

# B<sup>2</sup>MATERIALS

BASQUE CENTER FOR MATERIALS, APPLICATIONS & NANOSTRUCTURES

ehu group 



*ACTIVITY REPORT 2017*



*C'mon!  
Lets Work  
Together!*

2017 Activity Report

# BCMaterials 2017 Activity Report

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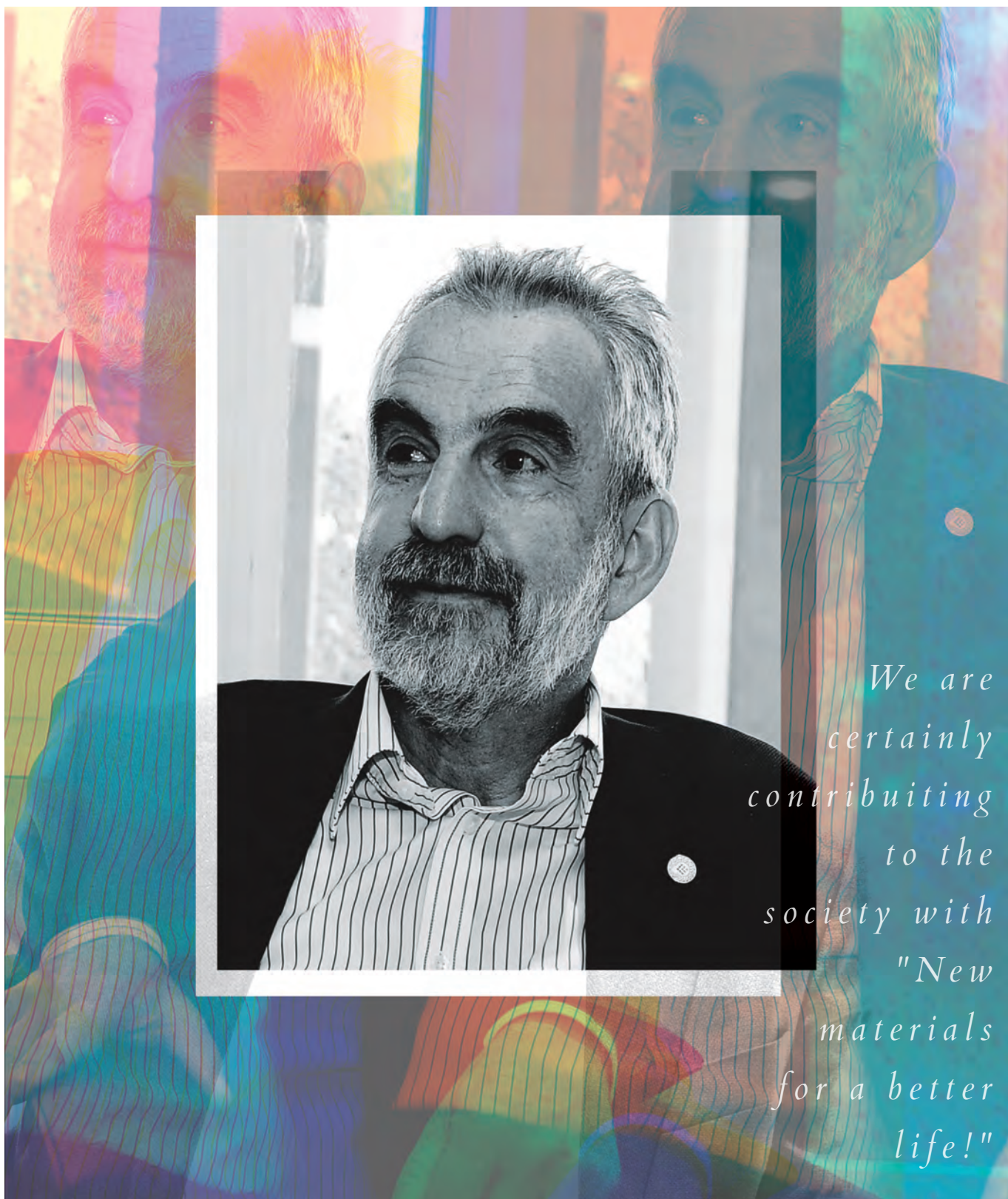
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*We are  
certainly  
contributing  
to the  
society with  
"New  
materials  
for a better  
life!"*

*Manu Barandiaran*

## PRESENTATION LETTER

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*We have a dream...make such a material  
as dreams are made on!*

I have the pleasure to present the 2017 annual activity report of BCMATERIALS, the last one during my scientific direction. It is, therefore, my farewell, as my time in starting the centre has already come to an end.

I want to thank the continuous effort and efficient work of our researchers and staff, in these years, which have achieved a steady value of the quantity and quality of the scientific production, in the upper rank of productivity among local and European centres. Next year the new scientific director of the centre will be Ikerbasque professor, Senentxu Lanceros, selected by our International Scientific Advisory Committee from a list of over 20 international candidates of the highest quality.

During this year we finally moved to the Scientific Park, located in the University of the Basque Country Campus of Leioa, and more research

projects, including two European ones, have started. Our activity is now well recognized all around the world and new researchers are approaching us to establish new collaborations and to incorporate in our team.

During 2017 we welcome a new Ikerbasque professor and ERC winner, Dr Shahzada Ahmad, and a new Marie Curie fellow, Dr Txema Porro, as well as other qualified pre and postdoctoral researchers.

At the same time, the alignment of BCMATERIALS with the productive priorities of the Basque Country fulfils one of the objectives of the creation of BCMATERIALS and we are certainly contributing to the society, as stated in our motto: "New Materials for a Better Life".

I hope you will enjoy this report, as we did when working in the projects and activities described.



Manu Barandiaran

Scientific Director

Derio, February 27th, 2017

*BCMaterials is committed to be an international reference center for research in the area of functional & active materials and nanomaterials.*

*IEEE Summer School. Outing to Guggenheim Bilbao Museum*



The background of the image is a complex, abstract geometric pattern composed of numerous overlapping triangles. The color palette is a gradient of reds and pinks, ranging from deep, dark reds to bright, vibrant pinks. The triangles vary in size and orientation, creating a dynamic and textured visual effect. In the center of the image, there is a white rectangular box with a thin white border. Inside this box, the text "ORGANIZATION AND MANAGEMENT" is written in a clean, white, uppercase, sans-serif font. The text is centered both horizontally and vertically within the box.

ORGANIZATION AND MANAGEMENT

*FUNDACIÓN BCMATERIALS - BASQUE CENTER FOR MATERIALS, APPLICATIONS AND NANOSTRUCTURES - is a strategic initiative of the Basque science system, whose key drivers are Ikerbasque, the Basque Foundation for Science, and the University of the Basque Country, UPV/EHU.*

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*BCMATERIALS was created with the objective of establishing a center for cutting-edge research under international quality standards in the area of materials science, which is one of the key priorities of European, Spanish and Basque strategic research programs.*

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*BCMATERIALS made sense based on existing groups of excellence in materials science at the University of the Basque Country. The Center provides a number of advantages that improve, the visibility, quality and productivity of these groups and boosts the scientific research in materials science in Biscay, providing a instrument for knowledge transfer of materials research to the Basque society.*



## ORGANIZATION AND MANAGEMENT

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### Mission, Vision, Values

The key elements of the strategy of BCMATERIALS are defined in its mission, vision and values, below:

#### Mission

Our mission is to develop high-quality interdisciplinary research in functional and active Materials with advanced Mechanical, Thermal, Electric, Magnetic and Optical properties, from basic aspects to applications, in close collaboration with research groups in Materials Science at the University of the Basque Country (UPV/EHU) in Biscay, while high-level post-graduate training in new materials.

#### Vision

BCMaterials is committed to be an international reference center for research in the area of functional & active materials and nanomaterials.

#### Values

Reference values assumed by BCMATERIALS are:

- » Commitment to the Principles of Excellence.
- » Transparency, effectiveness and efficiency in resource management.
- » Compliance with the “European Charter for Researchers”.
- » Quest for maximum return to the society and contribution to sustainability.

### Board of Trustees

The Board of BCMATERIALS FUNDAZIOA is its highest representation, administration and governing authority. It is composed by six members, from the Basque Government, Ikerbasque and the University of the Basque Country (UPV/EHU). At present these members are:

#### President:

- » *VICE-CHAIRMAN OF IKERBASQUE*: Adolfo Morais Ezquerro, Vice-Minister for Universities and Research, Basque Government.

#### Vicepresident:

- » *VICE-CHANCELLOR FOR RESEARCH AT THE UPV/EHU*: José Luis Martín González.

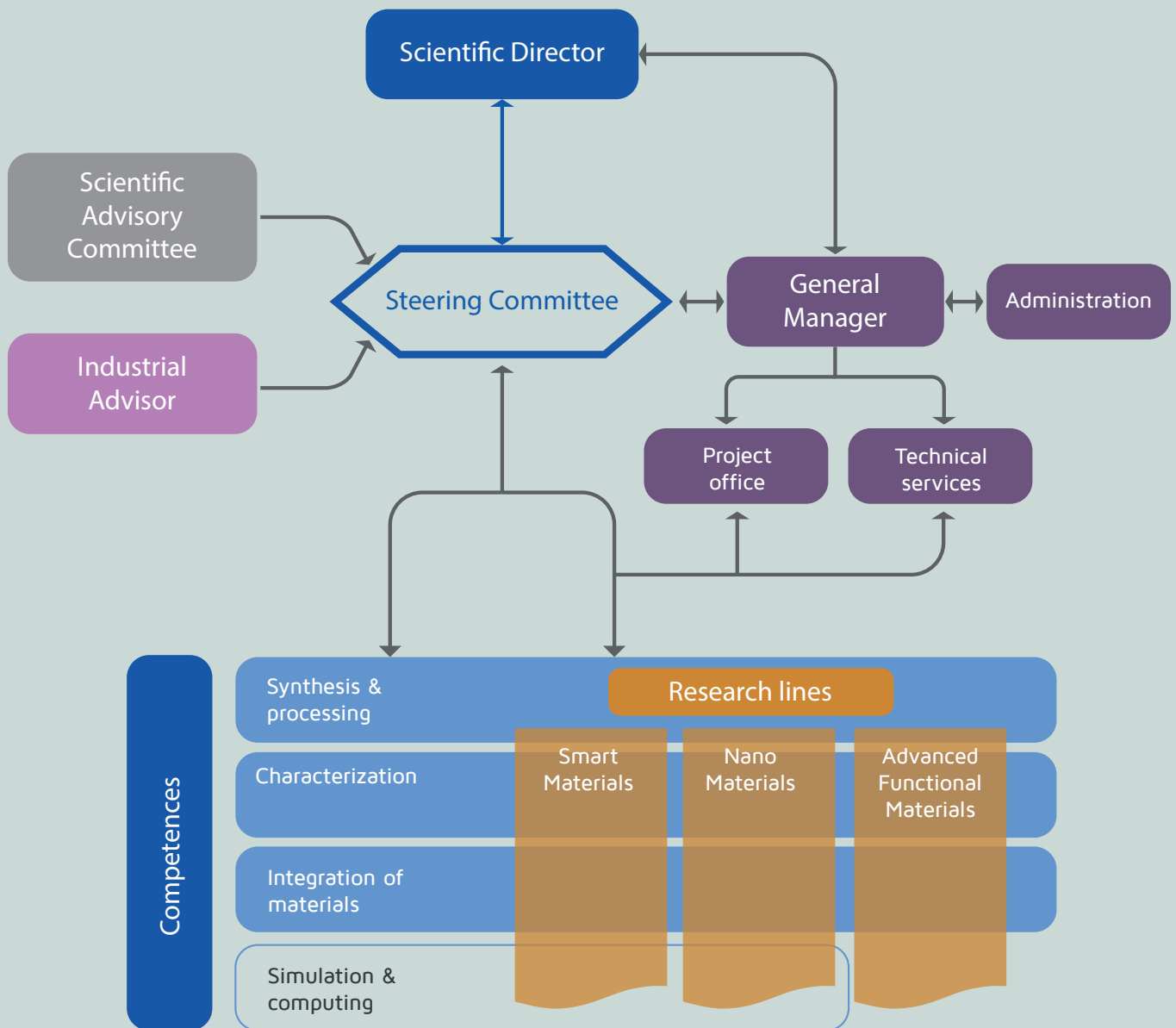
#### Secretary:

- » *GENERAL SECRETARY OF THE UPV/EHU*: Pedro Maria Iriondo Bengoa.

#### Chairs:

- » *SECRETARY OF IKERBASQUE*: Amaia Esquisabel Alegría, Director of Research, Basque Government.
- » *VICE-CHANCELLOR FOR OUTREACH AND TRANSFER AT THE UPV/EHU*: Arturo Muga Villate.
- » *SCIENTIFIC DIRECTOR OF THE IKERBASQUE EXECUTIVE COMMITTEE*: Fernando Cossio.

The direction of BCMATERIALS meets at least twice a year with the board of trustees to discuss scientific and administrative progress. Also, budget forecast, and actual expenses need approval from the board of trustees.



*Figure 1: Organization Breakdown structure of BCMaterials*



*Martina Casiano building*

## Management

The organization of the Center is showed in the figure on the previous page (FIGURE N°1).

The Steering Committee is the main executive body of the center presided by the Scientific director and assessed by the International Scientific Advisory Committee (ISAC) and the industrial advisor, already described in section 2.2.3. Internationalization plan and 2.2.6

Composition and role of the Steering Committee: this Committee is composed for the Principal Investigators of the different lines of the center and the responsible of each of the transversal competences. It meets every two months and whenever a decision has to be taken and supervised the quality of the research and the personal hiring. All proposals for projects, equipment and hiring positions in BCMATERIALS must be approved by the Steering Committee before the effective application or hiring takes place.

The Steering Committee appoints a commission for selecting and report about all presented proposals to the Steering Committee, before making the final decision.

The Selection and Evaluation Commission (SEC) is composed by a senior researcher of each of the main lines of BCMATERIALS, plus the Scientific Director or the person he (she) commissions.

At present the research lines represented are:

1. Smart Materials
2. Nanostructured Materials
3. Advanced Functional Materials.

People in the present SEC are:

- » Luis Lezama (Professor of Inorganic Chemistry)
- » M<sup>a</sup> Luisa Fdez-Gubieda (Professor of Applied Physics)
- » Senen Lanceros (Ikerbasque Research Professor)
- » Scientific Director: Manu Barandiaran

The SEC examines all proposals according to the strategic objectives and commitment of excellence of BCMATERIALS.

Other bodies in the organization are:

- » The Research Integrity Committee has been put forward in February 2015 and is composed by a representative of the PhD researchers, another of the post doctoral, one of the experienced and chaired by the Scientific Director. Its role is to act as a constative body for the implementation and surveillance of the code of good scientific practice, as well as to mediate and resolve all conflicts that can arise from the inobservance of such code.
- » A trade union representative has been elected and the negotiation for a workers' statute is in course.

Quality program EURAXES documentation has been presented in 2017, and we expect to obtain the "logo" in 2018.

From an operative perspective, researchers are grouped around a research line, with a research line head, and teams are formed to develop a specific project, so the composition of each team is variable. The lead researchers belonging to each research line and involved in the projects, currently supervise posdoctoral and PhD researchers.



*NEW MATERIALS FOR A BETTER  
LIFE!*

## PEOPLE

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### Scientific Director:

José Manuel Barandiaran

### General Manager:

Naiara Elejalde

### Administrative Staff:

Iñaki Serna (Administration and  
Accounting Manager)

David Serrano (Management  
Assistant)

### Technical Staff:

Juan Ignacio Tel (IT Manager)

### Academic Members (26)

Prof. Maribel Arriortua

Prof. María Luisa Fernández-  
Gubieda

Prof. José Ángel García

Prof. Juan Manuel Gutiérrez

Prof. Luis Manuel León

Prof. Fernando López-Arbeloa

Prof. Luis Lezama

Dr. Alicia Muela

Dr. Begoña Bazán

Dr. Alfredo García Arribas

Dr. Ana García Prieto

Dr. Izakun Gil del Muro

Dr. Aintzane Goñi

Dr. Jon Gutiérrez

Dr. José S. Garitaonandia

Dr. José Luis Vilas

Dr. Maite Insausti

Dr. Galina Kurlyandskaya

Dr. Leyre Perez

Dr. Alazne Peña

Dr. Esperanza Diaz

Dr. Gotzone Barandika

Dr. Verónica Palomares

Dr. Patricia Lazpita

Dr. Erlantz Lizundia

Dr. Leire Ruiz Rubio

### Ikerbasque Professors (4)

Prof. Volodimir Chernenko

Prof. Rafael Morales

Pro. Senentxu Lanceros

Prof. Shahzada Ahmad

### Senior Researcher (1)

Dr. Samrana Kazim

### MSCA – Individual Fellows (2)

Dr. Catarina Lopes

Dr. Jose Maria Porro

### Post docs from BCMaterials (15)

Dr. Javier Alonso

Dr. Roberto Fernández

Dr. Eduardo Fernández

Dr. Daniel Salazar

Dr. Cristina Echevarria

Dr. Rajasekhar Madugundo

Dr. Ikerne Etxebarria

Dr. Alberto Maceiras

Dr. Oihane Kistiñe Arriortua

Dr. Arkaitz Fidalgo Marijuan

Dr. Imanol Landa Medrano

Dr. Paula Sanchez Fontecoba

Dr. Clara Maria Garcia Astrain

Dr. Andoni Lasheras Aransay

Dr. Manuel Salado Manzorro

### Other post docs (4)

Dr. Ana Abad

Dr. Pablo Alonso

Dr. Jorge Feuchwanger

Dr. José Manuel Laza

### Pre docs from BCMaterials (19)

MSc. Nuria Garcia

MSc. Maite Goiriena

MSc. Xabier Lasheras

MSc. Jagoba Martin

MSc. Ariane Sagasti

MSc. Maite Goiriena

MSc. Anabel Pérez-Checa

MSc. Andrés Martín-Cid

MSc. Irati Rodrigo

MSc. Ana Maria Schönhöbel

MSc. Nelson Castro Fernandes

MSc. Sofia Dominguez Gil

MSc. Ander Reizabal Lopez-Para

MSc. David Gandia Aguado

MSc. Paula Gonzalez Saiz

MSc. Jesus Cristian Mendes Felipe

MSc. Irene Aizpitarte Moran

MSc. Lílana Sofia Correia

Fernandes

MSc. Virginia Vadillo Lacasa

### Other pre docs (5)

MSc. Iraultza Unzueta

MSc. Laura Bravo

MSc. Nastasia Soriano

MSc. Beatriz Mora

MSc. David Muñoz



Director

*José Manuel Barandiaran*

Magnetoelasticity and Magnetotransport; Gigant Magnetoimpedance; Magnetic Sensors y actuators; Amorphous and nanocrystalline Magnetic Materials; Nanogranular and Oxide Magnetoresistant Materials; Ferromagnetic Shape Memory Alloys.



General Manager

*Naiara Elejalde*

PhD in Applied Physics; R&D in the industry especially related the development of new sensors; Managing and coordinating multidisciplinary teams; Interface between industry and academia.



Financial and administrative manager

*Iñaki Serna*

PhD in Science and Technology by the University of the Basque Country (UPV/EHU). Master in Business Administration (MBA) by the University of the Basque Country (UPV/EHU). General manager in plastics processing companies and automotive



Management Assistant

*David Serrano*

Purchasing of scientific supplies & contact with related vendors



IT Manager

*Juan Ignacio Tel*

IT specialist; systems & network administration and security; purchasing of equipment & supplies; software licensing; technical support.



Senior Research Associate

*María Isabel Arriortua*

Crystal engineering; X-ray and neutron scattering; Structure study; Materials for fuel cells and batteries; Crystal structure and properties relationship; Project management.



Senior Research Associate

*María Luisa Fernández-Gubieda*

Magnetic characterization; X-ray absorption spectroscopies; Magnetic nanoparticles; Magnetotactic bacteria; Biomedical application of magnetosomes.



Senior Research Associate

*José Ángel García*

Hyperthermia magnetic applicators; Positron annihilation spectroscopy; PAS.



Senior Research Associate

*Juan Manuel Gutiérrez*

Inorganic synthesis; Single crystal X-ray diffraction.



Senior Research Associate

*Luis Manuel León*

Synthesis and characterization of new polymeric materials.



Senior Research Associate

*Fernando López-Arbeloa*

UV/vis absorption spectroscopy; Fluorescence (steady-state and time-correlated) spectroscopy; Linear-polarized light spectroscopy.



Senior Research Associate

*Luis Lezama*

EPR spectroscopy; Magnetic characterization; Materials Chemistry.



Senior Research Associate

*Alicia Muela*

Survival strategies of enteric bacteria in the aquatic systems; Magnetotactic bacteria; Synthesis of magnetic nanoparticles in bacteria and their applications.



Senior Research Associate

*Begoña Bazan*

Solid coordination frameworks (SCF), hydrothermal synthesis; X-ray diffraction; Crystal structures; Structural analysis.



Senior Research Associate

*Alfredo García Arribas*

Thin film technologies; Micro- and nano-patterning; Integration of materials for applications.



Senior Research Associate

*Ana García Prieto*

Magnetic nanostructures; Magnetic characterization of materials; Structural determination by synchrotron radiation techniques.



Senior Research Associate

*Izaskun Gil del Muro*

Transmission Electronic Microscopy.



Senior Research Associate

*Aintzane Goñi*

Synthesis of nanostructured inorganic materials such as transition metal oxides, phosphates and composites; Spectroscopic and magnetic characterization; Electrochemical study of lithium ion batteries.



Senior Research Associate

*Jon Gutiérrez*

Magnetic materials characterization at the macro- and micro-scale; Applications of magnetic materials.



Senior Research Associate

*José S. Garitaonandia*

Study of the magnetic nanostructures and magnetic mesoscopic systems using element selective techniques such as Mössbauer spectroscopy and synchrotron and neutron techniques.



Senior Research Associate

*Jose Luis Vilas*

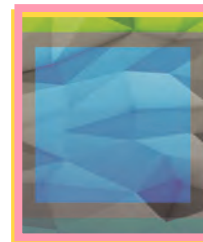
Synthesis and characterization of polymeric materials, focusing in polymeric materials and composites with smart properties; Synthesis of biocompatible polymers; Polymers from renewable sources.



Senior Research Associate

*Maite Insausti*

Soft chemistry routes for preparation of inorganic materials; Thermogravimetry, X ray diffraction. Electronic Microscopy.



Senior Research Associate

*Galina V. Kurllyandskaya*

Magnetism and magnetic nanomaterials.



Senior Research Associate

*Leyre Pérez*

Polymeric multilayers; Polymers modification; Stimuli responsive polymers; Coordinating work teams and research.



Senior Research Associate

*Alazne Peña*

Synthesis of sodium vanadium fluorophosphates; X-ray diffraction analysis (patternmatching and Rietveld); Morphological characterization; Electrochemical study of electroic materials.



Senior Research Associate

*Esperanza Díaz*

Thermal Analysis; Scanning Electron Microscopy; Mechanical Property.



Senior Research Associate

*Gotzone Barandika*

Coordination chemistry; X-ray diffraction; Crystal structure, microstructure; Electronic microscopy (SEM and TEM); Magnetic properties; DFT calculations; Topology; Synthesis methods; Pulvimetallurgy, catalysis, mechanical properties; Management models; Innovation in education.



Senior Research Associate

*Verónica Palomares*

Synthesis of new materials; Solid state chemistry; X-ray diffraction; Electrode preparation; Electrochemistry; Battery testing.



Senior Research Associate

*Patricia Lázpita*

Ferromagnetic shape memory alloys; Neutron and x-ray scattering; Magnetic properties and electrical transport.



Senior Research Associate

*Erlantz Lizundia*

Polymer synthesis and processing technologies; Thermal characterization (DSC, TGA); Mechanical characterization, Optical characterization; Structural determination: X-ray diffraction, FTIR, XPS, SEM, TEM, AFM.



Senior Research Associate

*Leire Ruiz Rubio*

Synthesis and characterization of polymeric materials; Thermal properties and degradation (DSC, TGA, DMTA...); Surface modification and characterization (XPS, SEM, AC, TEM...).



Ikerbasque Professor

*Volodymyr Chernenko*

Responsibilities for research line of BCMaterials: Magnetic Shape Memory Alloys as Active (smart) multifunctional materials; Preparation of national and EU projects; Supervising PhD students.



Ikerbasque Professor

*Rafael Morales*

Nanopatterning (electron beam and interference lithography); Thin film deposition; Magnetic nanostructure characterization.



Ikerbasque Professor

*Senentxu Lanceros*

Smart and functional materials and devices for sensors and actuators; Energy and biomedical applications.



Ikerbasque Professor

*Shahzada Ahmad*

Advanced materials development for energy conversion; Conservation storage materials application.



Senior Research Associate

*Samrana Kazim*

Electro-optical characterization of organic semiconductors, perovskite and nanocomposites; Thin film deposition by vacuum thermal evaporation and by wet chemistry; Synthesis of plasmonic metal nanoparticles, conducting polymers.



Individual Fellows

*Catarina Lopez*

Electroactive polymer composites; Dielectric Spectroscopy.



Individual Fellows

*José María Porro*

Electron Beam Lithography; Electron Beam Evaporation/Sputtering Deposition; Scanning Electron Microscopy; Atomic/Magnetic Force Microscopy; Magneto-Optic Kerr Effect Microscopy/Magnetometry; SQUID magnetometry; Python programming; X-Ray Magnetic Circular Dichroism.



Research Fellow

*Javier Alonso*

Nanomagnetism; Thin film deposition (sputtering and PLD); Structural characterization (XAS, XRD, TEM-SEM, AFM); Magnetic hyperthermia; Data analysis, fitting, and simulations; Synchrotron experiments.



Research Associate

*Roberto Fernández*

Single crystal and powder X-ray diffraction; Crystal structure solution and refinement. Crystallographic databases; Hydrothermal synthesis; IR and Raman spectroscopies; Thermal properties of materials.



Research Fellow

*Eduardo Fernández*

Micro and Nano patterning; Magnetic characterization; High frequency measurements; Magnetic sensors; Finite elements magnetic simulations.



Research Associate

*Daniel Salazar*

Single-crystal growth by floating zone method; Magnetic properties and electrical transport; Instrumentation design and engineering.



Senior Research Associate

*Cristina Echevarria*

Synthesis by arc melting or melt spinning, thermal annealing (for crystallization); Structural characterization; Magnetic characterization; Mössbauer, neutron diffraction; Diffusion of results in conferences and publications in peer-reviewed journals.



Research Associate

*Rajasekhar Madugundo*

Hard and soft magnetic materials; Preparation of materials by arc-melting, induction-melting, melt-spinning, mechanical-milling, mechanical alloying...; Processing of materials under high magnetic fields; High field superconducting magnets; Materials characterization: structure and microstructure characterization.



Research Associate

*Ikerne Etxebarria*

Organic electronics –Organic photovoltaics & Organic light emitting diodes; Thin Film deposition; Inkjet printing, Spray coating, Spin coating, Dr. Blading, Sputtering, PVD; Photolithography; 3D printing.



Research Associate

*Alberto Maceiras*

Technics: DSC, TGA, FTIR, GPC, RMN, Poling, Electrospinning, Battery testing; Simulation: Molecular dynamics using Materials Studio software; Polymer synthesis; Piezoelectric Polymers; Magnetolectric nanocomposites; Battery Separators.



Research Associate

*Oihane Kistiñe Arriortua*

Technics: DSC, TGA, FTIR, DLS; Nanoparticles synthesis; Magnetic nanoparticles; Peptide functionalization; Cytotoxicity.



Research Associate

*Arkaitz Fidalgo-Marijuan*

Single crystal and powder X-ray diffraction; Crystal structure solution and refinement; IR and Raman spectroscopies; Thermal properties of materials; Catalytic activity measurements; DFT calculations.





Research Associate

*Imanol Landa Medrano*

Electrochemical impedance spectroscopy; Cyclic voltammetry; Chronoamperometry; Chronovoltammetry; X-ray diffraction; Raman spectroscopy; Redox mediators.



Research Associate

*Paula Sánchez Fontecoba*

Synthesis of organic and carbonaceous materials; Characterization techniques: FTIR, XRD, SEM, BET; Raman spectroscopy; TGA-DSC and electrochemical testing (galvanostatic cycling and cyclic voltammetry).



Research Associate

*Clara María García Astrain*

Biomaterials; Materials for biomedical applications; (nano) composite materials; (bio) polymer functionalization, click chemistry; Techniques: Rheology, Nuclear Magnetic Resonance, Scanning Electron Microscopy, Thermogravimetric Analysis...



Research Associate

*Antonio Lasheras Aransay*

Magnetic Materials; Magnetoelastic laminated composites and their applications; Magnetic and magnetoelastic characterization; Piezoelectric materials; Dielectric characterization.



Research Associate

*Manuel Salado Manzorro*

Atomic force microscopy (AFM); X-Ray diffractogram (XRD); Optical measurements (J-V curves); Quantum efficiency (QE); Impedance Spectroscopy (IS); Differential scanning calorimetry (DSC); Scanning electron microscopy (SEM); Fabrication of solar cell devices (perovskite based).



Research Student

*Nuria Garcia*

Thermal characterization; Shape memory properties



Research Student

*Maite Goirienea*

Nanopatterning by Self-assembly; Reactive Ion Etching; Micropatterning by Photolithography; Characterizing magnetic structures by MOKE, VSM, AFM/MFM and SEM



Research Student

*Xabier Lasheras*

Synthesis of magnetic nanoparticles; Polymer coating; Surface modification of NPs, cell cultures; EMR, DLS, XRD, VSM, SQUID, TG, SEM, TEM; Magnetic hyperthermia



Research Student

*Jobaba Martin*

Experience in both classical and hydrothermal synthesis; Single crystal and Powder X-Ray Diffraction; FT-IR, EPR, Thermogravimetric (TG/DTA/DTG); Photoluminescent measurements; Spin coating.



Research Student

*Ariane Sagasti*

DSC, TGA, FTIR, UV-Vis; Spin-coating, RMN; Polymer synthesis; Mechanical polymer properties; pH and temperature responsive behaviour of hydrogels



Research Student

*Anabel Pérez-Checa*

Ferromagnetic shape memory alloys; Characterizing thermomechanical and magnetic properties; Single-crystal growth by floating zone method; Techniques: DSC, DMA, SEM



Research Student

*Andrés Martín-Cid*

Powder X-ray diffraction; DSC, TG/DTA, SEM, TEM, VSM.



Research Student

*Irati Rodrigo*

Characterization of the magnetic properties of nanoparticles by AC magnetometer, VSM and SQUID; In vivo studies of the application of magnetic hyperthermia in animal models in order to test the efficacy of the treatment.



Research Student

*Ana Maria Schönhöbel*

XRD, VSM, SEM; Mössbauer Spectroscopy; Data analysis, fitting and MC simulation.



Research Student

*Sofia Dominguez Gil*

FTIR, UV-Vis, BET, DLS; Solid NMR & NMR; Electrochemical techniques; Sol-gel synthesis.



Research Student

*Ander Reizabal Lopez-Para*

Molecular Dynamics simulations of mechanical and thermal properties for polymeric systems; Thermal characterization techniques (DSC and TGA) and mechanical characterization techniques (DMTA).



Research Student

*David Gandia Aguado*

Structural, Magnetic and Biological techniques, including Cell Manipulation; Scanning and Transmission Electron Microscopies (SEM and TEM); Vibrating Sample and SQUID Magnetometry (VSM and SQUID); Magnetic Hyperthermia.



Research Student

*Paula Gonzalez Saiz*

Techniques: SEM, DRX, SQUID, TGA



Research Student

*Nelson Castro Fernandez*

Developing the 3D model and interface electronics of an electromechanical bioreactor and magnetic bioreactor for cell stimulation; Instrumentation and data communication and analysis for printed sensor arrays; 3D printing of smart materials and electronics; and electroactive inks printing optimization.



Research Student

*Jesus Cristian Mendes Felipe*

Stereolithography of UV curable resins, thermal and mechanical characterization: DSC, TGA-FTIR, DMTA.



Research Student

*Irene Aizpirtate Moran*

DLS, FTIR, UV-Vis; Raman, Cell culture, PCR; Cytometry; Electrophoresis; Chromatography; Western Blotting; Cells transfection.



Research Student

*Liliana Sofia Correia Fernandes*

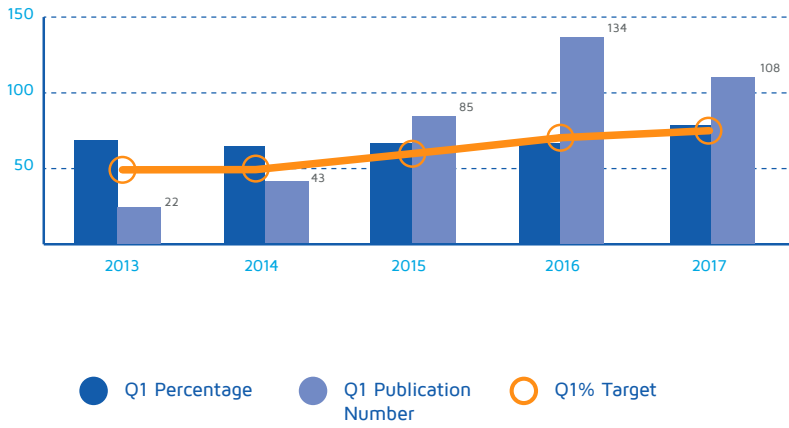
Theoretical simulation of smart materials properties and response; Multifunctional materials synthesis and characterization (morphological, thermal, electrical and magnetic); Device fabrication and characterization based on the developed smart and multifunctional materials.



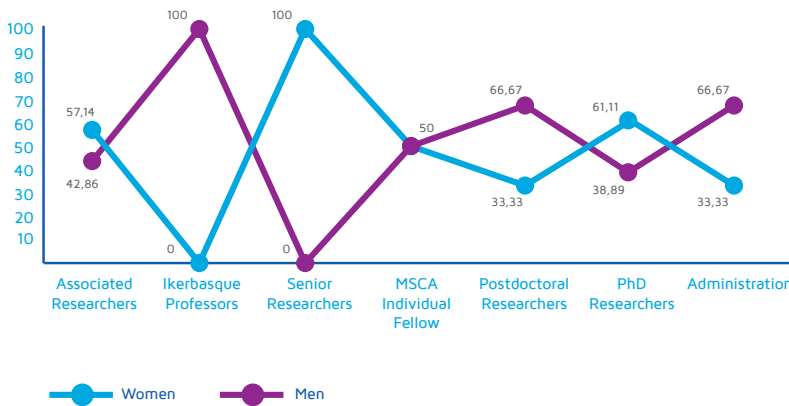
Research Student

*Virginia Vadillo Lacasa*

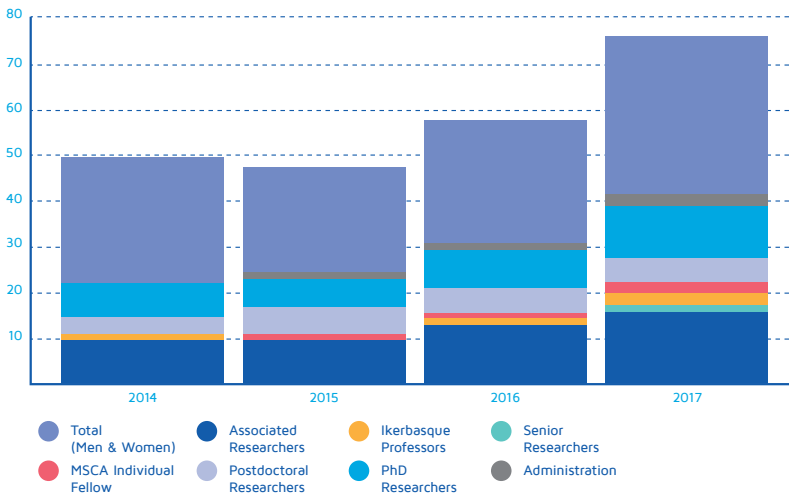
Magnetic nanoparticles synthesis by chemical and physical methods; Nanoparticles characterization (SEM, TEM, XRD, DLS, VSM); Design and characterization of magnetorheological fluids.



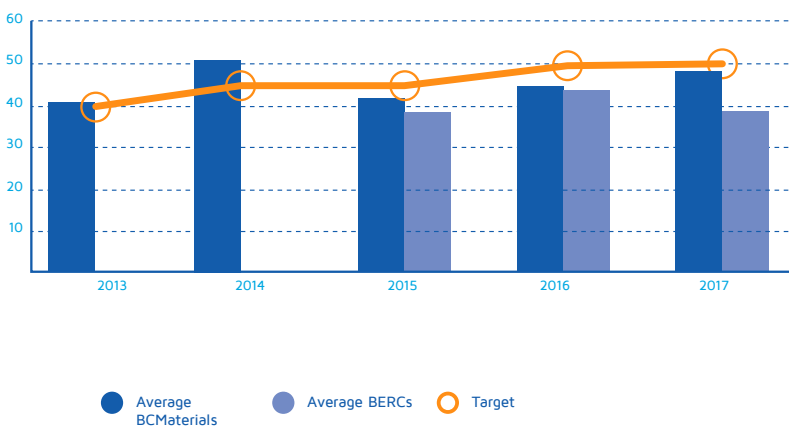
Share of BCMaterials Publications / BERCs



Share of Women BCMaterials 2017



Share of Women Among Researchers (BCMaterials)



Share of Women Researcher at BCMaterials and Average of the rest of BERCs



RESEARCH

## New Equipment

### Melt spinner

A new complete system consisting of small vacuum chamber, rack system, high vacuum pumping system, and 6 kW RF generator has been purchased for production of rapidly solidified amorphous or nano-crystalline ribbons by ejection of the melt onto a solid copper spinning wheel. Cooling rates 105 to 106 K/sec. and typical thickness of the ribbons between 20 and 60  $\mu\text{m}$  can be achieved.

The apparatus will be used in current projects as NOVAMAG, (EU H2020) related to nanostructured permanent magnets; FUNSAFE (MAT2014, MINECO), dealing with Magnetic Shape Memory Alloys for actuation, magnetocalorics and other applications; BIDMAG (MSCA Individual Fellowship) which develops magnetoelastic resonance sensors for bacteria, and ACTIMAT and SIMAM (Elkartek and Hazitek programs from the Basque Government) intending to develop new magnetoelastic materials and sensors for Structural Health Monitoring.



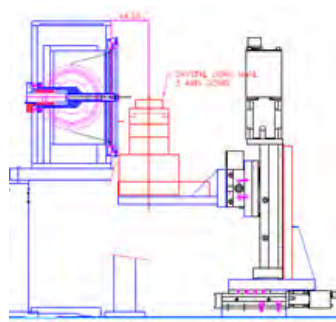
General view of the melt spinner.



Detail of the vacuum chamber, crucible and spinning wheel

### LAUE Diffractometer

A complete system consisting of goniometer X-Y-Z displacement system, CCD camera and software has been installed in a former X-Ray generator with Mo anode, in collaboration with the Department of Solid State Physics (UPV/EHU). The new system will allow determination of the quality, extension and orientation of metallic single crystals, and will be used for single crystal developed in the projects NOVAMAG, (EU H2020) dealing with novel phases for permanent magnets and FUNSAFE (MAT2014, MINECO) with Magnetic Shape Memory Alloys.



Scheme of the new LAUE diffractometer (Left).  
View of the goniometer (Right)

### Tilting Annealing furnace

For annealing and tempering by quenching in air or some liquid.

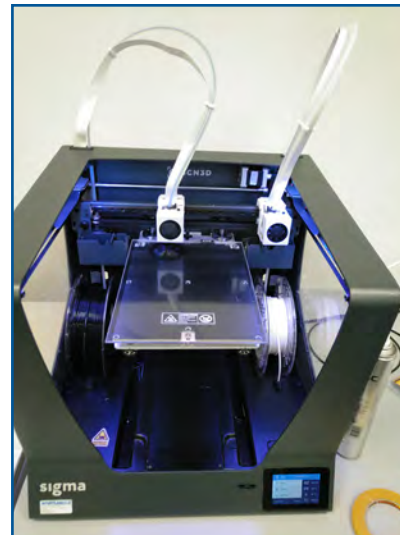
The complete system include the furnace, heating regulation, vacuum and controlled atmosphere system, etc. It will be used for single crystal and bulk alloys treatments, in the projects NOVAMAG, (EU H2020) and FUNSAFE (MAT2014, MINECO).



Tilting furnace

### 3D printer

Independent dual extruder system allowing to print two different materials in a single structure. The application ranges from the development of multifunctional smart templates for scaffolds to the development of smart functional materials and structures.



3D Printer

### Thermal evaporator

It is one of the simplest forms of PVD and typically uses a resistive heat source to evaporate a solid material in a vacuum environment to form a thin film. The material is heated in a high vacuum chamber until vapor pressure is produced. The evaporated material, traverses the vacuum chamber with thermal energy and coats the substrate. Thermal evaporation will be applied to deposit metallic contact layers for thin film devices.



Thermal evaporator

### Potenciostat

Electronic equipment is to able doing the measurements of electrical potential and the current intensity in the electrolytic cells. The equipment has a direct application in the electrochemistry impedance spectroscopy field “EIS” and to study possible charge recombinations on the solar devices.

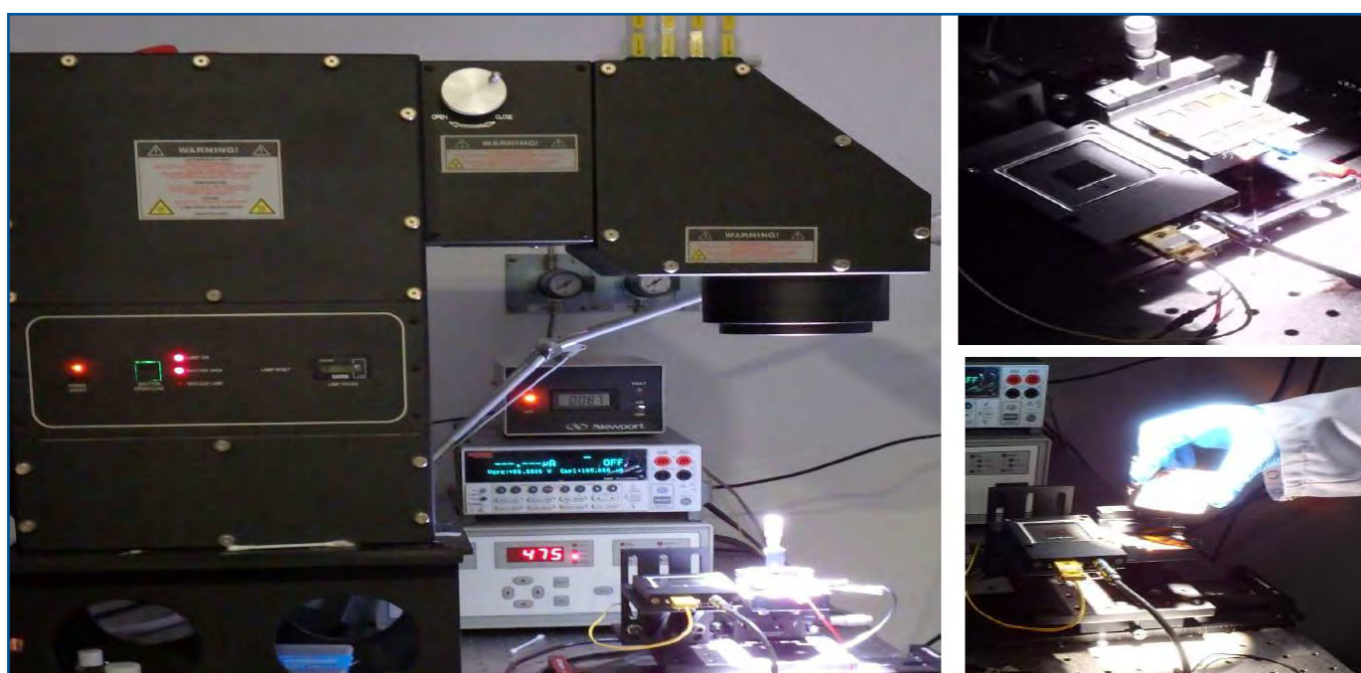


Potenciostat

### Solar simulator

The purpose of the solar simulator is to provide a controllable indoor test facility under laboratory conditions, used for the testing of solar cells.

Oriel Solar Simulators provide the closest spectral match to the sun available from any light source. The Class AAA Sol3A Series meets all industry standards for testing of PV materials.



Solar simulator

# Research Lines

## A Active or Smart Materials

Shape memory alloys and polymers, active surfaces, multiferroics, piezoelectric, magnetostrictive and magnetoresistant, magneto- and elasto- caloric materials, as well as others that appear as interesting for industrial applications.

MAGNETIC SHAPE MEMORY ALLOYS.

Prof. Volodymyr Chernenko

SHAPE MEMORY POLYMERS (SMPs).

Dr. José Luis Vilas

ELECTROACTIVE POLYMERS.

Ikerbasque Prof. Senentxu Lanceros

## B Nano- structured Materials

Mainly in the form of particles synthesized by chemical and biological routes and patterned thin films.

MAGNETIC NANOPARTICLES FOR BIOMEDICAL APPLICATIONS.

Prof. Maite Insausti

MAGNETIC NANOPARTICLES BIOSYNTHESIZED BY MAGNETOTACTIC BACTERIA.

Prof. M<sup>a</sup> Luisa Fdez-Gubieda

NANOSTRUCTURED DISCS FOR BIOMEDICAL APPLICATIONS.

Prof. Alfredo García-Arribas

NANOSTRUCTURED THIN FILMS AND MULTILAYERS.

Prof. Rafael Morales

NANOPOROUS MATERIALS.

Prof. Maribel Arriortua

## C Advanced functional materials

Advanced functional materials for sensors, energy and other specific applications.

ADVANCED MATERIALS FOR BATTERIES AND FUEL CELLS.

Prof. Luis Lezama

MATERIALS FOR PERMANENT MAGNETS.

Prof. Jose Manuel Barandiaran

FUNCTIONAL MEMBRANES.

Prof. Senentxu Lanceros

MATERIALS FOR MAGNETOIMPEDANCE SENSORS

MAGNETOELECTRIC MATERIALS

Prof. Jon Gutiérrez

## Other lines

MAGNETIC NANOPARTICLES AND INSTRUMENTATION FOR HYPERTHERMIA



## Topic: Magnetic Shape Memory Alloys

(Ikerbasque Prof. Volodymyr Chernenko)

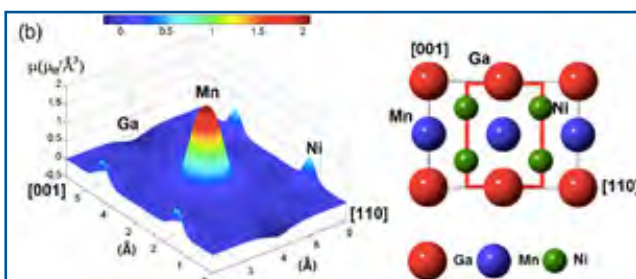
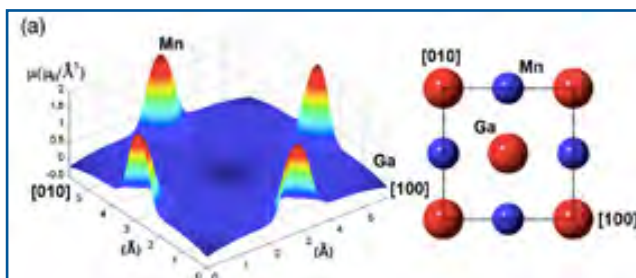
*DESCRIPTION:* Heusler-type magnetic SMAs have been under intense development during the last decade as novel multifunctional materials. Ferromagnetic FSMAs (Ni-Mn-Ga(Al), Ni-Fe-Ga(Al), Co-Ni-Ga(Al), Fe-Pt, Fe-Pd) could be used as replacement of multi-component actuators by a single element working as a machine under application of external magnetic field (e.g., linear motor). In addition, metamagnetic memory alloys, MetaSMAs (Mn-rich Ni-Mn-(In,Sn,Sb) and derivatives), could be used as refrigeration in solid state cooling machines. A key property of MSMAs is that due to a very high power density, they keep their advanced functionality down to micro-(nano) scale, opening up unknown applications to date. An indicator of their industrial growing interest is the number of companies dealing with applications of bulk FSMAs: ETO MAGNETIC GmbH, Stockach, Germany. FSMA-based motionless micropumps are produced by a spin-off company at Boise State University, Idaho, USA.

### Main scientific results:

- » In thin films of FMSMAs and MetaMSMAs nanotwins are interacting ferromagnetically for the former and antiferromagnetically for the latter.
- » Magnetomechanical behavior of MetaMSMAs is governed by the volume magnetoelastic interactions.
- » Experimental and theoretical evidences are obtained in NiFe(Co)Ga FSMA that the hysteresis of MT is controlled by closeness to the critical point, the defects play minor role.
- » Thermal actuation of NiMnGa/Si bimorphs depends on geometrical factors of constituents.
- » Magnetocaloric effect in NiMnSn(Fe) MetaMSMAs can be tuned by Fe doping.

### Representative publications:

Phys. Rev. B 95, 024422 (2017), Phys Rev. Letters 119, 155701 (2017)



Spin density maps in the (001) and (-110) planes of a Ni<sub>52</sub>Mn<sub>26</sub>Ga<sub>22</sub> single crystal (PRL 119, 2017)



## Topic: Shape Memory Polymers (SMPs)

(Dr. José Luis Vilas)

*DESCRIPTION:* Are polymeric materials that return from a deformed state to their original (permanent) shape induced by an external stimulus (trigger), such as a temperature change. This versatility makes SMP ideal for applications as dynamic configurable parts, deployable components, and inexpensive, reusable custom molds.

### Main scientific results:

- » Shape memory effect has been demonstrated in PCO cross-linked with dicumyl peroxide and gamma radiation. The later results in non-cytotoxic materials.
- » Shape memory behavior has been correlated with changes in the free volume by positron annihilation spectroscopy.
- » Hydrophobicity (wettability) of a micropatterned polymeric surface has been controlled by means of the thermally induced shape memory effect.

### Representative publication:

Polymer 2017, 109, 66–70.

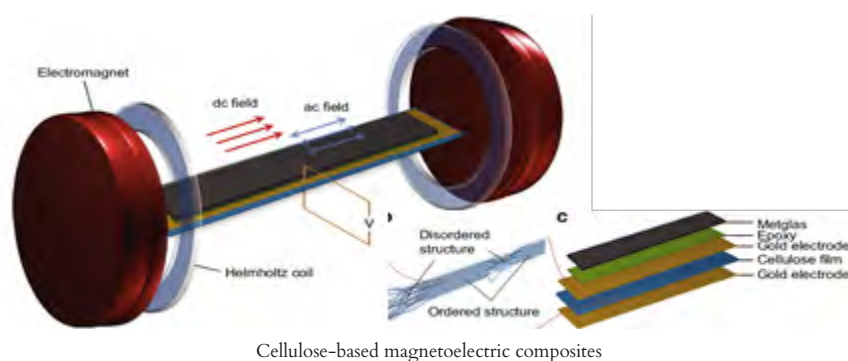
## Topic: Electroactive Polymers

(Ikerbasque Prof. Senentxu Lanceros)

*DESCRIPTION:* Are polymers that exhibit a change in size or shape under an electric field, while sustaining large forces. In several areas, including magnetoelectric, piezoelectric and piezoresistive materials, contributions have been achieved from the basic development and understanding of materials to practical application demonstrations: Demonstration of the use of piezoelectric natural polymers for the development of magnetoelectric materials and applications. In this area, it has been demonstrated the suitability of magnetoelectric composites for applications, by developing magnetic field and current sensors. Further, piezoresistive ink formulations have been developed and sensors have been printed. Finally, piezoelectric and magnetoelectric effects have been demonstrated to be suitable for tissue engineering strategies.

### Representative publications:

Nature Comm. 18, 38 (2017) (IF: 12.124); IEEE Trans on Industrial Electronics (2017), 64(6), 4928 - 4934, (IF: 7.168); Composites Part B: Engineering (2017), 112, pp. 344–352. (IF: 4.727).





Topic: Magnetic nanoparticles for Biomedical applications.

(Prof. Maite Insausti)

*DESCRIPTION:* The applications of Magnetic Nanoparticles (MNP) in the area of biomedicine are mainly related to diagnosis as MRI contrast agents and therapy as drug delivery systems or materials for magnetic hyperthermia. Such applications require the production of monodisperse nanoparticles with well-controlled size and composition, biocompatibility and adequate functionalization in order to obtain the desired properties. In this sense, the most promising materials are Iron oxides which morphology and magnetic behavior can be controlled by the optimization of the synthesis parameters. So, we have prepared magnetic nanoparticles with sizes in the 5 – 25 nm range which have been functionalized with different ligands (PMAO, PEG, DMSO, RGD, ...) showing biocompatibility and the absence of cytotoxicity. An exhaustive magnetic study has been performed by different techniques, presenting some of the superparamagnetic materials SAR values around 800 W/g.

Through collaboration with the University of South Florida, new multifunctional Fe/ $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> core/shell and hollow nanoparticles have been synthesized and studied. Also, tuning the shape, size and aspect ratio of Fe<sub>3</sub>O<sub>4</sub> nanoparticles an improvement of their heating efficiency for magnetic hyperthermia has been obtained.

Moreover, novel functional nanostructures have been developed for applications, including zinc-decorated magnetic silica spheres for protein purification and bio-sensor development.

**Representative publication:**

Colloids and Surfaces B: Biointerfaces, (2017) 157, pp. 48-55. (IF: 4.152)

## 2-c Topic: Magnetic nanoparticles biosynthesized by magnetotactic bacteria

(Prof. M<sup>a</sup> Luisa Fdez-Gubieda)

*DESCRIPTION:* Magnetotactic bacteria are microorganisms able to mineralize under precise biological control high quality magnetic nanocrystals in terms of chemical purity, morphology, and size. Most of the species of magnetotactic bacteria synthesize magnetite, Fe<sub>3</sub>O<sub>4</sub>, and some of them greigite, Fe<sub>3</sub>S<sub>4</sub>. A lipid bilayer membrane, around 3 - 4 nm thick, with embedded proteins, surrounds the magnetic nanoparticle. The nanoparticle and its enveloping membrane comprise a magnetosome. Magnetosomes present characteristics high porosity. Magnetosomes present characteristics of interest for biomedical applications that define a new type of theranostic agent.

### Main scientific results:

- » We have studied the evolution of the magnetic properties of magnetotactic bacteria during the biomineralization process, specially focus on the Verwey transition.
- » We have studied the magnetic configuration of the magnetosome chain
- » We have doped magnetosomes with other transition elements like Co, Mn, Zn among others

### Representative publication:

Biochimica et Biophysica Acta, (2017) 1861, 6, 1507-1514 (IF: 5,373)

## Topic: Nanostructured discs for biomedical applications

(Prof Alfredo García-Arribas)

*DESCRIPTION:* Sub-100 nm discs with a magnetic vortex state present extraordinary opportunities for new information storage systems, high performance spin-torque nano-oscillators and, most of all, as magneto-mechanical actuators for cancer cell-destruction. We aimed to develop a low-cost and high-yield fabrication technique to prepare sub-100 nm Permalloy discs in vortex state, uncover the detailed magnetic behavior of such nanostructures and analyzed the magneto-mechanical actuation capabilities of the nanostructures in solution, detached from the substrate, for upcoming application in the assessment of cancer cell destruction.

### Main scientific results:

- » The development of the Hole Mask Colloidal Lithography (HCL) technique.
- » Determination of the vortex magnetic phase diagram of the nanodiscs.
- » The discovery of the extra-large vortex state in small size nanodiscs.

### Representative publications:

Nanoscale, 9 11269 (2017).

## Topic: Nanostructured thin films and multilayers

(Ikerbasque Prof. Rafael Morales)

*DESCRIPTION:* The exchange bias phenomenon, currently used in electronic devices, is intimately related to the exchange interaction between ferromagnetic (FM) and antiferromagnetic (AFM) materials. However, it has also been observed in AFM/NM/FM trilayers, in which both magnetic materials are separated by a non-magnetic metal (NM). This multilayer configuration provides a new approach to design novel interacting heterostructures. We have investigated the magnetic coupling in heterostructures of Fe<sub>2</sub>/Au/Ni. The exchange bias dependence with the cooling field and the Au-thickness was successfully modeled, proving a new dipolar-based bias phenomenon.

### Main scientific results:

- Positive and negative exchange bias was obtained in AFM/NM/FM systems.
- Transitions from negative to positive exchange bias were observed in the Au-thickness dependence.
- A new dipolar model accounts for the bias phenomenon with NM spacers.

### Representative publications:

Nanoscale, 9 17074 (2017)

## Topic: Nanoporous materials

(Prof. Maribel Arriortua)

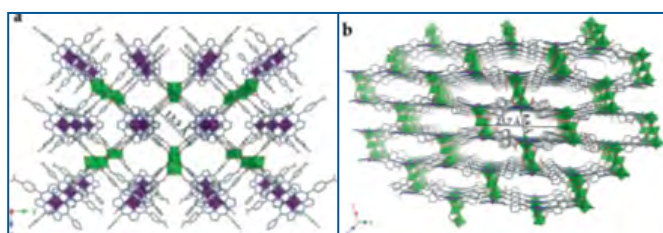
*DESCRIPTION:* MOF materials (Metal-Organic Frameworks) are a family of crystalline nanoporous materials built up from metal nodes or clusters and organic linkers. MOFs present incomparable properties due to their crystalline nature, high thermal stability, tunable chemical functionality, and ultra-high porosity. In addition, their inorganic-organic hybrid nature gives them physical and chemical properties of both components (optical, photonic, magnetic properties, among others). Moreover, due to their host-guest properties, MOFs have been widely studied for their application for gas and volatile organic compound (VOC) capture, storage, and separation, selective sensing, and heterogeneous catalysis, among others.

### Main scientific results:

Contributions have been achieved in several areas, including magnetism, catalysis and adsorption. Many adsorbent materials were developed for the effective capture of water, pollutants, such as dyes, or for iodide removal. The development of new heterogeneous catalysts has been accomplished, improving the efficiency for many organic reactions. Additionally, the study of the magnetic properties of MOFs and composite materials led to interesting results in this field.

### Representative publication:

CrystEngComm, 2017, 20, 301-311



Crystal structure of [Ni<sub>5</sub>]JH<sub>2</sub>TCPP)2OJ(H<sub>2</sub>O)<sub>4</sub>]-nS MOF.



## Advanced Materials for batteries and fuel cells

(Prof Luis Lezama)

*DESCRIPTION:* The preparation of new materials for energy generation and storage constitutes a research topic of the greatest significance due to its great economic potential and social impact. There will not be an extended use in society of either renewable energy sources or the electric vehicle unless cheap and efficient energy storage and conversion devices are readily available. With this aim, this research line has been focused on finding and design new materials capable of improving the performance of electrochemical devices as fuel cells (SOFC, IT-SOFC) and chemical batteries (Li-ion, Na-ion, M-air). In particular, we seek to develop advance materials by means of a nano- approach, given that the use of nanostructured components is known to significantly increase the rate of electrochemical reactions.

### Main scientific results:

- » New cathodes for Li- and Na-ion batteries based on hybrid organic-inorganic compounds and nanostructured composites have been prepared by using low cost and eco-efficient synthesis processes.
- » New materials have been developed for both cathodes and interconnectors to be used on Solid Oxide Fuel Cells (SOFCs).
- » The processes governing the discharge and charge of the sodium-oxygen batteries have been revealed.

### Representative publication:

Nano Energy 37, 224-231 (2017).

## Materials for permanent magnets

(Prof. Jose Manuel Barandiaran)

High performance permanent magnets (PM) are key components in energy production and conversion, with growing demand from wind generators and efficient motors for electric vehicles... All PM with high energy product value,  $(HB)_{max}$ , are based in Rare Earth (RE) metals, like  $(Nd-Dy)_2Fe_{14}B$  (2:14 compounds). However, REs are becoming increasingly important in different strategic areas for the future transition to a green, low carbon footprint society envisioned within the European policy. RE elements are classified in the landmark report Critical Raw Materials for the European Union, as the most critical raw materials group, with the highest supply risk. This fact has provoked a unified (Japan, USA, & EU) objective: Reduction of the RE content in PM.

### Main scientific results:

- » The development of grain boundary infiltration techniques of the eutectic PrCuCo alloy in 2:14 Nd defective alloys that leads to a x5 increase in coercivity.
- » New pure intermetallic RE free magnetic phases, as  $(Fe-Mn)_3(Sn-Sb)$  and MnAl-C, have been theoretically predicted, synthesized and characterized.
- » The role of Ce in increasing the magnetic anisotropy of  $(Ce-Zr)(Fe)_{10}Si_2$  has been determined by Mössbauer and neutron diffraction studies, as a starting point for developing 1:12 compounds.

### Representative publication:

Effect of Nb and Cu on the crystallization behavior of under-stoichiometric Nd-Fe-B alloys, J. Phys. D: Appl. Phys. 50 (2017) 015305.

## Functional membranes

(Ikerbasque Prof. Senentxu Lanceros)

In this area, novel membranes have been developed for water purification (both for filtration or photocatalytic processes); printable devices, such as TFT, passive electronic components and circuits; novel materials have been developed for printable batteries (in particular for both cathodes and separators) and, in a biomedical field, a new magnetically triggered drug release system has been proposed as well as novel structures for the development of electroactive tissue engineering microenvironments.

### Representative publication:

Journal of Hazardous Materials (2017), 336, pp. 188-194. (IF: 6.065)

## Materials for Magnetoimpedance Sensors

The magneto-impedance (MI) effect in thin-films and amorphous ribbons has been investigated for diverse sensing applications. On the one hand, the optimum structure and material characteristics have been determined to maximize the performance, developing multilayered microsensors with an extraordinary sensitivity of 27 k $\Omega$ /T. On the other hand, this outstanding performance is exploited in the detection of magnetic nanoparticles for biomedical applications and the development of new mechanical-deformation sensors.

### Main scientific results

- » Optimization of the structure to maximize the MI with sensitivities of 27 k $\Omega$ /T
- » Successful development of stress-sensitive (MI) materials deposited on flexible substrates.

### Representative publication:

IEEE Trans on Magn 53 (2017) 20000605.

## Magnetolectric Materials

(Prof. Jon Gutiérrez)

The combination of magnetostrictive with piezoelectric materials gives rise to magnetolectric composites. When using magnetostrictive metallic glasses in the form of ribbons combined with piezoelectric PVDF film, magnetolectric laminated composites can be easily fabricated. They lead to practical applications as energy harvesters or magnetic field sensors.

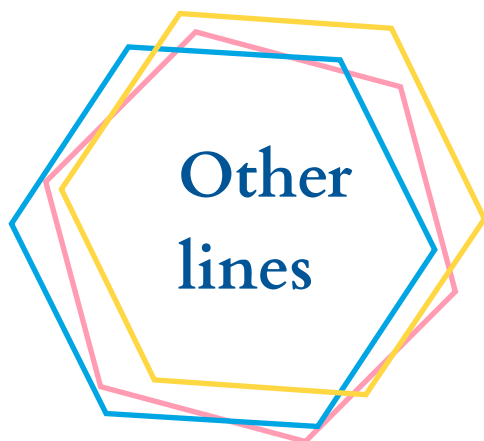
The same magnetostrictive metallic glasses can be used as magnetoelastic resonant platforms that show an extreme sensitivity to system mass changes

### Main scientific results

- » *The influence of the length of the magnetolectric laminates (through demagnetizing factor of the magnetostrictive constituent) when working in such applications has been demonstrated.*
- » *We have proposed a new definition for an intrinsic magnetolectric effect value that accounts for the maximum magnetolectric value that can be achieved for such a laminate in the best working conditions (no demagnetizing effects at all).*
- » *The current linear theory that correlated relative mass change vs relative resonance frequency change needs of a strong revision;*
- » *Polystyrene is a good candidate to functionalize metallic glasses ribbons surfaces,*

### Representative publication(s):

"Metallic glass/PVDF magnetolectric laminates for resonant sensors and actuators: a review", J. Gutiérrez, A. Iñiguez, P. Martins, N. Pereira, J.M. Barandiarán and S. Lanceros-Mendez Sensors, Volumen: 17 Pag: 1251 (18 pp), 2017 DOI: 10.3390/s17061251



### Other lines

Beside, activity on Radiofrequency (RF) instrumentation for hyperthermia has started recently (PhD thesis of Eneko Garaio and Irati Rodrigo). Other efforts in developing RF instrumentation, as a wide band Ferromagnetic Resonance (FMR) apparatus for magnetic thin films study and development, have been undertaken with the collaboration of the RF researchers in the Department of Electricity and Electronics, at the Faculty of Science and Technology. Finally a joint project between people from hyperthermia and RF has succeed in obtaining a Marie Curie Individual fellowship (Javier Alonso) for developing a MRI compact system. This project has recently started this year 2017 and extends at least over two years.

Representative activity in this field during 2017 has been:

### Topic: Magnetic nanoparticles and instrumentation for Hyperthermia

The therapy against cancer by hyperthermia mediated by magnetic nanoparticles is a growing interest topic. Colorectal cancer, is one of the most frequent neoplastic processes in the western world, and it is complicated by metastases in the liver. Functionalized MNP-mediated magnetic hyperthermia is one of the few methods that has the theoretical possibility of producing a much localized damage in the tumor, without damaging the adjacent healthy tissues, and with the added value that its economic cost will be much lower than the current ones. Hyperthermia cancer therapy would have a great economic impact for the Basque Health System.

#### Main scientific results:

- "State of the art" RF electromagnetic applicators, based on the calorimetric method and in magnetometry respectively, have been built to determine the SAR of magnetic nanoparticles.
- A magnetic hyperthermia equipment for laboratory animals has been built, and many experiments have been performed in WAG rats with colorectal tumors.

#### Representative publication(s):

- » *"Tuning sizes, morphologies, and magnetic properties of mono- vs. multi-core iron oxide nanoparticles through the controlled addition of water in the polyol synthesis"* Gauvin Hemery, Anthony C. Keyes Jr., Eneko Garaio, Irati Rodrigo, Jose Angel García, Fernando Plazaola, Elisabeth Garanger, Olivier Sandre. *Inorganic Chemistry*, 56 (14), 8232-8243, 2017

2D printing of functional materials and flexible electronics has started with the incorporation of Ikerbasque professor Senen Lanceros and deserves a clear space in materials development and also in device oriented activity.



## Agreements with Spanish and Foreign Research Institutions

**National Technical University of Athens, Greece**

(Erasmus agreement for graduate students and faculty in the field of materials and devices).

**University of Pittsburgh, Dept. Materials Science and Engineering, Pittsburgh, PA, USA**

(collaboration in additive manufacturing of magnetocaloric materials).

**Tokyo Institute of Technology, Tokyo, Japan**

(collaboration in composites of magnetic shape memory alloys/ polymers).

# New Projects started during 2017

## **MOLEMAT:**

*Molecularly Engineered Materials and Processes for Perovskite Solar Cell Technology*

Call: ERC – Consolidator 2016

IP: Shahzada Ahmad.

## **MELTER:**

*Aparato de enfriamiento ultrarrápido por "melt spinning"*

Call: Gobierno Vasco (Education) Type of action: EQUIPAMIENTO CIENTIFICO 2017

IP: Jose Manuel Barandiaran

## **SASPAT:**

Call: H2020-MSCA-IF-2016

Type of action: Marie Curie Individual Fellowship

Beneficiary: José María Porro

## **μ4f:**

*Microtecnologías como motor de desarrollo de microsistemas avanzados integrados en la fábrica inteligente. Monitorización estructural y detección de sustancias bio-químicas en medios productivos*

Call: Gobierno Vasco (Industria) Type of action: ELKARTEK, Coordinator: TEKNIKER – IK4

Partners: Universidad del País Vasco (UPV/EHU), BCMaterials, IKERLAN-IK4, TECNALIA, Mondragon Goi Eskola Politeknikoa, CEIT-IK4, DIPC, AZTI Fundazioa, GAIKER, IKOR technology center SL, Universidad de Navarra.

## **LIMOFilm:**

*Encapsulación de líquidos iónicos en redes metal-orgánicas porosas: Filtros avanzados para la eliminación de metales pesados de fuentes de agua contaminadas.*

Call: Gobierno Vasco (Education) Type of action: PIBA-2017.

IP: Roberto Fernández de Luis.

## **CICE2017:**

*Desarrollo de actividades de investigación fundamental estratégica en almacenamiento de energía electroquímica y térmica.*

Call: Gobierno Vasco (Industria) Type of action: ELKARTEK, Coordinator: CIC ENERGIGUNE

Partners: Universidad del País Vasco (UPV/EHU), BCMaterials, CIDETEC, TECNALIA, Mondragon Goi Eskola Politeknikoa, TEKNIKER-IK4, IKERLAN-IK4,

## **FLUMAN:**

*Fluidos magnéticos estables en base a nanopartículas magnéticas de alta imanación.*

Call: Gobierno Vasco (Education) Type of action: PIBA-2017.

Partners: BCM, Universidad de Mondragón (MU)



DISSEMINATION OF RESULTS

## DISSEMINATION OF RESULTS

### Organization of Conferences



*X REUNIÓN CIENTÍFICA DE BIOINORGÁNICA: BIOBILBAO 2017, BILBAO, 9-12 JULY 2017*

Participation: Organizing Committee.

Presidente: Gotzone Barandika

Secretario: Oscar Castillo

Tesorera: Begoña Bazán

Asesora científica: Maribel Arriortua, Eder Amayuelas, Arkaitz Fidalgo, Luis

Lezama, Roberto Fernández de Luis



*6<sup>TH</sup> WORKSHOP NEW MATERIALS FOR A BETTER LIFE: "A NEW NEUTRON SOURCE FOR A NEW GENERATION OF ADVANCED MATERIALS" (27 OCTOBER)*

Organized by BCMaterials and ESSBilbao



*INTERNATIONAL SYMPOSIUM MATERIAL FOR TISSUE ENGINEERING (9 NOVEMBER)*

Organized by Eneko Axpe and BCMaterials

*COST-RADIOMAG2017: ANNUAL ACTION CONFERENCE AND MC MEETING*

"Renaissance of thin film photovoltaics: Perovskites a game changing light harvesting material". Organised by BCMaterials, University of Basque Country (UPV-EHU) and OSI Barrualde-Galdakao de Osakidetza on April 27-28 in Bilbao.

### Invited Talks and Seminars

#### Invited speakers:

- » VLADIMIR GOLUB, INSTITUTE OF MAGNETISM, NATIONAL ACADEMY OF SCIENCES OF UKRAINE: "Ferromagnetic Resonance: Application to Magnetic Shape Memory Alloys"
- » GLEB KAKAZEI, DEPARTAMENTO DE FISICA E ASTRONOMIA, UNIVERSIDADE DO PORTO (PORTUGAL): "Complete spin wave excitation spectra of vortex state magnetic dots"
- » SHAHZADA AHMAD, IKERBASQUE PROFESSOR & ABENGOA RESEARCHER, SEVILLA: "Renaissance of thin film photovoltaics: Perovskites a game changing light harvesting material"
- » RON GOLDFARB, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST), COLORADO (USA) & IEEE MAGNETIC LETTERS (CHIEF EDITOR): "Mistakes to avoid in writing for publication"
- » IMRE GYUK, US DEPARTMENT OF ENERGY: "Grid scale energy storage poised for success: Finding new value propositions"



#### Other dissemination activities

- » XVII Semana de la Ciencia, la Tecnología y la Innovación, Bilbao 08-12 November 2017. Stand "BCMATERIALS – New materials for a better life! "
- » 2º Concurso de Cristalización en la Escuela del País Vasco, Leioa, 05-05-2017. Organization and member of the jury
- » Interview to Gotzone Barandika in Euskadi Irratia "Norteko Ferrocarrila" 10 November 2017.

## BCMaterials Fortnightly Seminars

Data	Speaker	Title
1	18/01/2017 OIHANE ARRIOTUA	MAGNETIC NANOPARTICLE APPROACHES FOR MAGNETIC HYPERTHERMIA
2	01/02/2017 JAGOBA MARTÍN	SUPERFICIAL CHARACTERIZATION OF POLLYOXOMETALATE/POLYMER HYBRID COMPOSITES USING LOW ENERGY ION SCATTERING (LEIS) AND TIME-OF-FLIGHT SECONDARY ION MASS SPECTROMETRY (ToF-SIMS) ADVANCED SURFACE ANALYSIS TECHNIQUES
3	ALBERTO MACEIRAS	POLYMER HYBRID ELECTROLYTES BASED ON POLY (ETHYLENE) OXIDE (PEO)
4	15/02/2017 IRATI RODRIGO	THE DESIGN OF A NEW AC MAGNETOMETER
5	VASILEIOS ALEXANDRAKIS	"HARD/SOFT" MAGNETIC COMPOSITES FOR MAGNETIC RECORDING APPLICATIONS
6	01/03/2017 KONSTANTIN GUSLIENKO	MAGNETIC SOLITON DYNAMICS IN PATTERNED NANOSTRUCTURES: FROM VORTICES TO SKYRMIONS
7	08/03/2017 ANABEL PÉREZ	INFLUENCE OF SELECTIVE AG ADDITION ON THE TRANSFORMATION TEMPERATURES, MAGNETIC PROPERTIES AND LATTICE PARAMETERS OF A MULTICOMPONENT Ni <sub>43</sub> Co <sub>7</sub> Mn <sub>20</sub> Fe <sub>2</sub> Ga <sub>21</sub> Cu <sub>7</sub> ALLOY
8	XABIER LASHERAS	DEVELOPING FERRITE BASED NANOCOMPOUNDS FOR MULTIPLE BIOMEDICAL APPLICATIONS: THE ROAD FROM THE BASE MATERIAL TO ITS APPLICATION
9	15/03/2017 IKERNE ETXEBARRIA	PRINTING SMART MATERIALS AND DEVICES
10	LOURDES MARCANO	FOLLOWING THE INCORPORATION OF COBALT INTO THE MAGNETOSOME STRUCTURE
11	29/03/2017 CATARINA LOPES	FABRICATION OF PURE B-PVDF FILM IN A 3D SHAPE
12	EDUARDO FERNÁNDEZ	BLOCK COPOLYMERS HIERARCHICAL TEMPLATING OF BiFeO <sub>3</sub> /CoFe <sub>2</sub> O <sub>4</sub> MULTIFERROIC NANOCOMPOSITE
13	05/04/2017 IRATI RODRIGO	THE DESIGN OF A NEW AC MAGNETOMETER
14	IMANOL LANDA	ELECTROCHEMICAL PROCESSES AND DISCHARGE PRODUCT CHARACTERIZATION IN NON-AQUEOUS Na-O <sub>2</sub> BATTERIES
15	12/04/2017 ROBERTO FERNÁNDEZ	ENCAPSULATION OF IONIC LIQUIDS WITHIN METAL ORGANIC FRAMEWORKS: TOWARDS NEW PROTONIC CONDUCTORS
16	RAJASEKHAR MADUGUNDO	"TBA"
17	20/04/2017 ANA MARÍA SCHÖNHÖBEL	STUDY OF Sm <sub>1-x</sub> Ce <sub>x</sub> Fe <sub>9</sub> Co <sub>2</sub> Ti BY MAGNETIZATION AND MÖSSBAUER MEASUREMENTS
18	MAITE GOIRIENA	MAGNETIZATION REVERSAL IN CIRCULAR VORTEX DOTS OF SMALL RADIUS
19	03/05/2017 JON OSTOLAZA	SYNTHESIS OF METAL ORGANIC FRAMEWORKS (MOFs) FOR THE REMOVAL OF HEAVY METALS SUCH AS ARSENIC AND CHROMIUM FROM WATER AND AS AN ACTIVE HIGH TEMPERATURE PROTON CONDUCTORS IN PEM FUEL CELLS.
20	ANDER PILAR	TiO <sub>2</sub> IMMOBILIZED IN P(VDF-TrFE) ELECTROSPUN MEMBRANES FOR WATER PURIFICATION
21	ANTTON IBARBIA	DEVELOPMENT OF NANOPARTICLE-FUNCTIONALIZED INKS FOR THE PRINTING OF PRESSURE AND STRAIN MICROSENSORS
22	18/05/2017 JAVIER ALONSO	SUPERPARAMAGNETIC IRON OXIDE NANODISCS FOR HYPERTHERMIA THERAPY: DOES SIZE MATTER?
23	ARIANE SAGASTI	CORROSION RESISTANT METALLIC GLASSES FOR BIOSENSING APPLICATIONS
24	31/05/2017 ANDRÉS MARTÍN	NITROGENATION OF (ZrNd)Fe <sub>10</sub> Si <sub>2</sub> ALLOYS WITH ThMn <sub>12</sub> STRUCTURE
25	CRISTINA ECHEVARRÍA	SYNTHESIS OF Fe-Sn METASTABLE PHASES BY NON-STANDARD TECHNIQUES, FOR PERMANENT MAGNETS APPLICATIONS

## BCMaterials Fortnightly Seminars

	Data	Speaker	Title
26	14/06/2017	IVÁN RODRÍGUEZ	SHAPE MEMORY AND SUPERELASTIC EFFECT AT THE NANOSCALE
27		ARKAITZ FIDALGO	ZN-MOF74 / IONIC LIQUID COMPOSITE: TOWARDS AN ENHANCE CO <sub>2</sub> STORAGE CAPACITY
28	28/06/2017	DANIEL SALAZAR	TUNING HYSTERESIS IN METAMAGNETIC SHAPE MEMORY ALLOYS FOR REFRIGERATION APPLICATIONS
29	12/07/2017	LAURA GRACIA	PREPARATION OF Au/TiO <sub>2</sub> NANOSTRUCTURES FOR INCORPORATION IN PHOTOANODES OF HIGH EFFICIENCY SOLAR CELLS
30		DAVID GANDÍA	RESPUESTA MAGNÉTICA DE BACTERIAS MAGNETOTÁCTICAS ALINEADAS
31		PAULA GONZÁLEZ	DEVELOPMENT OF PROTON EXCHANGE MEMBRANES BASED IN POLYMER@IONIC LIQUID COMPOSITES
32	26/07/2017	LETICIA FERNÁNDEZ	SYNTHESIS AND CHARACTERIZATION OF AN IONIC POLYOXOVANADATE-BASED HYBRID COMPOUND
33		PABLO BENDIALAUNETA	$\Delta E$ EFFECT, MAGNETOSTRICTION AND HYSTERESIS STUDY OF VITROVAC 4040 AND X6 FERROMAGNETIC MATERIALS
34		ASIER GALÍCIA	FABRICACIÓN DE UNA PLATAFORMA PARA EL CONTROL REMOTO DE BACTERIAS MAGNETO TÁCTICAS
35		ASIER RODRIGUEZ	SYNTHESIS AND CHARACTERIZATION OF A NEW FUNCTIONALISED METAL-ORGANIC FRAMEWORK (MOF) WITH POTENTIAL BIOLOGICAL APPLICATIONS
36	27/07/2017	AINARA VALVERDE	TOWARDS THE DEVELOPMENT OF UV CURABLE MAGNETOSTRICTIVE AND PIEZOELECTRIC INKS FOR SENSOR APPLICATIONS
37		SHEILA MAIZ	DEVELOPMENT OF ELECTROSPUN NANOFIBERS FOR TISSUE ENGINEERING APPLICATIONS
38	20/09/2017	MÓNICA GÓMEZ	CHARACTERIZATION AND STABILIZATION OF THE ThMn <sub>12</sub> PHASE FOR NdFe <sub>11</sub> Ti COMPOUNDS
39		NAROA IGLESIAS	GENERATION AND CHARACTERIZATION OF Fe <sub>3</sub> M MATERIALS (M =Sn, Ce, Ga) FOR USE AS PERMANENT MAGNETS
40	04/10/2017	ALBERTO MACEIRAS	MAGNETIC CELLULOSE NANOCRYSTAL NANOCOMPOSITES FOR THE DEVELOPMENT OF GREEN FUNCTIONAL MATERIALS
41		ANABEL PÉREZ	CORRELATION BETWEEN STRUCTURE AND MECHANICAL PROPERTIES IN MULTICOMPONENT SINGLE CRYSTALS BASED Ni-Mn-Ga ALLOYS
42	18/10/2017	EDUARDO FERNÁNDEZ	GMI SENSORS IN FLEXIBLE SUBSTRATES TBA
43		ROBERTO FERNÁNDEZ	COMPOSITE SILVER VANADIUM OXIDE HYDROGELS AND NANO-FILMS FOR ENVIRONMENTAL REMEDIATION AND ANTIMICROBIAL COATINGS
44	02/11/2017	IRATI RODRIGO	DESIGN AND ASSEMBLY OF AN ELECTROMAGNETIC APPLICATOR FOR MAGNETIC HYPERTHERMIA EXPERIMENTS
45		ARKAITZ FIDALGO	METALLOPORPHYRIN BASED SOLID COORDINATION FRAMEWORKS: MIMICKING THE NATURAL PROPERTIES
46	15/11/2107	PAULA SÁNCHEZ	CARBON-BASED ANODE MATERIALS FOR SODIUM ION BATTERIES
47		CLARA GARCÍA	INNOVATIVE MATERIALS; FROM HYDROGELS TO PIEZORESISTIVE SENSORS AND ACTUATORS
48	29/11/2017	JAVIER ALONSO	EXOSOME ENRICHMENT IN BLOOD BIOPSIES VIA NANOWIRE TAGS
49		ANA MARÍA SCHÖNHÖBEL	MAGNETIC PROPERTIES OF NEW SERIES Sm <sub>1-x</sub> Nd <sub>x</sub> Fe <sub>11</sub> V (x=0, 0.2, 0.4) WITH ThMn <sub>12</sub> TYPE STRUCTURE.
50	13/12/2017	ARIANE SAGASTI	METGLAS/ZnO/HEMOGLOBIN ELECTRODE TO DETECT THE OXIDATION OF THE HAEMOGLOBIN SIMULTANEOUSLY BY CV AND MR
51		ANDRÉS MARTÍN	ROLE OF Ce SUBSTITUTION IN THE MAGNETO-CRYSTALLINE ANISOTROPY OF TETRAGONAL ZrFe <sub>10</sub> Si <sub>2</sub>



2017 IN PICTURES





HIGH LEVEL EDUCATION



### Master

#### Master theses:

- » "DEVELOPMENT OF PROTON EXCHANGE MEMBRANES BASED IN POLYMER@IONIC LIQUID COMPOSITES", by Paula González Saiz; Máster de Nuevos Materiales (UPV/EHU). Supervisors: Ana Catarina Lopes / María Isabel Arriortua
- » "NANODISCS BY COLLOIDAL LITHOGRAPHY FOR BIOMEDICAL APPLICATIONS", by Claudia Ezquerro Toral. Máster de Nuevos Materiales (UPV/EHU). Supervisor: Alfredo García Arribas
- » "MAGNETIC CHARACTERIZATION OF  $Ce_{x}Sm_{1-x}Fe_{9}Co_{2}Ti$  ALLOYS FOR PERMANENT MAGNETS" Ana M<sup>a</sup> Schnobel, Máster de Nuevos Materiales (UPV/EHU). Supervisor: José Manuel Barandiaran
- » "SELF-ASSEMBLE AND MAGNETIC RESPONSE OF ALIGNED MAGNETOTACTIC BACTERIA", by David Gandia. Máster de Nuevos Materiales (UPV/EHU). Supervisor: María Luisa Fernández-Gubieda
- » "PREPARATION OF  $Au/TiO_2$  NANOSTRUCTURES FOR INCORPORATION IN PHOTOANODES OF HIGH EFFICIENCY SOLAR CELLS". Máster de Nuevos Materiales (UPV/EHU). Supervisor: Maite Intsausti

### Doctorate

#### PhD theses:

- » "Development and Applications of Semicrystalline Polymers: From Shape Memory to Self-Healing Materials" by Nuria García, UPV/EHU. Supervisors: Luis León Isidro, José Manuel Laza Torroba.
- » "Developing ferrite based nanocompounds for

biomedical applications" by Xabier Lasheras, UPV/EHU. Supervisor: Maite Insausti.

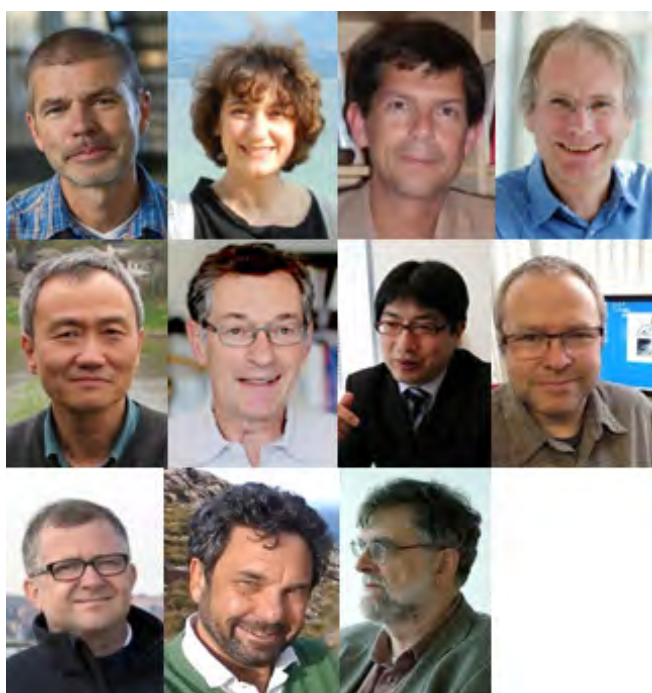
- » "Hybrid polyoxometalates: synthesis, crystal structures, thermostructural behavior and anchoring to tailored polymeric surfaces" by Jagoba Martín, UPV/EHU. Supervisors: Juan Manuel Gutiérrez-Zorrilla, José Luis Vilas.
- » "Magnetic vortex nanodiscs for cancer cell destruction" by Maite Goiriena, UPV/EHU. Supervisor: Alfredo García Arribas.
- » "Propiedades mecánicas y calóricas de cintas elaboradas por solidificación rápida de aleaciones ferromagnéticas con memoria de forma base Niquel" by Christian Omar Aguilar, Co-tuition among UPV/EHU and Instituto Potosino de Investigación Científica y Tecnológica, San Luis Potosí, México. Supervisors: Volodymyr Chernenko, Horacio Flores-Zúñiga.
- » "Magnetic Scaffolds for biomedical applications", by M<sup>a</sup> Blanca Valle, UPV/EHU. Supervisors: Esperanza Díaz, José Manuel Barandiaran.



### Summer Schools

The 2017 IEEE Magnetics Society Summer School was organized by BCMaterials in collaboration with the Department of Science and Engineering of Materials (CITIMAC), University of Cantabria, and the International University Menéndez Pelayo, UIMP. The support of the Spanish Club of Magnetism (sister Society to IEEE Magnetics Society) and the Chapters of the Magnetic Society of the IEEE in Spain, Italy and Romania was also decisive.

The School took place in the Palace of "La Magdalena" Santander, from 19 to 23 June, and was attended by



2017 IEEE SS Lecturers. From top to bottom, left to right: Oliver Gutfleisch, Puerto Morales, Robert Stamps, J Thomas Schrefl, Xiaofeng Jin, Bernard Dieny, Eiji Saitoh, Hendrik Ohldag, Jeff McCord, Michael Farle, Mike Coey

90 PhD students from 22 countries. Eleven scientist of first International rank (see below) did the lectures. The chairs of the local Organizing Committee were José Manuel Barandiarán (Scientific Director of BCMaterials) and José Carlos Gómez Sal (University of Cantabria). Manuel Vázquez, President of the IEEE Magnetics Society and Atsufumi Hirohata, Chair of the Education Committee were present during the School.

A new and special initiative of the Education Committee of the IEEE Magnetics Society was introduced in this school to support students-led projects for the first time. Students who shared common interests on their PhD studies formed groups of about 5 people to discuss a project in the designated group project time during the School and over e-mails/Skype before that. The winners will be invited to submit and present a poster at the Intermag 2018 in Singapore. 16 groups (including a total of 82 students) were formed and they presented their research and financial plans in 5 min talks on Thursday, 22 June. Each student had one vote at the end of the presentation. By adding votes by the Summer School lectures and organizing committee members, the



During a lecture



2017 MSSS Chair, Manu Barandiarán, EdCom Chair, Atsufumi Hirohata, and MagSoc President, Manuel Vazquez at the venue.



Homage to Blas Cabrera: Presentation of the exhibit

following project, which includes a PhD student from BCMaterials (Ana Maria Schönhöbel), was funded:

"NOVEL DESIGN FOR A MAGNETIC ENCODER SYSTEM"

- » Christian Huber, University of Vienna, Austria
- » Yaoying Zhong, Nanyang Technological University, Singapore
- » Ana Maria Schönhöbel, BCMaterials, University of the Basque Country, Spain
- » Daniel Simon, Robert Bosch GmbH, Germany
- » Chia Chang, National Tsing Hua University, Taiwan

As a part of the School activities, the homage to Blas Cabrera Felipe also took place. He was a distinguished Spanish scientist in magnetism and Chancellor of the Summer International University of Santander, the precursor of the present International University Menéndez Pelayo, in the 30's of the last century. He was the only Spanish participant in the Solvay conferences on the new quantum science: 1930 (Magnetism) and 1933 (Nuclear structure) as invited by Marie Curie and Albert Einstein.

#### Winter course:

*MAGNETISM IN BIOMEDICINE, AN INTRODUCTION*

– A COURSE FOR MASTER AND PHD STUDENTS –

FEBRUARY 2 AND 3, 2017

The 2017 Magnetism in Biomedicine winter course was organized by BCMaterials with the collaboration of the Instituto de Ciencia de Materiales, CSIC, Zaragoza and the University of Zaragoza.

The Course took place in the Paraninfo of the Faculty of Science and Technology FCT/ZTF, Leioa on 2nd and 3rd of February, and was attended by 40.

Five scientist of first International rank (see below) did the lectures. The chairs of the local Organizing Committee were Dr. Maria Luisa Fernandez-Gubieda and Dr. Maite Intsausti.

- » Dr. Laura Asin, Instituto de Ciencia de Materiales, CSIC, Zaragoza
- » Dr. Valeria Grazu, Universidad de Zaragoza, Zaragoza
- » Dr. Ana Garcia Prieto, Departamento Física Aplicada I, UPV/EHU
- » Dr. Maite Insausti, Departamento de Química Inorgánica, UPV/EHI
- » Dr. M<sup>a</sup> Luisa Fernandez-Gubieda, Departamento de Electricidad y Electrónica, UPV/EHU

#### Summer Internships

- » Ainara Valverde – “Development of conductive and piezoresistive inks for sensor applications”
- » Asier Galicia – “Development of Homemade magnetotaxis platform”
- » Leticia Fernandez – “Thermally Triggered crystal-to-crystal transformations in ployoxometalate based compounds”
- » Pablo Bedialauneta – “ $\Delta E$  Effect and Applications in devices”
- » Sheila Maiz – “Development of electrospun nanofibers for tissue engineering applictaions”
- » Asier Rodriguez – “Metal Organic Frameworks (MOFs) Nona-carriers dor controlled antimicrobial agents release”
- » Naroa Iglesias – “Production of new Fe-Rich based permanent magnets by non-equilibrium methods”
- » Mónica Iglesias – “Development of infiltrated permanent magnets from a nano-approach”

The background is a complex, low-poly geometric pattern. It consists of numerous irregular polygons in various shades of orange, from deep, dark red-orange to bright, sunny yellow-orange. The polygons are arranged in a way that creates a sense of depth and movement, with some shapes appearing to protrude or recede. The overall effect is a vibrant, textured surface.

## OTHER ACTIVITIES

## OTHER ACTIVITIES

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### Large Facilities experiments

- » "Spin correlation in clusters of magnetic nanoparticles" (5-53-267); P. Bender, L. Fernández-Barquín, M.L. Fernández-Gubieda, D. Gonzalez Alonso, L. Marcano, W. Szczerba. ILL (Grenoble); D33 (SANS), 29 January-02 February 2017
- » "Magnetic anisotropy of magnetite nanoparticles biosynthesized by magnetotactic bacteria" (17104775-ST); A. García Prieto, M.L. Fernández-Gubieda, L. Marcano, A. Muela, S. Valencia. BESSY (Berlin); UE49\_PGM SPEEM, 27 February-05 Mars 2017
- » "XANES spectroscopy on biologically synthesized magnetite nanoparticles doped with metallic elements (Ni, Zn, Cu)"; A. García Prieto, D. Muñoz Rodríguez, A. Muela, J. Alonso, M.L. Fernández-Gubieda, L. Marcano. ESRF (Grenoble); SpLine-BM25A, 27 April-02 May 2017
- » "Magnetic field suppression of the Martensitic transition in a Ni—Mn—In alloy: H-T phase diagram"; A. Pérez-Checa; P. Lázpita, V. Chernenko, J.M. Barandiaran. HFML (Nijmegen) 8-12 June 2017
- » "Single crystal X-ray diffraction studies on porphyrin based MOF and vanadate based MOF microcrystals: Structural Resolution and Thermal Behaviour". Data reduction and treatment; A. Fidalgo-Marijuan, E. Serrano Larrea, R. Fernández, M. I. Arriortua, B. Bazan, L. Bravo, F. Llano, J. L. Pizarro, K. Urriaga, G. Barandika. ESRF (Grenoble) BM25B 26-31 June 2017
- » "Magnetic properties of transition metal doped magnetosomes biosynthesized by magnetotactic bacteria"; A.García Prieto, M.L. Fernández-Gubieda, L. Marcano, A. Muela, S. Valencia, D.Muñoz, D. Gandía. Bessy II (Berlin-Germany), P:PM3, 16-22 October 2017

- » "New layered vanadium oxides with different intercalated species as electrode"; J. Orive, R. Fernández, E. Serrano, M. Arriortua; ESRF (Grenoble) SpLine-BM25A. October 2017

### Other: Visits of BCMaterials researcher to other institutions

- » V.A. Chernenko: Research visit in Tokyo Institute of Technology, Tokyo, Japan, July 20 - September 17.
- » Anabel Perez-Checa: research visit to Lappeenranta University of Technology, Material Physics Laboratory, Savonlinna, Finland. 1 month, July
- » P. Lazpita and A. Perez-Checa. High Field Magnet Laboratory HFML-EMFL, NIJMEGEN, Netherlands. June, 1 week
- » G.V. Kurlyandskaya, Physics Department, University of Maryland, USA. January, 2 weeks
- » G.V. Kurlyandskaya, Biomedical Physics and Engineering Department Ural State Medical University, Ekaterinburg, Russian Federation September-October, 5 weeks
- » J. Alonso, University of Minnesota - Dept. of Electrical and Computer Engineering July-September, 6weeks.
- » A. Martin, research visit to National Center for Scientific Research, "DEMOCRITOS, Athens, 3 months
- » C. Echevarria, research visit to University of Delaware, USA, 1 month
- » A.M. Schönhöbel, research visit to University of Delaware, USA, 2 months

The background is a complex, low-poly geometric pattern of triangles and polygons. The colors transition from a deep purple on the left to a bright red on the right, with various shades of magenta and pink in between. The shapes are irregular and overlapping, creating a textured, crystalline appearance.

MAIN RESEARCH PRODUCTION

## MAIN RESEARCH PRODUCTION

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### Selected Conference Contributions

*WORKSHOP H2BioCatO2 2017, CASTELLÓN, SPAIN, 22-24 NOVEMBER 2017*

Participation: María Isabel Arriortúa Chairing session 3.

*INTERNATIONAL WORKSHOP ON "HYSTERESIS IN MAGNETOCALORIC, ELECTROCALORIC AND ELASTOCALORIC REFRIGERATION". DRESDEN TECHNICAL UNIVERSITY, FEBRUARY 7-9, 2017, DRESDEN, GERMANY.*

Participation: VA Chernenko

Invited talk: "An hysteretic change of physical properties above critical point at stress-temperature phase diagram of martensitic transformation in shape memory alloys".

*"XXVI INTERNATIONAL MATERIALS RESEARCH CONGRESS", CANCÚN (MÉXICO) AUGUST 2017*

Participation: J. Gutiérrez, A. Lasheras, P. Martins, J.M. Barandiarán and S. Lanceros-Méndez: "Magnetoelastic metallic glass/PVDF laminated composites: from fabrication to applications" (Invited).

*REUNIÓN ANUAL DEL CLUB ESPAÑOL DE MAGNETISMO. 15 DE SEPTIEMBRE DE 2017. SEVILLA (ESPAÑA).*

Participation: A García-Arribas, Invited talk: "Magnetic vortex nanodiscs for cancer cell destruction".

*JORNADA: NEW MATERIALS FOR SENSORS AND ACTUATORS. INAMAT (INSTITUTE FOR ADVANCED MATERIALS) 28 SEPTIEMBRE 2017. PAMPLONA (ESPAÑA).*

Participation: A García-Arribas, Invited talk: "Soft magnetic materials: from microsensors to cancer therapy"

*"ENERGY MATERIALS NANOTECHNOLOGY, SOFT MATERIALS 2017", VIENNA (AUSTRIA) JUNE 2017*

Participation: D. Salazar: "Tuning hysteresis in metamagnetic shape memory alloys for refrigeration applications" (Invited)

*SMART AND FUNCTIONAL POLYMER-NANOPARTICLE BASED MATERIALS FOR ENVIRONMENTAL, BIOMEDICAL AND ENERGY APPLICATIONS.*

Participation: Francesko A, Cardoso VF, Lanceros-Méndez S. Talk given at the Instituto de Microelectrónica de Barcelona, IMB-CNM (CSIC), 15th – 16th February, 2017

*ELECTROACTIVE MICROENVIRONMENTS FOR TISSUE ENGINEERING APPLICATIONS. INTERNATIONAL SYMPOSIUM ON MATERIALS FOR TISSUE ENGINEERING; NOVEMBER 9TH 2017 BILBAO, SPAIN.*

Participation: C. Ribeiro, S. Ribeiro, D.M. Correia, I. Etxebarria, N. Castro, V. Correia and S. Lanceros-Méndez.

*"INK JET PRINTING: BASICS, TECHNIQUE, INKS AND ELECTRONIC DEVICES" ELOI RAMON (ICAS CNM, BARCELONA, SPAIN) & SENENTXU LANCEROS-MENDEZ (BCMATERIALS, SPAIN AND UNIV. MINHO, BRAGA, PORTUGAL).*

Invited course at the MNE-2017 43er International Meeting on Micro and Nanoengineering meeting, September 2017, Braga, Portugal

"Printing smart and functional polymers for sensor and actuator applications", Techconnect, May 13/5-17/5/2017, Washington, USA. S. Lancero-Mendez

## Selected Conference Contributions

*“ADVANCED TECHNOLOGIES BASED ON SMART-POLYMER NANOCOMPOSITES”*

Participation: P. Martins, S. Lanceros-Mendez, 27/3-29/3/, European Hengstberger Symposium New Horizons in Smart Materials, Heidelberg, Germany.

*“THE KEY ROLE OF SMART AND FUNCTIONAL MATERIALS IN THE DEVELOPMENT OF MODERN TECHNOLOGY”*

Participation: S. Lanceros-Mendez; The Vanguard Lecture, 20th February 2017; IIT Jodhpur, India

*“ADVANCED POLYMER BASED MATERIALS: FROM FUNDAMENTALS TO APPLICATIONS... AND BACK TO FUNDAMENTALS”*

Participation: S. Lanceros-Mendez, Invited seminar, University of Jadavpur, 02/2017

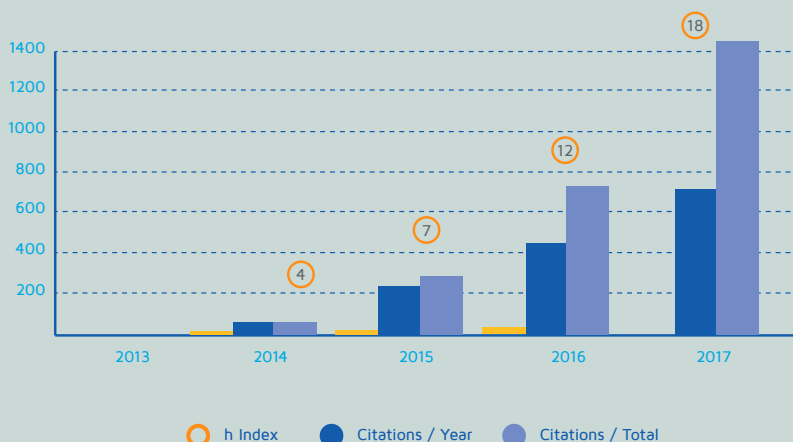
*“MULTIFUNCTIONAL POLYMER COMPOSITES: EXPANDING THEIR APPLICABILITY BY TUNING SHAPE AND RESPONSE”*

Participation: D. M. Correia, C. Ribeiro, V. F. Cardoso, P. Martins, S. Lanceros-Méndez, 6th International Conference on Functional Electroceramics and Polymers, 20th-22th February, 2017, IIT Kharagpur, India

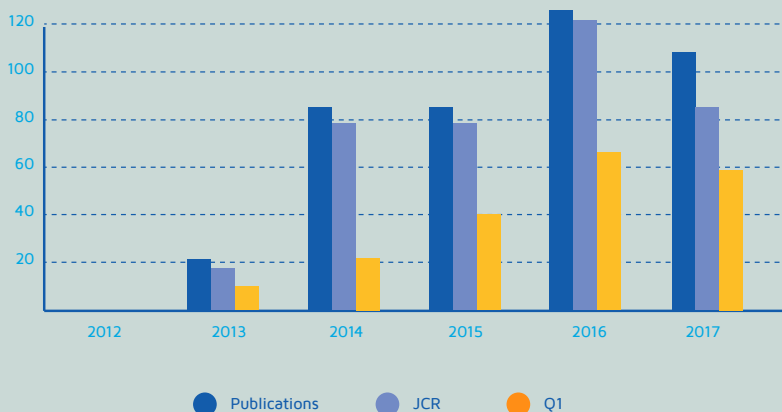
*“OPTIMIZATION AND INTEGRATION OF MULTIFUNCTIONAL POLYMER BASED MATERIALS: CHALLENGES AND TRENDS”*

Participation: S. Lanceros-Mendez, XIII Meeting of the Institute of Materials of Alicante (IUMA) 19-20/1/2017, Alicante, Spain

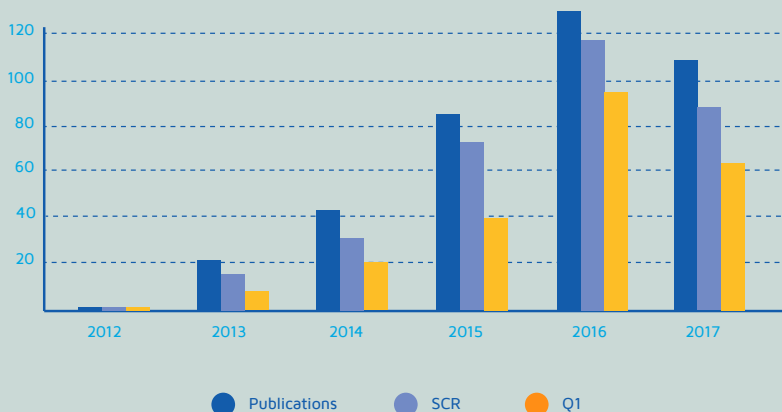
## Citations BCMaterials



## Publications BCMaterials WOS



## Publications BCMaterials SCOPUS





## Journal articles

1. Highly thermally stable heterogeneous catalysts: study of 0D and 3D porphyrinic MOFs. Eder Amayuelas; Arkaitz Fidalgo-Marijuan; Begoña Bazán; Miren-Karme Urtiaga; Gotzone Barandika; María Isabel Arriortua. *CrystEngComm*, Volume 20, 301-311.
2. In vivo demonstration of the suitability of piezoelectric stimuli for bone reparation. Clarisse Ribeiro; Daniela María Correia; I. Rodrigues; L. Guardão; S. Guimarães; R. Soares; S. Lanceros-Méndez. *Materials Letters*, Volume 209, 118-121.
3. Scalable synthetic method for SOFC compounds. Aritza Wain-Martin; Aroa Morán-Ruiz; Karme Urtiaga; Aitor Larrañaga; M.A Laguna-Bercero; María Isabel Arriortua. *Journal of Power Sources*, Volume 313, 52-57.
4. Transformation behavior and magnetocaloric effect in  $Mn_{1-x}Cr_xCoGe$  ( $x=0.04$  and  $0.11$ ) melt-spun ribbons tailored by heat treatment. Gerardo Daniel-Pérez; J. L. Sánchez Llamazares; P. Álvarez-Alonso; C. F. Sánchez-Valdés; R. Varga; Volodymyr A. Chernenko; A. Quintana-Nedelcos. *Journal of Magnetism and Magnetic Materials*, Volume 444, 263-269.
5. Marked Object Recognition Multitouch Screen Printed Touchpad for Interactive Applications. Jivago Serrado Nunes; N. Castro; Sergio Gonçalves; Néilson Pereira; Victor Correia; S. Lanceros-Méndez. *Sensors (MDPI)*, Volume 17, Issue 12, 2786.
6. Cu(II) and Zn(II) based Phthalocyanine as Hole selective layers for Perovskite Solar Cells. Laura Caliò; Jorge Follana-Berná; Samrana Kazim; Morten Madsen; Horst-Günter Rubahn; Ángela Sastre-Santos; Shahzada Ahmad. *Sustainable Energy & Fuels*, Issue 10.
7. High-performance graphene-based carbon nanofiller/polymer composites for piezoresistive sensor applications. Pedro Costa; Joao Nunes-Pereira; Juliana Oliveira; Jaime Silva; J. Agostinho Moreira; S. A. C. Carabineiro; J.G. Buijnsters; S. Lanceros-Méndez. *Composites Science and Technology*, Volume 153, 241-252.
8. On the Relevance of the Polar  $\beta$ -Phase of Poly(vinylidene fluoride) for High Performance Lithium-Ion Battery Separators. Manab Kundu; Carlos M. Costa; Juliana Dias; Alberto Maceiras; José L. Vilas; S. Lanceros-Méndez. *Journal of Physical Chemistry C*, Volume 121, 26216-26225.
9.  $Na_{2.5}Fe_{1.75}(SO_4)_3/Ketjen/rGO$ : An advanced cathode composite for sodium ion batteries. Aintzane Goñi; Amaia Iturrondobeitia; Izaskun Gil de Muro; Luis Lezama; Teófilo Rojo. *Journal of Power Sources*, Volume 369, 95-102.
10. Dipole-induced exchange bias. Felipe Torres; Rafael Morales; Ivan K. Schuller; Miguel Kiwi. *Nanoscale*, Volume 9, 17074.
11. Magnetic phases in thin films of Ni-Fe(Co)-Ga ferromagnetic shape memory alloy. Volodymyr A. Chernenko; Iván Rodríguez Aseguinolaza; Golub, V.; Salyuk, O. Y.; José Manuel Barandiarán. *Journal of Physics D: Applied Physics*, Volume 50, 45.
12. Improving Na-O<sub>2</sub> batteries with redox mediators. James T. Frith; Imanol Landa-Medrano; I. Ruiz de Larramendi; Teófilo Rojo; John R. Ower; Nuria García-Araez. *Chemical Communications*, Volume 53, 88, 12008-12011.
13. Microscopic reversal magnetization mechanisms in CoCrPt thin films with perpendicular magnetic anisotropy: Fractal structure versus labyrinth stripe domains. David Navas; Nastassia Soriano; F. Berón; C. T. Sousa; K. R. Pirota; J. Torrejon; Carolina Redondo; Rafael Morales; C. A. Ross. *Physical Review B*, Volume 96, Issue 18.
14. Water-Based Suspensions of Iron Oxide Nanoparticles with Electrostatic or Steric Stabilization by Chitosan: Fabrication, Characterization and Biocompatibility. Galina V. Kurlyandskaya; L. S. Litvinova; A. P. Safronov; V. V. Schupletsova; Irina S. Tyukova; Olga G. Khaziakhmatova; Galina B. Slepchenko; K. A. Yurova; Elena G. Cherempey; N. A. Kulesh; R. Andrade; I. Beketov; I. A. Khlusov. *Sensors (MDPI)*, Volume 17, 11.
15. Human Mesenchymal Stem Cells Growth and Osteogenic Differentiation on Piezoelectric Poly(vinylidene fluoride) Microsphere Substrates. R. Sobreiro-Almeida; M. N. Tamaño-Machiavello; E. O. Carvalho; L. Córdón; S. Doria; L. Senent; Daniela María Correia; Clarisse Ribeiro; S. Lanceros-Méndez; R. Sabater i Serra; J. L. Gómez Ribelles; A. Sempere. *International Journal of Molecular Sciences*, Volume 18, Issue 11, 2391.
16. Magnetoimpedance in Samples With Patterned Surfaces for the Detection of Magnetic Particles and Ferrofluids.

Alfredo García-Arribas; Maite Goiriena-Goikoetxea; Eduardo Fernández; José Manuel Barandiarán. IEEE Transactions on Magnetics, Volume 53, 11.

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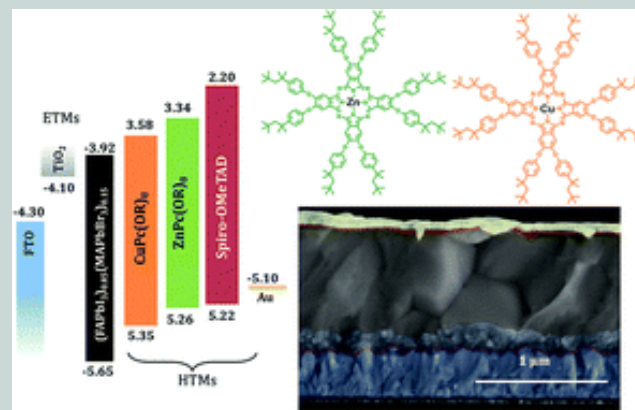
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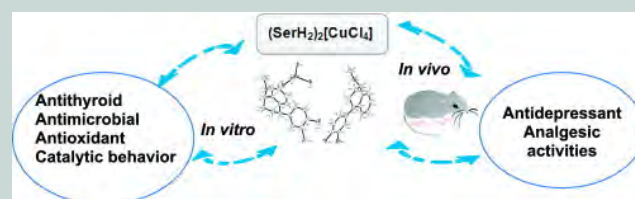
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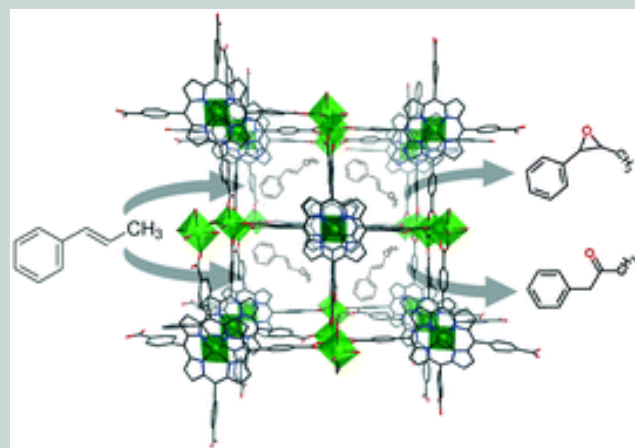
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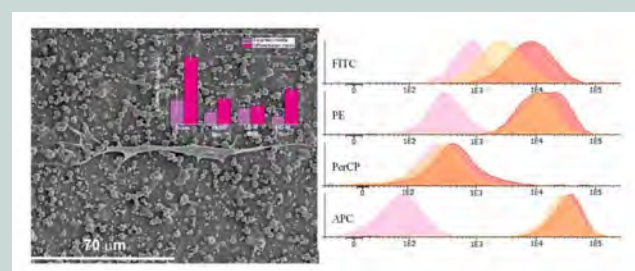
Cu(II) and Zn(II) based phthalocyanines as hole selective layers for perovskite solar cells



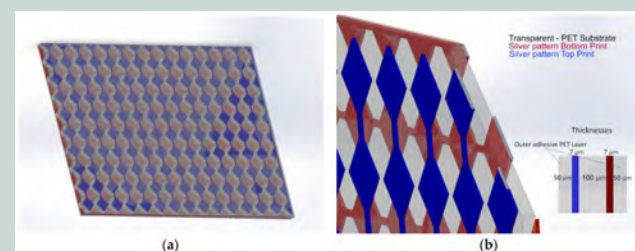
Evidence of promising biological-pharmacological activities



Highly thermally stable heterogeneous catalysts



Human Mesenchymal Stem Cells



Marked Object Recognition Multitouch

Notable results

24. Motor current signature analysis for gearbox condition monitoring under transient speeds using wavelet analysis and dual-level time synchronous averaging. Iñaki Bravo-Imaz; Hossein Davari Ardakani; Zongchang Liu; Alfredo García-Arribas; Aitor Arnaiz; Jay Lee. *Mechanical Systems and Signal Processing*, 94, 73–84.
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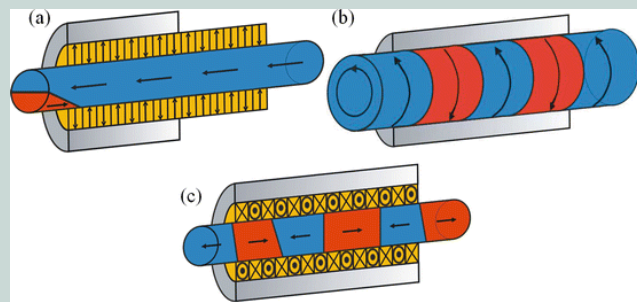
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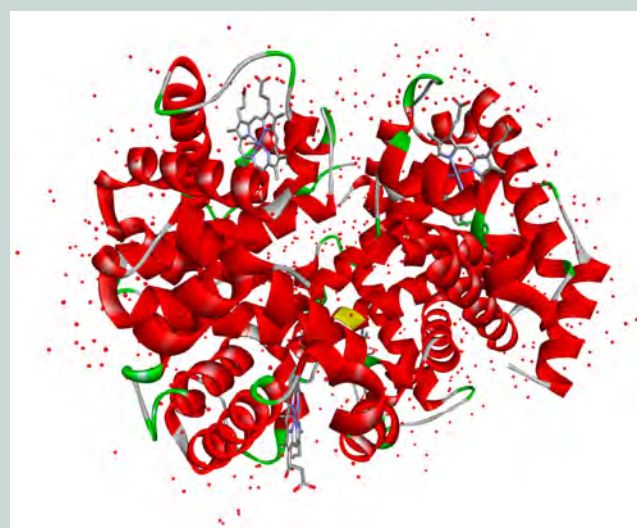
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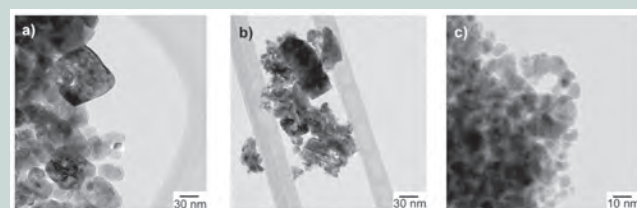
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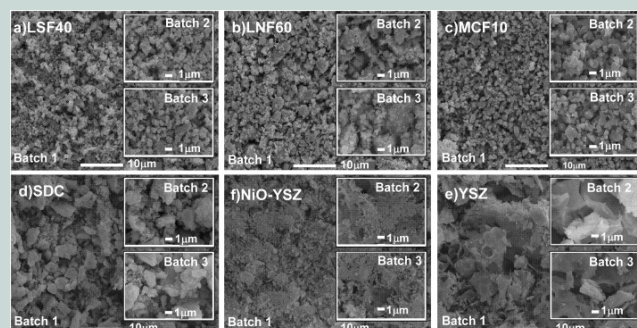
*Soft Ferromagnetic Microwires with Excellent Inductive*



*Nanostructured ZnO in a MetglasZnO Hemoglobin*



*Physico-Chemical and Electrochemical Properties*



*Scalable synthetic method for SOFC compounds*

*Notable results*

63. Cationic Mn<sup>2+</sup>/H<sup>+</sup> exchange leading a slow solid-state transformation of a 2D porphyrinic network at ambient conditions. Eder Amayuelas; Arkaitz Fidalgo-Marijuan; Begoña Bazán; Miren-Karme Urtiaga; Gotzone Barandika; Luis Lezama; María Isabel Arriortua. *Journal of Solid State Chemistry*, Volume 247, 161-167.
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### Book Chapters

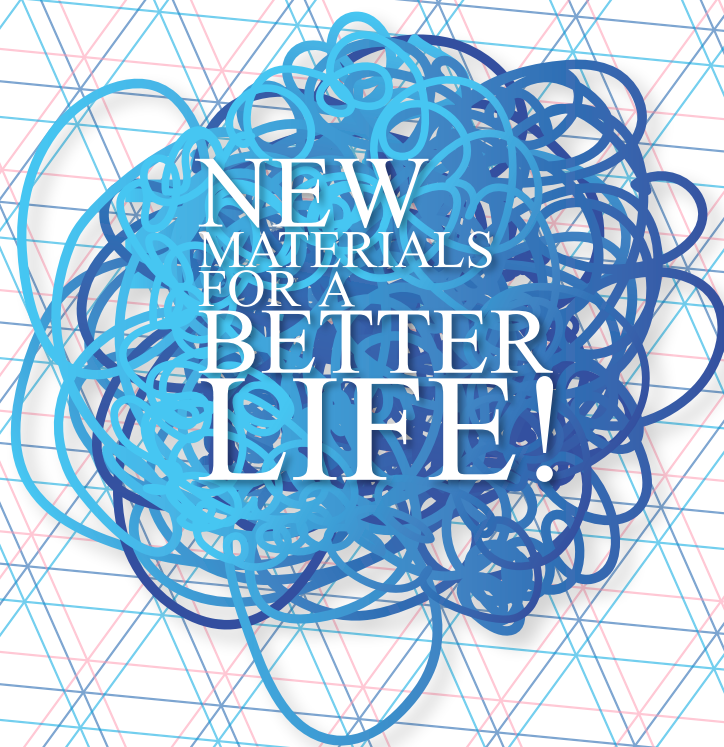
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### Patents

One patent has been registered in 2017 in the field of advanced functional materials:

Title: *"MÉTODO DE FABRICACIÓN DE UNA LÁMINA DE POLIFLUORURO DE VINILIDENO EN FASE BETA Y LÁMINA TRIDIMENSIONAL DE POLIFLUORURO DE VINILIDENO EN FASE BETA"*; APPLICATION NUMBER: *EP16382552.4*





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