti-6Al-4V walls during laser hot wire direct energy deposition*. **Journal of Materials Research and Technology**. 2024
20. Ao X.; Crouse R.; González C.; Wang D.Y. *Impact of nanohybrid on the performance of non-reinforced biocomposites and glass-fiber reinforced biocomposites: Synthesis, mechanical properties, and fire behavior*. **Construction and Building Materials**. 2024
21. Zhang J.; Zhang X.; Wang R.; Wang W.; Zhao H.; Yang S.; Dong Z.; Wang D.Y.; Pan Y.T. *Cyclodextrin-based host-guest hierarchical fire retardants: Synthesis and novel strategy to endow polylactic acid fire retardancy and UV resistance*. **Carbohydrate Polymers**. 2024
22. Schulte-Hermann J.; Rießland H.; MacKinnon N.; Korvink J.G.; Islam M. *Biomineralization of electrospun bacteria-encapsulated fibers: a relevant step toward living ceramic fibers*. **ACS Applied Bio Materials**. 2024
23. Rossi N.; Romero I.; Huespe A.E. *On the limit behavior of lattice-type metamaterials with bi-stable mechanisms*. **International Journal of Mechanical Sciences**. 2024
24. Ma K.; Xie C.; Li Y.; Yang B.; Jin Y.; Wang H.; Zeng Z.; Li Y.; Ye X. *Oxidation behavior of aluminide coatings on cobalt-based superalloys by a vapor phase aluminizing process.* **Materials**. 2024
25. Pilgar C.M.; Fernandez A.M.; Segurado J. *A fatigue life model accounting for the combined effect of surface roughness and microstructure: Application to SLM fabricated Hastelloy-X*. **International Journal of Fatigue**. 2024
26. Xu J.; Liu X.; Wang L.; Zhu Y.; Ao X.; Guo F.; Xie Z.; Liang F.; Wang D.Y.; Wu J. *Designing of carbon nanohorn-based heterostructure for improved mechanical properties, flame retardancy, and hydrophobicity of composite aerogels*. **Journal of Polymer Science**. 2024
27. Liu Z.; Chen T.; Shu R.; Wang J.; Sha G.; LLorca J. *Hot-isostatic pressed Al melt-spun ribbons with tailored microstructures and mechanical properties for metallic optics.* **Metallurgical and Materials Transactions A: Physical Metallurgy and Materials Science**. 2024
28. Tourret D.; Tavakoli R.; Boccardo A.D.; Boukellal A.K.; Li M.; Molina Aldareguía J.M. *Emergence of rapid solidification microstructure in additive manufacturing of a Magnesium alloy*. **Modelling and Simulation in Materials Science and Engineering**. 2024
29. Zhang Z.; Liu B.; Zhang X.; Pei Z.; Wang Y.; Liang J.; Shao W.; Yang J. *Influence behavior and mechanism of double-layer Gr stacking configuration on mechanical strength and thermoelectric transport properties of Cu/Gr composites*. **Vacuum**. 2024
30. Chen K.; Macías J.G.S.; Isac N.; Vallet M.; Cornet L.; Upadhyay M.V. *Silicon mediated twin formation in laser direct energy deposited 316L stainless steel*. **Scripta Materialia**. 2024
31. Wang R.; Zhang X.; Yuan M.; Wang D.Y.; Zhang J.; Pan Y.T. *Fire retardancy of epoxy composites: A comparative investigation on the influence of porous structure and transition metal of metal-organic framework*. **Composites Communications**. 2024
32. Biedma Á.; Sánchez G.; de Nicolás M.; Bertalan C.; Useldinger R.; Llanes L.; Gordo E. *A comparative study on the wear performance and high-temperature oxidation of Co-free cermets and hardmetals*. **Materials**. 2024

33. Li Z.; Chen S.F.; Tang E.; Zhang F.Y.; Li H.; Hu B.; Zeng Q.; Wang D.Y. *Isomerism-enabling low-temperature ultrasensitive and moisture-resistant fire-alarming "Guarder" via color changing*. **Polymer Degradation and Stability**. 2024
34. Ao X.; Xiao J.; Guerrero Muñoz G.; González C.; Wang D.Y. *Protective coating performance for structural integrity of polymer composites in fire: Novel bench scale instrument design and coupon level test*. **Composites Science and Technology**. 2024
35. Zarzoso M.; Mikhalchan A.; Mocerino D.; Romero-Rodriguez P.; Losada R.; Vilatela J.J.; González C. *Strain sensing of structural composites by integrated piezoresistive CNT yarn sensors*. **Composites Part B: Engineering**. 2024
36. Etacheri V.; Maça R.R.; Avvaru V.S.; Hong C.N.; Alazemi A.; *Pol V.G. Ultrathin (15 nm) carbon sheets with surface oxygen functionalization for efficient pseudocapacitive Na-ion storage*. **ChemElectroChem**. 2024
37. Roque E.; Segurado J.; Montero-Chacón F. *Phase-field modeling and computational design of structurally stable NMC materials*. **Materials and Design**. 2024
38. Jin X.; Barro O.; Riveiro A.; Pou J.; Pérez Prado M.T. *Anomalous twin boundary formation in magnesium alloys by rapid solidification*. **Acta Materialia**. 2024
39. Upama S.; Arevalo L.; Pendashteh A.; Mikhalchan A.; Green M.J.; Vilatela J.J. *Joule heating in controlled atmospheres to process nanocarbon/transition metal oxide composites and electrodes.* **ACS Applied Nano Materials**. 2024
40. Liu Q.; Chen H.; Wu X.; Yan J.; Yang B.; Shi C.; Li Y.; Yu S. *Microstructure and bioactivity of Ca- and Mg-modified silicon oxycarbide-based amorphous ceramics*. **Materials**. 2024
41. Ozdemir B.; Hernández del Valle M.; Gaunt M.; Schenk C.; Echevarría Pastrana L.; Fernández Blázquez J.P.; Wang D.Y.; Haranczyk M. *Toward 3D printability prediction for thermoplastic polymer nanocomposites: Insights from extrusion printing of PLA-based systems*. **Additive Manufacturing**. 2024
42. Meza A.; Macía E.; Serrano M.; Merten C.; Gaitzsch U.; Weißgärber T.; Campos M. *Enhancement of FeCrAl-ODS steels through optimised SPS parameters and addition of novel nano-oxide formers*. **Nuclear Engineering and Technology**. 2024
43. Mocerino D.; Zarzoso M.; Sket F.; Molina Aldareguía J.M.; González C. *A machine learning boosted data reduction methodology for translaminar fracture of structural composites*. **Applied Composite Materials.** 2024
44. Vasudevan A.; Prieto J.Z.; Zorkaltsev S.; Haranczyk M. *tda-segmentor: A tool to extract and analyze local structure and porosity features in porous materials*. **Computer Physics Communications**. 2024
45. Li Y.; Wang H.; Lai R.; Yang B.; Wang Z.; Li Y. *Effect of overlapping deposition strategy on microstructure and mechanical properties of Al-clad steel by AFSD*. **Journal of Manufacturing Processes**. 2024
46. Xu J.; Ao X.; de la Vega J.; Guo F.; Xie Z.; Liang F.; Wang D.Y.; Wu J. *Poly(vinyl alcohol) composite aerogel toward lightweight, remarkable flame retardancy, and thermal insulation properties by incorporating carbon nanohorns and phytic acid*. **ACS Applied Polymer Materials**. 2024
47. García de la Cruz L.; Alvaredo P.; Torralba J.M.; Campos M. *Material extrusion: A promising tool for processing CoCrMo alloy with excellent wear resistance for biomedical applications*. **Materials and Design**. 2024
48. Zhang M.; Gomes M.B.; Yusuf A.; Yin G.Z.; Sun C.C.; Wang D.Y. *Flame-retardant reinforced halloysite nanotubes as multi-functional fillers for PEO-based polymer electrolytes*. **European Polymer Journal**. 2024

49. Lei Y.; Avvaru V.S.; Ward Z.; Liu H.; Fujisawa K.; Bepete G.; Zhang N.; Carreno A.F.; Terrones H.; Etacheri V.; Terrones M. *Defect-driven ion storage on hexagonal boron nitride for fire-safe and high-performance lithium-ion batteries*. **Chemical Engineering Journal**. 2024
50. Li Y.M.; Li Y.R.; Fang H.P.; Wang D.Y. *Fabrication of multi-dimensional heterostructure towards highly efficient microwave absorbing performance and flame retardancy*. **Colloids and Surfaces A: Physicochemical and Engineering Aspects**. 2024
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3.2. Patent Applications

1. *Spark ablation device, method for generating nanoparticles by means of said device, and associated uses thereof*. IMDEA Materials Institute, Patent application number: EP24382060.2 (24/01/2024), Inventors: J.J. Vilatela, M. Vázquez.
2. *Methods for fabricating high-performance and lightweight lithium-ion batteries based on silicon and CNTs*. IMDEA Materials Institute and RICE University. Patent application number: 63/625,641 (26/01/2024), Inventors from IMDEA Materials Institute: A. Pendashteh and J.J. Vilatela.
3. *Dispositivo de detección de movimiento y/o fuerza de presión de un primer elemento respecto a un segundo elemento*. IMDEA Materials Institute and the Technical University of Madrid. Patent application number: P202430190 (15/03/2024), Inventors from IMDEA Materials Institute: J. Xu, D.Y. Wang and X. Ao.
4. *Materiales inorgánicos-orgánicos de base biológica*. IMDEA Materials Institute. Patent application number: P202430817 (10/10/2024), Inventors: W. Tang, J.A. Hobson, Y. Liu and D.Y. Wang.
5. *Laser-based additive manufacturing device and method for crystallisation control of metallic glasses*. IMDEA Materials Institute. Patent application number: EP24383248.2 (18/11/2024), Inventors: M. Rodríguez Sánchez, M.T. Pérez Prado, D. Tourret and A.D. Boccardo.

3.3. International Conferences. Invited and Keynote talks

1. *Additive manufacturing of energy saving materials*. **6th International Conference on Welding and Non-Destructive Testing**, Tabriz, Iran. M.T. Pérez Prado. February 2024.
2. *Role of residual dislocation burgers vector magnitude and mobility on grain boundary slip transfer in aluminum*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, USA. D. Spearot, R. Santos-Güemes, J. LLorca. March 2024.
3. *Fatigue crack nucleation mechanisms in AZ31 Mg alloy: experiments and simulations*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, USA. A. Jamali, A. Ma, J. LLorca. March 2024.
4. *Nucleation Mechanisms of GP Zones and Precipitates in Al-Zn-Mg Alloys. TMS 2024*, **TMS 2024 153rd Annual Meeting and Exhibition**. Orlando, USA. S. Liu, J. LLorca. March 2024.
5. *Accurate prediction of phase diagrams of binary and ternary systems from first-principles calculations.* **TMS 2024, 153rd Annual Meeting and Exhibition.** Orlando, USA. S. Liu, J. LLorca. March 2024.
6. *A critical and quantitative comparison of models for grain structure prediction in solidification processes*. **TMS 2024, 153rd Annual Meeting and Exhibition**, Orlando, USA. D. Tourret. March 2024.
7. *Twin boundary engineering in magnesium alloys*. **TMS 2024, 153rd Annual Meeting and Exhibition**, Orlando, USA. M.T. Pérez Prado. March 2024.
8. *Additive manufacturing of commercial Fe-based metallic glasses for soft magnetic applications*. **2nd International Metal Additive Manufacturing Symposium**, Senlis, France. M.T. Pérez Prado. March 2024.
9. *Role of residual dislocation burgers vector magnitude and mobility on grain boundary slip transfer in elastic interactions in object kinetic Monte Carlo for defect evolution: Hydrogen and radiation defect migration*. **MFO workshop: Mechanics of Materials: Multiscale Design of Advanced Materials and Structures**. Oberwolfach, Germany. J. Segurado. March 2024.
10. *Revealing twin nucleation mechanisms in Mg: in situ experiments and machine learning analysis*. **Schöntal Symposium on Dislocation-based Plasticity**. Schöntal, Germany. B. Yang, M. Sarebanzadeh, V. Vassilev Galindo, J. LLorca. April 2024.

11. *Macroscopic fibres of carbon nanotube intercalation compounds*. **Chemontubes Conference 2024**. Strasbourg, France. J.J. Vilatela. April 2024.
12. *On the use of data to unveil processing-structure-properties relationships in materials through machine learning*. **Materials Mechanics Beyond the Horizon**. Madrid, Spain. J. LLorca. May 2024.
13. *Macroscopic fibres of carbon nanotube intercalation compounds*. **JUNCTION Workshop**. Houston, USA. J.J. Vilatela. May 2024.
14. *Phase-field insights into microstructure selection during solidification of hcp Mg alloys*, **5th International Symposium on Phase-Field Modelling in Materials Science (PF24)**, Hangzhou, China. D. Tourret, A.K. Boukellal, R. Tavakoli, A. Boccardo, J. LLorca. May 2024.
15. 4*D printing of metallic alloys towards novel shape morphing medical devices*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. J.M. Molina Aldareguía. May 2024.
16. *Understanding serrated flow in Inconel 718 architected lattices*. **19th European Mechanics of Materials Conference (EMMC19)**, Madrid, Spain. S. Sahoo, Z. Chen, D. Mordehai, M. Haranczyk, M.T. Pérez Prado. May 2024.
17. *Laser-induced graphitization on fabrics: from smart technology to advanced application.* **International Conference on Eco-Textiles (ICET)**. Wuxi, China. D.Y. Wang. July 2024.
18. *Flame retardants to polymer materials: Flame retardant or flame assistant*. **15th National Conference on Fire Safety Materials**. Ningbo, China. D.Y. Wang. July 2024.
19. *High-Entropy Alloys and powder metallurgy*. **18th International Symposium on Novel and Nano Materials (ISNNM)**. Vienna, Austria. J.M. Torralba, M. Campos, P. Alvaredo, A. Meza, L. García de la Cruz, M. de Nicolás Morillas, S.V. Kumaran, R. Carbajales, D. Guerrero. July 2024.
20. *Smart Digital Twins for Structural Composites Manufacturing*. **European Conference on Composite Materials ECCM21**. Nantes, France. C. González. July 2024.
21. *Applications of machine learning to discover new materials and to reveal microstructure-properties relationships*. **Gordon Research Conference on Computational Materials Science and Engineering**. Newry, Maine. J. LLorca. July 2024.
22. *Tuning the magnetic properties of metals by severe straining.* **32nd International Materials Research Conference (IMRC 2024)**, Cancún, Mexico. C.M. Cepeda Jiménez, J.I. Beltrán, A. Hernando, M.A. García, F. Ynduráin, A. Zhilyaev, M.T. Pérez Prado. August 2024.
23. *My academic journey in Spain and international collaboration on advanced materials*. **2024 China-Spain Science and Technology Cooperation Theme Day**. Zaragoza, Spain. D.Y. Wang. September 2024.
24. *Crystal plasticity simulations of deformation and damage in metallic polycrystals including the effect of grain boundaries*. **11th International Conference on Multiscale Materials Modelling (MMM11)**. Prague, Czechia. J. LLorca. September 2024.
25. *FFT based simulation of fracture at the microscale: application to polycrystals*. **11th International Conference on Multiscale Materials Modelling (MMM11)**. Prague, Czechia. J. Segurado. September 2024.
26. *3D-printed bioresorbable polymers and polymer composites for cartilage and bone tissue engineering applications*. **1st Workshop on Additive Biofabrication (WAB2024)**. Madrid, Spain. J. LLorca. September 2024.
27. *Linking macroscopic behavior and microstructure by FFT based approaches*. **SolMech 2024**. Wroklaw, Poland. J. Segurado. September 2024.
28. *The emergence of complex microstructures during solidification – A multiscale challenge*. **LabEx DAMAS International Workshop on Innovative and Sustainable Metallurgy**. Pont-à-Mousson, France. D. Tourret. October 2024.
29. *Exploring the role of advanced characterisation in polymer composite development*. **China-Spain New Energy and Materials Forum for Academic and Industrial Cooperation.** Beijing, China. J.P. Fernández Blázquez. November 2024.

3.4. International Conferences. Regular contributions.

1. *Mathematical modeling and control of thermal and disease transmission dynamics*. **15th International Conference on Dynamical Systems Applied to Biology and Natural Sciences**. Caprica, Portugal. C. Schenk, A. Vasudevan, D. Portillo, I. Romero, M. Haranczyk. February 2024.
2. *Toward self-driving laboratory for the design of multifunctional nanocomposites*. **International Conference on Materials Science, Engineering and Technology**. Singapore, Singapore. M. Haranczyk. February 2024.
3. *Phase-field modeling of microstructure evolution during post-printing heat treatment of additively manufactured Ti6Al4V alloy*. **TMS 2024, 153rd Annual Meeting and Exhibition**, Orlando, USA. A. Boccardo, D. Tourret. March 2024.
4. *Toward the prediction of location-specific microstructures in metallic alloy additive manufacturing – combining phase-field and fast thermal models*. **TMS 2024, 153rd Annual Meeting and Exhibition**, Orlando, USA. J. Mancias, D. Tourret. March 2024.
5. *Ultrafine Ti-Fe-based eutectics for additive manufacturing: ptycho, micro, and operando X-ray imaging for characterization*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, Florida, USA. F. Sket, K. Bugelnig, J. Gussone, J. Haubrich, A. K. Pandey, P. Cloetens, U. Hecht, J. C. da Silva, M. Upadhyay, P. J. Withers, M. Easton, Y. Chen, A. Rack, G. Requena. March 2024.
6. *Bioabsorbable PLDL/Mg-wire composites manufactured by fused filament fabrication for tissue engineering Ti*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, USA. C. Thompson, C. González, J. LLorca. March 2024.
7. *In Situ EBSD/HRDIC analysis of twin transmission and co-nucleation at grain boundaries in Mg*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, USA. M. Sarebanzadeh, A. Orozco-Caballero, J. LLorca. March 2024.
8. *Assessing prismatic-to-prismatic slip transfer across grain boundaries in pure Ti via high-resolution digital image correlation*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, USA. E. Nieto Valeiras, A. Orozco Caballero, M. Sarebanzadeh, J. Sun, J. LLorca. March 2024.
9. *Application of machine learning to assess the influence of microstructure on twin nucleation in Mg alloys*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, USA. B. Yang, V. Vassilev Galindo, J. LLorca. March 2024.
10. *Deformation of Ti polycrystals from 3D diffraction contrast tomography data: experiments and simulations*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, USA. E. Nieto Valeiras, A. Orozco Caballero, M. Sarebanzadeh, J. Sun, J. LLorca. March 2024.
11. *Phase field modelling of environmentally assisted cracking of bioabsorbable Mg alloys for biomedical applications*. **TMS 2024, 153rd Annual Meeting and Exhibition**. Orlando, USA. S. Kovacevic, W. Ali, E. Martínez Pañeda, J. LLorca. March 2024.
12. *An incompatible finite element formulation for the enhanced representation of solutions in phase-field problems: application to regularised fracture*. **40th Congress of the Spanish Fracture Group**. Palma de Mallorca, Spain. M. Castillón, J. Segurado, I. Romero. March 2024.
13. **American Chemical Society Spring 2024 Meeting**. New Orleans, USA. M. Haranczyk. March 2024.
14. *Material acceleration platform for the design of polymer nanocomposites*. **American Chemical Society Spring 2024 Meeting**. New Orleans, USA. M. Haranczyk. March 2024.
15. **2nd International Seminar on Modelling, Simulation, and Machine Learning for the Rapid Development of Porous Materials**. Madrid, Spain. M. Haranczyk. March 2024.
16. *Using X-ray imaging and diffraction to assist the development of novel Ti alloys tailored for AM*. **Workshop on Additive Manufacturing (WAM2024)**. Grenoble, France. F. Sket. April 2024.
17. *Acoustic metamaterials based on reciprocity and parity transformation*. **PIERS 2024 Chengdu**. Chengdu, China. J. Shi, H. Chu, Ch. Liu, J. Christensen, X. Liu, and Y. Lai. April 2024.

18. *Synthesizing topological acoustic rainbow trapping at deep-subwavelength corners*. **PIERS 2024 Chengdu**. Chengdu, China. Z. Zhang, Y. Cheng, X.J. Liu, and J. Christensen. April 2024.
19. *Anti-parity-time symmetry in a Su-Schrieffer-Heeger sonic lattice*. **PIERS 2024 Chengdu**. Chengdu, China. B. Hu, Z. Zhang, Y. Cheng, X.J. Liu, and J. Christensen. April 2024.
20. *Advanced characterization of additively manufactured functionally graded materials coupled with thermodynamic simulations*. **19th European Mechanics of Materials Conference (EMMC19)**, Madrid, Spain. J. Valilla, D. Tourret, I. Sabirov. May 2024.
21. *An incompatible finite element formulation for enhanced representation of phase-field problems: applications to regularized fracture*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. M. Castillón, J. Segurado, I. Romero. May 2024.
22. *Phase field model of chemo-electro-mechanical processes during corrosion of bioabsorbable Mg alloys for biomedical applications*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. S. Kovacevic, W. Ali, E. Martínez Pañeda, J. LLorca. May 2024.
23. *Combining machine learning and in-situ EBSD to assess the influence of microstructure on twinning in polycrystal Mg*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. B. Yang, V. Vassilev Galindo, J. LLorca. May 2024.
24. *Experimental screening of mechanical and corrosion behavior as well as biocompatibility of Zn alloys for biomedical applications*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. G. Domínguez, P.L. Williams, M. Echeverry Rendón, J. LLorca. May 2024.
25. *Deformation mechanisms of Ti polycrystals from 3D diffraction contrast tomography and high-resolution digital image correlation data: experiments and simulations*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. E. Nieto Valeiras, A. Orozoco Caballero, M. Sarebanzadeh, J. Sun, J. LLorca. May 2024.
26. *Fatigue crack nucleation mechanisms in Ni-based superalloys subjected to strain-controlled cyclic deformation*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. I. Escobar, J. LLorca. May 2024.
27. *In situ EBSD/HRDIC-based investigation of twin-twin interaction at grain boundaries in Mg*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. M. Sarebanzadeh, A. Orozco Caballero, E. Nieto Valeiras, J. LLorca. May 2024.
28. *Effect of elastic strains on the catalytic activity of gold thin films for HER and ORR*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. J. Redondo, J. Subbian, M.A. Monclús, D. Pérez, J. Ruiz Hervías, C. Martínez Alonso, V. Vassilev Galindo, J.M. Molina Aldareguía, J. LLorca. May 2024.
29. *The energy-stepping Monte Carlo method: a highly efficient sampling algorithm for data-driven and statistical mechanics*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. I. Romero, M. Ortiz. May 2024.
30. *Progressive damage in unidirectional FRP plies*. **19th European Mechanics of Materials Conference (EMMC19)**. Madrid, Spain. R. Bouallala, C. González, I. Romero. May 2024.
31. *Pre-contour scans as a new design tool for PBF-LB/M thin-wall structures*. **19th European Mechanics of Materials Conference (EMMC19)**, Madrid, Spain. I. Rodríguez Barber, S. Milenkovic, M.T. Pérez Prado. May 2024.
32. *Influence of thickness on the (micro)structure and on the magnetic behavior of Kuamet6B2 thin walls*. **19th European Mechanics of Materials Conference (EMMC19)**, Madrid, Spain. S. Sadanand, M. Rodríguez Sánchez, A. Ghavimi, R. Busch, I. Gallino, P.M. Tiberto, E. Ferrara, G. Barrera, M.T. Pérez Prado. May 2024.
33. *Relating laser powder bed fusion process parameters to (micro)structure and to soft magnetic behaviour in a Fe-based bulk metallic glass*. **19th European Mechanics of Materials Conference (EMMC19)**, Madrid, Spain. M. Rodríguez Sánchez, S. Sadanand, A.H. Ghavimi, R. Busch, P. Maria Tiberto, E. Ferrara, G. Barrera, L. Thorsson, H.J. Wachter, I. Gallino, M.T. Pérez Prado. May 2024.

34. *Influence of lattice architecture mixing strategy for improved mechanical properties in additively manufactured Inconel718 lattices*. **19th European Mechanics of Materials Conference (EMMC19)**, Madrid, Spain. S. Sahoo, I. Toda Caraballo, M. Haranczyk, M.T. Pérez Prado. May 2024.
35. *Printing and full characterization of metamaterials using shape memory alloys for a new generation of smart personalized implants*. **12th World Biomaterials Congress**. Daegu, South Korea. M. Echeverry Rendón. May 2024.
36. *In vitro validation of electric fields using 2D and 3D systems to decrease cell proliferation in glioblastoma*. **12th World Biomaterials Congress**. Daegu, South Korea. M. Echeverry Rendón. May 2024.
37. *Calibrating complex material models: A comparative analysis of bayesian-based, optimization-based and neural network-based approaches in the presence of uncertainty*. **Conference of Mathematical Aspects of Materials Science (MS24)**. Pittsburg, Pennsylvania, USA. C. Schenk, I. Romero. May 2024.
38. *Novel titanium-based sulfur containing BMG for PBF-LB/M*, **RapidTech 2024**, Erfurt, Germany. H. Schönrath, J. Wegner, M. Frey, M. A. Schroer, X. Jin, M.T. Pérez Prado, R. Busch, S. Kleszczynski. May 2024.
39. *Corrosion of stainless steels in molten lead for power generation systems*. **XVII National Materials Conference (CNMAT 2024)**. Málaga, Spain. F. Masaril, P. Olsson, P. Szakalos, J.M. Torralba, M. Campos. June 2024.
40. *Development of High-Entropy Alloys for hydrogen storage via laser powder bed fusion*. **XVII National Materials Conference (CNMAT 2024)**. Málaga, Spain. A. Cotobal, J.A. Meza, M. de N. Morilla, V. Kumaran, D. Iriarte, S. Milenkovic, J.M. Torralba. June 2024.
41. *Study of the effect of iron powder particle morphology and size on the fabrication of Fe/FexOy soft magnetic composites*. **XVII National Materials Conference (CNMAT 2024)**. Málaga, Spain. L. Garcia de la Cruz, A. Montille, M. Campos, J.M. Torralba, P. Alvaredo. June 2024.
42. *Development of FeNiCoCrMo High-Entropy Alloys by metal injection moulding*. **XVII National Materials Conference (CNMAT 2024)**. Málaga, Spain. A. Alonso, L. García de la Cruz, J.M. Torralba, A. Meza. June 2024.
43. *Study of the influence of eutectic microconstituent morphology in High-Entropy Alloys on their mechanical behaviour*. **XVII National Materials Conference (CNMAT 2024)**. Málaga, Spain. D. Guerrero, R. Carbajales, J.M. Torralba, M. Campos, P. Alvaredo. June 2024.
44. *Application of digital volume correlation to in-situ XCT compression of LPBF Mg-based scaffolds using Avizo XDVC*. **7th Workshop on X-Ray Imaging**. Harwell, UK. F. Sket, M.D. Martín Alonso. June 2024.
45. *On the occurrence of rapid solidification in additive manufacturing of metallic alloys*, **9th European Thermal Sciences Conference (EUROTHERM)**, Bled, Slovenia. D. Tourret. June 2024.
46. *A variational method for the simulation of hydrogen diffusion in metals*. **9th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS)**. Lisbon, Portugal. E.M. Andrés, I. Romero. June 2024.
47. *Macromaterial assembly by gas phase aggregation of nanowire clusters*. **International Conference on Science and Technology of Nanotubes and Related Low-Dimensional Materials**. Boston, USA. J.J. Vilatela. June 2024.
48. *AI-based surrogate model for accelerating RTM virtual simulation.* **European Conference on Composite Materials (ECCM21)**. Nantes, France. S. Fernández, C. González. July 2024.
49. *AI-Powered prediction of cohesive fracture parameters in structural composites.* **European Conference on Composite Materials (ECCM21)**. Nantes, France. D. Mocerino, C. González. July 2024.
50. *Topological shear band engineering in mechanical metamaterials*. **META 2024**. Tayoma, Japan. J. Zhang, J. Liu, A. Souslov, M.T. Pérez Prado, J. Segurado, M. Haranczyk, and J. Christensen. July 2024.
51. *Acoustic fullerene metamaterials*. **META 2024**. Tayoma, Japan. D. Liao, J. Zhang, S. Wang, Z. Zhang, A. Cortijo, M.A.H. Vozmediano, F. Guinea, Y. Cheng, X. Liu, and J. Christensen. July 2024.

52. *Nanostructured networks to overcome the limits of traditional materials: multiscale studies and industrialisation progress*. **Europe-Korea Conference on Science and Technology 2024 (EKC2024)**. Coventry, UK. J.J. Vilatela. August 2024.
53. *Effect of PEO-coatings in Hybrid Zn - Mg alloys processed through high-pressure torsion*. **16th Biometal2024 Symposium**. Krakow, Poland. J. Salinas, N. Mollaei, C.J. Boehlert, J. LLorca, M. Echeverry Rendón. August 2024.
54. *Buoyancy-induced oscillatory growth instability during directional solidification of alloys*. **Solidification & Gravity '24**. Lillafüred, Hungary. D. Tourret, T. Isensee, J.M. Barbera. September 2024.
55. *On the occurrence of rapid solidification during laser powder-bed fusion of metallic alloys*. **Solidification & Gravity '24**. Paris, France. D. Tourret. September 2024.
56. *A variational method for the simulation of hydrogen diffusion in metals.* **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. E. M. Andrés, I. Romero. September 2024.
57. *The energy-stepping Monte Carlo method: a Markov chain Monte Carlo algorithm based on a symplectic, energy-conserving time integrator*. **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. I. Romero, M. Ortiz. September 2024.
58. *Embedded reduced models in three-dimensional bodies*. **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. D. Portillo, G. Zhang, W. Xie, I. Romero. September 2024.
59. *Numerical methods for the simulation of the interaction between incompressible fluids and structural models*. **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. R. Cantón Sánchez, D. Portillo, I. Romero. September 2024.
60. *A variational framework for thermodynamic topology optimisation*. **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. E. Bell Navas, D. Portillo, I. Romero. September 2024.
61. *ACBICI – A library for the calibration of complex and expensive models*. **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. C. Schenk, I. Romero. September 2024.
62. *A variational method for simulation of hydrogen transport in metals*. **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. E.M. Andrés, J. Segurado, I. Romero. September 2024.
63. *Embedded structures in continua*. **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. D. Portillo, G. Zhang, W. Xie, I. Romero. September 2024.
64. *Enriched discretizations for accurate phase field models with sharp interfaces: applications to fracture*. **Congress on Numerical Methods in Engineering (MNE 2024)**. Aveiro, Portugal. M. Castillón, J. Segurado, I. Romero. September 2024.
65. *Fast-speed ultrasonic imaging using a single sensor by combining disordered metasurface and artificial intelligence*. **META 2024**. Crete, Greece. W. Wang, J. Hu, J. Liu, B. Liang, J. Christensen, J. Cheng. September 2024.
66. *Multiscale modeling of rapid solidification in laser powder-bed fusion of a magnesium alloy*. **11th International Conference on Multiscale Materials Modeling (MMM11)**. Prague, Czechia. D. Tourret. September 2024.
67. *Revisiting the precipitation mechanisms of the Guinier-Preston zones and precipitates in Al-Zn-Mg alloy*. **11th International Conference on Multiscale Materials Modelling (MMM11)**. Prague, Czechia. S. Liu, W. Shao, J. LLorca. September 2024.
68. *Multiscale modelling of rapid solidification in laser power-bed fusion of a magnesium alloy*. **11th International Conference on Multiscale Materials Modelling (MMM11)**. Prague, Czechia. D. Tourret, R. Tavakoli, A. Boccardo, A. K. Boukellal, M. Li, J.M. Molina Aldareguía, J. LLorca. September 2024.
69. *Scaling laws and a homogenized plasticity model of additively manufactured lattice structures under large deformations*. **The 11th International Conference on Multiscale Materials Modeling (MMM11)**, Prague, Czechia. Z. Chen, S. Sahoo, M.T. Pérez Prado, D. Mordehai. September 2024.

70. *Bio-functional collagen-based 3D-printed Poly (Glycerol Sebacate) scaffold to enhance articular cartilage repair*. **1st Workshop on Additive Biofabrication (WAB2024)**. Madrid, Spain. Y.Y. Liu, C. Intini, M. Dobricic, F.J. O'Brien, J. LLorca, M. Echeverry Rendón. September 2024.
71. *Unraveling the interplay of mechanical and degradation performance in laser-powdered Mg scaffolds for bone regeneration: a multi-technique assessment.* **1st Workshop on Additive Biofabrication (WAB 2024)**. Madrid, Spain. M.D. Martín Alonso, F. Benn, A. Kopp, M. Majkut, J. Villanova, J.M. Molina Aldareguía, F. Sket. September 2024.
72. *Toward a self-driving laboratory for the design of multifunctional nanocomposites*. **XVII Meeting of the Specialised Polymers Group (GEP)**. Madrid, Spain. M. Haranczyk. September 2024.
73. *Relating laser powder bed fusion process parameters to (micro)structure and to soft magnetic behaviour in a Fe-based bulk metallic glass*. **Alloys for Additive Manufacturing Symposium (AAMS 2024)**. Palaiseau, France. M. Rodríguez Sánchez, S. Sadanand, A. Ghavimi, R. Busch, I. Gallino, P.M. Tiberto, E. Ferrara, G. Barrera, M.T. Pérez Prado. September 2024.
74. *Influence of thickness on the (micro)structure and the magnetic behavior of KUAMET6B2 thin walls*. **Alloys for Additive Manufacturing Symposium (AAMS 2024)**. Palaiseau, France. S. Sadanand, M. Rodríguez Sánchez, A. Ghavimi, R. Busch, I. Gallino, P.M. Tiberto, E. Ferrara, G. Barrera, M.T. Pérez Prado. September 2024.
75. *An analytical approach to scanning parameter selection: adapting normalized enthalpy to complex geometries*. **Alloys for Additive Manufacturing Symposium (AAMS 2024)**. Palaiseau, France. I. Rodríguez Barber, S. Milenkovic, M.T. Pérez Prado. September 2024.
76. *Influence of architecture on serrated flow appearance in additively manufactured Inconel 718 metamaterials*. **Alloys for Additive Manufacturing Symposium (AAMS 2024)**. Palaiseau, France. S. Sahoo, Z. Chen, S. Banait, D. Mordehai, M.T. Pérez Prado. September 2024.
77. *Unravelling the microstructure development and strengthening mechanisms of AMALLOY3D-HT, an aluminium grade developed for laser powder bed fusion and high-temperature applications*. **Alloys for Additive Manufacturing Symposium (AAMS 2024)**. Palaiseau, France. G. Del Guercio, F. Bosio, S. Robertson, P.A.J. Bagot, S. Sahoo, M.T. Pérez Prado, N.T. Aboulkhair. September 2024.
78. *A journey into alloy design, development, and industrialisation of custom Al alloys for Additive Manufacturing applications*. **Alloys for Additive Manufacturing Symposium (AAMS 2024)**. Palaiseau, France. F. Bosio, G. Del Guercio, C. Phutela, R. Casas, T. Choma, Alexander Pesl, M.T. Pérez Prado, N.T. Aboulkhair. September 2024.
79. *Advancing additive manufacturing of Ni-based superalloys: integrating High-Entropy Alloy thermodynamics into novel CoNi based superalloys for powder-based technologies*. **2024 Powder Metallurgy World Congress**. Yokohama, Japan. A. Mohammadzadeh, A. de Nardi, J.M. Torralba. October 2024.
80. *Developing CoCrFeNi High-Entropy Alloy with Mo and Nb via in situ alloying in laser powder bed fusion (PBF-LB/M) and evaluating its high-temperature properties*. **2024 Powder Metallurgy World Congress**. Yokohama, Japan. S. Venkatesh Kumaran, B. Malladi, A. Meza, E. Hryha, J.M. Torralba. October 2024.
81. *Improvement of mechanical properties of CoCrMo alloys through microstructure engineering using powder metallurgy*. **2024 Powder Metallurgy World Congress**. Yokohama, Japan. L. García de la Cruz, P. Alvaredo, J.M. Torralba, M. Campos. October 2024.
82. *Deformation mechanisms of dual-textured Mg-6.5Zn alloy with low tension-compression asymmetry: experiments and simulations*. **8th International Conference on Mg and 13th International Conference on Mg alloys and their Applications**. Chongqing, China. B. Yang, E. Nieto Valeiras, M. Zhang, J. LLorca. November 2024.

83. *Development of Mg wires and 3D printed scaffolds for biomedical applications*. **8th International Conference on Mg and 13th International Conference on Mg alloys and their Applications**. Chongqing, China. J. LLorca. November 2024.
84. *Understanding twin nucleation in Mg through in situ electron back-scatter diffraction and machine learning*. **8th International Conference on Mg and 13th International Conference on Mg alloys and their Applications**. Chongqing, China. J. LLorca. November 2024.
85. *Laboratory automation aiding the design of multifunctional nanocomposites*. **12th Singapore International Chemistry Conference**. Singapore. M. Haranczyk. December 2024.
86. *Correlation between mechanical properties and morphology of 3D-printed polymer parts.* **Latin American Symposium on Polymers (SLAP2024).** Puerto Varas, Chile. J.P. Fernández Blázquez. December 2024.

3.5. Invited Seminars by IMDEA Materials Institute Researchers

1. *A taste of X-ray imaging and diffraction on material science: examples.* **University of Florida**. Florida, USA. F. Sket. March 2024.
2. *Materials for healthcare*. **Herbert Wertheim College of Engineering**. Orlando, USA. J. LLorca. March 2024.
3. *Design of energy-saving materials*. **2024 Structural Nanomaterials Gordon Research Conference**. Les Diablerets, Switzerland. M.T. Pérez Prado. May 2024.
4. *Formation of complex microstructures in solidification of metallic alloys – Insights from multiscale modeling*. **Yanshan University**. Qinhuangdao, China. D. Tourret. May 2024.
5. *Nanomeric materials: new frontiers of properties and applications in batteries, composites and conductors*. **Texas A&M**. College Station, USA. J.J. Vilatela. May 2024.
6. *Tecnologías de digitalización en IMDEA Materiales*. **VIII JORNADA ITPAero - CENTROS TECNOLÓGICOS**. Burgos, Spain. F. Sket. May 2024.
7. *Solidification modeling across scales*. **CNRS Summer School on Solidification**. St Pierre d'Oléron, France. D. Tourret. June 2024.
8. *Multimaterial bioresorbable scaffolds manufactured by 3D printing for bone tissue engineering*. **School of Materials Science and Engineering**, **Shanghai Jiao Tong University.** Shanghai, China. J. LLorca. June 2024.
9. *Experimental and computational analysis of the effect of grain boundaries on deformation of Ti*. **State Key Laboratory of Metastable Materials Science and Technology**. Yanshan University. Qinhuangdao, China. J. LLorca. June 2024.
10. *Multimaterial bioresorbable scaffolds manufactured by 3D printing for bone tissue engineering*. **State Key Laboratory for Advanced Materials and Metals, Beijing University of Science and Technology**. Beijing, China. J. LLorca. June 2024.
11. *Multimaterial bioresorbable scaffolds manufactured by 3D printing for bone tissue engineering*. **School of Materials Science and Engineering, Peking University**. Beijing, China. J. LLorca. June 2024
12. *Seeing is believing!* **The Past Metallurgists Society Lecture Series**, **University of Cambridge**, Cambridge, United Kingdom. M.T. Pérez Prado. June 2024.
13. *Smart Digital Twins for Structural Composites Manufacturing*. **European Conference on Composite Materials ECCM21**. Nantes, France. C. González. July 2024.
14. *Experimental and computational analysis of the effect of grain boundaries on deformation of Ti*. **Massachusetts Institute of Technology**. Cambridge, UK. J. LLorca. July 2024.

15. *New generation fire-safe polymeric materials and polymer nanocomposites*. **Shanghai Polytechnic University**. Shanghai, China. D.Y. Wang. July 2024.
16. *Post Sintering Treatments*. **European Powder Metallurgy Association Summer School**. Alessandria, Italia. J.M. Torralba. July 2024.
17. *4D printing of metallic alloys towards novel shape morphing medical devices*. **Karlsruhe Institute of Technology (KIT)**. Karlsruhe, Germany. J.M. Molina Aldareguía. July 2024.
18. *Additive manufacturing of energy-saving materials*. **Lawrence Livermore National Laboratory**. California, USA. M.T. Pérez Prado. August 2024.
19. *3D printing of metals for energy saving applications*. **100th IUVSTA Workshop on "How sustainable are thin films and thin film processing? Pathways towards responsible surface engineering"**. Ludwigsburg, Germany. M.T. Pérez Prado. October 2024.
20. *Do we have enough metals for the energy transition?* **FORO La Región**. Orense, Spain. J.M. Torralba. October 2024.
21. *Topological Phononic Metamaterials*. **Centre for Nanosciences and Nanotechnologies**. Paris Saclay, France. J. Christensen. October 2024.
22. *Corrosion and mechanical degradation of additively-manufactured Mg scaffolds for tissue engineering*. **2024 International Symposium on Structural Integrity (ISSI2024)**. Dongguan, China. J. LLorca. November 2024.
23. *Sustainable metallurgy: toward a new paradigm in materials design*. **MATERPLAT General Assembly.** Getafe, Spain. J.M. Torralba. December 2024.
24. *Innovative approaches to enhance steel performance under extreme conditions*. **Materials for a Better Defense.** IMDEA Materials. Madrid, Spain. I. Sabirov. December 2024.
25. *Lightweighting vehicles and aircraft using the next generation of batteries*. **Materials for a Better Defense.** IMDEA Materials. Madrid, Spain. December 2024.
26. *Material characterisation through 2D, 3D and 4D x-ray imaging*. **Materials for a Better Defense.** IMDEA Materials. F. Sket. December 2024.
27. *Meta-Military*. **Materials for a Better Defense.** IMDEA Materials. Madrid, Spain. J. Christensen. December 2024.
28. *Structural composites for lightweight applications: design, manufacturing and performance*. **Materials for a Better Defense.** IMDEA Materials. Madrid, Spain. C. González. December 2024.

3.6. Invited Seminars Hosted by IMDEA Materials Institute

1. *Triboelectric nanogenerators and quantum-mechanical modeling of contact electrification*. **Beijing Nanoenergy and Nanosystems Institute**, China. Prof. M. Willatzen. March 2024.
2. *AI-guided accelerated synthesis of functional inorganic materials.* **NTU Singapore**, Singapore. Dr. J. Recatala. April 2024.
3. *Optimisation of Fe-Mc-C steels for biodegradable vascular implant applications*. **Leibniz Institute for Solid State and Materials Research**, Germany. M. Otto. May 2024.
4. *In situ investigation of hydrogen-assisted crack initiation in nickel-based alloy 725.* **Washington and Lee University**, USA. Prof. M. Liu. May 2024.
5. *From lab to market, challenges and opportunities of a start-up with impact.* **Polykey**, Spain. A. Basterretxea and C. Jehanno. May 2024.
6. *Architecting carbonaceous electrodes*. **Clemson University**, USA. Prof. R. Martínez. June 2024.
7. *Multiscale phenomena in additive manufactured lattice and thin-wall structures.* **University of**

Arizona, USA. Prof. K. Hazeli. June 2024.

8. *Not everything is possible in science! The fundamental role of ethics in research.* **CSIC** and **National Biotechnology Centre**, Spain. Dr. L. Montoliu. June 2024.
9. *Physics-based modelling, machine learning and cyber-infrastructure accelerating materials research and innovation.* **Purdue University**, USA. Prof. A. Strachan. June 2024.
10. *Developing impactful medical technologies in international contexts.* **University of Cape Town**, South Africa. Prof. S. Sivarasu. June 2024.
11. *Electrolyte and electrode design for next-generation batteries.* **Czech Academy of Sciences**, Czechia. Dr. J. Červenka. June 2024.
12. *Multiphysics modelling for multifunctional composite materials.* **Basque Center on Materials, Applications and Nanostructures**, Spain. Dr. S. Lucarini. June 2024.
13. *Developing impactful medical technologies in international contexts.* **ETH Zurich**, Switzerland. Dr. W. Yan. June 2024.
14. *2D layered materials for sustainable energy storage.* **Dresden University of Technology**, Germany. Dr. M. Yu. June 2024.
15. *These is plenty of room at the bottom…for magnesium alloys!* **Colorado School of Mines**, USA. Prof. S. Mathaudu. June 2024.
16. *How do charge carrier transport and microstructure influence solid-state battery performance: solving the jigsaw.* **Delft University of Technology**, Netherlands. Dr. M. Rana. July 2024.
17. *Flame-retardant polymer for impact and energy-absorbing composites*. **Beijing Institute of Technology**, China. Dr. Y. Yang. July 2024.
18. *Static recrystallisation behaviour in magnesium alloys.* **University of Southhampton**, United Kingdom. Dr. D. Guan. August 2024.
19. *Engineering electronic and thermal transport in complex crystals*. **University of Oregon**, USA. Dr. M.T. Agne. August 2024.
20. *The synergy between metallurgical and construction sectors: waste to wealth.* **KU Leuven**, Belgium. D. Som. September 2024.
21. *Battery simulations: capacities and challenges.* **IMDEA Energy Institute**, Madrid, Spain. Dr. S. Pinilla. September 2024.
22. *The contact makes the device: molecules that rule the solar cells efficiency.* **Institute of Chemical Research in Catalonia**, Spain. Prof. E.J. Palomares Gil. September 2024.
23. *Dietary regulation of liver regeneration.* **National Centre for Cardiovascular Research,** Spain. Dr. M.A. Fernández Rojo. October 2024.
24. *Designing covalent organic framework (COF) for photocatalytic water remediation and clean energy applications.* **Autonomous University of Madrid**, Spain. Dr. A. Moya. October 2024.
25. *Microstructure design in multi-phase metallic materials via additive manufacturing.* **Imperial College London**, United Kingdom. Prof. N. Haghdadi. November 2024.
26. *Modelling of continuous casting of steel: nozzle clogging, alloy segregation and semi-solid deformation.* **McMaster University**, Canada. Prof. A. Phillion. November 2024.

3.7. International Conferences. Membership of Organising Committees.

1. *Computational Thermodynamics & Kinetics.* Orlando, USA. Dr. D. Tourret (Symposium Organiser). March 2024
2. *Beamtime Allocation Panel (BTAP).* European Synchrotron Radiation Facility (ESRF). Grenoble, France. Dr. F. Sket (Panel Chair). April 2024.
3. *5th International Symposium on Phase-Field Modelling in Materials Science (PF24)*. Hangzhou, China. Dr. D. Tourret (Scientific Committee Member). May 2024.
4. *"Advances in Additive Manufacturing"* symposium at European Mechanics of Materials Conference (EMMC19). Madrid, Spain. Dr. M.T. Pérez Prado (Symposium Organiser). May 2024.
5. *CNRS Summer School on Solidification*. St Pierre d'Oléron, France. Dr. D. Tourret (Scientific Committee Member). June 2024.
6. *"Multiscale and multi-physics modeling of metal additive manufacturing processes"* symposium at 11th International Conference on Multiscale Materials Modeling (MMM11). Prague, Czechia. M.V. Upadhyay, A.M. Beese, D. Tourret (Symposium Organiser). September 2024.
7. *Alloys for Additive Manufacturing Symposium 2024 (AAMS2024)*. Palaiseau, France. M.T. Pérez Prado (Scientific Committee Member). September 2024.

3.8. Researcher and Institutional Awards.

1. **Prof. J. LLorca.** *Morris Cohen Award*, The Minerals, Metals & Materials Society (TMS), March 2024.
2. **C. Martínez Alonso, B. Limones Ahijón** and **Y. Liu.** *Four Minute Thesis Contest,* IMDEA Materials Institute. April 2024.
3. **Dr. L. Doyle.** *Falling Walls Lab Marie Skłodowska Curie Actions (Second Place).* April 2024.
4. **C. Martínez Alonso.** *Complutense University of Madrid and Madrid Regional Three Minute Thesis (3MT) Contests (Winner: Science Category).* June 2024.
5. **B. Limones Ahijón**. *Carlos III University of Madrid Three Minute Thesis (3MT) Contest (Third Place).* June 2024.
6. **Dr. M. Islam, Dr. C. Ruestes, J. Redondo Sánchez, M. Hernández del Valle, B. Ozdemir** and **Dr. J. Ordoño.** *13th Annual IMDEA Materials Institute Imaging Contest*, IMDEA Materials Institute. June 2024.
7. **Prof. D.Y. Wang.** ***Fellowship,*** European Academy of Sciences (EurASc). September 2024.
8. **Prof. J. LLorca, Prof. J.M. Torralba, Prof. D.Y. Wang, Prof. C. González, Prof. J. Segurado, Dr. M.T. Pérez Prado, Dr. J. Christensen, Dr. I. Sabirov** and **Dr. Harun Tüysüz.** *World's Most Influential Scientists*, Stanford University. October 2024.
9. **Prof. Dr. E. Oñate.** *National Research Prize in Engineering and Architecture*, Spanish Ministry of Science, Innovation and Universities. October 2024.
10. **B. Yang.** *Best Paper Award*, International Magnesium Society (IMS). October 2024.
11. **Prof. J. Llorca.** *Annual Award*, International Magnesium Society (IMS). October 2024.
12. **Prof. D.Y. Wang.** *Honorary Professorship*, Xi'an University. December 2024.

4. Technology Offer

IMDEA Materials Institute is constantly developing new technologies and inventions based on the results of the projects we carry out. Here, you can find our technology offer. For all enquiries, please contact us at techtransfer.materials@imdea.org.

Title: *Structure comprising a first, rapidly degradable part and a second, slowly or non-degradable part (European patent filed, EP25143513.4, joint ownership with Meotec GmbH and the Technical University of Madrid)*
Description: Innovative new shape-morphing designs for biomedical applications.
Opportunity: Technology License

Title: *Laser-based additive manufacturing device and method for crystallisation control of metallic glasses* (European patent filed, EP24383248.2)
Description: A slicer for metallic laser-based additive manufacturing printers enabling the manufacturing of metallic glass components by preventing unwanted crystalline formation.
Opportunity: Technology License

Title: *Inorganic-organic bio-based materials (Spanish patent filed, P202430817)*
Description: Bio-based flame retardant coatings with excellent flame retardancy (>1400°C), eco-friendly, non-toxic, form a strong char barrier, enhance adhesion at high temperature, and suit coatings for metals, textiles, and polymers, etc.
Opportunity: Technology License

Title: *Device for detecting movement and/or pressure force of a first element relative to a second element (Spanish patent awarded, ES2977823, joint ownership with the Technical University of Madrid)*
Description: Battery-free, high-sensitivity motion and force sensor using TENG technology. It detects slow/fast movements (up to 200 Hz), works in harsh conditions, is low-cost, scalable, and ideal for industrial and seismic use.
Opportunity: Technology license

Title: *Methods for fabricating high-performance and lightweight lithium-ion batteries based on silicon and CNTs (US patent filed, PCT extension, PCT/US25/13097, joint ownership with RICE University)*
Description: High-performance, lightweight Li-ion battery anode using silicon and carbon nanotubes. It enhances energy density, extends cycle life, and reduces weight compared to conventional copper-based designs.
Opportunity: Technology license.

Title: *Spark ablation device, method for generating nanoparticles by means of said device, and associated uses thereof (European patent filed, EP24382060.2)*
Description: Spark ablation device used for generating large concentrations (10^8 particles/cm^3) of very small conductive nanoparticles (<5 nm geometric mean size).
Opportunity: Technology license

Title: *Mechanical testing device attachable to a cone calorimeter (Spanish utility model awarded, ES1308130)*
Description: Mechanical testing device attachable to a cone calorimeter configured to perform tests for safety design and to test mechanical properties under load and extreme thermal conditions.
Opportunity: Technology license

Title: *Portable, communicating impact detection and wearer condition monitoring device and system comprising the device (Spanish patent awarded, ES2958227, joint ownership with the Technical University of Madrid)*
Description: A device capable of identifying impacts, their magnitude and location, as well as a person's vital signs if applied as a wearable, and transmitting these parameters via the internet.
Opportunity: Technology license

Title: *Method of inspecting a volume of a composite component, apparatus for inspecting the composite component and a computer program (Spanish patent awarded, ES2947809, joint ownership with the Technical University of Madrid)*
Description: Non-destructive machine learning-based methodology capable of improving porosity estimation and types of porosity on composite materials.
Opportunity: Technology license

Title: *Halogen-free flame-retardant copolymerised macromolecule and flame-retardant polyolefin material thereof (Chinese patent filed, CN202310359958A, joint ownership with Beijing Technology and Business University)*
Description: Halogen-free, synergistic flame-retardant polyolefin enhances fire safety, reduces smoke, and improves strength and flexibility, ideal for high-end manufacturing.
Opportunity: Technology license

Title: *PLA aerogel-based phase-change composites for thermal energy storage and heat management (European patent filed, PCT extension, PCT/EP2023/080316, joint ownership with Francisco de Vitoria University)*
Description: Shape-stabilised composite phase-change material (PCM), physically stable and with high phase change enthalpy. The material is suitable for thermal

management applications in electronics, power electronics, solar energy, batteries, or construction.
Opportunity: Technology license

Title: *Breathing monitoring device (Spanish patent awarded, ES2935558)*
Description: Smart face mask with self-powered sensors capable of monitoring vital parameters such as respiration rate and characteristics of respiration pulses that wirelessly transmit them through IoT protocols to a telemedicine platform.
Opportunity: Technology license

Title: *Seismic detection system (Spanish patent awarded, ES2913295, joint ownership with the Technical University of Madrid and Rey Juan Carlos University)*
Description: A sensor device that detects seismic waves and plenty of physical magnitudes characteristic of them through a wide range of frequencies, capable of communicating data signals in real-time. The device is also mechanically robust and capable of withstanding extreme environmental conditions.
Opportunity: Technology license

Title: *Electrode for capacitive deionisation (Spanish patent awarded, ES2694653, joint ownership with IMDEA Energy Institute)*
Description: Electrode for capacitive deionisation in which the active phase and the current collector are included in a single element, i.e. a composite material.
Opportunity: Technology license

Title: *Method of manufacturing composite materials with monitoring capability and obtainable material* (Spanish patent awarded, ES2567527, joint ownership with the Technical University of Madrid)
Description: Thin sensor laid between dry fabric layers and connected to a simple electrical power meter that provides real-time information about the resin flow and the gel point during resin infusion and curing, remains embedded in the composite and can be used for structural health monitoring and damage detection.
Opportunity: Technology license

Title: *A halogen free flame-retardant epoxy resin composition (Spanish patent awarded, ES2566567)*
Description: New halogen-free flame-retardant epoxy resin with excellent mechanical properties, thermal resistance, low smoke release and good processability, which can also be used as an adhesive.
Opportunity: Technology license

Software

Title: *CAPSUL*
Description: CAPSUL is a package of crystal plasticity and polycrystalline homogenisation simulation tools.
Opportunity: Software license via HEXAGON Digimat

Title: *FFTMAD (Fast Fourier Transform based homogenisation code, MADrid)*
Description: FFT-based simulation tool developed by IMDEA Materials for computational homogenisation of any heterogeneous material, such as composites, polycrystals or celular materials, by simulating the behavior of a representative volume element (RVE) of the microstructure.
Opportunity: Software license

Title: *VIPER (VIrtual Ply propERty)*
Description: Simulation tool developed by IMDEA Materials to predict ply properties of fiber-reinforced composite materials from the properties and spatial distribution of the different phases and interfaces in the composite.
Opportunity: Software license

Title: *IRIS*
Description: IRIS is an object oriented, general purpose, parallel code for computational mechanics in solid, fluid, and structural applications. It has finite element and meshless capabilities, a wide range of material models, and solvers for linear and nonlinear, stationary and transient simulations.
Opportunity: Software license

Title: *MUESLI*
Description: MUESLI, a Material UnivErSal LIbrary, is a collection of C++ classes and functions designed to model material behavior at the continuum level. It is available to the material science and computational mechanics community as a suite of standard models and as a platform for developing new ones.
Opportunity: Software license

5. Training, Internships and Visiting researchers

5.1. PhD theses

Student: X. Li
Thesis Title: *Highly sensitive smart sensor for early fire warning detection*
Supervisor/s: Prof. D.Y. Wang
Defense Date: January 24, 2024
Awarding Institution: Technical University of Madrid

Student: C. Thompson
Thesis Title: *Medical grade bioabsorbable composites for the 3D printing of multi-material orthopaedic devices*
Supervisor/s: Profs. C. González and J. LLorca
Defense Date: February 15, 2024
Awarding Institution: Carlos III University of Madrid

Student: M.E. Nieto Valeiras
Thesis Title: *Effect of grain boundaries on the deformation and fracture of metallic polycrystals*
Supervisor/s: Prof. J. LLorca
Defense Date: February 16, 2024
Awarding Institution: Technical University of Madrid

Student: J.D. Aveiga García
Thesis Title: *Mechanical behavior and numerical modelling of uncured prepreg composites for thermoforming processes*
Supervisor/s: Prof. C. González
Defense Date: March 15, 2024
Awarding Institution: Technical University of Madrid

Student: I. Lizarralde Delgado
Thesis Title: *Dimensional stability of carbon fibre reinforced polymers prepared by infusion processes*
Supervisor/s: Prof. C. González and Dr. E. Sapountzi
Defense Date: April 19, 2024
Awarding Institution: Technical University of Madrid

Student: C.P. Lobato Costa
Thesis Title: *PLA-PCL textile reinforced composites for connective tissue applications*
Supervisor/s: Profs. C. González and J. LLorca
Defense Date: May 10, 2024
Awarding Institution: Carlos III University of Madrid.

Student: A. Sierra Soraluce
Thesis Title: *Microstructural design in martensitic stainless steels via quenching and partitioning to improve their mechanical properties*
Supervisor/s: Dr. I. Sabirov
Defense Date: June 25, 2024
Awarding Institution: Carlos III University of Madrid

Student: V.K. Sivagnana Desigan
Thesis Title: *Developing new high entropy alloys for high temperature applications using advanced powder metallurgy routes and additive manufacturing*
Supervisor/s: Prof. J.M. Torralba
Defense Date: September 13, 2024
Awarding Institution: Carlos III University of Madrid

Student: W. Shao
Thesis Title: *Accurate prediction of phase diagrams of binary alloys from first-principles calculations and statistical mechanics*
Supervisor/s: Prof. J. LLorca and Dr. S. Liu
Defense Date: September 20, 2024
Awarding Institution: Technical University of Madrid

Student: C. Martínez Alonso
Thesis Title: *High-throughput computational strategies to discover new catalyst for the Hydrogen Economy including elastic strain engineering*
Supervisor/s: Prof. J. LLorca
Defense Date: October 2, 2024
Awarding Institution: Complutense University of Madrid

Student: M. Sarebanzadeh
Thesis Title: *Grain boundaries in Mg: formation during solidification and their influence on deformation*
Supervisor: Prof. J. LLorca and Dr. A. Orozco Caballero
Defense Date: November 29, 2024
Awarding Institution: Technical University of Madrid

5.2. Master's and Bachelor's Degree research

1. Characterisation of a new microphysiological system for in vitro evaluation of cardiovascular devices
   Student: N. Téllez Fouz
   Advisor: Prof. J.M. Molina Aldareguía
   University: Carlos III University of Madrid

2. Characterisation of the microstructure and mechanical behaviour of coatings, and their service life and wear mechanisms under operating conditions
   Student: D. Sanmartín Plano
   Advisor: Prof. J.M. Molina Aldareguía
   University: Technical University of Madrid

3. Study of the evolution of the microstructure of metallic glasses manufactured by selective laser melting (SLM)
   Student: M. del Carmen Garrote Junco
   Advisor: Dr. M.T. Pérez Prado
   University: Technical University of Madrid

4. Mechanical and microstructural characterisation of 3D-printed PA12 and TPU: effect of ageing
   Student: C. Cantador Flores
   Advisor: Prof. J. Segurado
   University: Carlos III University of Madrid

5. Application of a non-destructive inspection method for damage evaluation in composite material samples
   Student: M. Ortíz Villarejo
   Advisor: Dr. F. Sket.
   University: Carlos III University of Madrid

6. High Entropy Alloy components prepared from commodity alloys and metal injection moulding techniques
   Student: A. Alonso Romero
   Advisor: Prof. J.M. Torralba
   University: Carlos III University of Madrid

7. Optimisation of a modified H13 tool steel for manufacturing by metal injection moulding
   Student: Á. Martín Martín
   Advisor: Prof. J.M. Torralba
   University: Carlos III University of Madrid

8. Microstructural and mechanical characterisation of high-entropy alloys resistant to hydrogen embrittlement
   Student: D. Martín Nolasco
   Advisor: Prof. J.M. Torralba
   University: Universidad Europea de Madrid

9. Development of lightweight high-entropy alloys through powder metallurgy routes
   Student: E. González García
   Advisor: Prof. J.M. Torralba
   University: Carlos III University of Madrid

10. Hydrolig: selective drug delivery via hydrogel/lig smart actuators
    Student: Y. Sbihi Mohamed
    Advisor: Prof. D.Y. Wang
    University: Carlos III University of Madrid

5.3. Visiting researchers

Prof. Humberto Terrones Maldonado
Visiting researcher

Birkbeck College, University of London, United Kingdom

Rayleigh Endowed Chair Professor, Department of Physics, Applied Physics & Astronomy, Rensselaer Polytechnic Institute, USA

Prof. José Antonio Rodriguez Martínez
Visiting researcher

Associate Professor in the Department of Continuum Mechanics and Structural Analysis, Carlos III University of Madrid, Spain

Dr. Michael Shaw Titus
Visiting researcher

Associate Professor of Materials Engineering, School of Materials Engineering, Purdue University, USA

Prof. Morten Willatzen
Visiting researcher

Senior Full Professor at the Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China

Dr. Jian Yang
Visiting researcher

Professor, Department of Materials Processing Engineering, School of Materials Science and Engineering, University of Science and Technology Beijing, China

5.4. Visiting Research Associates

1. **Name:** Dr. E. García Álvarez
   Advisor/s: Prof. J. LLorca
   Research Topic: *Implantable device for brain tumour treatment*

2. **Name:** Dr. A.D. Boccardo
   Advisor/s: Dr. D. Tourret
   Research Topic: *Combined phase field and mechanical modelling for solid-state transformations in AM Ti6Al4V alloys*

3. **Name:** Dr. A. Bouzas Muñoz
   Advisor/s: Dr. M. Echeverry Rendón and Prof. J. LLorca
   Research Topic: *Phase-field modelling of additive manufacturing*

4. **Name:** Dr. A.K. Boukellal
   Advisor/s: Dr. D. Tourret
   Research Topic: *Modelling and simulation of materials processing*

5. **Name:** Dr. A. Fernández Gorgojo
   Advisor/s: J.M. Molina Aldareguía
   Research Topic: *Recycling composite materials*

6. **Name:** J.M. Guevara Vela
   Advisor/s: Prof. J. LLorca
   Research Topic: *Design of novel materials by first principles calculations*

7. **Name:** Dr. R. Lehane
   Advisor/s: Dr. J.J. Vilatela
   Research Topic: *Multifunctional nanocomposites*

8. **Name:** Dr. X. Liu
   Advisor/s: Prof. H. Tüysüz
   Research Topic: *Catalysis and energy materials*

9. **Name:** Dr. A. Orozco Caballero
   Advisor/s: Profs. J. LLorca and J.M. Molina Aldareguía
   Research Topic: *Materials mechanics*

10. **Name:** Dr. R. Pernas-Salomón
    Advisor/s: Dr. J. Christensen
    Research Topic: *Electro-momentum coupling in piezoelectric heterostructures*

11. **Name:** Dr. Z. Regaieg
    Advisor/s: Dr. D. Tourret
    Research Topic: *Modelling and simulation of materials processing*

12. **Name:** Dr. C.J. Ruestes Vegas
    Advisor/s: Prof. J. Segurado
    Research Topic: *Multiscale simulation of nano-porous tungsten under irradiation damage*

13. **Name:** Dr. J. Sánchez del Río Sáez
    Advisor/s: Profs. D.Y. Wang and J.M. Molina Aldareguía
    Research Topic: *Micro- and nano-mechanics and high-performance polymers and fire retardants*

14. **Name:** Dr. R. Sánchez Díaz
    Advisor/s: Prof. D.Y. Wang
    Research Topic: *High-performance polymers and fire retardants*

15. **Name:** Dr. M.A. Jabbari Taleghani
    Advisor/s: Prof. J.M. Torralba
    Research Topic: *Master alloy design for sintered steel*

16. **Name:** Dr. R. Tavakoli
    Advisor/s: Dr. D. Tourret
    Research Topic: *Phase-field modelling of additive manufacturing*

17. **Name:** Dr. A. Vázquez López
    Advisor/s: Prof. D.Y. Wang
    Research Topic: *Development of antibacterial polymer-based textiles*

18. **Name:** Dr. W. Warzanskyj Prieto
    Advisor/s: Prof. J. Segurado
    Research Topic: *Crystal plasticity modelling of SLM fabricated Ti for TPMS structures*

19. **Name:** Dr. Z. Ye
Advisor/s: Dr. I. Sabirov
Research Topic: *Physical simulation*

20. **Name:** Dr. G. Yin
Advisor/s: Prof. D.Y. Wang
Research Topic: *Chemical synthesis and nanomaterials*

21. **Name:** Dr. Y. Zhao
Advisor/s: Prof. H. Tüysüz
Research Topic: *Catalysis and energy materials*

5.5. Visiting Research Assistants

1. **Name:** C. Aguilar Vega
Advisor/s: Prof. J.M. Molina Aldareguía
Research Topic: *Metamaterials printing using shape memory alloys and functional gradients for a new generation of smart implants*

2. **Name:** S.A. Arévalo Aguirre
Advisor/s: Prof. J.M. Torralba
Research Topic: *Solid state processing*

3. **Name:** G.J. Caballero García
Advisor/s: Prof. J.M. Torralba
Research Topic: *Advanced rheological characterisation of feedstocks for pellet-based 3D printing by extrusion*

4. **Name:** R. Carbajales Hernández
Advisor/s: Prof. J.M. Torralba
Research Topic: *Solid state processing*

5. **Name:** R. Castellote Álvarez
Advisor/s: Prof. J.M. Molina Aldareguía
Research Topic: *Additive manufacturing of High Entropy Alloys*

6. **Name:** A. Duke
Advisor/s: Dr. J. Patterson
Research Topic: *Biomaterials and regenerative medicine*

7. **Name:** L. Echevarría Pastrana
Advisor/s: Dr. M. Haranczyk
Research Topic: Nanomaterial synthesis for high-energy density lithium-ion battery electrodes

8. **Name:** D.A. García Carrero
Advisor/s: Prof. J.M. Molina Aldareguía
Research Topic: *Micro- and nano-mechanics (Industrial Ph.D.)*

9. **Name:** Á. García de la Camacha Díaz
Advisor/s: Prof. J. LLorca
Research Topic: *Biodegradable textile scaffolds for biomedical applications scaffolds by 3D printing for osteochondral tissue regeneration*

10. **Name:** Cl. Giudici
Advisor/s: Dr. J.J. Vilatela
Research Topic: *Experimental campaign on FCCVD processes for CNT synthesis from CH4*

11. **Name:** A. Gómez Fernández
Advisor/s: Dr. I. Sabirov
Research Topic: *Microstructural design in lightweight steels*

12. **Name:** I. Gómez Palos
Advisor/s: Dr. J.J. Vilatela
Research Topic: *1D nanostructure synthesis for energy conversion and storage*

13. **Name:** E. Juarez González
Advisor/s: Dr. J. Patterson
Research Topic: *Biomaterials and regenerative medicine*

14. **Name:** C.P. Lobato Costa
Advisor/s: Profs. J. LLorca and C. González
Research Topic: *Biodegradable textile scaffolds for biomedical applications*

15. **Name:** J. Macías
Advisor/s: Dr. D. Tourret
Research Topic: *Computational design of metallic alloys for additive manufacturing*

16. **Name:** F.T. Masari
Advisor/s: Prof. J.M. Torralba
Research Topic: *Development of alumina-forming martensitic steels*

17. **Name:** A. McKee
Advisor/s: Prof. J. LLorca
Research Topic: *Microelectrodes and flexible batteries to treat brain tumours with carbon nanotubes*

18. **Name:** M. Mustafa
Advisor/s: Prof. J. Segurado
Research Topic: *Lattice material simulation*

19. **Name:** A.L. Olaizola Heil
Advisor/s: Dr. J. Patterson
Research Topic: *Bioengineering of skeletal muscle satellite cells*

20. **Name:** M. Ortega
Advisor/s: Dr. J. Patterson
Research Topic: *Biomaterials and regenerative medicine*

21. **Name:** T. Piekkola
Advisor/s: Dr. J. Patterson
Research Topic: *Dynamic coil-shaped polylactic acid-reinforced extracellular matrix-derived scaffolds with oriented pores for articular cartilage*

22. **Name:** J. Porath
Advisor/s: Dr. M. Haranczyk
Research Topic: Machine automation

23. **Name:** P. Ramesh Narayan
Advisor/s: Dr. I. Sabirov
Research Topic: *Topological properties in mechanical and electronic metamaterials*

24. **Name:** L. Reinke
Advisor/s: Dr. J. Patterson
Research Topic: *Biomaterials and regenerative medicine*

25. **Name:** J. Salinas
Advisor/s: Prof. J. LLorca
Research Topic: *Zinc alloys*

26. **Name:** R. Santos Güemes
Advisor/s: Prof. J. LLorca
Research Topic: *Virtual design, virtual processing and virtual testing of metallic materials*

27. **Name:** M. Sarebanzadeh
Advisor/s: Prof. J. LLorca
Research Topic: *Grain boundaries in Mg. alloys*

28. **Name:** S. Kail
Advisor/s: Dr. J. Patterson
Research Topic: *Materials and models against pandemics*

29. **Name:** W. Shao
Advisor/s: Prof. J. LLorca
Research Topic: *First principles simulations of phase diagrams*

30. **Name:** M. Sheikhi
Advisor/s: Dr. D. Tourret
Research Topic: *Phase-field simulation of microstructure evolution in Ti alloy*

31. **Name:** A. Sierra Soraluce
Advisor/s: Dr. I. Sabirov
Research Topic: *Development of new martensitic stainless steels*

32. **Name:** V.K. Sivagnana Desigan
Advisor/s: Prof. J.M. Torralba
Research Topic: *High entropy alloys by powder metallurgy*

33. **Name:** E. Suslu
Advisor/s: Dr. I. Sabirov
Research Topic: *Characteristation of additively manufactured carbon steels*

34. **Name:** S. Swaminathan
Advisor/s: Dr. J. Patterson
Research Topic: *Enhancing cardiac stem cell differentiation with biomimetic and stretchable cell culture platforms*

35. **Name:** B. Stack
Advisor/s: Dr. M. Haranczyk
Research Topic: Robotically automated 3D printing and testing of thermoplastic material specimens

36. **Name:** S. Tahsin Upama
Advisor/s: Dr. J.J. Vilatela
Research Topic: *High-performance composites based on CNT fibres and ceramic matrices*

37. **Name:** C.T. Thompson
Advisor/s: Profs. J. LLorca and C. González
Research Topic: *3D printed bioabsorbable composite materials for orthopaedic applications*

38. **Name:** A. Toplu
Advisor/s: Dr. I. Sabirov
Research Topic: *Characterisation of additively manufactured carbon steels*

39. **Name:** V.A. Tucker
Advisor/s: Prof. J. LLorca and Dr. I. Sabirov
Research Topic: *Deformation mechanisms of metallic alloys*

40. **Name:** M. Yu
Advisor/s: Prof. J. LLorca
Research Topic: *Mechanics of materials*

41. **Name:** R. Zapata Martínez
Advisor: Prof. J.M. Molina Aldareguía
Research Topic: *Metamaterials printing using shape memory alloys and functional gradients for a new generation of smart implants*

42. **Name:** Z. Zellar
Advisor: Dr. J. Patterson
Research Topic: *Bioengineering of skeletal muscle satellite cells*

5.6. Visiting Master/Bachelor students

1. **Name:** A. Alonso Romero
Supervisor/s: Prof. J.M. Torralba and Dr. F. Sket
Associated University: Carlos III University of Madrid

2. **Name:** R. Bendjelloul
Supervisor/s: Prof. J. Segurado
Associated University: UNE Paris-Saclay

3. **Name:** C. Caballero Rivas
Supervisor/s: Prof. J.M. Molina Aldareguía
Associated University: Technical University of Madrid

4. **Name:** C. Cantador Flores
Supervisor/s: Prof. J. Segurado
Associated University: Carlos III University of Madrid

5. **Name:** M. del Carmen Garrote Junco
Supervisor/s: Dr. M.T. Pérez Prado
Associated University: Technical University of Madrid

6. **Name:** J. del Rio Moya
Supervisor/s: A. Johnston
Associated University: Carlos III University of Madrid

7. **Name:** T. Edtmaier
Supervisor/s: Prof. J.M. Torralba
Associated University: TU Wien

8. **Name:** J.M. González Victores
Supervisor/s: Dr. D. Tourret
Associated University: Carlos III University of Madrid (Research Initiation Fellowship)

9. **Name:** C. Lelong
Supervisor/s: Dr. J. Patterson
Associated University: ENS Paris-Saclay

10. **Name:** E. Liguori
Supervisor/s: Prof. C. González
Associated University: University of Naples Federico II

11. **Name:** M.O. Milanesi Giraudo
Supervisor/s: Prof. C. González
Associated University: ENS Paris-Saclay

12. **Name:** Á. Martín Martín
Supervisor/s: Prof. J.M. Torralba
Associated University: Carlos III University of Madrid

13. **Name:** D. Martín Nolasco
Supervisor/s: Prof. J.M. Torralba
Associated University: Universidad Europea de Madrid

14. **Name:** M. Ortíz Villarejo
Supervisor/s: Dr. F. Sket
Associated University: Carlos III University of Madrid

15. **Name:** L. Puertas Paláez
Supervisor/s: Dr. F. Sket
Associated University: Carlos III University of Madrid

16. **Name:** D. Sanmartin Plano
Supervisor/s: Prof. J.M. Molina Aldareguía
Associated University: Technical University of Madrid

17. **Name:** Y. Sbihi Mohamed
Supervisor/s: Prof. D.Y. Wang
Associated University: Carlos III University of Madrid

18. **Name:** M. Solís Lorente
Supervisor/s: Prof. D.Y. Wang
Associated University: Technical University of Madrid

19. **Name:** W. Tang
Supervisor/s: Prof. D.Y. Wang
Associated University: Carlos III University of Madrid

20. **Name:** N. Téllez Fouz
Supervisor/s: Prof. J.M. Molina Aldareguía
Associated University: Carlos III University of Madrid

21. **Name:** M. Zhou
Supervisor/s: Prof. D.Y. Wang
Associated University: Rey Juan Carlos University Madrid

22. **Name:** L. Langeois
Supervisor/s: Dr. M. Haranczyk
Associated University: University of Limoges

23. **Name:** A.M. Vizcaino Rojas
Supervisor: Dr. M. Haranczyk
Associated University: University of Rennes

5.7. University Teaching – Undergraduate and Master

1. Civil and Territorial Engineering
Undergraduate and Master's Degrees in Materials Engineering
Technical University of Madrid
Prof. C. González

2. Composite Materials
Master's Degree in Materials Engineering
Technical University of Madrid in collaboration with AIRBUS
Prof. C. González

3. Composite Materials
Undergraduate Degree in Materials Engineering
Technical University of Madrid
Prof. J. LLorca

4. Modelling and Simulation in Materials Science and Engineering
Master's Degree in Materials Engineering
Technical University of Madrid
Prof. J. LLorca

5. Neuroethics
Master's Degree in Neurotechnology
Technical University of Madrid
Prof. J. LLorca

6. Continuum Mechanics
Industrial Engineering Undergraduate Degree
Technical University of Madrid
Prof. I. Romero

7. Advanced Simulation Methods
Master's Degree in Mechanical Engineering
Technical University of Madrid
Prof. I. Romero

8. Advanced Simulation Methods
Master's Degree in Mechanical Engineering
Technical University of Madrid
Prof. I. Romero

9. Materials Science and Engineering
Bachelor's Degree in Industrial Engineering
Carlos III University of Madrid
Prof. J.M. Torralba

10. Aerospace Materials II
Bachelor's Degree in Aerospace Engineering
Carlos III University of Madrid
Prof. J.M. Torralba

11. Modelling and Simulation in Materials Engineering
Master's Degree in Materials Engineering
Technical University of Madrid
Dr. D. Tourret

12. Carbon Nanomaterials
Master's Degree in Materials Science
Universidad Carlos III de Madrid
Dr. J.J. Vilatela

13. Continuum Mechanics
Undergraduate Degree in Industrial Engineering
Technical University of Madrid
Prof. D.Y. Wang

14. Advanced Materials Resistance
Master's Degree in Industrial Engineering
Technical University of Madrid
Prof. D.Y. Wang

15. Advanced Simulation Methods
Master's Degree in Mechanical Engineering
Technical University of Madrid
Prof. D.Y. Wang

5.8. Institutional activities

1. Member of the European Innovative Advanced Materials Initiative Association (IAM-I)
2. Member of the European Technology Platform for Advanced Engineering Materials and Technologies (EUMAT)
3. Member of the European Materials Characterization Council (EMCC)
4. Member of the European Aeronautics Science Network (EASN)
5. Member of the European Energy Research Alliance (EERA)
6. Member of the Batteries European Partnership Association (BEPA)
7. Member of the European Technology and Innovation Platform Batteries Europe
8. Member of the Royal Society of Chemistry
9. Member of the European Mechanics Society (EUROMECH)
10. Member of the Spanish Association of Composite Materials (AEMAC)
11. Technical Secretariat of the Spanish Technological Platform of Advanced Materials and Nanomaterials (MATERPLAT)
12. Member of the Spanish Aerospace Platform (PAE)
13. Member of the Spanish Technological Platform for Advanced Manufacturing (MANUKET)
14. Member of the Spanish Railway Technological Platform (PTFE)
15. Member of the Spanish Energy Storage Technological Platform (BatteryPlat)

16. Member of the Spanish Steel Technological Platform (PLATEA)
17. Member of the Spanish Technological and Innovation Platform in Biocircularity (BIOPLAT)
18. Member of the Spanish Ceramics and Glass Society (SECV)
19. Member of the Spanish Society of Numerical Methods in Engineering (SEMNI)
20. Member of the Spanish Materials Society (SOCIEMAT)
21. Member of the Spanish Society of Theoretical and Applied Mechanics (SEMTA)
22. Member of the Spanish Catalysis Society (SECAT)
23. Member of the Spanish Royal Society of Chemistry (RSEQ)
24. Member of the Madrid Aerospace CITT Cluster
25. Member of the Madrid Semiconductors CITT Cluster
26. Member of the Madrid Biomedical Technologies and Biotechnology CITT Cluster
27. Member of the Hub Getafe Aerospace (GAN)
28. Member of the Severo Ochoa Centres and María de Maetzu Units Alliance (SOMMA)
29. Local Contact Point of the EURAXESS network
30. Member of the Spanish Association of Foundations (AFE)
31. Member of the Network of Research Laboratories of the Comunidad de Madrid (REDLAB)

5.9. Training courses provided to researchers and staff

1. **Managing conflict constructively across cultures**. Delivered by: A.M. Muniesa, The Sky is the Limit. March 2024.

2. **Antifraud Measures Plan.** Delivered by: IMDEA Materials. March 2024.

3. **Training in FreeCAD software.** Delivered by: Dr. P.J. Navarrete Segado, IMDEA Materials. April 2024.

4. **Funding opportunities for research and development: grants overview at national and European levels.** Delivered by: M.T. Ferrando García, Kveloce. May 2024.

5. **Microsoft Office 365.** Delivered by: 2FFormación. May 2024.

6. **Fundamentals of intellectual and industrial property.** Delivered by: C. Modet. September 2024.

7. **ERC Starting Grant proposal writing course for researchers**. Delivered by: Peter Sheard, Trend 2000 Ltd. October 2024.

8. **Artificial Intelligence in Horizon Europe grant writing:** practical application tools. Delivered by: Kristjan Zemljic, Global Disruption. November 2024.

6. Communication, Outreach and Events

6.1. Organisation of scientific/industrial events

1. **DOMMINIO Project General Assembly Meeting.** Principal Investigators: Prof. C. González and Dr. J.J. Vilatela. IMDEA Materials Institute. January 2024.

2. **3D-MetJet Project Launch Meeting.** Principal Investigators: Prof. J.M. Torralba and Dr. F. Sket. IMDEA Materials Institute. February 2024.

3. **IRIDISCENTE Project Launch Meeting.** Principal Investigator: Prof. J.M. Torralba. IMDEA Materials Institute. March 2024.

4. **Winter Metals Meeting.** Participants: Dr. M.A. Jabbari, Dr. M. Li, Dr. M. Sabbaghian, Dr. S. Sahoo, Dr. J.G. Santos Macías, A. Cotobal Gómez, G. Domínguez, A. Gómez Fernández, B. Limones Ahijón, J. Redondo, S. Sadanand, I. Rodríguez Barber, M. Rodríguez Sánchez and J. Valilla Robles. Organisers: Prof. I. Sabirov and Prof. J. Segurado. IMDEA Materials Institute. March 2024.

5. **2nd International Seminar on Modelling, Simulation and Machine Learning for the Rapid Development of Porous Materials.** Organisers: Dr. M. Haranczyk, Dr. P. Vo, Prof. Dr. A. Rege and Prof. Dr. P. Gurikov. IMDEA Materials Institute. March 2024.

6. **4 Minute Thesis Talk.** Participants: A. Gómez Fernández, M. Hernández del Valle, Y. Hu, J. León Ramos, B. Limones Ahijón, Y. Liu, C. Martínez Alonso, E. Sánchez Ahijón, and J. Valilla Robles. IMDEA Materials Institute. April 2024.

7. **19th European Mechanics of Materials Conference (EMMC19).** Organisers: Prof. C. González and Prof. J. Segurado. Technical University of Madrid. June 2024.

8. **Workshop on Additive Biofabrication 2024 (WAB2024).** Organisers: Dr. A. Bouzas, Dr. P. Díaz Payno, Dr. P.J. Navarrete Segado, Dr. J. Ordoño and Dr. V. Sevostianova. September 2024.

9. **Inaugural Project Training Session, Additive Manufacturing and Advanced Materials Competence Centre.** Participants: Dr. M.T. Pérez Prado, Dr. J.G. Santos Macías, I. Escobar Moreno, M.T. Nieto Valeiras and H. Summers (IMDEA Materials) and A. Evangelou, K. Georgiou, T. Kyratsi and A. Loizou (University of Cyprus).

10. **Business-Academia Collaboration Meeting.** IMDEA Materials Institute in conjunction with the Spanish Association of Composite Materials (AEMAC). Organisers: Prof. C. González and Dr. J.P. Fernández Blázquez. October 2024.

11. **MATERPLAT General Assembly.** IMDEA Materials Institute in conjunction with MATERPLAT. Organisers: E. Izquierdo and M.A. Rodiel. December 2024.

12. **Workshop on Materials for a Better Defense.** IMDEA Materials Institute in conjunction with the Academy of Military Sciences and Arts (ACAMI). Organiser: Prof. J.M. Torralba. December 2024.

6.2. Participation in Scientific/Industrial Events

1. **Science4i.** Organised by UAM Madrid and BeAbleCapital. Dr. E. Troche and M.A. Rodiel. La Nave. Madrid. January 2024.

2. **14th annual 'Madrid is Science' Fair.** Organised by the Madrid Regional Government and madri+d. Participants: Dr. D. Mocerino, Dr. P.J. Navarrete Segado, A. Cotobal Gómez, O. Contreras, C. Corchado, Á. de la Camacha Díaz, M. de Nicolás Morillas, R. De Armas Rodríguez, E. Dios, S. Du, J. León, B. Limones Ahijón, Y. Liu, F. Lopes, M.D. Martín Alonso, C. Martínez Alonso, I. Rodriguez Barber, and J. Valilla Robles. IFEMA Madrid. March 2024.

3. **Falling Walls Lab MSCA Finals 2024** and **Falling Walls Lab Global Finals 2024.** Dr. L. Doyle. Breaking the walls of unrecyclable composites. Falling Walls Foundation Science Summit. Mons, Belgium and Berlin, Germany. April and November 2024.

4. **VivaTech 2024.** M.A. Rodiel. Paris, France. May 2024.

5. **8th annual Three Minute Thesis (3MT) Talk Madrid.** C. Martínez Alonso, B. Limones Ahijón.

6. **South Summit 2024.** M.A. Rodiel. La Nave, Madrid. June 2024.

7. **Falling Walls Lab Three-Minute Thesis (3MT) competition.** C. Martínez Alonso. Winner: Public Choice. CSIC, Madrid. June 2024.

8. **European Researchers' Night.** Prof. J.M. Torralba and Dr. L. Doyle. Student's Residence (CSIC), Madrid. September 2024.

6.3. School and University Visits

1. IES Lope de Vega. Students in attendance: 20. January 23, 2024.
2. Highlands School El Encinar. Students in attendance: 20. February 7, 2024.
3. CASVI Villaviciosa de Odón. Students in attendance: 30. February 21, 2024.
4. IES La Senda Getafe. Students in attendance: 80. March 14, 2024
5. 4ESO + Empresa. Students in attendance: 3. April 9-10, 2024.
6. IES Carpe Diem Fuenlabrada. Students in attendance: 25. April 10, 2024.
7. IES Las Rozas. Students in attendance: 30. April 7, 2024.
8. Cátedra Ingeniería y Empresa de COIIM – UPM. Students in attendance: 10. May 9, 2024.
9. Colegio Sierra Blanca-El Romeral (Malaga). Students in attendance: 12. May 21, 2024.
10. Instituto FP Opesa. Students in attendance: 60. June 6, 2024.
11. Colegio Virgen de Europa. Students in attendance: 60. October 10, 2024.
12. Universidad Internacional Menéndez Pelayo. Students in attendance: 13. October 31, 2024.
13. Tampere University. November 5, 2024.
14. IES Talavera de la Reina. Students in attendance: 60. November 13, 2024
15. Technical University of Madrid. Students in attendance: 8. November 19, 2024.
16. Universidad Europea de Madrid. Students in attendance: 29. December 9, 2024.
17. IES Antonio de Nebrija. Students in attendance: 30. December 18, 2024.

6.4. Highlighted Media Appearances

1. *Getafe will have a pilot plant for silicon manufacturing for new lithium batteries for future electric cars.* **Europa Press.** January 6, 2024.
2. *A research project by IMDEA Materials in Getafe manages to eliminate viruses and bacteria with filters for ventilation*. **CadenaSER**. February 8, 2024.
3. *IMDEA introduces digital twin for real-time analysis of composite materials production*. **CompositesWorld**. March 15, 2024.

4. *Researchers demonstrate breakthrough recyclability of carbon nanotube sheets*. **Phys.org.** March 18, 2024.
5. *Advanced materials, Brussels' secret weapon to regain industrial leadership*. **Cinco Días (El País).** April 30, 2024.
6. *I will win the Nobel Prize in 2034 for a hydrogen car that costs 500 euros*. **El País**. June 16, 2024.
7. *A new therapy could save the lives of patients who have suffered an acute myocardial infarction*. **Crónica Norte.** June 17, 2024.
8. *The Madrid genius in artificial organ creation relying on crowdfunding to enter a leading center*. **El Mundo.** August 8, 2024.
9. *IMDEA Materials is researching how to improve 4D printing for its application in biomedical implants*. **La Vanguardia.** August 17, 2024.
10. *Confronting Spain's eternal scientific brain drain*. **RTVE.** September 3, 2024.
11. *Searching for the perfect alloy.* **RNE.** October 13, 2024.
12. *Carbon nanotubes, the second assault of the 'small things' revolution*. **ABC Economía.** October 28, 2024.
13. *This is how the fire resistance of electric vehicle batteries is tested*. **La Razón.** November 24, 2024.
14. *IMDEA Materials seeks to catalyse green energy production via catalysis and energy materials*. **Industría Química.** November 27, 2024.
15. *Advanced New Materials for Hydrogen Production and Chemical Recycling of Plastics*. **RETEMA.** December 30, 2024.

6.5. Researcher Articles Featured in The Conversation

1. *New materials to combat colds and the flu before we become infected*. **Dr. M. Echeverry Rendón**. February 5, 2024.
2. *The Valencia fire: another example of the danger of flammable materials in construction*. **Prof. D.Y. Wang**. February 23, 2024.
3. *Radiation, the invisible threat to the colonisation of Mars*. **Dr. J. Ordoño**. April 12, 2024.
4. *Printed organs, stents made to measure and other medical applications of 3D printing.* **Dr. P.J. Navarrete Segado**. May 7, 2024.
5. *Before we save the world with carbon nanotubes, do we know if they are recyclable?* **Dr. A. Mikhalchan**. June 20, 2024.
6. *We'll see cheap diamonds in Tiffany's*. **Prof. J.M. Torralba**. July 8, 2024.
7. *What is going on with transparent dental aligners?* **J.I. Delgado Castaño**. July 23, 2024.
8. *Why Elon Musk uses stainless steel in his spaceships*. **Prof. J.M. Torralba**. October 2, 2024.
9. *80 years since Roosevelt's letter: politicians take note!* **Prof. J.M. Torralba**. November 14, 2024.
10. *The supermaterials that will transform our lives in 2025*. **Prof. J.M. Torralba**. December 3, 2024.
11. *¿Are electric car batteries really safe?* **J. de la Vega**. December 19, 2024

Comunidad de Madrid

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institute imdea materials

Contact
contact.materials@imdea.org
tel. +34 91 549 34 22
fax +34 91 550 30 47

C/ Eric Kandel, 2
Tecnogetafe
28906, Getafe, Madrid
(Spain)