Index

Research and Technical Development

Letter from the Director 4
Organisation and People 6

Severo Ochoa Award
Severo Ochoa Award - Nanodevices for Social Challenges 10

Research Groups
Atomic Manipulation and Spectroscopy Group 14
Force Probe Microscopy and Surface Nanoengineering Group 18
Inorganic Nanoparticles Group 24
Magnetic Nanostructures Group 30
NanoBioelectronics and Biosensors Group 36
NanoBiosensors and Bioanalytical Applications Group 44
Nanostructured Functional Materials Group 52
Nanostructured Materials for Photovoltaic Energy Group 56
2014 was a year of growth and intense activity for the Catalan Institute of Nanoscience and Nanotechnology (ICN2).

After the conversion from the former ICN (Institut Català de Nanotecnologia) to the new ICN2 (Institut Català de Nanociència i Nanotecnologia), with the integration of the CSIC groups from the former Centro Mixto CIN2, the process started in 2011 is almost complete. The Board of Trustees of the ICN2 Foundation is formed by the Generalitat de Catalunya (Catalan Government), the Consejo Superior de Investigaciones Científicas (CSIC) and the Universitat Autònoma de Barcelona (UAB). Our Patrons are united in their efforts to build a strong centre for research in Nanoscience and Nanotechnology, taking advantage of the strengths of each institution, and enhancing ICN2’s scientific potential and impact, financial resources, and competitiveness.

The ICN2 building was officially inaugurated on January 20, 2014, with the presence of Andreu Mas-Colell (Minister of Economy and Knowledge of Catalonia, and President of the ICN2 Board of Trustees), Carmen Vela (Secretary of State for Research, Development and Innovation of Spain), Emilio Lora Tamayo (President of the Consejo Superior de Investigaciones Científicas) and Ferran Sancho (Rector of the Universitat Autònoma de Barcelona). Shortly after, ICN2 received the Severo Ochoa Excellence Award, confirming that our efforts were headed in the right direction.

The Severo Ochoa Programme, sponsored by the Spanish Ministry of Economy and Competitiveness (MINECO), aims to identify and support Spanish research centres that are among the world’s best in their specialty. This is an outstanding achievement, given the level of competitiveness of these awards,
and will mean a qualitative improvement in the research capabilities of ICN2 and act as a driving force for collaborative activities between the research groups of our Institute, focused on specific, common objectives in “Nanodevices for Societal Challenges in Life, Energy and ICT”.

The number of indexed publications (131), with a remarkably high impact factor (5.61), remained notable despite the complexity of the merger process we are completing. ICN2 is strongly involved in the development of one of the European Commission’s two FET Flagship Programmes: the Graphene Flagship. In this Annual Report you will also find impressive figures on our success at attracting national and international competitive funding. Additionally, we continued the strategy launched in 2012 to promote technological transfer as a key activity of ICN2. The role and resources of the Technology Transfer Office have been strengthened, which is having a significant impact on the transfer results.

In summary, 2014 was a year of great activity and results for ICN2. Again, our staff have performed exceptionally well in a period of economic hardship and uncertainties. The completion of the institutional changes leading to the conversion to ICN2, the forecast of a brighter economic situation, and the recent attainment of the Severo Ochoa Award are factors that encourage me to be extremely optimistic about the future of our Institute.

I invite you to join me in building this bright future every day, and to participate in this collective journey towards personal and professional growth.

Sincerely,
Prof Pablo Ordejón
Organisation and People

The Institut Català de Nanociència i Nanotecnologia (ICN2) is a non-profit international research institute located in Barcelona, Spain. It was created in 2013, when CSIC joined the Board of Trustees of the former Institut Català de Nanotecnologia (ICN), created in 2003 by the Ministry of Universities, Research and Information Society (DIUE) of the Catalan Government and the Universitat Autònoma de Barcelona (UAB), and with the incorporation of the CSIC groups from the former Centro de Investigación en Nanociencia y Nanotecnología (CIN2), created in 2006 as a joint collaboration between CSIC and ICN.

ICN2 is led by its Director, Prof Pablo Ordejón, who reports to the Board of Patrons and is advised by the Scientific Advisory Board, made up of numerous distinguished international scientists.

Research activities are directed by Research Group Leaders - senior scientists of international repute that lead research teams focused on their respective areas of expertise, and that are supported by specialised laboratory engineers and technical and administrative staff.

In 2014, ICN2 comprised 15 Research Groups and 5 Technical Development and Support Divisions and Facilities, covering different areas of nanoscience and nanotechnology.

Research Groups

• Atomic Manipulation and Spectroscopy Group
• Force Probe Microscopy and Surface Nanoengineering Group
• Inorganic Nanoparticles Group
• Magnetic Nanostructures Group
• NanoBioelectronics and Biosensors Group
• NanoBiosensors and Bioanalytical Applications Group
• Nanostructured Functional Materials Group
• Nanostructured Materials for Photovoltaic Energy Group
• Novel Energy-Oriented Materials Group
• Oxide Nanoelectronics Group
• Phononic and Photonic Nanostructures Group
• Physics and Engineering of Nanodevices Group
• Supramolecular NanoChemistry and Materials Group (NANOUP)
• Theoretical and Computational Nanoscience Group
• Theory and Simulation Group

Technical Development and Support

• Electron Microscopy Division
• Nanofabrication Division
• Nanomaterials Growth Division
• Nanoscience Instrument Development Division
• Core Research Support Facilities
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President of CSIC (Consejo Superior de Investigaciones Científicas).

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Prof Fernando Briones  
Professor of Research, Microelectronics Institute of Madrid (IMM - CSIC); Madrid, Spain

Prof Manuel Cardona (He passed away on July 2, 2014. ICN2 mourns him)  
Co-founder and Emeritus Professor, the Max Planck Institute; Stuttgart, Baden-Württemberg, Germany

Prof Bruno Chaudret  
Director, Laboratoire de Physique et Chimie des Nano-Objets (LPCNO); Toulouse, France

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University Research Professor; Distinguished Professor, College of Arts & Sciences; and Gill Eminent Professor of Analytical and Biological Chemistry, University of Kentucky; Lexington, Kentucky, USA

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Professor of Physics, Department of Physics, Chalmers University of Technology; Gothenburg, Sweden.

Prof Jörg P. Kotthaus  
Professor of Experimental Physics, Ludwig-Maximilians-Universität München; Munich, Bavaria, Germany

Prof Ernst Meyer  
Professor, Institut für Physik, University of Basel; Basel, Switzerland

Prof Anthony Turner  
Head of Biosensors & Bioelectronics Centre IFM, Linköping University; Linköping, Sweden

**THE ICN2 TEAM**

ICN2 is defined by its people. From senior researchers to administration staff, ICN2 personnel work as a team, contributing their creativity, energy, dedication and hard work to further the Institute.

ICN2 prides itself on being an attractor of talent, seeking to provide an environment and an image of excellence that draws
talented scientists, technicians and support personnel from around the world. The Institute has succeeded in this endeavour, as embodied in its highly-qualified scientific staff and demonstrated by its high level of scientific output. Many researchers who have completed a doctoral thesis or post-doctoral stay at ICN2 have moved on to highly prestigious institutes such as Harvard, Yale, the Max Planck institutes, CNRS and CEA. Thus, ICN2 is continuously offering new positions for junior scientists.

Over the course of 2014, ICN2 engaged an annual average workforce of 226.4 people. Recruitment reached an historic peak, as the Institute fully consolidated its management and administrative teams and met its human resources objectives.

ICN2 is an equal opportunity employer and seeks a workforce diverse in age, culture nationality and gender. By the end of 2014, ICN2 personnel represented multiple nationalities; women comprised an important percentage of all personnel.

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<td>Spain</td>
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<td>Grand Total</td>
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<td>20.5</td>
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<td>14.7</td>
<td>26.8</td>
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<tr>
<td>Visitor</td>
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<tr>
<td>Total</td>
<td>88.9</td>
<td>137.5</td>
<td>226.4</td>
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ICN2 ICREA CSIC
Secondments Fellowship Internship Remunerated Internship Visitor

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Severo Ochoa Award - Nanodevices for Social Challenges

The research developed at ICN2 has a big impact on fields such as life sciences (medicine, health, environment), energy and information and communication technologies. This is one of the main reasons why the Spanish Ministry of Economy and Competitiveness acknowledged the Institute in 2014 as a Severo Ochoa Center of Excellence. This Programme recognizes the excellence of the scientific contributions of centres, their potential industrial and social impact and their potential for talent attraction. At the time ICN2 received the award, only 18 research centres had been awarded.

The funding provided by the Severo Ochoa award will focus on the Programme on “Nanodevices for Social Challenges”. It is largely devoted to the recruitment of staff and the procurement of equipment to support the development of research projects.

CROSS-DISCIPLINARY APPROACHES

The Programme is based on four cross-disciplinary methodological approaches:

• Growth and synthesis of nanomaterials
  Expertise in growth of thin films, PLD, CVD, ALD, etc. with a broad range of materials, including graphene, metal and multiple component oxides.

• Nanofabrication
  Expertise in both bottom-up and top-down fabrication, including self-assembly, nanoparticle synthesis, corrosive etching, supramolecular chemistry, screenprinting, nanoimprint lithography, roll-to-roll lithography on flexible substrates, inkjet printing, and rapid prototyping.

• Characterisation and metrology
  World-class expertise in a very broad range of characterisation techniques, some of them developed by ICN2 researchers. Experience in nanometrology includes two patent applications, and the plan to establish a dedicated industrial Nanometrology centre with private partners.

• Theory and simulation
  Expertise includes pioneering developments of tools for atomistic simulations of matter, including electronic and thermal processes in nanodevices, and the structure and properties of nanomaterials.

RESEARCH AREAS

The research will produce specific applications and devices which are able to reach the market, providing new solutions to major social challenges in the following areas:

• Biosystems
  Expertise in optical and electrochemical biosensing, biofunctionalised inorganic
nanoparticles, supramolecular chemistry, water-surface interactions and characterisation. Related activities include EU projects in point-of-care devices and biosensors, ERC in nanomaterials for diagnostics & therapy, commercialisation with numerous licensed patents and two spin-off companies (biosensing and drug delivery).

- **Energy**

  Expertise in materials, capacitors and energy transfer, phononics and photonics, photovoltaics, piezoelectrics, nanofabrication of flexible substrates and thin-film materials, spectroscopy and characterisation, leadership positions in EU projects and platforms (Graphene Flagship, Photonics platform, ERC in piezolectrics), collaborative prototyping with industry in next-generation photovoltaics, roll-to-roll lithography, and inks for active layers.

- **Information and communication technologies**

  Expertise in materials, spintronics, magnetism, graphene, topological isolators, photonics, phononics and heat transfer, nanodevice fabrication and characterisation.

In 2009, the EU identified KETs for their potential impact in strengthening Europe’s industrial and innovation capacity. Six KETs were highlighted as key for European sustainable growth: Nanotechnology; Micro- and Nano-electronics; Advanced Materials; Photonics; Industrial Biotechnology and, Advanced Manufacturing. In this context, the relevance of the ICN2 Programme on “Nanodevices for Social Challenges” is evident, as it involves virtually all the six KETs.

### BEYOND RESEARCH

In addition to the scientific cross-disciplinary goals, ICN2 will carry out a comprehensive **recruiting and training programme** aimed at attracting and developing the professional careers of talented senior and junior researchers associated with the Severo Ochoa Programme (PhD programme; Postdoctoral programme; Visitors programme; ICN2-User Programme Training; Academia Intern Programme; and workshops and seminars). It also includes other ambitious actions such as the creation of a specific Gender action plan and international knowledge dissemination and outreach activities.

An external **Scientific and Industrial Advisory Committee** (SIAC), appointed by the Director with the advice of the ICN2 Scientific Advisory Board, advises on strategic directions and the progress of the project. The work plan is divided into **seven Work Packages**, one per Application Area and Cross-Disciplinary Activity. Overall management is carried out by the **Project Management Committee**, which is formed by one representative of each WP, plus two additional members to follow up dissemination and technology transfer activities.
The research workforce of ICN2 is distributed across 15 highly specialized research groups. Synergies among groups with complementary research lines are stimulated.
> Atomic Manipulation and Spectroscopy Group
> Force Probe Microscopy and Surface Nanoengineering Group
> Inorganic Nanoparticles Group
> Magnetic Nanostructures Group
> NanoBioelectronics and Biosensors Group
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> Physics and Engineering of Nanodevices Group
> Supramolecular NanoChemistry and Materials Group
> Theoretical and Computational Nanoscience Group
> Theory and Simulation Group
Atomic Manipulation and Spectroscopy Group

Main Research Lines

• Hybrid interfaces for spintronics: metalorganic networks on metals and topological insulators
• Graphene-based nanostructures: tailoring morphology, edge structure and electronic properties
• Electron scattering in 2D nanostructures and materials with strong spin-orbit interaction

GROUP MEMBERS

Michele Gastaldo, Doctoral Student
Sylvie Godey, Technician
Aitor Mugarza, Tenure Track and Group Leader
Stefano Schirone, Fd Doctoral Student
Miguel Ángel Valbuena, Postdoctoral Researcher

GROUP LEADER

Dr Aitor Mugarza earned his BS degree in Physics in 1997 and his PhD in Physics in 2002, both at the University of the Basque Country. After his doctoral studies, he was awarded a Marie Curie fellowship to work as a postdoctoral scientist at the Lawrence Berkeley National Laboratory, USA, and at the Materials Science Institute of Barcelona (ICMAB). He later joined ICN in 2007 with a Ramon y Cajal Fellowship. In 2013, he was appointed Group Leader of the Atomic Manipulation and Spectroscopy Group at ICN2. He is author of 49 articles
In 2014 the Atomic Manipulation and Spectroscopy Group focused on three main objectives.

One of the main ongoing research lines has been the study of electronic and magnetic properties of hybrid metal-organic heterostructures. In particular, by combining local probe microscopy and X-ray spectroscopy, we have demonstrated: i) how the molecular charge and spin can be manipulated by selectively doping molecular orbitals; ii) how the momentum of the smallest magnetic objects, single-molecule magnets, can be coupled to ferromagnetic and antiferromagnetic substrates.

Another active field for the group has been the study of electron scattering on different nanostructured materials. Here we have focused on the role of order and periodicity of metallic nanostructures, and of the edge structure of graphene nanoislands, on the scattering of surface electrons.

A new project (Covalent Hybrids on Surfaces) was launched, covering research lines dedicated to hybrid organic topological insulator and graphene-based heterostructures, with the incorporation of three new postdoctoral researchers (one a Beatriu de Pinós Fellow), and a doctoral student (Severo Ochoa PhD Fellow).

(h-index = 18), and more than 30 invited talks at international conferences, universities and schools since 2007.

His research activity is based on the investigation of the electronic and magnetic properties of matter on the nanoscale, and developing strategies to manipulate them with atomic precision. By combining Scanning Tunnelling Microscopy techniques with Synchrotron Radiation Spectroscopy, he correlates microscopic phenomena to macroscopic observables that are relevant for the understanding and design of new materials and devices. He is currently focusing on novel materials that include molecular nanostructures, graphene, topological insulators and other 2D Dirac materials.


PROJECTS

SGR, funded by AGAUR, 01/01/2014 - 31/12/2016, Aitor Mugarza

Electron Scattering in materials with strong spin-orbit coupling, funded by AGAUR, 01/03/2014 - 28/02/2017, Aitor Mugarza

Atomic-scale engineering of unconventional organic superconductors, funded by AGAUR, 30/09/2014 - 29/09/2016, Aitor Mugarza

Materiales con efecto espin-orbita amplificados para espintronica, funded by MINECO, 01/01/2011 - 30/06/2014, Aitor Mugarza

Híbridos covalentes en superficies (SuperHybrid), funded by MINECO, 01/01/2014 - 31/12/2016, Aitor Mugarza
CONTRIBUTIONS

Graphene nanostructures on Ni(111): structural, electronic and scattering properties, Nanospain 2014, organized by Phantoms Foundation, Madrid (Spain), 11-14/03/2014, Mugarza, A. (Invited)

Graphene nanostructures on Ni(111): structural, electronic and scattering properties, 32nd National Meeting on Condensed Matter Physics, Sao Paulo (Brazil), 13-17/05/2014, Mugarza, A. (Invited)

Tuning molecular properties at metallic surfaces, European Conference on Surface Science - ECOSS30, organized by Bilkent University, Ankara (Turkey), 31-08/2014 - 05/09/2014, Mugarza, A. (Invited)

Manipulating the spin by doping single molecules at the metallic interface, Conference on Spintronics and Magnetoechemistry on the Atomic and Molecular Level, organized by Laboratory for Micro- and Nanotechnology Paul Scherrer Institut, Switzerland, Ascona (Switzerland), 26-30/10/2014, Mugarza, A. (Invited)

Electron Scattering of Rashba-split states in the BiAg2 surface alloy, Fuerzas y Tunel, 2014, organized by Centro de Física de Materiales (CSIC-UPV/EHU), Donostia, Spain; Centro Nacional de Biotecnología (CNB-CSIC), Madrid, Spain, San Sebastián (Spain), 27-29/08/2014, Schirone, S. (Oral)


COURSES

Nanoscale Surface Characterisation, in Master’s Degree in Nanotechnology & Materials Science, Universitat Autònoma de Barcelona, Barcelona (Spain), 10/2013-01/2014, Dr Aitor Mugarza

Local Probe Microscopies, in Master’s Degree in Nanotechnology & Materials Science, Universitat Autònoma de Barcelona, Barcelona (Spain), 10/2014-12/2014, Dr Aitor Mugarza

More information: http://ams.icn.cat/
Force Probe Microscopy and Surface Nanoengineering Group

Main Research Lines
- Force Probe Spectroscopy and Metrology
- Self-sustained motion and catalytic micropumps
- Interfacial water
- Polymer-based interfaces
- Nanoparticles of organic superconductors

GROUP MEMBERS

Carlo Alberto Amadei, CSIC Visiting Doctoral Student
Laura Cabezas, CSIC Visiting Student
Annalisa Calò, Postdoctoral Researcher
María José Esplandiu, CSIC Tenured Scientist
Laura Evangelio, CSIC Visiting Doctoral Student
Jordi Fraxedas, CSIC Research Scientist and Group Leader
Roger Fraxedas, Assistant
Armak Karimi González, CSIC Visiting Student
Federico Gramazio, Doctoral Student
Alba Mesa, CSIC Visiting Student
Ramón Pérez, CSIC Visiting Student
Daniel Ruso, CSIC Technician
Sergi Santos, CSIC Visiting Postdoctoral Researcher
Albert Verdaguer, CSIC Tenured Scientist
Oriol Vidal, CSIC Visiting Student

GROUP LEADER

Jordi Fraxedas (Tarragona, 1962) graduated in Physics from the University of Zaragoza (Spain) in 1985 and obtained his PhD (Dr rer. nat.) in 1990 from the University of Stuttgart (Germany). His thesis work was performed at the Max Planck Institut für Festkörperforschung and at the Berliner Speicherring für Synchrotronstrahlung (BESSY), under the supervision of Prof M. Cardona. After a post-doctoral position at the European Synchrotron Radiation Facility (ESRF) in Grenoble (France) and an Established Researcher position at the European Laboratory
NEW PROJECTS & MILESTONES

The Group participates in several projects at the European and Spanish level. Within the EU FP7 the Group is involved in advanced AFM instrumentation and in directed self-assembly of block co-polymers in collaboration with leading European universities and companies. In the first case, a prototype of an AFM head is being designed which should be able to be operated in industrial environments with a robot arm at high speed (3 MHz) and providing real-time information on the mechanical properties of surfaces of industrial interest (plastic injection, solar cells, etc.). In the second case the interfacial mechanisms of self-assembly are being investigated at the fundamental level in order to better address the future use of new smaller polymers.

At the Spanish level the Group participates in two projects focused on the tailoring of the affinity of water to surfaces and to micro/nanofluidics using carbon-based materials (nanotubes and graphene), respectively. The main objective is to be able to control the dynamics of water at different interfaces, i.e., structuring water as ice at temperatures above 0 degrees C and inducing mass transport via electrokinetic processes.

for Particle Physics (CERN) in Geneva (Switzerland), he joined the Solid State Research Institute of Barcelona (ICMAB) of the Spanish Research Council (CSIC) in 1995 and worked as a Chercheur associé at the Centre National de la Recherche Scientifique (CNRS) in 2002.

His research activity is focused on interfacial phenomena and surface science. He has co-authored more than 100 peer-reviewed scientific articles and published the books entitled Molecular Organic Materials: From Molecules to Crystalline Solids (Cambridge University Press, 2006) and Water at Interfaces: A Molecular Approach (Taylor and Francis CRC (2014)).
PUBLICATIONS


PROJECTS

Nanoscòpia i Nanoenginyeria de Superfícies, funded by AGAUR, 01/01/2014 - 31/12/2016, Jordi Fraxedas

Automated In-line Metrology for Nanoscale Production (AIM4NP), funded by EC, 01/03/2013 - 28/02/2016, Jordi Fraxedas

Afinidad y estructura del agua interfacial sobre superficies nanoestructuradas en condiciones ambientales (NANEAU), funded by MINECO, 01/01/2013 - 31/12/2015, Albert Verdaguer

CONTRIBUTIONS

Confocal Fluorescence Microscopy: the use of ion fluorescent probes for studying micro/nanoactuators propelled by catalytical reactions, 31st Leica Workshop, organized by Leica. Barcelona (Spain), Esplandiu, M. José (Invited)

Controlling water freezing on surfaces, CECAM-ETHZ. Zurich (Switzerland), 02-04/04/2014, Verdaguer, A. (Invited)

Development and performance analysis of catalytic micropumps, International Workshop on Micro and Nanomachines (MNMM2014), organized by Center for Integrated Nanotechnologies, USA; Columbia University, USA; Max Planck Institute for Intelligent Systems, Germany. Hannover (Germany), 02-05/07/2014, Esplandiu, M. José (Invited)

Optimizing the performance of catalytic micropumps: a theoretical approach, International Workshop on Micro and Nanomachines (MNMM2014), organized by Center for Integrated Nanotechnologies, USA; Columbia University, USA; Max Planck Institute for Intelligent Systems, Germany. Hannover (Germany), 02-05/07/2014, Esplandiu, M. José (Invited)


Neutral amphiphilic molecules as structuring agents for the growth of nanocrystals or nanoparticles of molecule-based superconductors, VI Journées Franco-Catalanes de Chimie Moléculaire, Toulouse (France), 01/2014, D. de Caro; K. Jacob; S. Foulal; I. Chtioui; C. Faulmann; L. Valade; J. Fraxedas (Oral presentation)
**Euro AFM Forum 2014**, organized by Third Institute of Physics - Biophysics, Göttingen; The Institute for Materials Physics - Georg-August University Göttingen. Göttingen (Germany), 17-19/03/2014 (Oral presentation)

*Room temperature ice water films induced by surfaces: BaF₂ and CaF₂ lattice mismatch,*

**WaterEurope**, organized by CNRS and UPMC, Paris, France and EPFL, Lausanne, Switzerland; University of Barcelona, Spain; Universitat Politècnica de Catalunya-Barcelona Tech, Spain. Zaragoza (Spain), 12-14/06/2014, A. Verdaguer, J. Fraxedas (Oral presentation)

*Water-induced surface passivation of amino acids,* **WaterEurope**, organized by CNRS and UPMC, Paris, France and EPFL, Lausanne, Switzerland; University of Barcelona, Spain; Universitat Politècnica de Catalunya-Barcelona Tech, Spain. Zaragoza (Spain), 12-14/06/2014, J. Fraxedas; A. Verdaguer; E. Barrena; C. Ocal (Oral presentation)

*Water footprints in tip-sample force reconstruction for dynamic atomic force microscopy in ambient conditions,* **5th Multifrequency AFM Conference**, organized by Instituto de Ciencias de Materiales, CSIC. Madrid (Spain), 16-18/06/2014, Verdaguer, A. (Oral presentation)

**Room temperature Ice Films Induced by Structural Lattice Mismatch: BaF₂ and CaF₂,**

**The 45th Annual Conference of the British Association for Crystal Growth**, organized by British Association for Crystal Growth. Leeds, United Kingdom, 13-15/07/2014, Verdaguer, A. (Oral presentation)

**Attractive Tip-sample Force Reconstruction For Dynamic Atomic Force Microscopy in Ambient Conditions,** **Fuerzas y Túnel, 2014**, organized by Centro de Física de Materiales (CSIC-UPV/ EHU), Donostia, Spain; Centro Nacional de Biotecnología (CNB-CSIC), Madrid, Spain. San Sebastián (Spain), 27-29/08/2014, Verdaguer, A. (Oral presentation)


**Creation of chemical guiding patterns for directed self-assembly of block co-polymers by AFM lithography,** **SPIE Advanced Lithography**, San Diego (USA), 23/02/2014 - 27/07/2014, F. Pérez-Murano; M. Fernández-Regulez; L. Evangelio; J. Fraxedas (Poster)

**Automated In-line Metrology for Nanoscale Production - aim4np,** **ECOSS-30, 30th European Conference on Surface Science**, organized by Bilkent University. Ankara (Turkey), 31/08/2014 - 05/09/2014, J. Fraxedas; U. Staufer; R. Munnig Schmidt; J. Spronck; E. Rull Trinidad; R. Deng, G. Schitter; M. Thier; R. Hainisch; R. Saathof; F. Pérez-Murano; A. Verdaguer; A. Blümel; E. J. W. List-Kratchovil; R. Koops; M. van Vehel; R. Sum; A. Lieb; W. Schott; D. Dovtsiöy; T. Sulzbach; W. Engl; C. Penzkofer; C. Colominas; K. Fluch; A. García-Granada; J. M. Puigoriol-Forcada (Poster)
BOOKS


COURSES

Chemistry for Specific Materials, included in the Master Universitari en Química Industrial i Introducció a la Recerca Química. Universitat Autònoma de Barcelona, Barcelona (Spain), 28/10/2014

THESES 2014

Doctorand: Ali Afshar Farinya
Title: Development and Performance Analysis of Autonomous Catalytic Micropumps
Defense Date: 41774
Director: Dr María José Esplandiu
Inorganic Nanoparticles Group

Main Research Lines

- Design and development of synthetic strategies for the production of complex nanoparticles
- Functionalisation with specific relevant (bio)molecules
- The study of their physicochemical and fundamental properties

GROUP MEMBERS

Martí Busquets, Doctoral Student
Eudald Casals, Laboratory Engineer
Sarah Deville, Visiting Doctoral Student
Agnieszka Dybowska, Visiting Doctoral Student
Víctor F. Puntes, ICREA Research Professor and Group Leader
Neus Gómez, Ramón y Cajal Postdoctoral Researcher
Cecilia López, Group Project Manager
Jedrzej Rafał Malec, CSIC Visiting Student
Katia Maltoni, Visiting Senior Researcher
Florind Merkoçi, Technician
Laura Moreno, Visiting Student
Javier Patarroyo, Doctoral Student
Rozhin Penjweini, Visiting Doctoral Student
Ariadna Peral, Group Project Manager
Jordi Piella, Doctoral Student
Joana Ribeiro, Visiting Postdoctoral Researcher
Sofía Rubio, Doctoral Student
Ngoc Tran Thi Thanh, Doctoral Student
Jonathan Yeung, Visiting Student
Tetyana Yudina, Doctoral Student
Yiayuan Zhao, Visiting Doctoral Student
Mirjam Zimmerman, Visiting Doctoral Student

GROUP LEADER

ICREA Research Prof Víctor F. Puntes’ work spans the full breadth of nanoparticle research: synthesis, conjugation and characterisation of inorganic nanoparticles; nanotoxicology and nanosafety; and myriad applications for sectors including medicine and the environment.

Prof Puntes completed his undergraduate studies in Chemical Engineering and Materials Science at the Université Louis Pasteur Strasbourg (France) and at the Universitat Autònoma de Barcelona (UAB). In 1998, he earned his PhD in Physics from the Universitat de Barcelona (UB), working with Prof Xavier Batlle and Prof Amilcar Labarta on Giant Magnetoresistance
Ingranular alloys. He then spent more than 3 years at the University of California, Berkeley, and the Lawrence Berkeley National Laboratory (LBNL), in the groups of Prof Paul Alivisatos and Prof Kannan Krishnan, working on the synthesis and control of nanostructures. In 2003 he returned to Catalonia with a Ramón y Cajal research position at the University of Barcelona, and in 2005 obtained an ICREA Professorship at ICN to create the Inorganic Nanoparticles Group, which he presently heads.

By the end of 2013, Prof Puntes held 110 peer-reviewed publications and over 6,000 total citations. He is also well-known for his work in science communication for the general public, his industrial and commercial efforts, and for his endeavours linking science and art.

By the end of 2014, Prof Puntes held 110 peer-reviewed publications and over 7,000 total citations.

Nanoparticles are engineered and designed in view of their applicability in materials science, (photo) catalysis, energy harvesting, environmental remediation and nanobiomedicine and nanotoxicology, among others. This is achieved by controlling the size, shape and structure of their inorganic core, and selectively linking active molecules to the nanoparticle surface, which allows them to selectively interact with specific systems (materials, biological, environmental etc.).

In 2014 the Inorganic Nanoparticles Group completed several of its ongoing projects, such as NanoTOES - Nanotechnology: Training of Experts in Safety, and began many new ones, such as Framework to respond to regulatory needs of future nanomaterials and Markets from European Union - FP7.
In this regard, the main scientific objectives of the group include:

I. Design and development of synthetic strategies for the production of complex nanoparticles (focusing on complex multicomponent and hollow nanoparticles comprising different families of metal, metal oxides, semiconductor oxides and semiconductors).

II. Functionalisation with specific relevant (bio)molecules and

III. The study of their physicochemical and fundamental properties. As a result, we design new drug-delivery platforms, advanced catalysts to improve energy-chemical processes, optimize NP’s features to enhance the production of hydrogen or boost the biogas production. We also focus on the precise characterisation of the obtained nanoparticles in terms of their reactivity (aggregation, corrosion and dissolution) and physicochemical properties, as prepared, during and after use.

**PUBLICATIONS**


PROJECTS

SGR, funded by AGAUUR, 28/09/09 - 30/04/2014, Víctor F. Puntes

SGR, funded by AGAUUR, 01/01/2014 - 31/12/2016, Víctor F. Puntes

NanoTOES—Nanotechnology: Training Of Experts in Safety (NANOTOES), funded by EC, 01/11/10 - 28/02/2015, Víctor F. Puntes

A pan-European infrastructure for quality in nanomaterials safety testing (QNANO), funded by EC, 01/02/11 - 31/01/2015, Víctor F. Puntes

Developing New Strategies for the Production of Viable Hybrid Nanocrystals with Applicability in Energy Conversion and (Photo)catalysis (MINE), funded by EC, 01/12/2012 - 30/11/2015, Neus Gómez Bastús

Assessment and mitigation of nano-enabled product risks on human and environmental health: Development of new strategies and creation of a web-based guidance tool for nanotech industries (GUIDEnano), funded by EC, 01/11/2013 - 30/04/2017, Víctor F. Puntes

Framework to respond to regulatory needs of future nanomaterials and markets (FutureNanoNeeds), funded by EC, 01/01/2014 - 31/12/17, Víctor F. Puntes

Cerium Oxide nanoparticles as a new therapeutic tool for tissue regeneration in liver diseases, funded by La Marató TV3, 14/01/2013 - 13/01/2016, Víctor F. Puntes

Synthesis of metal-semiconductor hybrid nanocrystals for energy conversion and catalysis, funded by MINECO, 01/01/2012 - 14/12/2014, Víctor F. Puntes

Desarrollo de Estrategias para Síntesis de Nanocristales Inorgánicos Multi-componente Complejos con Propiedades Físico-Químicas Ajustables (TUNANOCRYSTAL), funded by MINECO, 01/01/2013 - 31/12/2015, Víctor F. Puntes
**CONTRIBUTIONS**

*Nanoceria, NaNaX 6 Nanoscience with nanocrystals*, organized by University of Linz & Gme; ETH Zurich; CEA Grenoble; City University of Hong Kong, Bad Hofgastein (Austria), 18-23/05/2014, Puntes, V. (Invited)

*Nanoceria for nanomedicine, E-MRS 2014 Spring Meeting*, organized by E-MRS. Lille (France), 26-30/05/2014, Puntes, V. (Invited)

*Hi ha nous escenaris per a la construcció del coneixement?, FIET: Fòrum Internacional d’Educació i Tecnologia*, organized by Grup de recerca ARGET. URV. Tarragona (Spain), 25-28/06/2014, Puntes, V. (Invited)

*Nanotechnology in Health: Gold Nanoparticles as Radiotherapy Enhancers, Radio Oncology Department*, organized by Radio Oncology Department. Lausanne (Switzerland), 23-24/01/2014, Puntes, V. (Invited Seminar)

*Nanoparticle properties and their interactions with the environment, Putting environmental realism into nanosafety assessment*, organized by QualityNano NanoFATE & NAnoMILE. Birmingham (United Kingdom), 04-07/03/2014, Puntes, V. (Invited talk)

*Application of inorganic nanoparticles in medicine, II Reunión de Jóvenes Investigadores en Coloides e Interfases*, organized by Universidad de Granada. Granada (Spain), 27-30/04/2014, Puntes, V. (Invited talk)

*Nanoparticles synthesis and reactivity, Lecture at Nanoscience Ile-de-France Summer School*, organized by Nanoscience Ile-de-France Summer School. Etiolles (France), 23-25/06/2014, Puntes, V. (Invited talk)

*Nanocrystals as reagents: building the next generation of nanoparticles, New frontiers of nanomaterial technologies for applications in biology and medicine*, organized by DSCTM, IC, CN2, IIT, (ISOF)-CNR, Università degli di Studi di Bari, OPAL, Tirana University. Tirana (Albania), 10-11/07/2014, Puntes, V. (Invited talk)

Medical Nanochemistry, the use of reactive inorganic nanoparticles in medicine, 14th *Nanomedicine Symposium*, organized by CEN, Centro Europeo Nanomedicina, Politecnico di Milano, IRCCS. Milan (Italy), 13-14/11/2014, Puntes, V. (Invited talk)
COURSES

Chemistry for Specific Materials, included in Màster Universitari en Química Industrial i Introducció a la Recerca Química, Universitat Autònoma de Barcelona, Spain, 28/10/2013

More information:
http://www.inorganicnanoparticles.net/
Magnetic Nanostructures Group

Main Research Lines
- Exchange coupling in bi-magnetic core/shell nanoparticles and nanostructures
- Magnetoplasmonic effects
- Novel magnetic and structural characterisation tools for nanoparticles
- Innovative fabrication approaches

GROUP MEMBERS

Sebastià Agramunt, Postdoctoral Researcher
Alejandro Gómez, Beatriu de Pinós Postdoctoral Researcher
Pau Güell, Master Student
Mark Laver, Visiting Researcher
José Francisco López-Barberá, CSIC Visiting Postdoctoral Researcher
Enric Menéndez, Visiting Researcher
Josep Nogués, ICREA Research Professor and Group Leader

GROUP LEADER

Prof Nogués earned his BSc from the Universitat Autònoma de Barcelona (UAB), in Spain, in 1986. After obtaining his PhD at the Royal Institute of Technology in Stockholm, Sweden, in 1993, he moved to the University of California San Diego for post-doctoral studies. In 1997 he returned to UAB. He is currently an ICREA Research Professor and Group Leader of ICN’s Magnetic Nanostructures Group. Prof Nogués has published over 210 articles (including 8 reviews), and has more than 11,500 citations and an h-index of 45. He has authored two patents and given over 160 invited talks.
NEW PROJECTS & MILESTONES

In 2014, the Group continued working on the study of exchange coupling in core/shell nanoparticles and magnetic nanostructures in the context of various ongoing projects (MAGTUNE, ONDA and COEFNANO).

Moreover, the Group advanced in the study of magnetic nanowires to be used for molecule manipulation within the MANAQA project.

It also started working on novel nanoparticles and nanostructures for biomedical application in the framework of THERANANO (Multifunctional magnetic and magnetoplasmonic theranostic nanostructures). The aim of the project is designing bottom-up and top-down hybrid magnetic nanostructures for diverse biomedical applications (hyperthermia or multimode imaging).

PUBLICATIONS


PROJECTS

Understanding the Properties of Advanced Multifunctional Materials for Technological Applications, funded by AGAUR, 07/01/2013 - 06/01/2015

Coupling effects in magnetic systems of reduced dimensionality (COEFNANO), funded by EC, 01/01/2013 - 31/12/2016

Ordered hetero- and Nano-structures with Epitaxial Dielectrics for magnetic and electronics Applications (ONDA), funded by EC, 15/06/2010 - 14/06/2014

Magnetic nano actuators for quantitative analysis, funded by EC, 01/08/2012 - 31/07/2015

Modulación de las propiedades magnéticas de nanopartículas y estructuras litografiadas, mediante parámetros intrínsecos y extrínsecos (MAGTUNE), funded by MINECO, 01/01/2011 - 30/06/2014

Nanoestructuras magnéticas y magnetoplasmónicas teranósticas (THERANANO), funded by MINECO, 01/01/2014 - 31/12/2016

Magneto-optical mechanical nanoresonators, funded by MINECO, 01/09/2014 - 31/08/2015

CONTRIBUTIONS

Antiferromagnetic coupling in ferrimagnetic hard-soft core/shell nanoparticles, Materials Research Society Spring Meeting, organized by MRS. San Francisco (USA), 21/04/2014 - 25/01/2014, J. Nogués; M. Estrader; A. López-Ortega; S. Estradé; I. Golosovsky; G. Salazar-Álvarez; M. Vasilakaki; K.N. Trohidou; M. Varela; D.C. Stanley; M. Sinko; M.J. Pechan; D. J. Keavney; F. Peiró; S. Suriñach; M.D. Baró (Invited)

Antiferromagnetic coupling in ferrimagnetic hard-soft core/shell nanoparticles, Encontro Nacional de Fisica da Materia Condensada, organized by UFBAC. Costa do Sauípe (Brazil), 12-16/05/2014, J. Nogués; M. Estrader; A. López-Ortega; S. Estradé; I. Golosovsky; G. Salazar-Álvarez; M. Vasilakaki; K.N. Trohidou; M. Varela; D.C. Stanley; M. Sinko; M.J. Pechan; D. J. Keavney; F. Peiró; S. Suriñach; M.D. Baró (Invited)

Size-dependent magnetism in FeO/Fe3O4 core/shell nanoparticles, International Union of Materials Research Societies – International Conference on Electronic Materials (IUMRS-ICEM), organized by MRS-T, Taiwan. Taipei (Taiwan), 10-14/06/2014, A.G. Roca; M. Estrader; A. López-Ortega; G. Salazar-Álvarez; S. Estradé; E. Winkler; I.V. Golosovsky; M. Vasilakaki; K.N. Trohidou; J.S. Ardisson; W. Macedo; F. Peiró; S. Suriñach; R.D. Zysler; M.D. Baró; J. Nogués (Invited)

Antiferromagnetic coupling in ferrimagnetic hard-soft core/shell nanoparticles, Collaborative Conference on 3D & Materials Research, organized by Seoul National University; Korea Advanced Institute of Science and Technology, Gwangju Institute of Science & Technology. Incheon (Korea), 23-27/06/2014, M. Estrader; S. Estradé; F. Peiró; A. López-Ortega; I. Golosovsky; G. Salazar-Álvarez; M. Vasilakaki; K.N. Trohidou; M.A. Roldán; M. Varela; D.C. Stanley; M. Sinko; M.J. Pechan; D. J. Keavney; M. Laver; K. Krycka; J.A: Borchers; S. Suriñach; M.D. Baró; J. Nogués (Invited)
Semiconductor 3D ordered mesoporous architectures prepared by nanocasting: (i) oxide diluted magnetic semiconductors and (ii) photoluminescent antidots. Prospects and new challenges, Collaborative Conference on 3D & Materials Research, organized by Seoul National University; Korea Advanced Institute of Science and Technology, Gwangju Institute of Science & Technology. Incheon (Korea), 23-27/06/2014, J. Sort; E. Menéndez; M. Guerrero; J. Fornell; E. Rossinyol; M. Roldán; O. Castell; S. Suriñach; M.D. Baró; A. Vantomme; K. Temst; J. Nogués; E. Pellicer (Invited)

Evidence of an interfacial antiferromagnetic coupling in ferrimagnetic hard-soft core/shell nanoparticles, ISMANAM. Cancun (Mexico), 30/06/2014 - 04/07/2014, M. Estrader; S. Estradé, F. Peiró, A. López-Ortega; I. Golosovsky; G. Salazar-Álvarez; M. Vasilakaki; K.N. Trohidou; M.A. Roldán; M. Varela; D.C. Stanley; M. Sinko; M.J. Pechan; D. J. Keavney; S. Suriñach; M.D. Baró; J. Nogués (Invited)

Antiferromagnetic coupling in ferrimagnetic hard-soft core/shell nanoparticles, International Union of Materials Research Societies – International Conference in Asia (IUMRS_ICA), organized by MRS-J. Fukuoka (Japan), 24-30/08/2014, M. Estrader; S. Estradé; F. Peiró; A. López-Ortega; I. Golosovsky; G. Salazar-Álvarez; M. Vasilakaki; K.N. Trohidou; M.A. Roldán; M. Varela; D.C. Stanley; M. Sinko; M.J. Pechan; D. J. Keavney; M. Laver; K.L. Krycka; J.A. Borchers; S. Suriñach; M.D. Baró; J. Nogués (Invited)


AWARDS

• Fellow of the American Physical Society
• First-prize winner of the Science as Art competition of the MRS-Spring Meeting
• Outstanding reviewer of the American Physical Society, 2014
• Outstanding reviewer of the Journal of Magnetism and Magnetic Materials, 2014
NanoBioelectronics and Biosensors Group

Main Research Lines

- Nanoparticles study and application in innovative sensing technologies
- Development of novel nanostructured, nanochannel flexible platforms based on nanoimprinting and ink-jet printing technologies
- Study of graphene related materials and their integration into biosensing platforms
- Development of novel paper-based platforms with improved architecture, microfluidics and enhanced detection capabilities
- Design and application of lab-on-a-chip devices for biosensing, drug screening and other applications

GROUP MEMBERS

Abdellatif Alt Lahcen, Visiting Doctoral Student
Irene Álvarez, Technician
Wicem Argoubi, Visiting Doctoral Student
Joan Ariño, Bachelor Student
Alessandra Baiocco, Visiting Doctoral Student
Luis Miguel Baptista-Pires, FPI Doctoral Student
Michaela Cadkova, Visiting Doctoral Student
Fabio Roberto Caetano, Visiting Doctoral Student
Andrzej Chalupniak, Doctoral Student
Alejandro Chamorro, Doctoral Student
Natalia Chamorro, Master Student
Dun-Wei Cheng, Visiting Doctoral Student
Mari Ángeles Crespo, Undergraduate Student
Everson Thiago Da Silva, Visiting Doctoral Student
Alfredo de la Escosura, Senior Researcher
Loubna El Harrad, Visiting Doctoral Student
Marisol Espinoza, FPU Doctoral Student
Lívia Florio, Visiting Doctoral Student

GROUP LEADER

ICREA Professor and head of Nanobioelectronics & Biosensors Group at ICN2 (Institut Català de Nanociència i Nanotecnologia). He obtained his PhD at the University of Tirana working on ion selective electrodes. Since 1992 he has been doing research as postdoctoral fellow and research professor at Polytechnic Univ. of Budapest, Univ. of Ioanina, Univ. degli Studi di Padua, Univ. Politècnica de Catalunya, Univ.
Autònoma de Barcelona and New Mexico State Univ. His research is focused on the integration of biological molecules and other species with micro- and nanostructures with interest for the design of novel (bio)sensors. Prof Merkoçi has been awarded the IAAM Medal 2011 and Nano Award-2013 for outstanding research in the field of nanoscience and nanotechnology by the International Association of Advanced Materials. He has published more than 200 articles and supervised around 20 PhD theses.
NEW PROJECTS & MILESTONES

During 2014 the group started becoming involved in new competitive and challenging projects at national and international levels. In the framework of the FP7 SMS project we started to develop, in collaboration with EU partners, innovative electrochemical and optical detection platforms for contaminants detection in sea water while with two national projects in collaboration with other national research centres and companies we will be involved in nanobiosensors development for smart paper applications. Last year two of our PhD students Marisol Espinosa and Miquel Cadevall defended their PhD theses.

PUBLICATIONS


PROJECTS

SGR (2009 SGR 076), funded by AGAUR, 10/09/2009-30/04/2014, Arben Merkoçi

SGR (2014 SGR 260), funded by AGAUR, 01/01/2014-31/12/2016, Arben Merkoçi

Accions de promoció de doctorats industrials (2014 PRODI 00012), funded by AGAUR, 30/09/2014, Arben Merkoçi

Nanosystems for early Diagnosis of Neurodegenerative Diseases, NADINE (246513), funded by EC, 01/09/2010 - 31/08/2015, Arben Merkoçi

Development of Electrochemical Peptide Nanosensors for protein and antibody detection., PEPTIDE NANOSENSORS (294901), funded by EC, 01/05/2012 - 30/04/2015, Arben Merkoçi

Point-of-care diagnostics for rapid and cheap pathogen detection of companion animals, POC4PETS (315653), funded by EC, 01/09/2012 - 31/08/2014, Arben Merkoçi

Sensing toxicants in Marine waters makes Sense using biosensors, SMS (613844), funded by EC, 01/12/2013 - 31/08/2017, Arben Merkoçi

ICREA Workshop on Graphene Nanobiosensors, funded by ICREA, 01/08/2014 - 31/12/2015, Stephan ROCHE / Arben Merkoçi

Nanomateriales con alta capacidad de reconocimiento modulable electrónicamente, tipo on-off, para su aplicación en biosensores electroquímicos con características excepcionales, NANOHEROES (MAT2011-25870), funded by MINECO, 01/01/2012 - 31/12/2014, Arben Merkoçi

SMART PRINTED PAPER: Printed Electronics para nuevas funcionalidades en papel (RTC-2014-2619-7), funded by MINECO, 01/02/2014 - 31/12/2016, Arben Merkoçi

Desarrollo de un sistema de detección de endotoxina de alta sensibilidad y libre de interferencias basado en nanomateriales y fenómenos nuevos, ENDOSENSE (BIO2013-49464-EXP), funded by MINECO, 01/09/2014 - 31/08/2016, Arben Merkoçi
CONTRIBUTIONS

Nanobiosensing devices using plastic and paper-based platforms, 2nd International Conference on Analytical Chemistry, organized by Valahia University of Targoviste, Targoviste, Rumania, 17-21/09/2014, Arben Merkoçi (Invited)

Nanomaterials-based biosensing platforms, 2nd International Conference on Applied Biotechnology, organized by University of Tirana, Tirana, Albania, 22/09/2014, Arben Merkoçi (Invited)


Micro/Nanomaterials and microarray technology, XIX Trobada Transfronterera sobre Sensors i Biosensors, organized by ICN2, Bellaterra, Spain, 25-26/09/2014, Eden Morales-Narváez, Arben Merkoçi (Invited)


Graphene in Biosensing Platforms, XXX Trobades Científiques de la Mediterrània, organized by Societat Catalana de Física, Mahón, Spain, 15-17/10/2014, Eden Morales-Narváez, Arben Merkoçi (Invited)

Nanochannel array devices for sensitive label-free immunodetection of cancer biomarkers, 24th Biosensors World Congress, organized by Elsevier, Melbourne, Australia, 27-30/05/2014, Marisol Espinoza-Castañeda, Alejandro Chamorro, Carmen de Torres, Arben Merkoçi, Alfredo de la Escosura-Muñiz (Oral presentation)

Integration of micro/nanomaterials into microarray technology: boosting biosensing platform, 24th Biosensors World Congress, organized by Elsevier, Melbourne, Australia, 27-30/05/2014, Eden Morales-Narváez, Arben Merkoçi (Oral presentation)

Nanomaterials-based biosensors, Cell Models Systems Summer School, Rome, Italy, 18-19/06/2014, Eden Morales, Arben Merkoçi (Oral presentation)

Biosensing using graphene, Graphene & 2D Materials, Singapore-Spain Workshop, organized by National University of Singapore, Singapore, 19-20/06/2014, Arben Merkoçi (Oral presentation)

On-chip magneto-immunoassay for Alzheimer’s biomarker electrochemical detection using QDs as labels, WORKSHOP WAM NANO, organized by University of Copenhagen, Copenhagen, Denmark, 22-24/06/2014, Sandrine Miserere, Arben Merkoçi (Oral presentation)

Nanobiosensing and actuating in lab-on-a-chip and paper-based lateral flow platforms, New frontiers of nanomaterial technologies for applications in biology and medicine, organized by University of Tirana, Tirana, Albania, 10-11/07/2014, Arben Merkoçi (Oral presentation)

Graphene-based sensing and biosensing platforms, The International Graphene Innovation Conference (GrapChina, 2014), organized by Graphene CGIA, Ningbo, China, 01-03/09/2014, Arben Merkoçi (Oral presentation)

Bioanalytical nanosystems. Building nanoblocks (Part I & ii), 3rd Bioanalytical Nanotechnology School, organized by Bioanalytical Nanotechnology School, Manila, Philippines, 29/01/2014-01/02/2014, Arben Merkoçi (Poster)

Biosensing using nanomaterials, 34th Summer School of Chemistry in Brazil, organized by University of Sao Carlos, Sao Carlos, Brazil, 17-21/02/2014, Arben Merkoçi (Poster)

Point-of-care diagnostics using simple nanomaterials-based platforms, Universitat Pompeu Fabra, organized by Universitat Pompeu Fabra, Barcelona, Spain, 07/03/2014, Arben Merkoçi (Poster)

Recent trends and applications of nanomaterial-based biosensing systems, Advances in Biodetection and Biosensors, organized by SelectBio, Berlin, Germany, 10-11/03/2014, Arben Merkoçi (Poster)
Carbon-based electrodes in nanomaterials-involved biosensing systems, *International Symposium on Diamond Electrochemistry*, organized by Keio University, Yokohama, Japan, 18-19/03/2014, Arben Merkoçi (Poster)

Nanomaterials-based platforms for biosensing applications, *Nagoya University*, organized by Nagoya University, Nagoya, Japan, 20/03/2014, Arben Merkoçi (Poster)

Nanomaterials-based biosensing systems for diagnostics and environment monitoring applications, *Department of Chemical Sciences, University of Naples*, organized by University of Naples, Napoli, Italy, 28/04/2014, Arben Merkoçi (Poster)


Nanomaterials as signalling and actuation tools in biosensing, *EHPS2014 - Electrospinning for High-Performance Sensing*, organized by Institute of Atmospheric Pollution Research, Rome, Italy, 29-30/04/2014, Arben Merkoçi (Poster)

Antithyroid drug detection using an enzyme cascade blocking in a nanoparticle-based lab-on-a-chip system, *24th Biosensors World Congress*, organized by Elsevier, Melbourne, Australia, 27-30/05/2014, Sevinc Kurbanoglu, Carmen C. Mayorga-Martínez, Mariana Medina, Lourdes Rivas, Sibel A. Ozkan, Arben Merkoçi (Poster)

Electrochemical Impedance Spectroscopy (biosensing through hydrogen evolution reaction induced by gold nanoparticles, *24th Biosensors World Congress*, organized by Elsevier, Melbourne, Australia, 27-30/05/2014, Alejandro Chamorro, Carmen C. Mayorga-Martínez and Arben Merkoçi (Poster)


Highly sensitive and rapid determination of *Escherichia coli* O157:H7 in minced beef and water using electrocatalytic gold nanoparticle tags, *24th Biosensors World Congress*, organized by Elsevier, Melbourne, Australia, 27-30/05/2014, Abdel-Rahim Hussein Abdel-Azzem Hassan, Alfredo de la Escosura-Muñiz, Arben Merkoçi (Poster)


Label-free impedimetric aptasensor for ochratoxin-A using iridium oxide nanoparticles, *24th Biosensors World Congress*, organized by Elsevier, Melbourne, Australia, 27-30/05/2014, Carmen C. Mayorga-Martínez, Alejandro Zamora, Daniel Quesada, Alfredo de la Escosura-Muñiz, Arben Merkoçi (Poster)

Nanoparticle-induced dual catalytic/inhibition-based detection of phenol and pesticide compounds, *24th Biosensors World Congress*, organized by Elsevier, Melbourne, Australia, 27-30/05/2014, Carmen C. Mayorga-Martínez, Flavio Pino, Sevinc Kurbanoglu, Lourdes Rivas, Sibel A. Ozkan, Arben Merkoçi (Poster)

Novel porous magnetic microspheres as enhanced capturing platforms for the detection of Alzheimer disease biomarkers in human samples using electrocatalytic gold nanoparticle tags, *24th Biosensors World Congress*, organized by Elsevier, Melbourne, Australia, 27-30/05/2014, Alfredo de la Escosura-Muñiz, Zdeněk Plícha, Daniel Horák, Arben Merkoçi (Poster)
**BOOKS**


**COURSES**

Module: Nanochemistry, in Master in Nanotechnology and Materials Science, 
*Universitat Autònoma de Barcelona, Barcelona, Spain*, 13/01/2014, Dr Alfredo de la Escosura-Muñiz

Module: Nanochemistry, in Master in Nanotechnology and Materials Science, 
*Universitat Autònoma de Barcelona, Barcelona, Spain*, 15/01/2014, Dr Eden Morales

Module: Nanochemistry, in Master in Nanotechnology and Materials Science, 
*Universitat Autònoma de Barcelona, Barcelona, Spain*, 17/01/2014, Prof Arben Merkoçi

**THESES**

- Doctorand: **Marisol Espinoza**
  Title: Study and Development of New Biosensors Based on Nanoparticles and Nanochannels. 
  Defense Date: 21/07/2014 
  Directors: Prof Arben Merkoçi / Dr Alfredo de la Escosura

- Doctorand: **Miquel Cadevall**
  Title: Bismuth-based (nano)materials and plformats for (bio) sensing. 
  Defense Date: 14/11/2014 
  Directors: Prof Arben Merkoçi / Prof Josep Ros

**OTHER HIGHLIGHTS**

- European Patents filed 

- PCT Extensions filed 
  ICNPAT 07/13. Sensitive qualitative bioassay using graphene oxide as analyte revealing agent

NanoBiosensors and Bioanalytical Applications Group

Main Research Lines

• Plasmonic and nanoplasmonic biosensor
• Silicon photonic biosensor
• Nanomechanical biosensor
• Bioanalytical applications

GROUP MEMBERS

Maria del Mar Álvarez, CSIC Postdoctoral Researcher
Iulia Arghir, CSIC Visiting Doctoral Student (KU Leuven, Belgium)
Carlos Caro, CSIC Postdoctoral Researcher
Blanca Chocarro, FPI Doctoral Student
Jhonattan Cordoba, CSIC Visiting Doctoral Student (Campinas University, Brazil)
Stefania Dante, CSIC FPU Doctoral Student
Rebeca Diéguez, Group Project Manager
Santos Domínguez, CSIC Doctoral Student
Firehun Tsige Dullo, CSIC Visiting Doctoral Student (University of Tromso, Norway)

Daphné Duval, CIBER Postdoctoral Researcher
M.ª Carmen Estévez, CIBER Postdoctoral Researcher
David Fariña, CIBER Technician
Adrián Fernández, Postdoctoral Researcher
Silvia Gómez, CIBER Technician
Ana Belén González, CSIC Postdoctoral Researcher
Daniel Grajales, CSIC Visiting Doctoral Student (CONACYT, Mexico)
Joel Hernández, CSIC Visiting Doctoral Student
Sonia Herranz, CSIC Postdoctoral Researcher
Laura Lechuga, CSIC Research Professor, Group Leader

GROUP LEADER

Prof Laura M. Lechuga received her PhD in Chemistry from the University Complutense of Madrid (Spain) in 1992. She is Full Professor of the Spanish National Research Council (CSIC); since 2012 she has been Adjunct Professor at the Dept. of Physics&Technology, at the Arctic University (Norway) and since 2013 she has been a Distinguished Visiting Professor at the Dept. of Microwaves and Photonics, School of Electrical and Computer Sciences, University of Campinas (Brazil).

Prof Lechuga is the Head of the Nanobiosensors and Bioanalytical Applications Group at the Catalan Institute for Nanoscience and Nanotechnology (ICN2) in Barcelona (Spain). The principal focus of her research programme is the technological development of photonic (plasmonics and silicon-
based) and nanomechanical biosensors, their integration in portable lab-on-a-chip platforms and their application in clinical and environmental diagnostics.

She has published over 160 articles, book chapters and conference proceedings, has 8 families of awarded patents at European, US or international level, and has presented more than 200 invited research papers. She has been the driving force for the establishment of one spin-off company in 2004 (SENSIA, SL) and co-founder of a new spin-off in 2010 (BIOD, SL).

Prof Lechuga is associate editor of the *IEEE Photonics Journal*, associate editor of the *Journal Optics and Laser Technology* (Elsevier) and is on the Editorial Board of the journal of *Nanobiosensors in Disease Diagnosis* and of the *Journal of Sensors*. She has been nominated as Fellow of the Optical Society (OSA) in 2014, and she is a member of the International Society for Optical Engineering (SPIE), and member of the European Optical Society (EOS). She is a member of Permanent Steering Committees for the Advanced Study Course on Optical Chemical Sensors (ASCOS) and Europt(r)ode Conference Series.
In the research line of integrated silicon nanophotonic biosensors, important milestones have been reached for the implementation of a sensitive, affordable, hand-held and portable point-of-care device. The ultrasensitive limit of detection of this technology at the pM-fM level is far beyond the state of the art and the Group has demonstrated the detection of a few numbers of infectious microorganisms directly in patients’ samples. A technological transfer plan with a private company has been developing during 2014. Several new projects have been granted in 2014 related to this research line:

- **COLOnTEST**: Diseño y puesta a punto de kits para el diagnóstico del cáncer de colon en sangre basados en plataformas multiplex. Financial management: Programa RETOS-COLABORACIÓN. Ministerio de Economía y Competitividad. (RTC-2014-1518-1) Participants: Protein Alternatives, SL; Azurebio, SL; ICN2; CSIC; IDIBAPS. Duration: 01/09/2014-01/09/2017

- **rAiS**: Scalable, point-of-care and label-free microarray platform for rapid detection of Sepsis. Financial management: UE. H2020-ICT-2014-1-644956 Duration: 01/01/2015-01/01/2018

The utility of our nanophotonic biosensing techniques for real bioanalytical applications has been successfully demonstrated. The Group is focusing on point-of-care detection of diseases as for example Malaria (collaboration with FIND diagnostics Foundation) or Tuberculosis (POCKET EU project); early detection of several types of cancer such as colorectal cancer (COLOnTEST national project); early detection of liver complications (CIBER internal project); monitoring of celiac or allergic patients directly in their body fluids, among others (most of them in collaboration with private companies).

In the environmental field, the Group is focusing on the early detection of toxic pollutants such as pesticides, antibiotics or alga toxins (BRAAVOO EU project).

The Group has successfully developed in 2014 the fundamental research line in Molecular Biology using our nanobiosensing technology for the deciphering of alterations in cellular pathways, including alternative splicing of RNA, and epigenetics modifications (DNA metylation or microRNA release).
**PUBLICATIONS**


**PROJECTS**

Nanobiosensors and Bioanalytical Applications, funded by AGAUR, 01/01/2014 - 31/12/2016, Laura Lechuga

Advanced diagnostic tool for early identification of liver failure (LIVERPOC), funded by CIBERBBN, 2012-2014, Laura Lechuga

Advanced diagnostic tool for early identification of liver diseases and infections in Intensive Care Units (HEPATOPOC), funded by CIBER-BBN, 2014-2015, Laura Lechuga

Development of a biosensing diagnostic tool for the fast identification of infection by Pneumocystis (PCP-Sens), funded by CIBER-BBN, 2014-2015, Laura Lechuga

Point of Care biosensor devices to detect biomarkers as evaluation end-points for therapeutic clinical trials in ocular surface inflammation (EYEPOC), funded by CIBER-BBN, 2014-2015, Laura Lechuga

Development of a low-cost point-of-care test for tuberculosis detection (POCKET), funded by EC, 01/11/2013 - 31/10/2016, Laura Lechuga
Biosensors, Reporters and Algal Autonomous Vessels for Ocean Operation (BRAAVOO), funded by EC, 01/12/2013 - 30/11/2016, Laura Lechuga

Modulación óptica de fase para biosensores interferométricos avanzados para aplicaciones “point-of-care”, funded by MECD, 16/10/2010 - 15/10/2014, Laura Lechuga

Pistas celulares durotácticas para la detección in vivo de interacciones entre ligandos y receptores de membrana (iDuroSens), funded by MINECO, 20/12/2011 - 30/06/2014, Borja Sepúlveda

Innovación y desarrollo de sistemas portátiles de detección biológica óptica de alta eficiencia (INNBIOD), funded by MINECO, 30/06/2012 - 31/12/2014, Laura Lechuga

Integración Lab-on-a-chip de dispositivos biofotónicos para el estudio de alteraciones de la expresión génica en rutas celulares (EPISENS), funded by MINECO, 01/01/2013 - 31/12/2015, Laura Lechuga

Petición y Coordinación de proyectos colaborativos ICT y Health de H2020 (CoorEU), funded by MINECO, 01/11/2013 - 31/10/2015, Borja Sepúlveda

Nanoresonadores Magneto-Opto-Mecanicos (MORE), funded by MINECO, 01/09/2014 - 31/08/2015, Borja Sepúlveda

Proyecto COLONTEST: Diseño y puesta a punto de kits de diagnóstico del cáncer de colon en sangre basados en plataformas multiplex (COLONTEST), funded by MINECO, 01/09/2014 - 31/12/2017, Laura Lechuga

**CONTRIBUTIONS**

Nanophotonic lab-on-a-chip biosensors for point-of-care diagnostics: from concept to real applications, Conferencia Nacional de Nanotecnología, organized by Gobierno de Chile, Puerto Varas, Chile, 10-12/09/2014, Laura M. Lechuga (Invited)

Nanophotonic lab-on-a-chip biosensors for advanced nanodiagnostics, 19th Transfrontier Meeting of Sensors and Biosensors, Bellaterra, Barcelona (Spain), 25-26/09/2014, Laura M. Lechuga (Invited)

Point-of-care nanobiosensors for global health diagnostics: challenges and opportunities, 9th Ibero-American Congress on Sensors-IBERSENSOR, organized by Universidad de Los Andes, Bogotá, Colombia, 15-18/10/2014, Laura M. Lechuga (Invited)


Nanophotonic lab-on-chip biosensors for point-of-care diagnostics, TNT 2014 Trends in Nanotechnology International Conference, Barcelona (Spain), 27-31/10/2014, L.M. Lechuga (Keynote speaker)

Nanophotonic biosensors for the next diagnostics generation, The Latin America Optics and Photonics (LAOP) Conference (OSA Conferences), Cancún (Mexico), 17-21/11/2014, L.M. Lechuga (Plenary Lecture)

Full integration of Photonic nanobiosensors in portable and multiplexed lab-on-a-chip platforms, EUROPT(R)ODE XII: 12th European Conference on Optical Chemical Sensors and Biosensors, Athens (Greece), 13-16/04/2014, Laura M. Lechuga (Oral presentation)
Experiències d'èxit en emprendedoria femenina, I Jornada Interuniversitària: Dones, Emprenedoria i Coneixement, organized by Generalitat de Catalunya, Barcelona (Spain), 28/05/2014, Laura M. Lechuga (Oral presentation)

Nanobiosensor devices for the direct and label-free deciphering of cellular pathways, Workshop Physics and Biological Systems 2014, Paris-Saclay (France), 24-27/06/2014, Laura M. Lechuga (Oral presentation)

Nanobiotechnology for advanced nanodiagnostics and nanotherapy, Biotech Annual Congress 2014, organized by Federación Española de Biotecnólogos, Barcelona (Spain), 09-11/07/2014, Laura M. Lechuga (Oral presentation)

Towards real point-of-care diagnostics using interferometric nanobiosensors, Advanced Photonics Conference 2014, organized by Optical Society of America Sensors (OSA), Barcelona (Spain), 27-31/07/2014, Laura M. Lechuga (Oral presentation)


Nanoplasmonic biosensors for label-free deciphering of cellular pathways, The Latin America Optics and Photonics (LAOP) Confer, organized by OSA conferences, Cancun, Mexico, 17-21/11/2014, Laura M. Lechuga (Oral presentation)

Nanomedicina y salud: últimos avances en nanodiagnóstico y nanoterapia, III Congreso Nacional de la Sociedad Española de Cabeza y Cuello, organized by Sociedad Española de Cabeza y Cuello, LasCaldas, Spain, 27-28/11/2014, Laura M. Lechuga (Oral presentation)


Biosensores SPR yTLR5-proteoliposomas como elementos de afinidad para la detección de flagelan bacteriana: efecto de lípidos y surfactantes sobre la funcionalidad del sistema, Conferencia Nacional de Nanotecnología, organized by Gobierno de Chile, Puerto Varas, Chile, 10-12/09/2014, Y. Olguín, L. Carrascosa, L.M. Lechuga, M. Young (Poster)


Nucleic Acids For Biosensing Applications, Nanobiomed 2014, Barcelona, Spain, 18-21/11/2014, Anna Aviñó, César Sánchez, Mar Oroval, Laura Carrascosa, Ramón Martínez-Mañez, Laura Lechuga, Ramon Eritja (Poster)

Fabricación de un Biosensor Nano-Optomecánico para el Estudio del Comportamiento Celular, IV Simposio Becarios CONACYT en Europa, Strasbourg, France, 05-07/11/2014, Verónica Iráis Solís, Laura M. Lechuga (Poster)
BOOKS


COURSES

Dispositivos nanobiosensores “point-of-care” para el diagnóstico ultrasensible en tiempo real, Instituto Universitario de Ofthalmología Aplicada (IOBA), Universidad de Valladolid, Valladolid (Spain), 29/01/2014, L. Lechuga

Nanophotonic lab-on-a-chip biosensors for ultrasensitive and early diagnostics, Cambridge Graphene Centre (CGC), University of Cambridge, Cambridge, (United Kingdom) 09/02/2014, L. Lechuga

Nanophotonic lab-on-a-chip biosensors for advanced diagnostics, Universitat Rovira i Virgili, Tarragona (Spain), L. Lechuga

Nanophotonic biosensors as diagnostic tools for deciphering cellular pathways, Instituto de Biología Molecular y Celular (IBMC), Universidad Miguel Hernández. Campus de Elche, Elche (Spain), 28/02/2014, L. Lechuga

Photonic lab-on-a-chip nanobiosensors for deciphering cellular pathways, Chalmers University of Technology, Gothenburg, Gothenburg (Sweden), 04/04/2014, L. Lechuga

Nanophotonic Lab-on-a-chip biosensors as interactive diagnostics tools for deciphering cellular pathways, BIONAND, Centro Andaluz de Nanomedicina y Biotecnología, Málaga (Spain), 09/05/2014, L. Lechuga


Part 2. Photonic biosensors based on integrated optics. Integration in lab-on-a-chip platforms, Department of Microwaves and Optics. School of Electrical and Computer Science. University of Campinas, Campinas (Brazil), 25/08/2014, L. Lechuga

The future of diagnostics: point-of-care mobile devices, SAMSUNG Research Institute. Campinas (Brazil), 26/08/2014, L. Lechuga

Photonic lab-on-a-chip nanobiosensors for ultrasensitive diagnostics, School of Electrical and Computer Science. University of Campinas. Campinas (Brazil), 27/08/2014, L. Lechuga

Photonic lab-on-a-chip nanobiosensors for ultrasensitive diagnostics, Instituto de Pesquisas Tecnológicas (IPT). University of Sao Paulo, Sao Paulo (Brazil), 01/09/2014, L. Lechuga

Nanobiosensores lab-on-a-chip para el diagnóstico descentralizado, Universidad de Valparaíso, Valparaíso (Chile), 08/09/2014, L. Lechuga
THESES

Doctorand: **Stefania Dante**  
Title: All-optical phase modulation for advanced interferometric point-of-care biosensors  
Defense Date: 11/12/2014  
Director: Dra Laura Lechuga Gómez

Doctorand: **Esteban David Fariña**  
Title: Desarrollo de un sistema biosensor opto-mecánico basado en cantilevers  
Defense Date: 31/10/2014  
Directors: Dra Laura M. Lechuga, Dra Mar Álvarez and Dr José Ramón Senra

AWARDS

**OSA Fellow.** Prof Laura Lechuga was elected as Fellow of the Optical Society (OSA) in 2014 due to her significant research leadership and pioneering development of a novel and compact biomedical sensor based on advanced integrated photonic techniques and plasmonic devices, combining science with real-life applications and technology transfer.

More information:  
http://nanob2a.cin2.es/
Nanostructured Functional Materials Group

Main Research Lines
• Future and emerging technologies
• Biomaterials
• Sustainability

GROUP MEMBERS

Christian Bellacanzone, Doctoral Student
Marta Borges, CSIC Visiting Doctoral Student
Sebastián Castilla, CSIC Visiting Student
Beatriz García, Doctoral Student
Pablo González, Technician
Mireia Guardingo, CSIC Doctoral Student
Alejandro Ricar Julià, CSIC Visiting Student
Juan Mancebo, Postdoctoral Researcher
David Martínez, CSIC Visiting Student
Giuseppina Massaro, CSIC Visiting Doctoral Student
David Montpeyó, Doctoral Student
Miguel Ángel Moreno, CSIC Visiting Student
Fabiana Nador, CSIC Visiting Postdoctoral Researcher
Fernando Novió, Beatriu de Pinós Postdoctoral Researcher
Guadalupe Del Carmen Pizarro, CSIC Visiting Senior Researcher
Claudio Roscini, CSIC Postdoctoral Researcher
Daniel Ruiz, CSIC Research Scientist and Group Leader
Josep Sedó, CSIC Project Manager
Juliane Simmchen, CSIC Doctoral Student
Rubén Solorzano, CSIC Visiting Student
Salvio Suárez, CSIC Visiting Student
Héctor Torres, CSIC Visiting Doctoral Student
Núria Alexandra Vázquez, Doctoral Student
Jon Vilasau, Postdoctoral Researcher
Karolina Wnuk, CSIC FI Doctoral Student

GROUP LEADER

CSIC Research Scientist
Dr Daniel Ruiz-Molina

Daniel Ruiz-Molina earned his PhD on polyradical dendrimers at the Institute of Materials Science of Barcelona (CSIC) with Prof Jaume Veciana. Afterwards he took a postdoctoral position at the UC San Diego working on single-molecule magnets and molecular switches for three years. Since 2001 he has held a permanent position at the CSIC and more recently at CIN2 - CSIC, where he is heading the Nanostructured Functional Materials group. His main research areas are fabrication of hybrid colloids and surfaces, biomimetic functional nanostructures and micro-/nanoparticles for smart applications and encapsulation/delivery systems.
NEW PROJECTS & MILESTONES

1. Mussel-Inspired Hydrophobic Coatings for improved adhesion properties, water-repellent and functional oil removal interphases
2. Development of novel coordination polymer particles for Biomedicine, including drug delivery and MRI
3. Novel approaches for the fabrication of spin transition molecular nanoparticles with designed morphologies and smart responses in front of external stimuli
4. Novel micromotors with enhanced performances and durability

The objective of the Nanostructured Functional Materials group (NANOSFUN) is to obtain (bio) molecular nanostructures with tailored properties and smart responses to external stimuli, taking advantage of the flexibility and richness of (supra)molecular chemistry and self-assembly processes.

PUBLICATIONS


Synthesis of polydopamine at the femtoliter scale and confined fabrication of Ag nanoparticles on surfaces, M. Guardingo, M. J. Esplandiu and D. Ruiz-Molina, Chemical Communications: vol. 50, 12548-12551 (2014)

**PROJECTS**

Smart theranostic metal-organic nanostructures for cancer cure, funded by AGAUR, 01/04/2013 - 31/03/2016, Daniel Ruiz-Molina

Ordered hetero- and Nano-structures with Epitaxial Dielectrics for magnetic and electronics Applications (ONDA), funded by EC, 15/06/2010 - 14/06/2014

Dispositivos Moleculares, MOLDEV, funded by MINECO, 01/01/2013 - 31/12/2015, Daniel Ruiz-Molina

Desarrollo de nanoencapsulación funcionalizada de fragancias para aplicación en formulación de suavizantes, MICROFRAG, funded by MINECO, 28/02/2013 - 31/12/2014, Daniel Ruiz-Molina

Pinturas fotocrómicas en polvo para su uso en arquitectura de exteriores de alto valor añadido, ADAPTALITE, funded by MINECO, 01/09/2014 - 31/12/2017, Daniel Ruiz-Molina
BOOKS


OTHER HIGHLIGHTS

1 SPIN-OFF created: Futurechromes SL.

A new spin-off company, Futurechromes, S.L., based on the patent Ref. CIN2PAT 01/12 - WO2013/132123 Coating with photochromic properties, method for producing said coating and use thereof applicable to optical articles and glazed surfaces developed by the Nanostructured Functional Materials Group was created in June 2014.

More information:
http://nanosfun.icn2.cat/
Nanostructured Materials for Photovoltaic Energy Group

Main Research Lines

- Organic, Hybrid, Dye-sensitized, Halide Perovskite and All-oxide Solar Cells: materials synthesis and characterisation and complete device fabrication
- Synthesis of metal oxides by low-cost, low-temperature and “green” solution processing methods
- Solution processing methods for the fabrication of solar cells (and printed electronics)
- Degradation studies of the stability of Solar Cells following ISOS protocols

GROUP MEMBERS

Irene Álvarez de Lasarte, Technician
Andressa Antunes Bortoti, CSIC Visiting Doctoral Student
Julio Bastos, CSIC Visiting Postdoctoral Researcher
Chloé Bonnet, CSIC Visiting Doctoral Student
Andreia de Morais, CSIC Visiting Doctoral Student
Francisco Anderson de Sousa Lima, CSIC Visiting Doctoral Student
Fernando Echeverría, CSIC Visiting Doctoral Student
Enrique Fernández, CSIC Visiting Student
Marta Fonrodona, Project Manager
Mónica Lira, CSIC Tenured Track and Group Leader

GROUP LEADER

Mónica Lira-Cantú (Chemistry, 1992), obtained a Master and PhD degrees in Materials Science at the Materials Science Institute of Barcelona (ICMAB) / Universitat Autònoma de Barcelona (1995/1997) and completed her postdoctoral work under a contract with the company Schneider Electric/ICMAB (1998). From 1999 to 2001 she worked as permanent Senior Staff Chemist at ExxonMobil Research & Engineering (formerly Mobil Technology Co) in New Jersey (USA) initiating a laboratory on energy-related applications. Currently, she is Group Leader of the Nanostructured Materials for Photovoltaic Energy Group (nanostructuredmaterials.icn2.cat) of the Catalan Institute of Nanoscience and Nanotechnology, ICN2.
The Nanostructured Materials for Photovoltaic Energy Group focuses on different objectives, all related to the development of highly efficient, highly stable and low-cost solution processable photovoltaic and optoelectronic devices:

- The synthesis of nanostructured materials, especially those involving transition metal oxides (TMOs) and graphene, applying low-cost and solution processing methods is a major goal for the group. TMOs have many possible applications as main active materials or barrier layers, but are also applied as materials for external light management. The application of low-temperature synthesis methods (sol-gel, hydrothermal, SILAR, among many others) permits tuning and control of the properties of the final device.
- The stability and long life of optoelectronic devices, especially organic solar cells, is a major limitation for these technologies to reach the marketplace. A consortium of more than 260 members, among them 60

She received different awards/fellowships as a visiting scientist to the following laboratories: University of Oslo, Norway (2003), Riso National Laboratory, Denmark (2004/2005) and the Center for Advanced Science and Innovation, Japan (2006). She obtained a permanent position in 2007 at the Spanish National Research Council (CSIC, Spain) and started the laboratory on Photovoltaic Energy at CIN2 in 2007. Since then she has directed more than 20 researchers (including Postdocs, PhD students and undergraduate students). She has been the PI of several projects (including national, industrial and European), and she is the principal coordinator of a COST Action Proposal (approved in 2013) related to the study of the stability of Organic solar cells (OPVs).

Her research interests are the synthesis and application of nanostructured materials for stable next-generation thin film solar cells: Perovskite solar cells, Dye-sensitized, Hybrid and Organic Solar Cells. Mónica Lira-Cantú has more than 70 published papers, 7 patents and 8 book chapters, h index = 25
internationally-recognized research laboratories and 17 industries from 31 countries, have joined an EU COST Action project related to the stability of organic solar cells. The project is led by ICN2 through Group Leader Mónica Lira-Cantú, coordinator of the consortium. The goal is to take advantage of the multiple characterisation techniques available from the different partners to elucidate the degradation mechanism of these devices and propose disruptive solutions towards highly stable Organic solar cells.

The review article “Vertically-aligned nanostructures of ZnO for excitonic solar cells: a review” by Irene González-Valls and Mónica Lira-Cantú, has been in the top 10 most cited articles of the journal Energy & Environmental Science (impact factor 15.49) since 2009.

PUBLICATIONS


PROJECTS

Nanostructured Materials for Photovoltaic Energy, funded by AGAUR, 01/01/2014-31/12/2016, Mónica Lira-Cantú

Produção De Células Solares De Terceira Geração Baseadas Em ZnO E SnO2 Sintetizados Por Eletrodeposição, Moagem Mecânica E Sol-gel Proteico, funded by Brasilian government (FUNCAP), 01/01/2014-31/12/2016, Mónica Lira-Cantú / Igor Vasconcelos


Células Solares Nanoestruturadas Fabricadas a partir de soluções: Novos Nanomateriais basados em Óxidos de Metales de Transição y Grafeno, NanoSOL-DEV, funded by MINECO, 01/01/2014-31/12/2016, Mónica Lira-Cantú

Xarxa de Referència en Materials Avançats per a l’Energia - XaRMAE, funded by XaRMAE, 01/01/2009-31/12/2016, Mónica Lira-Cantú

CONTRIBUTIONS


Nanostructured Oxide Semiconductors for Thin Film Photovoltaics, Nanoselect, organized by Consolider, St Feliu de Guíxols, Spain, 06/07/2014, Nanostructured Materials for Photovoltaic Energy, Gerardo Teran-Escobar, Jonas Pampel and Mónica Lira-Cantú (Invited)


Novel Energy-Oriented Materials Group

Main Research Lines

- Hybrid electrode materials for supercapacitors and hybrid energy storage devices
- Cathode materials with fractal granularity for Li-ion batteries based on LiFePO4
- Nanofluids. Thermal nanofluids for heat transfer in solar conversion. Molten salts
- Electroactive nanofluids for energy storage in flow cells. Redox flow batteries based on quinones
- Graphene synthesis, hybridisation and applications in energy storage

GROUP MEMBERS

Omar Ayyad, Postdoctoral Researcher
Zahilia Caban, Doctoral Student
Deepak Prakash Dubal, CSIC Beatriu de Pinós Postdoctoral Researcher
Andrea Fedorková, Visiting Postdoctoral Researcher
Ramón García, CSIC Visiting Student
Daniel Gómez, Assistant
Pedro Gómez, CSIC Full Professor and Group Leader
Girish Gund, CSIC Postdoctoral Researcher
Rita Humana, CSIC Visiting Doctoral Student
Tomas Kazda, CSIC Visiting Doctoral Student
Mara Olivares, CSIC Visiting Postdoctoral Researcher
Daniel Rueda, CSIC Visiting Student
Amel Slamani, CSIC Visiting Doctoral Student
Jullieth Gabriela Suarez, CSIC Doctoral Student
Franciele Wolfart, CSIC Visiting Doctoral Student

GROUP LEADER

NEW PROJECTS & MILESTONES

2014 witnessed the consolidation of the new research topics in the group. Among them, we developed redox flow batteries based on quinones, new molten salt formulations for heat transfer and storage and the low-cost synthesis of high-quality graphene that we had begun in 2013.

Hybrid materials as improved electrodes for electrochemical supercapacitors. The boundaries between batteries and capacitors are now quickly blurring. Nanostructure control is of great importance in the design of high-performance energy storing devices. Thus, we are developing materials with a high specific surface, and ultradispersed molecular materials, for applications in electrochemical supercapacitors that have greater power density than that of batteries. Examples of this type of electrodes prepared for the first time in our laboratory include activated carbons or graphene with polyoxometalates or oxide nanoparticles. (NANOCARHIBE MAT2012 National Project).

Directs projects on hybrid organic-inorganic nanostructures, nanocomposite materials for energy storage and conversion (lithium batteries, supercapacitors, PEM FCs, solar-thermal energy, nanofluids, graphene). Vicedirector of MATGAS (2010-2014).

Micro-supercapacitors based on Si Nanowires and MnO2-coated Si Nanowires. Also related with supercapacitors we collaborate with an international consortium led by CEA (France) on the development of nanowire electrodes for energy storage (NEST EU Project). One of our main contributions to this project has been the coating of these Nanowire electrodes with MnO2 nanoflakes. This approach has led to micro-supercapacitors with excellent performance which are one of the main milestones of this European Project.

Eco-friendly high-performance electrodes for rechargeable lithium batteries. It includes our work on the optimisation of micro- and nanostructures of electroactive inorganic materials such as LiFePO4 with fractal granularity used in electrodes for lithium batteries. Here, we are aiming for low-cost, safe batteries, prepared under the mildest conditions with faster recharging rates (SOMABAT EU Project).

Nanofluids. The development of nanofluids, including electroactive nanofluids and heat-transfer nanofluids for thermal solar energy conversion is now at full thrust. This is an internationally emergent research line with implications in fundamental science and application in new technologies such as load-levelling of renewable energies, Electric Vehicles or high temperature (concentration) solar power electricity generation.

Graphene. The new kid in the Nanocarbon town is the subject of our interest too. We work on large-scale methods for the preparation of high-quality graphene and its use in the synthesis of nanohybrid materials.

**PUBLICATIONS**


**PROJECTS**

High energy and high-power supercapacitor-battery hybrid energy storage devices based on graphene-enhanced (MnO2/G) electrode materials, funded by AGAUR, 15/04/2014 - 14/04/2016, Pedro Gómez-Romero

Nanowires for Energy Storage (NEST), funded by EC, 01/11/2012 - 30/10/2015, Pedro Gómez-Romero

Materiales Nanoestructurados de Carbono e Híbridos para Almacenamiento de Energía, (NANOCARHIBEs), funded by MINECO, 01/01/2013 - 31/12/2015, Pedro Gómez-Romero

**CONTRIBUTIONS**

Materials for electrochemical storage II: supercapacitors, MAT4Energy. Materials for Sustainable Energy Applications: Conversion, Storage and Efficiency, organized by LMGP. Grenoble (France), 16-18/06/2014, Pedro Gómez-Romero (Invited)

Synthesis of graphene hybrid nanocomposites for energy and environmental applications, International Graphene Innovation Conference, organized by GraphChina. Ningbo (China), 01-03/09/2014, Pedro Gómez-Romero (Invited)

Hybrid energy storage. Merging Battery and Supercapacitor Chemistries, 5th EUCHEMS Chemistry Congress, organized by Turkish Chemical Society. Istambul (Turkey), 31/08/2014-04/09/2014, Pedro Gómez-Romero (Keynote)

Investigating Energy, Plenary Opening Conference (60 min). MAT4Energy. Materials for Sustainable Energy Applications: Conversion, Storage and Efficiency, organized by LMGP. Grenoble (France), 16-18/06/2014, Pedro Gómez-Romero (Opening)

Hybrid Energy Storage: merging battery and supercapacitor chemistries, Power our Future 2014, organized by CIC energigune. Vitoria (Spain), 01-04/04/2014, Pedro Gómez-Romero (Oral)

Hybrid Energy Storage. Merging the Chemistries of Batteries and Supercapacitors Nanotech, MEET. Hammamet (Tunisia), 24-26/04/2014, Pedro Gómez-Romero (Oral)

Hybrid Materials for Energy Storage, XIII Congreso Nacional de Materiales, organized by UB, CPT, sociemat. Barcelona (Spain), 18-20/06/2014, Pedro Gómez-Romero (Oral)

All there is inside a pencil. The graphene revolution and other nanostories, TEDx Conference. Peralada (Spain), 27/06/2014, Pedro Gómez-Romero (Oral)


Microassemblies of LiFePO4 nanoparticles for use as cathodes in Lithium ion batteries, XIII Congreso Nacional de Materiales, organized by UB, CPT, sociemat. Barcelona, Spain, 18-20/06/2014, Z. Caban-Huertas, O. Ayyad and P. Gómez-Romero (Oral)
COURSES

Chemistry for Specific Materials, in Màster Universitari en Química Industrial i Introducció a la Recerca Química, Universitat Autònoma de Barcelona, Barcelona (Spain), Prof Pedro Gómez-Romero

THESES

Doctorand: Julieth Suarez-Guevara
Title: Materiales híbridos basados en nanocarbones y polioxometalatos para aplicación como electrodos en supercondensadores con mecanismo dual de almacenamiento de energía
Defense Date: 20/11/2014
Directors: Prof Pedro Gómez Romero and Dra Vanesa Ruiz
ICREA Prof Gustau Catalán earned his BSc in Physics at the Universitat de Barcelona (1997), and his PhD in Physics at Queen’s University of Belfast (2001). He then took research positions at the Mediterranean Institute for Advanced Studies (2002-2004), the University of Groningen (2004-2005) and the University of Cambridge (2005-2009). In 2009 he joined CIN2 as an ICREA Research Professor and Group Leader of the Oxide Nanoelectronics (ON) Laboratory, and three years later he transferred his research to ICN. Both Institutions recently joined their efforts and became ICN2, where he continues to lead the Group. In 2012, he earned an ERC Starting Grant to set up in Barcelona the world’s first dedicated laboratory of nanoflexoelectricity.
NEW PROJECTS & MILESTONES

Most of this year’s effort was focused on completing the big investments (equipment purchase, hiring of personnel) for the ERC project. The human team is now complete and the equipment is up and running, so now that the big admin tasks are over we expect more scientific progress.

On the research front, the outstanding contributor has been Xavi Martí, who has produced a string of high-profile articles about spintronics with antiferromagnetic materials. This year has also finally seen the publication of our investigation on the origin of giant flexoelectricity in relaxors. We have also produced eye-catching results in layered iridium oxides (Sr$_2$IrO$_4$); but this work was not published until 2015, so we will talk about it in next year’s annual report.
ICN2 Annual Report 2014

PUBLICATIONS


PROJECTS

SGR, funded by AGAUR, 01/01/2014 - 31/12/2016, Gustau Catalán

Flexoelectricity, funded by EC, 01/01/2013 - 31/12/2017, Gustau Catalán

Magnetism of nanostructures on surfaces: from isolated nanoparticles to magnetic domain walls, funded by MINECO, 01/12/2010-30/11/2015, Gustau Catalán

Estrestrónica de óxidos, OSTRES, funded by MINECO, 01/01/2014-31/12/2016, Gustau Catalán
CONTRIBUTIONS

Flexoelectricity, Research Seminar, organized by Peking University, Beijing, China, 2014, Gustau Catalán (Invited)

On the true size of flexoelectricity, Conference on Advanced Topics in Ferroelectrics, Jiang Tang, China, 2014, Gustau Catalán (Invited)

Pressure-induced effects at the nanoscale, organized by Max Planck Institute, Stuttgart, Germany, 2014, Neus Domingo (Invited)

Giant piezoresistance in oxide thin films, 3rd International Workshop on Complex Oxides, organized by Vanderbilt University, Cyprus, 19-23/05/2014, Gustau Catalán (Invited)

Interplay between flexoelectricity and nanodomains, CIMTEC conference on Advanced Ceramics, Montecatini Terme, organized by CIMTEC, Montecatini Terme, Italy, 08-13/06/2014, Gustau Catalán (Invited)

Nanoscopically confined metal-insulator transitions in oxides, European Materials Research Society (E-MRS) Fall Meeting, organized by European Materials Research Society, Warsaw, Poland, 15-18/09/2014, Gustau Catalán (Invited)

Contribution of polar nanorregions to the giant flexoelectricity of relaxor ferroelectrics, Spring Meeting of the American Physics Society (APS), organized by APS, Denver, USA, 03-07/03/2014, J. Narváez (Oral)

Scanning piezoresistance: a new experimental tool, Trends in Nanotechnology (TNT2014), Barcelona, Spain, 27-31/10/2014, Neus Domingo (Oral)

BOOKS

Phononic and Photonic Nanostructures Group

Main Research Lines

- Nanophononics and Nanophotonics
- Nanofabrication
- Nanometrology
- Oxide-based Nanostructures

GROUP MEMBERS

Francesc Alzina, Senior Researcher
Noèlia Arias, Group Administrator and Project Manager
Eglantina Benavente, Visiting Professor
Monica Emperatriz Bernal, Visiting Doctoral Student
Sweta Bhansali, FI Doctoral Student
Emigdio Chávez, Postdoctoral Researcher
Claudia Delgado Simao, Postdoctoral Researcher
Sindy Devis, Visiting Doctoral Student
Alexandros El Sachat, Doctoral Student
Ariadna Fernández, Doctoral Student
Achille Leo Francone, Postdoctoral Researcher
Yamila García, Postdoctoral Researcher
Jordi Gomis, Juan de la Cierva Postdoctoral Researcher
Guillermo González, Visiting Professor
Bartłomiej Graczykowski, Postdoctoral Researcher
Erwan Guillotel, Group Administrator and Project Manager
Martin Kreuzer, DFG Postdoctoral Researcher
Juan Ignacio Medina, Doctoral Student and Laboratory Engineer
Daniel Navarro, Beatriu de Pinós Postdoctoral Researcher
Juan Sebastián Reparaz, Postdoctoral Researcher
Marianna Sledzinska, Laboratory Engineer
Clivia Sotomayor, ICREA Research Professor and Group Leader
Markus Wagner, Marie Curie Postdoctoral Researcher

GROUP LEADER

ICREA Research Professor Dr Clivia M. Sotomayor Torres was awarded her PhD in Physics in 1984 by Manchester University (UK). She then held tenured academic appointments at St. Andrews and Glasgow Universities in the UK and became a C4 professor at Wuppertal University (Germany) in 1996. She was a research professor at University College Cork, Tyndall National Institute (Ireland) from 2004 to 2008. Since May 2007 she has been ICREA Research Professor based at the Catalan Institute of Nanotechnology (ICN), now ICN2.
NEW PROJECTS & MILESTONES

The Group completed two of its ongoing projects: EUPHONON (Building a European NanoPhononics Community) and NANO-TEG (Nanostructured ThermoElectric Systems for Green Transport & Energy Efficient Applications).

Seven projects are still ongoing: MERGING (Membrane-based phonon engineering for energy harvesting), PLAST4FUTURE (Injection-moulding production technology for multi-functional nano-structured plastic components enabled by Nano Imprint Lithography), TAPHOR (Tailoring Acoustic Phonon Dispersion Relations), and QUANTIHEAT (Quantitative scanning probe microscopy techniques for heat transfer management in nanomaterials and nanodevices), nanoTHERM (Spanish CONSOLIDER on Tailoring electronic and phononic properties of nanomaterials : Towards ideal Thermoelectricity), NANO-RF (Carbon-based smart systems for wireless applications), and NANOTHERM (Innovative Nano and Micro Technologies for Advanced Thermo and Mechanical Interfaces).

She has received awards from the Royal Society of Edinburgh, the Nuffield Foundation and an Amelia Earhart Fellowship from ZONTA International (USA). She is author of over 450 scientific publications and has edited six books (Researcher ID; E-8418-2010, Hirsch index 38, over 6000 citations). She leads a strong team working on phonon engineering and is actively engaged in European-level research. She serves on Scientific Advisory Committees in Nanoscience and Nanotechnology in France and she is a jury member of the FWO Research Foundation Flanders Odysseus Programme. She is a Member of the Board of Stakeholders of Photonics21 and a Visiting Professor at the Royal Institute of Technology, KTH, in Sweden.
Recently the group designed a silicon 1D Optomechanical crystal built up so that it allows stable localisation of both phonons and photons. In 2014 the results were reported in Nature Communications (vol. 5, 4452 (2014)) and later highlighted in Nature Photonics (vol. 8, 746 (2014)).

**PUBLICATIONS**


Ordered 2D colloidal photonic crystals on gold substrates by surfactant-assisted fast-rate dip coating, Armstrong E., Khunsin W., Osiak M., Blomker M., Sotomayor Torres C. M., O’Dwyer C., Small (10): 10, 1895-1901 (2014). IF: 7.514


PROJECTS

SGR, funded by AGAUR, 18/07/2009-30/04/2014, Clivia Sotomayor Torres

Thermal properties of SrTiO3: Nanotechnology for thermoelectric generation, funded by AGAUR, 02/01/2013-01/01/2015, Clivia Sotomayor Torres

SGR, funded by AGAUR, 01/01/2014-31/12/2016, Clivia Sotomayor Torres

Nanostructured ThermoElectric Systems for Green Transport & Energy Efficient Applications (NANOTEG), funded by EC, 01/07/2011-28/02/2015, Clivia Sotomayor Torres

Carbon-based smart systems for wireless applications (NANO-RF), funded by EC, 01/09/2012-31/08/2015, Clivia Sotomayor Torres

Innovative Nano and Micro Technologies for Advanced Thermo and Mechanical Interfaces (NANOTHERM), funded by EC, 01/09/2012-31/08/2015, Clivia Sotomayor Torres (Coordinator)

Injection-moulding production technology for multi-functional nano-structured plastic components enabled by Nano Imprint Lithography (PLAST4FUTURE), funded by EC, 01/01/2013-31/12/2015, Clivia Sotomayor Torres

Membrane-based phonon engineering for energy harvesting (MERGING), funded by EC, 01/01/2013-31/12/2015, Clivia Sotomayor Torres (Coordinator)

Building a European NanoPhononics Community (EUPHONON), funded by EC, 01/11/2013-31/10/2014, Clivia Sotomayor Torres

QUANTitative scanning probe microscopy techniques for HEAT transfer management in nanomaterials and nanodevices (QUANTIHEAT), funded by EC, 01/12/2013-30/11/2017, Clivia Sotomayor Torres

Heat Propagation and Thermal Conductivity in Nanomaterials for Nanoscale Energy Management (HeatProNano), funded by EC, 01/03/2014-29/02/2016, Clivia Sotomayor Torres

Tailoring Electronic and Phononic Properties of Nanomaterials: Towards Improved Thermoelectricity (nanoTHERM), nanoTHERM, funded by MINECO, 27/12/2010-26/12/2015, Clivia Sotomayor Torres (Coordinator)

Diseño de las Relaciones de Dispersión de Fonones Acústicos (TAPHOR), funded by MINECO, 01/01/2013-31/12/2015, Clivia Sotomayor Torres
**CONTRIBUTIONS**

*Developments in nanoscience and nanotechnology, U de Chile, Fac. Sciences, CEDENNA, UTEM.* Santiago (Chile), 07-09/01/2014, C. M. Sotomayor Torres (Invited)

*Dimensional and defectivity metrology in NIL and NIL-related nanofabrication technologies, NIL Industrial Day.* Linz (Austria), 13-15/03/2014, J. Gomis-Bresco, C. Simao, N. Kehagias, and C. M. Sotomayor Torres (Invited)

*Thermal transport in suspended Si membranes, Linneus Seminar to the Dept of Physics, Chemistry and Biology.* Linköping (Sweden) 15/05/2014, 2014, C. M. Sotomayor Torres (Invited)

*Photonics in Europe: Trends and roadmap, Optopub.* Kista (Sweden), 22/05/2014, C. M. Sotomayor Torres (Invited)

*Optomechanics, Cleo.* San Jose (USA), 08-13/06/2014, J. Gomis-Bresco, et al. (Invited)

*Optomechanics, ICTON 2014.* Graz (Austria), 06-10/jul/2014, J. Gomis-Bresco, C. M. Sotomayor Torres (Invited)

*Phonon Transport and Scattering in Rough and Porous Silicon Nanowires, 2014 ECS and SMEQ Joint International Meeting.* Cancun (Mexico), 05-10/10/2014, C. M. Sotomayor Torres, C. O’Dwyre (Invited)

*Phonons in free-standing Si membranes, International School on Quantum Electronics, Third Mediterranean International Workshop on Photoacoustic and Photothermal phenomena.* Erice (Italy), 05-12/10/2014, C. M. Sotomayor Torres (Invited)

*A coherent phonon source driven by optical sources, ADOPT Day 2014.* Stockholm (Sweden), 23/10/2014, C. M. Sotomayor Torres (Invited)

*Silicon free-standing membranes: Fabrication, thermal transport and phonon confinement, Department of Applied Electronics, Tokyo University of Science.* Tokyo (Japan), 30/10/2014, C. M. Sotomayor Torres (Invited)

*Nanoimprint lithography as a directed self-assembly tool: approaches and nanometry, 27th International Microprocesses and Nanotechnology Conference MNC.* Fukuoka (Japan), 04-07/11/2014, C. Simão, C. M. Sotomayor Torres (Invited)


*Dimensional and Defectivity Nanometry of sub-20 nm line arrays prepared by directed self-assembly, Nanospain.* Madrid (Spain), 11-14/03/2014, C. Simão, D. Tuchapsky, W. Khunis, A. Amann, M. A. Morris and C. M. Sotomayor Torres (Oral)


*One-dimensional surface phononic crystals, Nanospain.* Madrid (Spain), 11-14/03/2014, B. Graczykowski, M. Sledzinska, N. Kehagias, F. Alzina, S. Reparaz, and C. M. Sotomayor Torres (Oral)

*Metal incorporation in block copolymer templates, Nanospain.* Madrid (Spain), 11-14/03/2014, M. Kreuzer, C. Delgado Simao, A. Diaz, and C. Sotomayor Torres (Oral)

*Order and defectivity nanometry by image processing and analysis of sub-20 nm BCPs features for lithographic applications, SPIE DSS.* Baltimore (USA), 05-09/04/2014, C. Simao, D. Tuchapsky, W. Khunis, A. Amann, M. A. Morris and C. M. Sotomayor Torres (Oral)
Dimensional and Defectivity Nanometrology of sub-20 nm line arrays prepared by directed self-assembly, Industrial Technologies 2014. Athens (Greece), 09-11/04/2014, C. Simao, D. Tuchapsky, W. Khunsin, A. Amann, M. A. Morris and C. M. Sotomayor Torres (Oral)

Theoretical thermal rectification in Si and Ge thin films, E-MRS. Lille (France), 27-29/05/2014, E. Chávez et al. (Oral)

Modelling of the phonon attenuation in Si-based nanostructures, E-MRS. Lille (France), 27-29/05/2014, E. Chávez et al. (Oral)

Optomechanics, E-MRS. Lille (France), 27-29/05/2014, J. Gomis-Bresco, et al. (Oral)

Imprint-based techniques for the fabrication of embedded silver grid electrodes for organic solar cells applications, ISFOE 2014. Thessaloniki (Greece), 07-10/07/2014, N. Kehagias (Oral)


Theoretical thermal rectification in Si and Ge thin films, MSE 2014. Darmstadt (Germany), 23-25/09/2014, E. Chávez et al. (Oral)

Modification of the Akhieser mechanism in Si nanoresonators, Eurotherm 103, Nano scale and Microscale Heat Transfer IV. Lyon (France), 15-17/10/2014, C. M. Sotomayor Torres (Oral)

Dimensional and defectivity nanometrology of directed self-assembly patterns, SPIE Advanced Lithography. San Jose (USA), 23-27/02/2014, C. Simao, W. Khunsin, A. Amann, N. Kehagias, M. A. Morris, and C. M. Sotomayor Torres (Poster)

Theoretical thermal rectification in Si and Ge thin films, Nanospain. Madrid (Spain), 11-14/03/2014, E. Chávez-Ángel, F. Alzina, and C. M. Sotomayor Torres (Poster)

Subwavelength diffraction for quality control in nano fabrication processing, Nanospain. Madrid (Spain), 11-14/03/2014, J. Gomis-Bresco, C. Simao, M. Kreuzer, and C. M. Sotomayor Torres (Poster)

Etch-free method to prepare nanoporous metal layers using directed self-assembly, Nanospain. Madrid (Spain), 11-14/03/2014, M. Bernal Salamanca, C. Simao, M. Sledzinska and C. M. Sotomayor Torres (Poster)

Anti-wetting surfaces fabricated by Reverse Nanoimprint Lithography on Silicon and metal-coated substrates, Nanospain. Madrid (Spain), 11-14/03/2014, A. Fernández, J. Medina, C. Benkel, M. Gutteman, B. Bilenberg, T. Nielsen, C. M. Sotomayor Torres, and N. Kehagias (Poster)

Acoustic phonon dynamics in free-standing group IV semiconductor membranes studied by ultra-fast pump & probe spectroscopy, Nanospain. Madrid (Spain), 11-14/03/2014, M. R. Wagner, J. S. Reparaz, J. Gomis-Bresco, E. Chávez-Ángel, B. Graczykowski, F. Alzina, and C. M. Sotomayor Torres (Poster)

Nanoimprint-assisted directed self-assembly of low-molecular weight block copolymers for advanced lithographic applications, SPIE DSS. Baltimore (USA), 05-09/04/2014, C. Simao, Nikos Kehagias, M. Morris, C. M. Sotomayor Torres (Poster)

**BOOKS**

**Beyond CMOS Nanodevices 1** - Chap. 7

**Beyond CMOS Nanodevices 1** - Chap. 12


**Order and defectivity nanometrology by image processing and analysis of sub-20 nm BCPs features for lithographic applications**, Simao C., Tuchapsky D., Khunsin W., Amann A., Morris M.A., Sotomayor Torres C. M., Proceedings of SPIE, 9110, Dimensional optical metrology and inspection for practical applications III. Doi: 10.1117/12.2050182

**THESES**

**Doctorand: Emigdio Chávez Ángel**
Title: Confined acoustic phonons in Si nanomembranes: impact on thermal properties
Defense date: 03/10/2014
Director: Prof Dr Clivia M. Sotomayor Torres

**OTHER HIGHLIGHTS**

**European Patents filed**
European patent (EP) application
ICN PAT 02/13
Inspecting nanostructures
With Ref. EP14156430 and priority date 24/02/2014
P2N Group.

**PCT Extensions filed**
ICN PAT 08/12
Methods and devices for analysing nanostructure array images
P2N Group

More information:
http://www.icn.cat/~p2n/
Physics and Engineering of Nanodevices Group

Main Research Lines

- Development of novel nanodevice structures and nanofabrication methods to investigate the physical properties of materials at the nanoscale and their technological relevance
- Spin and thermal transport in two-dimensional systems such as topological insulators, graphene and transition metal dichalcogenides
- Control of the magnetic state of ferro- and antiferromagnetic systems by means of the spin-orbit interaction and, particularly, the spin Hall effect

GROUP MEMBERS

Frédéric Bonell, Marie Curie Postdoctoral Researcher
Marius Vasile Costache, Ramón y Cajal Postdoctoral Researcher
Jo Cuppens, Postdoctoral Researcher
Ingmar Neumann, Postdoctoral Researcher
Bart Raes, Postdoctoral Researcher
Juan Francisco Sierra, Juan de la Cierva Postdoctoral Researcher
Sergio Valenzuela, ICREA Research Professor and Group Leader

GROUP LEADER

Prof Valenzuela obtained his PhD in Physics in 2001 at the University of Buenos Aires, Argentina, and went on to be a Postdoctoral Fellow and Research Associate at Harvard University, and a Research Scientist at the Massachusetts Institute of Technology (MIT). Since July 2008, Prof Valenzuela has been an ICREA Research Professor as well as Group Leader of ICN’s, now ICN2’s, Physics and Engineering of Nanoelectronic Devices Group. Since September 2008 he has also served as Associate Professor at the Physics department of the Universitat Autònoma de Barcelona (UAB).
In 2014 the Physics and Engineering of Nanodevices Group continued with its progress on the ERC Starting Grant project to investigate the spin properties of materials with large spin-orbit interaction, in particular topological insulators. The project (SPINBOUND) was launched in February 2013 and, in January 2014, the first results were published in the journal *Physical Review Letters*. The work reported the role of electron-phonon coupling in the electronic properties of surface states of topological insulators, putting forward constraints that will be key for future devices based on these materials. In addition, the group started a new project (Spintronics in 2-Dimensional Dirac Systems, S2DDS), and has been active in the investigation of spin transport properties in graphene (e.g. *Nature Physics* article) in collaboration with S. Roche’s group. It also participated in Training Networks; hosting researcher Frédéric Bonell with a Marie Curie project (STIFNANO), which was awarded in 2013 to work on the electronic properties of ferromagnet / topological insulators heterostructures. From the point of view of infrastructure, a crucial milestone was achieved for the future activities of the group with the installation of a dual-chamber Molecular Beam Epitaxial (MBE) system, which will allow the growth of ultrahigh purity epitaxial thin films.

Prof Valenzuela’s research is focused on the unique properties of materials in samples with nanoscale dimensions. Such studies are motivated both by their intrinsic scientific interest and by their potential importance for electronic applications, and they rely on innovative devices or innovative implementations of known devices. Recent research has encompassed spintronics, quantum computation with superconducting circuits, and nanoelectromechanical systems (NEMS).

Prof Valenzuela received the 2009 IUPAP Young Scientist Prize in Magnetism for his contributions to the field of spintronics, and was awarded an ERC Starting Grant in 2012. He has authored over 40 papers, three patents and four books or book chapters.
**PUBLICATIONS**


**PROJECTS**

**Spin pumping and magnetisation dynamics in metallic nanostructures**, funded by AGAUR, 01/01/2013-31/12/2014, Sergio Valenzuela

**SGR**, funded by AGAUR, 01/01/2014-31/12/2016, Sergio Valenzuela

**Exploring the spin physics at the boundaries of materials with strong spin orbit interaction**, SpinBound, funded by EC, 01/02/2013-31/01/2018, Sergio Valenzuela

**Spintronics with Topological Insulator/Ferromagnet Nanodevices**, STIFnano, funded by EC, 01/04/2014-31/03/2016, Sergio Valenzuela

**Spin transport and magnetisation dynamics in nanostructures**, funded by MINECO, 01/01/2012-31/12/2016, Sergio Valenzuela

**Espintrónica en Sistemas de Dirac en 2 Dimensiones**, S2DDS, funded by MINECO, 01/01/2014-31/12/2016, Sergio Valenzuela
**BOOKS**


**THESES**

Doctorand: **Ingmar Neumann**
Title: Spin Transport and Thermoelectric Effects in Graphene.
Defense Date: 21/05/2014
Director: Prof Sergio O. Valenzuela

Supramolecular NanoChemistry and Materials Group

Main Research Lines

- Nanoporous Metal-Organic Frameworks and related nanoparticles
- Frontier nanochemistry-based methodologies towards new multifunctional nanocarriers
- New products based on Micro- and Nano-encapsulation Technologies

GROUP MEMBERS

Celia Aranda, Visiting Student
Javier Ariñez, FPU Doctoral Student
Civan Avci, Doctoral Student
Abraham Ayala, Visiting Doctoral Student
Ivan Patricio Burneo, Visiting Doctoral Student
Antonia Maria Cano, Postdoctoral Researcher
Carlos Carbonell, Laboratory Engineer
Arnau Carné, Doctoral Student
Jorge Cruz, Visiting Postdoctoral Researcher
Jordi Espín, FPI Doctoral Student
María Emilia Evangelio, Beatriu de Pinós Postdoctoral Researcher
Sonia García, Postdoctoral Researcher
Luís Carlos Garzón, Doctoral Student
Marta González, Group Project Manager
Inhar Imaz, Ramón y Cajal Postdoctoral Researcher
Jaya Ramulu Kolleboyina, Postdoctoral Researcher
David Martínez, Visiting Student
Rubén Mas, Visiting Postdoctoral Researcher
Daniel Maspoch, ICREA Research Professor and Group Leader
Nereida Mejías, Technician
Elsa Rivoire, Technician
Sabina Rodríguez, Postdoctoral Researcher
David Rodríguez, Visiting Doctoral Student
Àngels Ruyra, Doctoral Student
Vahid Safarifard, Visiting Doctoral Student
Kyriacos Stylianou, Marie Curie Postdoctoral Researcher
Min Ying Tsang, Visiting Doctoral Student
Claudia Vignatti, Doctoral Student
Christian Vila, Visiting Student
Zhuopeng Wang, Visiting Postdoctoral Researcher
Heng Xu, Doctoral Student

GROUP LEADER

ICREA Prof Daniel Maspoch

Born in l’Escala (Girona) in 1976. He graduated in chemistry at the Universitat de Girona and obtained his PhD in materials science at the Universitat Autònoma de Barcelona & Institut de Ciència de Materials de Barcelona. He then moved to Northwestern University, where he worked as a postdoctoral fellow in the group of professor Chad A. Mirkin. He moved back to the Institut Català de Nanotecnologia (ICN), now ICN2, thanks
NEW PROJECTS & MILESTONES

In 2014, NANOUP Group completed two of its on-going projects (“NanoBioMOFs, Nanoscale Metal-Organic Frameworks for Biomedical Applications”, a Marie-Curie project supported by the European Commission under the 7th FP, and “MOFINP Starting Grant: Multifunctional Hybrid Nanoparticle Pairs made from Metal-Organic Frameworks and Inorganic Nanoparticles”, a Complementary Action supported by MINECO). The group also began the project “InanoMOF: Multifunctional micro- and nanostructures assembled from nanoscale metal-organic frameworks and inorganic nanoparticles”, for which a prestigious ERC Consolidator Grant was awarded to Prof Daniel Maspoch.

The Group has also continued its development of customised micro- and nano-encapsulation technologies for companies, working in parallel with 7 different companies.

to a Ramón y Cajal contract, and he founded the Supramolecular NanoChemistry & Materials Group. Since September 2011, he has been ICREA Research Professor and Group Leader at the ICN2, and in 2014 he was awarded European Research Council (ERC) Consolidator Grant.

Prof Maspoch has authored 70 scientific publications, 5 book chapters and 7 patents, and has established 14 contracts with private companies, including 3 successful transfers of in-house technology for immediate application to consumer products.
**PUBLICATIONS**


PROJECTS

SGR, AGAUR, 01/01/2014-31/12/2016, Daniel Maspoch

*Multifunctional micro- and nano-structures assembled from nanoscale metal-organic frameworks and inorganic nanoparticles (InanoMOF), funded by EC, 01/04/2014-31/03/2019, Daniel Maspoch*

*Micro- and nano-encapsulated biocides: the next generation of disinfectants with short + long2Life antimicrobial activity, BIOCIDE2LIFE?, funded by CERCA, 2012-2014, Daniel Maspoch*

*Desarrollo de una nueva generación de productos biocidas con efecto inmediato, remanente y capacidad para reducir la transferencia de microorganismos (DESPRO-CIDE), funded by MINECO, 15/07/2012-31/12/2015, Daniel Maspoch*

*Starting Grant: Multifunctional Hybrid Nanoparticle Pairs made from Metal-Organic Frameworks and Inorganic Nanoparticles (Bio2-nanoMOF), funded by MINECO, 01/01/2013-30/06/2014, Daniel Maspoch*

*Diseño y Síntesis de Metal-Organic Frameworks Nanoscópicos para Aplicaciones Biomédicas Avanzadas (MOFs@bio), funded by MINECO, 01/01/2013-31/12/2015, Daniel Maspoch*
CONTRIBUTIONS

A new type of nanomaterials, Nanoscale Metal-Organic Frameworks, organized by Universitat de Barcelona. Barcelona (Spain), 22/04/2014, Daniel Maspoch, (Invited)

Biocide2Life, Catalan Technology: an overview on Prova’t Projects, First CERCA Conference. Barcelona (Spain), 28/04/2014, Daniel Maspoch (Invited)

Nanoscale Metal-Organic Frameworks, Instituto de Nanociencia de Aragón (INA). Zaragoza (Spain), 14/05/2014, Daniel Maspoch (Invited)

Nanotechnology & Supramolecular Chemistry: hand in hand, Symposium of Supramolecular Chemistry in Science. Girona (Spain), 16/09/2014, Daniel Maspoch (Invited)

Nanoscale Metal-Organic Frameworks (nanoMOFs), Institut Ciencia de Materials de Barcelona (ICMAB-CSIC). Barcelona (Spain), 22/09/2014, Daniel Maspoch (Invited)


Encapsulation of Insulin Peptides in Liposomes for Preventing Type 1 Diabetes in NOD Mice, Controlled Release Society Annual Meeting and Exposition. Chicago (USA), 13-16/07/2014, Mary Cano (Poster)


Femtolitre Chemistry assisted by Microfluidic Pen Lithography (MPL), 1st International Symposium on Nanoparticles/ Nanomaterials and Applications (isn2a2014), organized by Universidade NOVA de Lisboa. Caparica (Portugal), 20-22/01/2014, K. Stylianou, D. Maspoch (Talk)

Lipidic-Coated Bacteriophages for Controlling Salmonella Colonisation, EMBO conference: Viruses of microbes structure and function, from molecules to communities. Zurich (Switzerland), 14-18/07/2014, Joan Colom (Talk)

Nanoscale MOFs for Contrast Agent Applications, Young MOF Symposium 2014. Kyoto (Japan), 26/09/2014, Inhar Imaz (Talk)

Liposome-based immunotherapy for Type 1 Diabetes, Reunión annual del grupo de islotes de la sociedad Española de Diabetes (SED). Madrid (Spain), 16/10/2014, Imma Pujol (Talk)

BOOKS

COURSES

UT Austin/UAB Nanotechnology Innovation Course, in Curso de grado, Universitat Autònoma de Barcelona, Barcelona (Spain), 14/06/2014, Mary Cano

Chemistry for Specific materials/metal-organic frameworks, in Màster Universitari en Quimica Industrial i Introduccio a la Recerca Quimica, Universitat Autònoma de Barcelona, Barcelona (Spain), 28/10/2013, Inhar Imaz

Nanotecnología y Sociedad, in Grado de Nanotecnología, Universitat Autònoma de Barcelona, Barcelona (Spain), 18/11/2014, Mary Cano

OTHER HIGHLIGHTS

European Patents filed

European Patent (EP) application, ICN PAT 09/13, Novel compositions comprising lipidic-coated bacteriophages, With Ref. EP14382057.9 and priority date 20/02/2014

European Patent (EP) application, ICN PAT 03/13, Biocidal composition with dual immediate and remnant activity, With Ref. EP14382498 and priority date 05/12/2014


Patents entered into national phases

ICN PAT 01/11, Method for the preparation of metal organic frameworks entered regional phases in USA on 04/04/2014 and in Europe on 29/04/2014

THESES

Doctorand: Marta Rubio
Title: Coordination Polymer Nanofibers made of Amino Acids and Peptides and their Use as Templates to Synthesize Inorganic Nanoparticle Superstructures
Defense date: 28/05/2014
Directors: Dr Inhar Imaz and Prof Daniel Maspoch

Doctorand: Arnau Carne
Title: A New Synthetic Method for Nanoscale Metal-organic Frameworks and their Application as Contrast Agents for Magnetic Resonance Imaging
Defense date: 10/10/2014
Directors: Prof Daniel Maspoch and Dr Inhar Imaz

Doctorand: Carles Carbonell
Title: Surface Structuration of Metal-Organic Frameworks Using Tip-Based Lithographies
Defense date: 09/12/2014
Directors: Prof Daniel Maspoch and Dr Inhar Imaz

More information:
http://www.nanoup.org/
Theoretical and Computational Nanoscience Group

Main Research Lines

- Leading-edge theoretical research on quantum transport phenomena in Graphene
- Spin dynamics in Dirac Matter (graphene, topological insulators)
- Thermal properties and Thermoelectricity in two-dimensional Materials
- Predictive Modelling and Multiscale numerical simulation of complex nanomaterials and quantum nanodevices

GROUP MEMBERS

José Eduardo Barrios,
Visiting Postdoctoral Researcher
Aron Cummings,
Postdoctoral Researcher
Van Tuan Dinh,
Postdoctoral Researcher
Nicolas Leconte,
Postdoctoral Researcher
Stephan Roche,
ICREA Research Professor and Group Leader
David Soriano,
Postdoctoral Researcher

GROUP LEADER

Prof Stephan Roche is a theoretician with more than twenty years of experience in the study of transport theory of low-dimensional systems, including graphene, carbon nanotubes, semiconducting nanowires, organic materials and topological insulators. He has published more than 100 papers in journals such as Review of Modern Physics, Nature Physics, Nano Lett. and Phys. Rev. Lett. (40 papers) and he is the co-author
1) A successful computational implementation of the Hall Kubo conductivity to study high-magnetic field transport regimes in disordered graphene. Graphene displays an anomalous Quantum Hall Effect (QHE) due to the peculiar nature of low-energy electronic excitations, but the nature and role of disorder is extremely difficult to include in the theory and simulation. Roche’s group has successfully developed an unrivalled method to study QHE in disordered graphene. A first demonstration of its scientific validity was given in *PRL* 110,086602 (2013) in a case study, while a successful application to the European PRACE high-performance infrastructure has provided massive computing resources and has allowed the stimulation or models of realistic disordered graphene containing several hundred millions of carbon atoms, giving the group an international leadership in this research area. Remarkable results showing unprecedented features in the QHE and driven by the presence of defect-induced resonances have been recently obtained, and should lead to a revised analysis of prior literature and current state of the art.

2) A comprehensive understanding of fundamental limits of polycrystalline graphene-based materials and devices. While single-crystal graphene is the best choice for highest device performances (such as graphene field effect transistors), the most promising approach for mass-producing wafer-scale graphene is chemical vapour deposition (CVD), which results in a material that is polycrystalline. Roche’s group has performed the first charge transport study in realistic models of polycrystalline graphene. An important scaling law which dictates the variation of the elastic mean free path (and related mobility) to the average grain sizes of the polycrystalline sample and the quality of grain boundaries was found and the quantitative description of grain boundary resistivity in polycrystalline samples was reported in *Advanced Materials* in 2014. Such results provide strategic guidance to engineers for predicting device performances based on morphology characterisation, thus providing a clear milestone for the understanding of transport properties in CVD-grown graphene-based devices, the material of choice for large-scale integration and applications in nanoelectronics, transparent electrodes or sensors.

3) The discovery of a new mechanism of spin relaxation unique to graphene. Roche’s group has discovered a completely new mechanism for spin relaxation in weakly-disordered graphene, in sharp contrast with the conventional use of semi-classical approaches such as Elliott-Yafet and Dyakonov-Perel. The mechanism discovered is driven by quantum dephasing effects and spin-pseudospin entanglement and should lead to a thorough revision of the field, potentially gathering massive scientific and technological impact by creating novel ways of controlling electron spin dynamics. The paper was published in *Nature Physics* in 2014.

of the recently published book on “Introduction to Graphene-Based Nanomaterials: From Electronic Structure to Quantum Transport” (Cambridge University Press 2014). He received the Authorisation to conduct PhD projects in 2004 at the University Joseph-Fourier (Grenoble, France), and since then he has supervised 5 PhD students and more than a dozen postdoctoral researchers in France, Germany and Spain. S. Roche has been awarded the prestigious Friedrich Wilhelm Bessel prize by the Alexander Von-Humboldt Foundation (Germany), and finally, since 2011, he has been actively involved in the Graphene Flagship project, currently as a co-leader of the Graphene spintronics workpackage.
PUBLICATIONS


Multiple quantum phases in graphene with enhanced spin-orbit coupling: from the quantum spin Hall regime to the spin Hall effect and a robust metallic state, Cresti A., Van Tuan D., Soriano D., Cummings A.W., Roche S., Phys Rev Lett. 2014; 113(24): 246603. IF: 7.728


Quantum transport in chemically functionalized graphene at high magnetic field: defect-induced critical states and breakdown of electron-hole symmetry, Nicolas Leconte; Frank Ortmann; Alessandro Cresti; Jean-Christophe Charlier; Stephan Roche, *Theoretical and Computational Nanoscience, 2D Materials* (2): vol. 1 (2014)


**PROJECTS**

SGR, funded by AGAUR, 01/01/2014 - 31/12/2016, Stephan Roche

Graphene-Based Revolutions in ICT And Beyond, GRAPHENE, funded by EC, 01/10/2013 - 31/03/2016, Stephan Roche

ICREA Workshop on Graphene Nanobiosensors, funded by ICREA, 01/08/2014 - 31/12/2015, Stephan Roche, Arben Merkoçi

Simulación Multi-escala de transporte cuántico en grafeno y aislantes topológicos, MQT-GRAPHTI, funded by MINECO, 01/01/2013 - 31/12/2015, Stephan Roche

Multiscale simulation of charge transport properties in polycrystalline graphene, funded by SAMSUNG (Company), 01/03/2014 - 28/02/2015, Stephan Roche
CONTRIBUTIONS

Surprises in GRAPHENE spintronics, International Winterschool on Electronic Properties of Novel Materials, organized by Institut für Festkörperphysik. Kirchberg (Austria), 12/03/2014, Stephan Roche (Invited)

Multiscale simulation of two-dimensional materials-based devices, Singapore-Spain workshop on Two-dimensional Materials, organized by National University of Singapore. Singapore (Singapore), 18/06/2014, Stephan Roche (Invited)

Introduction to quantum transport properties and spin dynamics in graphene, Graphene and Related Materials (GRM-2014) Summer School, organized by Izmir Institute of Technology. Urla-Izmir (Turkey), 09/07/2014, Stephan Roche (Invited)

Understanding Charge Transport in Graphene-based Materials: From Concepts to Applications, GRAPHCHINA 2014, organized by Graphene CGI. Ningbo (China), 01/09/2014, Stephan Roche (Invited)


Predictive Modelling for Fostering Graphene and Two dimensional Materials Applications, Trends in Nanotechnology JAPAN - NANOTECH 2014, organized by NIMS, MANA. Tokyo (Japan), 29/01/2014, Stephan Roche (Keynote)

Quantum Transport in Graphene-based nanostructures, Graphene School 2014, organized by CNRS. Cargèse (Corsica) (France), 15/04/2014, Stephan Roche (Keynote)

Spintronics in Graphene, Graphene week 2014, organized by Graphene Flagship. Gothenburg (Sweden), 24/06/2014, Stephan Roche (Oral)

Ad-atoms induced Spin-orbit coupling effect on Graphene: From Quantum Spin Hall effect to Spin Relaxation, CMD25-JMC14, organized by Université Paris-Descartes, CNRS. Paris (France), 26/08/2014, Stephan Roche (Oral)
BOOKS

Introduction to Graphene-Based Nanomaterials: From Electronic Structure to Quantum Transport, Luis E.F. Foa Torres, Stephan Roche and Jean-Christophe Charlier, Cambridge University Press, 2014

THESES

Doctorand: Dinh Van Tuan
Title: Charge and Spin Transport in Disordered Graphene-Based Materials
Defense date: 30/09/2014
Director: Prof Stephan Roche

More information:
http://www.icrea.cat/Web/ScientificStaff/Stephan-Roche-523
Theory and Simulation Group

Main Research Lines

- Development of theoretical methods, numerical algorithms and simulation tools
- Codes: SIESTA & TRANSIESTA
- First Principles simulations at the nanoscale
- Novel physical properties in 2D materials

GROUP MEMBERS

Paula Abufager, Visiting Postdoctoral Researcher
José Miguel A. Pruneda, CSIC Tenured Scientist
Desanka Boskovic, Doctoral Student
Francisco Javier Hidalgo, Visiting Postdoctoral Researcher
Georg Huhs, Visiting Doctoral Student
Nicolás Lorente, CSIC Research Scientist
Rafael Martínez, Doctoral Student

Annapaola Migani, CSIC Ramon y Cajal Researcher
Pablo Ordejón, Director and Group Leader
Lorenzo Riches, Doctoral Student
Maitreyi Robledo, Visiting Doctoral Student
Roberto Robles, Postdoctoral Researcher
Rubén Ruperez, Visiting Student
José Ángel Silva, FPI Doctoral Student

GROUP LEADER

CSIC Research Prof
Pablo Ordejón

Prof Ordejón earned his BSc in Physics (1987) and PhD in Science (1992) at the Universidad Autónoma de Madrid (Spain). He worked as a postdoctoral researcher at the University of Illinois at Urbana-Champaign (USA) from 1992 to 1995, and as Assistant Professor at the Universidad de Oviedo from 1995 to 1999. In 1999, he obtained a research staff position at the Institut de Ciència de Materials de Barcelona of the Consejo Superior de Investigaciones Científicas (CSIC). In 2007 he moved to CIN2 (now ICN2), where he is currently CSIC Research Profesor. Since July 2012, he has served as Director of ICN2, where he also leads the Theory and Simulation Research Group.
During 2014 the group has continued the study of the interface of molecules, clusters, and nanostructures with metals. Such studies are of great interest in fields such as supramolecular chemistry, catalysis, molecular electronics, and data storage. In particular, we have shown how chemical doping offers a promising mechanism to locally manipulate charge and spin of individual molecules with unprecedented spatial resolution. We have also studied the formation of chiral supramolecular pentamers. These pentamers are able to self-assemble to form large ordered arrays, covering big areas of a gold surface using motifs with five-fold symmetry.

The group has also focused on new 2D materials. Firstly, pristine monolayers of MoS2 were studied and a new tight-binding model to describe its electronic properties proposed. Secondly, a number of hybrid heterostructures have been analysed.

He has published more than 190 scientific articles, which have received over 17,000 citations (h = 47). Since 2009 he has served as Co-Editor of EPL (formerly Euro Physics Letters) and since 2004, as Regional Editor of physica status solidi. He was in charge of the Condensed Matter Physics area of the Physics Panel of the Spanish National Scientific Evaluation Agency (ANEP), from 2003 to 2006, and the Head of the Physics and Engineering Panel of the Access Committee to the Spanish Supercomputing Network, from 2005 to 2011. He became a Fellow of the American Physical Society in 2005.

His research is focused on the development of efficient methods for electronic structure calculations in large and complex systems, with contributions to the development of techniques for large-scale atomistic simulations based on first principles methods such as SIESTA. He has also been involved in the study of the fundamental properties of materials at the atomistic level. His current interests include, among many others, electronic transport in nanoscale devices and electronic processes at surfaces. He maintains frequent collaborations with industrial laboratories on the simulation of materials processes at the atomic level.
Vertical stacks of graphene and BN revealed a wealth of surprising physical properties, with the appearance of new superlattice Dirac points that affect the electronic transport properties. These were studied with large-scale DFT calculations, but also with a simplified tight-binding model which was later applied to the study of transport properties within the Kubo formalism developed by Prof Stephan Roche. Finally, coplanar heterostructures of different 2D materials were examined, in search for novel interfacial effects due to polarity discontinuities, similar to those observed at the interfaces of complex oxides.

**PUBLICATIONS**


**Orbital Redistribution in Molecular Nanostructures Mediated by Metal–Organic Bonds**, Zechao Yang; Martina Corso; Roberto Robles; Christian Lotze; Roland Fitzner; Elena Mena-Osteritz; Peter Bäuerle; Katharina J. Franke; José I. Pascual, *ACS Nano*: vol. 8 (2014). IF: 12.033


**Spin transport in dangling-bond wires on doped H-passivated Si(100)**, Mikaël Kepenekian; Roberto Robles; Riccardo Rurai; Nicolás Lorente, *Nanotechnology*: vol. 25 (2014). IF: 3.672


**PROJECTS**

Atomic Scale and Single Molecule Logic Gate Technologies, ATMOL, funded by EC, 01/01/2012-31/12/2014, Nicolás Lorente

Simulaciones Atomísticas de Primeros Principios: Metodología y Aplicaciones en Nanociencia, SIESTA-CIN2, funded by MINECO, 01/01/2013-31/12/2015, Pablo Ordejón

**CONTRIBUTIONS**

Spin Correlations of supported nano-objects, MANA International Symposium, organized by NIMS, Epochal Tsukuba, Japan, 05/03/2014, Nicolás Lorente (Invited)

Spin correlations as revealed by the STM, Aalto University Physics Boat Workshop, organized by Aalto University, Espoo, Finland, 03/06/2014, Nicolás Lorente (Invited)

Piezoelectric effects in hybrid C/BN nanosheets, Graphene and 2D Materials workshop, organized by National University of Singapore, Singapore, 19-20/06/2014, M. Pruneda (Invited)

Spontaneous magnetic switching due to decoherence, Donostia International Physics Center, DIPC Workshop: A tribute to Heinrich Rohrer, organized by DIPC, San Sebastián, Spain, 11/09/2014, Nicolás Lorente (Invited)

STM studies of adsorbed magnetic atomic and molecular systems, Spinmol 2014, organized by Universität Bern, Bern, Switzerland, 26-30/10/2014, Nicolás Lorente (Invited)

**COURSES**

CECAM School “Efficient DFT calculations with atomic orbitals: A hands-on tutorial of the SIESTA and TRANSIESTA codes”, Tel Aviv University, Tel Aviv (Israel), 08-11/09/2014, P. Ordejón

Simulación de sistemas nanométricos, 4th year Grado de Nanociencia, Universitat Autònoma de Barcelona (UAB), Bellaterra (Spain), February-June 2014, J.M.A. Pruneda (Coordinator)

**THESES**

Doctorand: Rafael Martínez Gordillo
Title: Atomistic simulations in hybrid C/BN structures
Defense date: 01/10/2014
Director: José Miguel A. Pruneda
The research support divisions and core facilities constitute a centralized research support infrastructure, led by Dr Gustavo Ceballos, that allows research scientists shared access to sophisticated instruments, technologies and specialized services and expertise. It aims to offer, for the research groups within the ICN2 and neighbouring research institutions, a collaborative platform and a repository of expertise and know-how to develop new methods, materials, instruments and techniques. A highly qualified multidisciplinary team of experts supports activities within the research facilities providing expertise that may be lacking in research laboratories and fostering collaborations between investigators as well as inter-disciplinary research.
> Electron Microscopy Division
> Nanofabrication Division
> Nanomaterials Growth Division
> Nanoscience Instrument Development Division
> Core Research Support Facilities
Electron Microscopy Division

Main Research Lines

• Use of electron microscopy techniques for nanoscience and nanotechnology research and applications
• Scientific-technical support both for internal research groups of the institute and external scientists and companies
• Study of the structure and chemistry of functional carbon nanotubes
• Exploration of 2-D layered inorganic nanotube systems
• Electron microscopy studies on graphene

DIVISION MEMBERS

Belén Ballesteros, Division Leader
Francisco Javier Belarre, Technician
Elzbieta Pach, Doctoral Student
Marcos Rosado, PTA Technician

DIVISION LEADER

Dr Belén Ballesteros earned her BSc in Chemistry with Honours at the Universitat Autònoma de Barcelona (UAB) in 2001 and obtained her PhD in 2006 at the Institut de Ciència de Materials de Barcelona (ICMAB-CSIC). During her doctoral studies she undertook research stays at various European universities, including University of Twente (Netherlands), University of Oslo (Norway), University of Saint Andrews (UK) and Universidad de...
NEW PROJECTS & MILESTONES

During 2014 the Electron Microscopy Division strengthened its scientific-technical support, increasing the amount of internal and external users with respect to 2013.

Furthermore, the set of equipment at the sample preparation laboratory was completed by the transfer and installation of equipment from ICMAB (ion milling system, diamond wire saw and automatic polishing system). The laboratory is now a joint project between this nearby institution and ICN2.

During 2014 the Division hosted a visiting postdoctoral researcher from University of Trieste (José Miguel González).

Researchwise the Electron Microscopy Division continued working on the study of functional carbon nanomaterials for biomedical applications in the framework of the ongoing project RADDEL. For instance, we studied MWCNTs functionalized with a Gd-chelate for MRI applications, graphene produced by dry milling with a hydrophobic drug and single-layered inorganic nanotubes formed inside MWCNTs. Also, the procedure for in-situ ice formation onto different substrates in the ESEM was optimized.

Dr Ballesteros has authored 47 articles and has around 600 citations.
PUBLICATIONS


Projects

Nanocapsules for targeted delivery of radioactivity, RADDEL, funded by Marie Curie Actions, 01/02/2012 - 31/01/2016, Dr Belén Ballesteros

Nanostructured materials for photovoltaic energy Group (SGR), funded by AGAUR, 01/01/2014 - 31/12/2016, Dr Mónica Lira-Cantú

Solution Processable nanostructured solar cells: New nanomaterials based on transition metal oxides and graphene, funded by MINECO, 01/01/2014 - 31/12/2016, Dr Mónica Lira-Cantú
Nanofabrication Division

Main Research Lines

- Nanofabrication methods and techniques
- Flexible Nanofabrication platform for processing diverse materials and substrates
- High-quality services for internal and external users
- Process development and/or prototyping of novel nanostructures and devices
- Lithography techniques and materials

DIVISION MEMBERS

Nikos Kehagias, Division Leader
Dina Augusta Simoes, Postdoctoral Researcher

NEW PROJECTS & MILESTONES

In 2012 ICN’s Nanofabrication Division Leader Dr Kehagias, together with colleagues at the company PTMTEC Oy (Finland), developed a desk-top Roll-to-Roll Ultraviolet Light-Assisted Nanoimprint Lithography Machine. This one-of-a-kind machine enables meter-per-meter production of nanoscale devices and components.

The Division completed a research collaboration with the technology centre CETEMMSA, aimed at replacing indium tin oxide (ITO), the dominant transparent conductor currently on the market. They developed alternative transparent electrodes based on nano-imprinted metallic grids to support inkjet-printed organic solar cells.

DIVISION LEADER

Dr Nikos Kehagias earned a BSc in Physics from Aristotle University in Thessaloniki (Greece), in 2002; an MSc in Physics of Laser Communications, from Essex University (UK), in 2003; and a PhD from the National University of Ireland, Cork, in 2007, where he continued to work as a postdoctoral fellow until May 2008. At that point he joined ICN (now ICN2) as a member of the Phononic and Photonic Nanostructures Group. Since July 2010 he has led the Nanofabrication Division at ICN2. Dr Kehagias has co-authored more than 30 scientific journal articles, plus two book chapters in the field of Nanofabrication and Nanoimprint Lithography. He has pioneered the use of Reverse Ultraviolet Light-Assisted Nanoimprint Lithography (RUVNIL) as an alternative nanolithography technique.
It also began the new project “Moulding Production Technology for multifunctional structured plastic components enabled by nanoimprint lithography” (Plast4Future), part of the European Commission’s Seventh Framework Programme (FP7).

Lastly, ICN’s Nanofabrication Division began negotiations with a multinational company on a possible new research agreement on roll-to-roll (R2R) nanofabrication.

**SERVICES**

ICN2’s Nanofabrication Division offers diverse services to internal and external users for applications in Nanoelectronics, Nanophononics, Nanophotonics, Spintronics, Nanobioelectronics and Biosensors:

**Lithography:**
- Thermal and UV nanoimprinting - Obducat 3 inch
- Hot embossing machine
- UV nanoimprinting module
- SEM/Litho - FEI/Raith
- Self-assembly growth set-up
- Roll to Roll UV-light-assisted nanoimprinting tool
- Reverse gravure coating
- CNI thermal nanoimprinting tool

**Deposition:**
- E-beam evaporator 1 (Au, Ag, Al, Cr, Ti, Pt, Al2O3) - AJA International
- ITO-Molecular beam epitaxy
- Sputter (Au) coater - Edmunds
- Spin coater - Laurel

**Characterisation:**
- Atomic force microscope - Veeco Instruments
- Optical microscope - Nikon Eclipse LV100
- Gold-ball bonder - Delvotek

**General:**
- Plasma cleaner - PVA Tepla PS210
- Oven - Memmert
- Hot plates
- Microwave annealing

**PUBLICATIONS**


## Nanomaterials Growth Division

<table>
<thead>
<tr>
<th>Main Research Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Epitaxial thin film deposition and characterisation of different materials, mainly perovskite-structure related oxides. Interplay between strain and relaxation mechanisms, microstructure and functional properties of ultrathin films</td>
</tr>
<tr>
<td>• Present research is mainly devoted to thin epitaxial growth of mixed ionic-electronic conducting oxides and multilayers by PLD, their structure characterisation by RHEED and XRD, and high-temperature electronic transport properties. Oxide and Protonic Ionic conductivity in thin films</td>
</tr>
<tr>
<td>• Fundamental aspects of interfacial phenomena in the electrical characterisation of thin films of layered oxide materials and multilayers, for their use as components in intermediate temperature SOFCs</td>
</tr>
<tr>
<td>• Surface composition segregation and its effect on oxygen surface exchange kinetics and ageing phenomena</td>
</tr>
</tbody>
</table>

### DIVISION MEMBERS

- **Núria Bagués Salguero**, FPI-CSIC Doctoral Student
- **José Manuel Caicedo**, ICN2 Lab Engineer
- **Araceli Gutiérrez**, URJC Visiting Postdoctoral Researcher
- **Anna Magrasó**, Abel-Nils Visiting Postdoctoral Researcher
- **Roberto Moreno**, CSIC Visiting Doctoral Student
- **Jaume Roqueta**, CSIC Lab Engineer

### DIVISION LEADER

[Dr José Santiso](#)

**CSIC Tenured Scientist**

Dr José Santiso earned his BSc degree in Physics at the Universitat Autònoma de Barcelona (UAB), Spain, in 1988 and obtained his PhD from the University of Barcelona (UB) in 1993. After his doctoral studies, he worked as a Visiting Scientist at Cambridge University, UK from 1994 to 1996. After this stage he joined the Material Science Institute (ICMAB) as a research associate and became CSIC staff scientist in 2002. In 2007 he
NEW PROJECTS & MILESTONES

In 2014 the Nanomaterials Growth Division continued working on the following closely-related main objectives:

**Thin film deposition of epitaxial oxide materials by means of pulsed Laser deposition technique.** In this case our division produces films for a large number of groups within the ICN2, in close collaboration with these groups. In some cases the thin film deposition required the use of Reflection high energy electron diffraction (RHEED). Our division carries out the preliminary structure characterisation concerning mostly X-Ray diffraction. (Some of the ICN2 group leaders who we collaborate with are: G. Catalan, J. Fraxedas, S. Valenzuela, C. Torres, and J. Nogués)

**Investigation of the interplay between strain relaxation phenomena and functional properties in complex oxide films.** Development of novel methods for the X-ray diffraction and diffuse scattering characterisation of microstructure features in epitaxial thin films. These included in-plane diffraction, GISAXS analysis, as well as 3D reciprocal space mapping (this last type of analysis required the use of synchrotron radiation source: at BM25-ESRF and KMC2-Bessy). Most of the work is carried out in collaboration with Institut de Ciència de Materials de Barcelona (ICMAB).

moved to CIN2 as leader of the Pulsed Laser Deposition and Nanoionics Group, Nanomaterials Growth Division, which recently turned into the ICN2 Nanomaterials Growth Division that he also leads. In 2012 he received the Somiya Award of the International Union of Materials Research Society (IUMRS) for his contribution to Solid State Ionics. Recently, in 2014, he obtained a grant from the Japan Society for Promotion of Science as a 3-month visitor at the International Institute for Carbon-neutral Research, I2CNER, (Univ. Kyushu).
The microstructure investigation is completed by HRTEM characterisation.

**Study of fundamental aspects of ionic and electronic charge and mass transport in the electrical characterisation of thin films of layered oxide materials and multilayers, for their use as components in intermediate-temperature SOFCs.** We are particularly interested in surface and interfacial oxygen exchange phenomena in order to obtain enhanced oxygen transport performance. Development of novel characterisation tools of the oxygen surface exchange kinetics: For this purpose we have developed a novel technique that uses the subtle chemical expansion measured by X-ray diffraction produced in transition metal oxide thin films when changing their oxygen stoichiometry to in-situ probe their redox kinetics at high temperature in time intervals as short as a few seconds. The setup also allows for electrical contacts which may be used either to simultaneously measure electrical conductivity relaxation or to apply an electric field for in-operando device electrochemical characterisation.

**Investigation of the surface activity for oxygen reduction in transition metal oxide perovskite thin films.** Development of novel methods for determining oxygen surface exchange rate by combination of electric conductivity relaxation and time-resolved X-ray diffraction experiments. We explore surface cation composition segregation mechanisms affecting the reactivity of the surfaces. This work is mostly carried out in collaboration with different international partners (Imperial College London, I2CNER at Kyushu Univ. and MIT).

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**PUBLICATIONS**


PROJECTS

Nano-sized proton conductors for the next generation of environmentally-friendly fuel cells, ABEL-NILS, 021-ABEL-AM-2013, funded by EEA, 01/07/2014-01/12/2015, Anna Magrasó

Low-Energy Ion Scattering measurements on atomically flat epitaxial layers of mixed ionic electronic conducting oxides for cathodes in SOFC/SOEC technology, funded by Japan Society for the Promotion of Science, 01/12/2014-01/02/2015, Jose Santiso, Tatsumi Ishihara

CONTRIBUTIONS


Band Diagrams for Electrochemical Devices, E-MRS - Symp C:Solid state ionics: thin films for energy and information applications. Lille (France), 26/05/2014-30/05/2014, J. Santiso, J. Roqueta (Oral)
Nanoscience Instrument Development Division

Main Research Lines

- Design, development and improvement of advanced precision instrumentation
- Active collaboration for experimental research
- Scientific Computing, signal processing, data acquisition
- 3D-CAD design of precision devices

DIVISION MEMBERS

Gustavo Ceballos, Division Leader
Marc Maymó, Laboratory Engineer

DIVISION LEADER

Dr. Gustavo Ceballos earned his BSc in Chemistry at the Central University of Venezuela in 1989. He obtained his PhD in 1996 at the Institut für Physikalische und Theoretische Chemie der Universität Bonn, Germany. In 1997 he moved to the Institut für Experimentalphysik der Freie Universität Berlin for postdoctoral studies, and from 2001 to 2002, worked at the Low-Temperature Scanning Tunnelling Microscopy (STM)
NEW PROJECTS & MILESTONES

The Division provides scientific and technical assistance in Applied Physics; Precision Instrumentation; Microengineering; Nanotechnology; Metrology, Scientific Computing; and 3D-design of precision devices, to address challenging instrumental projects in basic Nanoscience research as well as in applied technology.

PUBLICATIONS


Group at the Fritz-Haber-Institut der Max-Planck-Gesellschaft, also in Berlin. From 2002 to 2006 he was Research Scientist at the XSTM and Low-Temperature STM of Nanostructures Division at the Laboratorio Nazionale TASC-INFM, Trieste, Italy. In 2006 he joined ICN (now ICN2) as a Senior Scientist, where he eventually created the Nanoscience Instrument Development Division and where he actively participates in the research of the Atomic Manipulation and Spectroscopy Group.

Throughout his career, when endeavouring to perform new experiments, Dr Ceballos has frequently had to modify existing instruments or experimental setups, or develop new ones.
Core Research Support Facilities

DIVISION MEMBERS

Gustavo Ceballos, Head of the Core Facilities
Pablo García, Technician
Juan Luis Marte, Technician
Javier Saiz, Technician
Guillaume Sauthier, Technician
The ICN2 Core Scientific Facilities provide an array of specialized equipment, technologies and services, efficiently operated by a highly qualified staff to enable scientists to achieve ambitious research goals in a cost-effective way. From routine, though essential support services to advanced technical and consulting services, these cores facilitate and enhance the important research conducted at the institute on a daily basis.

**SERVICES**

Facilities cover the following areas:

- Photoemission Spectroscopy for surface analysis (XPS/ARUPS)
- Molecular Spectrometry (UV/Vis, FT-IR, Fluorescence)
- Physicochemical Instrumental Analysis (ICP-MS, LC-MS, TGA, DSC)
- Light Microscopy
- X-Ray Diffraction
- SQUID Magnetometry
- Bio-Lab
Management and Output
> Management and Services
> Scientific Output
> Projects
> Finances
> Facilities and Equipment
> Technology Transfer
> Public Outreach
ICN2’s Management and Services team performs a wide range of functions and provides numerous support services to the Institute’s Research Groups. Its members are distributed across eight departments: Human Resources & Education, Finance, Projects, Information Technologies, General Services, Technology Transfer, Marketing and Communication, and Strategy. Additionally, the Strategy Department reports directly to the Director. Each department has been designed and scaled to provide services to the whole ICN2 community, including 15 Research Groups and 5 Technical Development and Support Divisions and Facilities.

**HUMAN RESOURCES & EDUCATION**

ICN2’s HR policies are a key competitive advantage in recruiting international talent. During 2014, the Human Resources Department made all the necessary arrangements for an average workforce of 226.4 people having their activity at ICN2 (including full-time personnel, visiting researchers, interns and students).

**FINANCE**

All ICN2 financial management is supported by SAP, and the Finance team has been expanded to serve the 15 Research Groups and 5 Technical Development and Support Divisions and Facilities that configure ICN2.
After the segregation off the Finance Department, the Projects Department has grown and has focused even further on providing a complete service to all ICN2 researchers, including those from CSIC. The Group Project Managers of some groups have been also involved in some of the Department’s tasks in a more comprehensive and coordinated way. Also, institutional projects management acquired special relevance during 2014.

The number of submissions handled was the largest in the history of ICN2 and the number of active projects during 2014 was 114. The philosophy of the Department is based on direct contact with the researcher, who considers its Project Manager as a key-person in relation to any step related to project management.

In 2014, the IT department continued the implementation of the infrastructure for ICN2’s new headquarters (network, IP communications, firewalls, etc.). The Department provides support to all ICN2.

During 2014, the General Services department satisfied the needs of Groups and equipment in the new headquarters. The Department takes care of infrastructure maintenance, the Risk Prevention plan and works to keep over 40 laboratories fully operational.

ICN2’s Technology Transfer Department offers a specialised service to support technology transfer within ICN2. Some of the major goals achieved by the Department in 2014 are: 5 European patent (EP) applications, 2 PCT extension filed and 1 patent entered into national phase, and a new spin-off company, Futurechromes, S.L., created in June 2014.

The Marketing and Communication Department supports the dissemination of the research activity and the impact of the work developed by the ICN2 community.

In addition to managing the public and media relations of the Institute, the Department developed a series of classroom activities and training sessions for school teachers. The Department also offered Illustration, Graphic Design and Web Design services to offer an appealing image and message in all major publications and public materials produced by ICN2 scientists and Departments. The museum exhibition on Nanotechnology inaugurated in 2012 and partly financed by FECYT, Dimension Nano, could be visited until December 2014 at the mNACTEC museum in Terrassa (Spain).

This Department is deeply involved in the implementation of the new ICN2 image and working on internal cohesion tasks.

During 2014 the Strategy Department focused on developing the process and initial drafts of the 2015-2020 Strategic Plan, including full-day workshops involving all Group Leaders and Administration Managers. This was supported by the development of a wikimedia-based intranet to facilitate collaborative and transparent management of the strategic plan, infrastructure investment and other issues. The Department plays a key role in developing joint actions with other research centres, such as the Barcelona Nanocluster (BNC-b), promoting commercialisation opportunities in CERCA centres to venture capital funds, seeking new local collaborations in order to develop proposals for RIS3CAT projects and actions (especially in the B30 area), and promoting internal continuous improvement processes.
The scientific production of the ICN2 is remarkable. With 131 indexed publications in 2014, and an average impact factor of 5.61, the Institute achieves notable figures that are expected to increase in the years to come.

TOP 10 journals

<table>
<thead>
<tr>
<th>Journal</th>
<th>IF</th>
<th>articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Reviews</td>
<td>45.661</td>
<td>1</td>
</tr>
<tr>
<td>Nature Physics</td>
<td>20.603</td>
<td>1</td>
</tr>
<tr>
<td>Advanced Materials</td>
<td>15.409</td>
<td>3</td>
</tr>
<tr>
<td>Nano Letters</td>
<td>12.94</td>
<td>1</td>
</tr>
<tr>
<td>ACS Nano</td>
<td>12.033</td>
<td>5</td>
</tr>
<tr>
<td>Journal of the American Chemical Society</td>
<td>11.444</td>
<td>1</td>
</tr>
<tr>
<td>Nature Communications</td>
<td>10.742</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Functional Materials</td>
<td>10.439</td>
<td>2</td>
</tr>
<tr>
<td>Nano Energy</td>
<td>10.211</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry of Materials</td>
<td>8.535</td>
<td>1</td>
</tr>
</tbody>
</table>

(*) 2013 figures include CSIC Groups' information for the first time
ICN2 researchers, with the support and collaboration of the administration departments, develop a leading role in Europe in the field of Nanoscience and Nanotechnology. It involves the organisation of international events attracting scientists from around the globe to Barcelona.

Some outstanding examples of events organized by ICN2 are:

**TNT 2014 “Nanodevices for Societal Challenges”**
- The Session gathered experts from around Europe in the areas of Biosensors, Theory, ICT and Energy. It was an opportunity to celebrate the Severo Ochoa accreditation in the context of a first-line international event.
- Half-day Session.
- 4 Keynote Speakers, 4 ICN2 Group Leaders and the Director presented the ICN2 Severo Ochoa programme.

**International Summit on OPV Stability (ISOS-7) Summit**
- StableNextSol, funded by the European Commission through a COST Action coordinated from ICN2 by Dr Mónica Lira-Cantú, is an interdisciplinary network of academic and industry researchers to study the degradation mechanisms occurring in state-of-the-art organic photovoltaic devices.
- 22 Presentations
- 2 round tables
- 100 participants

**Aplicaciones Industriales de la Nanotecnología (AIN)**
- A yearly event co-organized with the Instituto de Nanociencia de Aragón (INA). With the support of LEITAT and the Chamber of Commerce, AIN brings together innovation, discussion and interaction at one unique event.
- 15 Speakers
- 100 participants
XXX Trobades Científiques de la Mediterrània

- Stephan Roche, Group leader and ICREA researcher at ICN2 and European co-leader of Spintronics for the Graphene Flagship, is among the event organizers. The meeting, held from October 15-17, offers a unique environment for collaboration
  - 29 Presentations
  - 1 round tables
  - 60 participants

19th Transfrontier Meeting of Sensors and Biosensors – TMSB

- Researchers from the Euroregion between France and Spain (Catalonia, Languedoc-Roussillon, Midi-Pyrénées) and surroundings areas meet with the objective to share the latest achievements in the field of sensors and biosensors. The team led by ICREA Prof Arben Merkoçi organized the latest edition
  - 2 days Session
  - 2 Keynote Speakers, 20 presentations
  - 60 participants

EVENTS IN WHICH ICN2 RESEARCHERS PARTICIPATED

In 2014 ICN2 researchers made 201 contributions at conferences related to Nanoscience and Nanotechnology. A breakdown of their contributions is shown beside.

<table>
<thead>
<tr>
<th>Talks offered by ICN2 researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral contributions</td>
</tr>
<tr>
<td>Invited talks</td>
</tr>
<tr>
<td>Posters</td>
</tr>
<tr>
<td>Percentage of contributions</td>
</tr>
<tr>
<td>30%</td>
</tr>
<tr>
<td>47%</td>
</tr>
<tr>
<td>23%</td>
</tr>
</tbody>
</table>

ICN2 BOOTH IN TRADE SHOWS AND FAIRS

The Knowledge and Technology Transfer Department, together with the Strategy and the Marketing & Communication Departments, participates actively in the major international events about nanoscience and nanotechnology. The institutional booth travels with ICN2 representatives to events such as:

Nanospain

- Consolidated as a reference meeting of Nanoscience and Nanotechnology (N&N) in Spain
- ICN2 supported the event with a stand and several speakers
- 15 Keynote Speakers, 24 invited speakers
- 200 participants

Graphene 2014

- Event in Toulouse, France, Dr Stephan Roche, Theoretical and Computational Nanosciences Group Leader is one of the members of the organising committee. ICN2 attended the event with an institutional booth
- 1,000 participants
Competitive research funding is vital for ICN2’s financial viability and serves as an indicator of the quality and international competitiveness of the Institute's research. In 2014 competitive funding continued to stem in a high percentage from EU & International research projects.

The breakdown of competitive funding at ICN2 for 2014 is illustrated in the chart below:

![Evolution of competitive funding 2005-2014](chart)

### Evolution of competitive funding 2005-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Requested</th>
<th>Approved</th>
<th>Rejected</th>
<th>Pending</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>132</td>
<td>42</td>
<td>87</td>
<td>3</td>
</tr>
<tr>
<td>2013</td>
<td>52</td>
<td>14</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>2012</td>
<td>10</td>
<td>26</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>2011</td>
<td>1</td>
<td>22</td>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
<td>86</td>
<td>41</td>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>2009</td>
<td>75</td>
<td>41</td>
<td>45</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>91</td>
<td>31</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>2007</td>
<td>48</td>
<td>18</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>24</td>
<td>12</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2005</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Evolution of accumulated approved funding 2005-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Approved</th>
<th>Accumulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>7,474,975 €</td>
<td>46,936,463 €</td>
</tr>
<tr>
<td>2013</td>
<td>4,557,138 €</td>
<td>39,461,488 €</td>
</tr>
<tr>
<td>2012</td>
<td>3,877,351 €</td>
<td>34,904,351 €</td>
</tr>
<tr>
<td>2011</td>
<td>2,675,173 €</td>
<td>30,026,997 €</td>
</tr>
<tr>
<td>2010</td>
<td>2,148,577 €</td>
<td>24,396,577 €</td>
</tr>
<tr>
<td>2009</td>
<td>1,597,835 €</td>
<td>19,486,400 €</td>
</tr>
<tr>
<td>2008</td>
<td>1,413,524 €</td>
<td>14,418,458 €</td>
</tr>
<tr>
<td>2007</td>
<td>1,242,458 €</td>
<td>10,141,034 €</td>
</tr>
<tr>
<td>2006</td>
<td>1,123,189 €</td>
<td>6,283,645 €</td>
</tr>
<tr>
<td>2005</td>
<td>1,473,596 €</td>
<td>0 €</td>
</tr>
</tbody>
</table>

The chart above shows the evolution of competitive funding from 2005 to 2014, with bars indicating the number of requests, approvals, rejections, and pending requests for each year.
Finances

FINANCIAL ACCOUNTS 2014

The Institute’s operating budget comprises revenues from contributions by public administrations and agencies, from competitive grants, and from companies (via Technology Transfer). These revenues fund the operational activities of the Institute. The main items are Personnel Costs, General Operating Expenses and Depreciation (of equipment and facilities).

ICN2’s total operating funds in 2014 were €8,512,497.
One of ICN2’s principal objectives is to be highly competitive at the international level, both in the quality of the science it produces and the levels of competitive funding that it secures through national and international grants and fellowships and through commercialisation agreements with companies. To date, ICN2 has obtained competitive funding from numerous entities, including the European Commission; the Spanish Ministry of Economy and Competitiveness (MINECO), with special mention to the Severo Ochoa Excellence Award; ACC1Ò; and the Catalan Agency for the Administration of University and Research Grants (AGAUR).

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**Distribution of competitive funding approvals**

<table>
<thead>
<tr>
<th>Year</th>
<th>Commercialisation Projects</th>
<th>Fellowships</th>
<th>EU &amp; Int. Projects</th>
<th>National Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>-</td>
<td>175,400</td>
<td>1,298,196</td>
<td>-</td>
</tr>
<tr>
<td>2006</td>
<td>-</td>
<td>367,600</td>
<td>341,415</td>
<td>81,174</td>
</tr>
<tr>
<td>2007</td>
<td>-</td>
<td>284,935.61</td>
<td>2,333,548.90</td>
<td>297,485</td>
</tr>
<tr>
<td>2008</td>
<td>-</td>
<td>642,236.80</td>
<td>4,486,646</td>
<td>945,389</td>
</tr>
<tr>
<td>2009</td>
<td>53,708.87</td>
<td>544,832</td>
<td>817,276.80</td>
<td>1,436,035</td>
</tr>
<tr>
<td>2010</td>
<td>74,579.59</td>
<td>892,343.20</td>
<td>5,368,981.70</td>
<td>3,628,829</td>
</tr>
<tr>
<td>2011</td>
<td>325,964.49</td>
<td>1,100,560.77</td>
<td>2,615,392.74</td>
<td>752,897</td>
</tr>
<tr>
<td>2012</td>
<td>161,570</td>
<td>416,372.05</td>
<td>4,627,620</td>
<td>741,886</td>
</tr>
<tr>
<td>2013</td>
<td>91,475.20</td>
<td>627,672.40</td>
<td>3,564,229.18</td>
<td>-</td>
</tr>
<tr>
<td>2014</td>
<td>365,236.85</td>
<td>1,228,292.64</td>
<td>400,143</td>
<td>5,260,418</td>
</tr>
</tbody>
</table>
ICN2’s total operating funds in 2014 were €8,512,497. In 2014 ICN2 obtained 50% of its operating funds from competitive grants (45%) and technology transfer projects (5%).

### INCOME

Breakdown of operating funds in 2014

- **Catalan Government, CSIC & Other Funds**: 50%
- **Competitive funds**: 45%
- **Tech transfer**: 5%

ICN2’s total operating funds in 2014 were €8,512,497. In 2014 ICN2 obtained 50% of its operating funds from competitive grants (45%) and technology transfer projects (5%).

### EXPENSES

In 2014 total expenditure at ICN2 was €8,677,564. Expenses, which comprise current expenses, personnel costs and depreciation, are classified as follows:

- **Project Expenses**: These fund research and technology transfer.
- **Ordinary Expenses**: These fund management structure and services.

Expenses 2014

- **Personnel**: 61.5%
- **Current expenses**: 25.5%
- **Depreciation**: 13%
In 2014 ICN2’s total accumulated investment including scientific equipment, common services and general infrastructure was €17,859,554. Investment for the year 2014 was €1,100,066.

The main scientific, technical and IT equipment acquired in 2014 comprised:

- MBE Analysis Chamber and Electric Characterization Set-Up
- IT: Software Business One
- IT: Storage San
- IT: Computer and Network Infrastructure for ICN2
- Gravimetric Analyzer Adsorption of Water and Organic Vapors
- Cryogen-Free Low Vibration Cryostat
- Cooling System Electric and Hydraulic
- Low Temperature Scanning Probe Microscope
- ICN2 – Adaptation and Improvements in Building ICN2 and Boratories
- Holographic Microscope Digital Mems Analyzer
- System Multi Molecular Beam Epitaxy

Equipments funded with FEDER Funds:

- Fast Detector
- Optical Table
- 4 Shaker RCT-Basic
- Multi Shaker
- Phmetro
- Electric Blanket 2CR-KE95
- XY Precision Stage
- Centrifuge Digicen 21

![Evolution of ICN2 total investments, 2004-2014](image)
Technology Transfer

In 2014 ICN2 furthered its efforts to maximise the commercialisation of its research results through intellectual property and patents, commercial contracts, public sector collaborations, and other endeavours.

**INTELLECTUAL PROPERTY AND SPIN-OFFS**

5 European patent (EP) applications


1 patent entered into national phase

- Patent ICN PAT 01/11 Method for the preparation of metal organic frameworks has entered regional phases in USA on 04/04/2014 and in Europe on 29/04/2014.

2 international PCT extensions were filed


1 Spin-off was created

- Futurechromes, S.L.. The new spin-off company based on the CSIC patent Ref. CIN2PAT 01/12 - WO2013/132123 (Coating with photochromic properties, method for producing said coating and use thereof applicable to optical articles and glazed surfaces), developed by the ICN2 Nanostructured Functional Materials Group, was created in June 2014.

**OTHER HIGHLIGHTS**

Beyond ICN2’s principal mission to be a centre of scientific excellence and frontier research in Nanoscience and Nanotechnology, the Institute also has a social responsibility in Science Communication and Education. As a publicly-funded research institute, ICN2 is committed to serving, and engaging with the public at all levels.

Sparking the interest of young people in Nanoscience and Nanotechnology, and providing them with the tools they need to pursue careers in these fields, is paramount in ensuring ICN2’s future success in the research arena. Furthermore, providing contents created for the general public about these areas is essential to guaranteeing that they can understand the implications of the Institute’s research and its consequent developments.
**HIGHLIGHTS 2014**

**Media relations:** In 2014 ICN2 redoubled its efforts to reach the general public through the media. The following chart shows the number of Online Impacts on journalistic websites during the last two years.

![Chart showing Online impacts on journalistic websites]

**Traditional media appearances of ICN2 in 2014**

<table>
<thead>
<tr>
<th>Medium</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magazines</td>
<td>2</td>
</tr>
<tr>
<td>Newspapers</td>
<td>36</td>
</tr>
<tr>
<td>Radio</td>
<td>2</td>
</tr>
<tr>
<td>TV</td>
<td>6</td>
</tr>
</tbody>
</table>

**Dimenió Nano:** ICN2, Recrea, La Mandarina de Newton and the museum mNACTEC created a multimedia exhibit dedicated to introducing Nanoscience and Nanotechnology to the public. Dimenió Nano was inaugurated at the Museum in June 2012 and was exhibited at mNACTEC until December 2014. Within the Severo Ochoa Programme the exhibit will be shown at new venues during the next few years.

**ESCOLAB:** Groups of secondary school children visited ICN2 labs to learn about Nanoscience and Nanotechnology and to ask researchers questions.

**Joves i Ciència:** High school students performed short research stays in the laboratories of ICN2 research groups during summer 2014.
Catalan Institute of Nanoscience and Nanotechnology (ICN2)

Campus de la UAB
08193 Bellaterra
Barcelona, Spain
Tel: +34 937 372 649
Email: info@icn2.cat
Web: www.icn2.cat