

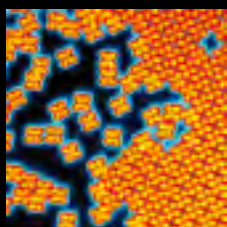
ICN ANNUAL REPORT 2008

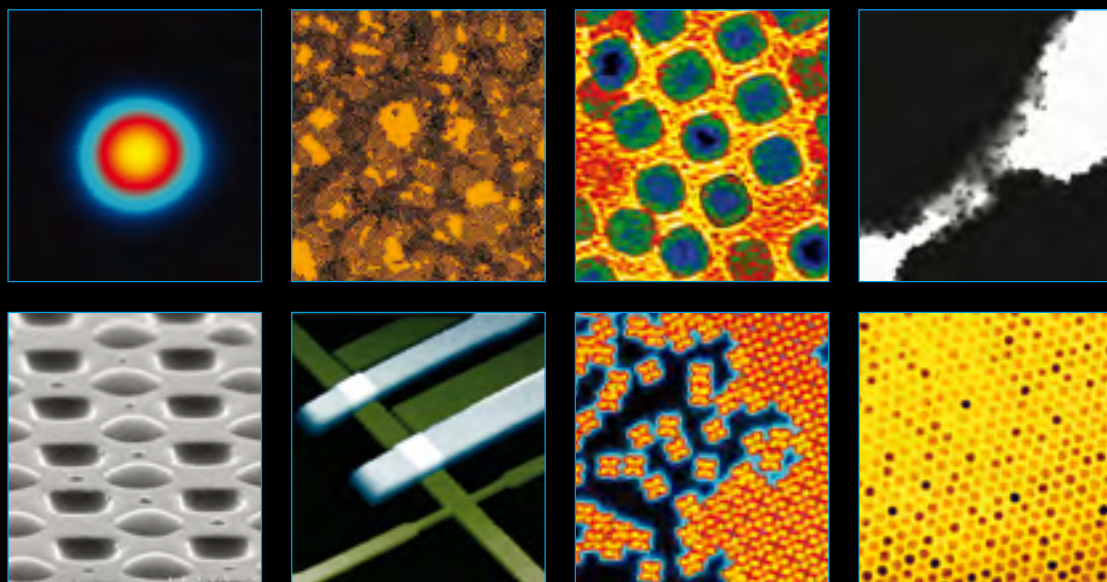
CREATING A DIMENSION OF INFINITE POSSIBILITIES



Institut Català
de Nanotecnologia

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LETTER FROM THE DIRECTOR 1



The Catalan Institute of Nanotechnology (ICN) was created in mid-2003 but only commenced activities some two years later, when the first researchers were contracted and the basic administrative

structure was formed. During 2006 and 2007 the activities of ICN were primarily formative, representing the first phase of development, and it was only towards the end of 2008 that the key characteristics that will define the future of our Institute began to be seen.

During 2008, the Institute's consistent strong growth of previous years was maintained, incorporating new personnel and opening new research lines in spintronics and in photonics and phononics, led respectively by Profs. S. Valenzuela and C. Sotomayor, whilst further consolidating the four previously existing research lines, all led by ICREA professors. This consolidation of research in atomic manipulation and spectroscopy, magnetic nanostructures, synthesis and functionalisation of nanoparticles and applications in nanobioelectronics and nanobiosensors, together with the active participation of six Ramon y Cajal researchers contracted by ICN gave rise to a significant increase in the number of projects granted at national and international levels, as well as with private companies. Of special note are the two Starting Grants awarded by the European Research Council to Prof. P. Gambardella and Dr F. Moreno, projects which form a part of the global success of Catalan Institutes in the ERC's calls for Starting and Advanced Grants, with particularly strong showings by researchers of the CERCA centres of the Generalitat of

Catalonia, and especially those holding ICREA professorships. In addition, during 2008 ICN continued to acquire latest-generation scientific equipment, providing research groups with the necessary tools to undertake their various research programs and projects.

The scientific quality of the research undertaken at ICN is reflected in the publication of research results in journals of high impact factor, with the average impact factor showing a sustained steady increase over time, and also in the high percentage of international conferences and congresses to which ICN researchers were invited to present. Additionally, the growth and consolidation of the ICN structure enabled the organisation of the first international scientific workshops.

The development of new research lines at the frontier of knowledge is a fundamental characteristic of the research performed at ICN and from this derive the character and quality of knowledge transfer undertaken by our Institute. As a result of research activities during 2008, a number of patents were filed relating to different fields of nanotechnology, evaluation studies were performed on several technologies developed within the Institute, and the development of knowledge transfer projects with private companies was initiated.

These are the key milestones attained by our researchers and support staff in a year that has marked a definitive push towards the consolidation of our Institute. In this Annual Report you will find information on the main concepts and figures pertaining to our activities. More detailed information can be consulted on our website.

Jordi Pascual
Director

2.1 Organisation

The Catalan Institute of Nanotechnology (ICN) is a non-profit international research institute located in Barcelona, Spain. It was created in July 2003 by the Ministry of Universities, Research and Information Society of the Catalan Government (DIUE) and the Autonomous University of Barcelona (UAB).

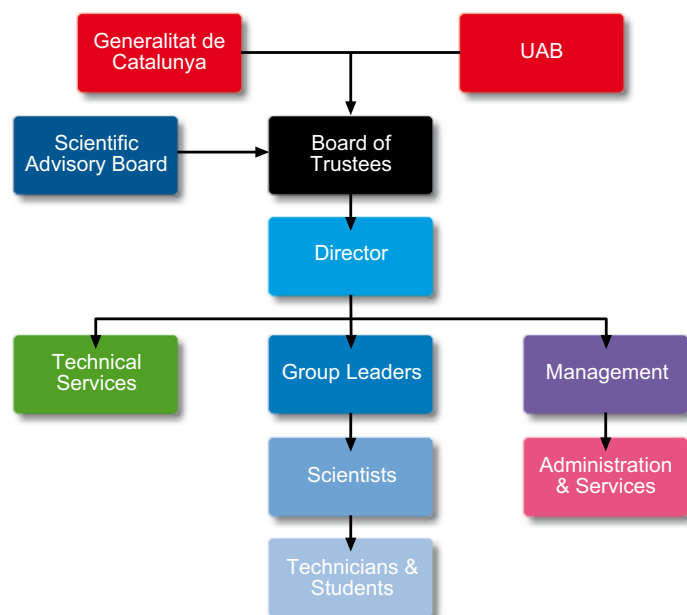
The ICN is led by its Director, Dr Jordi Pascual, who reports to the Board of Patrons and is advised by the Scientific Advisory Board, which consists of a number of distinguished international scientists.

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

In 2008, the ICN had six core Groups:

- Atomic Manipulation and Spectroscopy Group
- Inorganic Nanoparticles Group
- Magnetic Nanostructures Group
- Nanobioelectronics and Biosensors Group
- Phononic and Photonic Nanostructures Group
- Physics and Engineering of Nanodevices Group

2.2 Organisational Chart



2.3 Board of Patrons

PRESIDENT

Hon. Mr. Josep Huguet i Biosca,
Minister of Education and Universities, Government of Catalonia.

VICE-PRESIDENT

Lluís Ferrer,
Chancellor of the Universitat Autònoma de Barcelona (UAB).

MEMBERS

Joan Roca i Acín,
General Director of Research of the Ministry of Innovation, Universities and Enterprises.

Ramón Moreno,
Director of CERCA Research Centers Programme.

Jordi Marquet Cortés,
Vice Chancellor for Strategic Projects of the Autonomous University of Barcelona (UAB).

Miquel Salmerón,
Principal Researcher in the Lawrence Berkeley Laboratory, Berkeley, California, U.S.A.

M. Dolors Baro,
Professor of Physics at the Universitat Autònoma de Barcelona (UAB).

2.4 Scientific Advisory Board 2008

PRESIDENT

Prof. Miquel Salmerón,
Principal Researcher in the Lawrence Berkeley Laboratory, Berkeley, California, U.S.A.

MEMBERS

Prof. Jeff Bokor,
Department of Electrical Engineering and Computer Sciences. University of California at Berkeley and Deputy Director for Science, The Molecular Foundry, Lawrence Berkeley National Laboratory.

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

Prof. Carlos Bustamante,
Researcher of the Howard Hughes Medical Institute, University of California, Berkeley, U.S.A.

Prof. Manuel Cardona,
Co-founder and emeritus professor of the Max Planck Institut, Stuttgart, Baden-Württemberg, Germany.

Prof. Bengt Kasemo,
Professor of Physics at the Department of Physics, Chalmers University of Technology, Gothenburg, Sweden.

Prof. Jean-Pierre Launay,
Professor at the Université Paul Sabatier and at the Institut Universitaire de France. Director of CEMES.

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

Prof. Peter Vettiger,
IBM Zurich Research Laboratory.

2.5 People of the ICN

The ICN is its people. Without their creativity, energy, dedication and hard work, nothing would be achieved. The ICN prides itself on being an attractor of talent – it seeks to provide an environment and an image of excellence that attracts talented scientists, technicians and support personnel from all over the world.

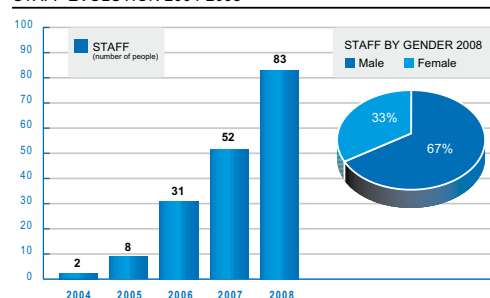
Evidence of ICN's success in attracting talent, besides from the high level of scientific output achieved, is given by the high numbers of ICN staff with top-level competitive recognition. All six Group Leaders hold ICREA professorships, six senior postdoctoral researchers hold Ramón y Cajal grants, and two scientists secured the highly prestigious ERC starting grants in 2008.

During 2008 the ICN grew dramatically, with the number of people having worked at the Institute during the year rising from 52 in 2007, to 83 in 2008. This growth was due to new researchers contracted via competitively gained project funding, as well as the continued evolution of the ICN's core support structure, which aims to support a final size of some 150-200 staff within 5 years.

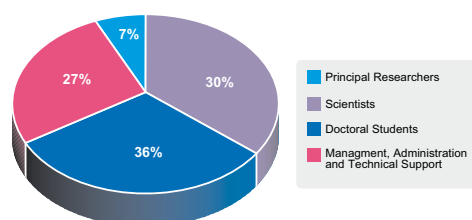
Also of note is the diversity of ICN people, with over one third of foreign nationality, and one third female. The ICN is an equal opportunity employer and seeks to encourage a workforce diverse in age, race, nationality and gender.

2.6 Statistics

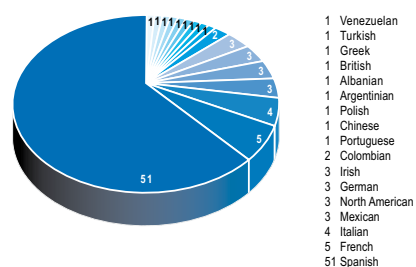
STAFF EVOLUTION 2004-2008



ICN STAFF BY ROLE 2008



ICN STAFF NATIONALITIES 2008



From Left to Right: P. Gambardella, A. Mugarza, G. Ceballos, C. Krull, A. Lodi Rizzini, M. Ollé,
Absent: J. Kavich, S. Stepanow

NEW PROJECTS & MILESTONES

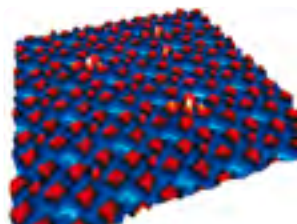
In 2008, the Group secured competitive funding for 4 new projects:

NOMAD - Nanoscale magnetisation dynamics, ERC Starting Grant

To develop frontier approaches to control the magnetodynamic properties of nanometer-sized molecular and metallic elements.

Development and construction of a chamber for the growth and characterisation of nanostructures combining morphological studies and spectroscopy using Synchrotron light, MEC

The project consists of the design, construction and exploitation of an Ultra High Vacuum chamber for the fabrication and morphological and spectroscopic characterisation of nanostructured



surfaces. The project is a collaboration between the ALBA and CIN2, and will serve to complement the lines of Circular Magnetic Dicroism and Resonant Diffraction which are under construction.

Element- and spatially-resolved nonlinear magnetisation dynamics in ferrites, Spanish-German Integrated Actions HA2007-009

The project brings together state-of-the-art expertise in magnetisation dynamics and synchrotron radiation spectroscopy in order to investigate nonlinear dynamic phenomena in heterogeneous magnetic systems with both elemental and spatial resolution.

Synthesis and manipulation of two-dimensional molecular spin networks, MEC

This project aims at exploiting self-assembling processes for fabricating ultrathin magnetic films constituted by nanometer-sized functional molecular elements.

KEY PUBLICATIONS AND INVITED TALKS 2008

High magnetic moments and anisotropies for FexCo_{1-x} monolayers on Pt(111), G. Moulas, A. Lehnert, S. Rusponi, J. Zabloudil, C. Etz, S. Ouazi, M. Etzkorn, P. Bencok, P. Gambardella, P. Weinberger, and H. Brune, Phys. Rev. B 78, 214424 (2008).

Kondo Effect in Single Atom Contacts: The Importance of the Atomic Geometry, L. Vitali, R. Ohmann, S. Stepanow, P. Gambardella, K. Tao, R. Huang, V. S. Stepanyuk, P. Bruno, and K. Kern, Phys. Rev. Lett. 101, 216802 (2008).

Element-resolved x-ray ferrimagnetic and ferromagnetic resonance spectroscopy, G. Boero, S. Mouaziz, S. Rusponi, P. Bencok, F. Nolting, S. Stepanow, and P. Gambardella, New J. Phys. 10, 013011 (2008).

Single-ion magnetic anisotropy and magnetic resonance probed by polarized x-ray absorption spectroscopy, Debye Institute for NanoMaterials Science, Utrecht, the Netherlands, December 16, 2008.

Single ion magnetic anisotropy and magnetic resonance phenomena, Annual Meeting of the Spanish Club of Magnetism, Universidad Complutense de Madrid, Spain, December 4, 2008.

Structure and manipulation of metal-organic molecules investigated by STM, II Spanish Workshop on Nanolithography, Barcelona, Spain, November 10-13, 2008.

Spin, orbit, and all those moments: from dilute impurities to resonantly excited bulk systems, Physikalisches Kolloquium, Universität Regensburg, Germany, October 27, 2008.

OTHER ACTIVITIES

Organiser, Magnetism and Spintronics Symposium, European Conference on Surface Science, Liverpool, UK (2008).

Lectures, Characterisation Techniques in Surface Science, Nanoscience and Nanotechnology Master, Universitat Autònoma de Barcelona.

Lectures, Magnetism in nanoparticles and thin films, International School Nanosciences Ile de France, Domaine du Tremblay, France.

Led by ICREA Prof. Víctor Puntès, the Inorganic Nanoparticles Group works on the synthesis, characterisation and bio-applications of engineered inorganic nanoparticles. By controlling the size, structure and shape of the inorganic core, and controlling the linking of biologically active molecules to the nanoparticle surface, either during synthesis or later when the nanoparticles are introduced into a biological environment, the group aims to design nanoparticles that can target or otherwise interact with specific biological systems.



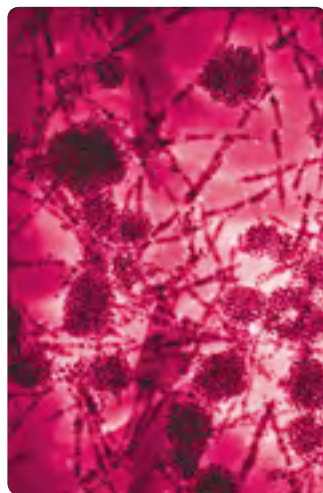
From Left to Right: V. Puntès, S. Lim, M. Varón, L. García J. Comenge, N. Gómez-Bastús, E. Casals, E. González
Absent: P. Guardia, S. Vázquez Campos

NEW PROJECTS & MILESTONES

Many of the results in 2008 were related to the use of engineered inorganic nanoparticles with biological systems. In particular, nanotoxicology, immunology and drug delivery of antitumoral drugs, as reflected in the granted projects, published papers and submitted patents.

In 2008, the Group secured competitive funding for a new project with the Environmental Agency: **NANOCLEAN - Determination of the potential of different functionalised inorganic nanoparticles.**

To determine the potential of different nanoparticles for the elimination of contaminants such as nitrogen (in all its forms), phosphorous (in phosphate form), heavy metals and organic pesticides.



Important results in ongoing projects included observations in toxicology via in vitro studies that nanoparticles (Au, Ag, CoO, FeOx, CeO2, Pt), at practical concentrations (mainly determined by colloidal stability), pose threat other than that which typically would be expected as a consequence of aggregation or corrosion. In addition the detoxifying properties of serum supplemented biological media were observed.

Experimental results led to two patents being solicited:
PCT/EP2009/067136 – CisPlatinum gold nanoparticles with a pH sensitive linker for intracellular delivery and the use of nanoparticles conjugate. A two steps conjugation to 20 nm gold NPs with carboxylic acids and cisplatin leads to vehicles which deliver higher drug payloads while decreasing side effects in vivo mice models.

PCT/EP2009/063777 – Immunoactivating conjugates comprising nanoparticles coated with peptides. Carefully conjugating a peptidic coating may stimulate the immune system regarding pattern presentation to toll like receptors, with proposed applications as potential safe and tailor-made adjuvants for vaccination.

KEY PUBLICATIONS AND INVITED TALKS 2008

Deserving of mention is the publication of two review articles about the interactions of nanoparticles and biological systems, in which the Group reviewed and contributed experiments regarding how different types of nanoparticles and carbon nanostructures travel and are modified in biological systems, in vitro and in vivo:

Distribution and potential toxicity of engineered inorganic nanoparticles and carbon nanostructures in biological systems, E. Casals, S. Vazquez-Campos, N.G. Bastus, V. Puentes, Trends in Analytical Chemistry, 27 (8), 672-683 (2008)

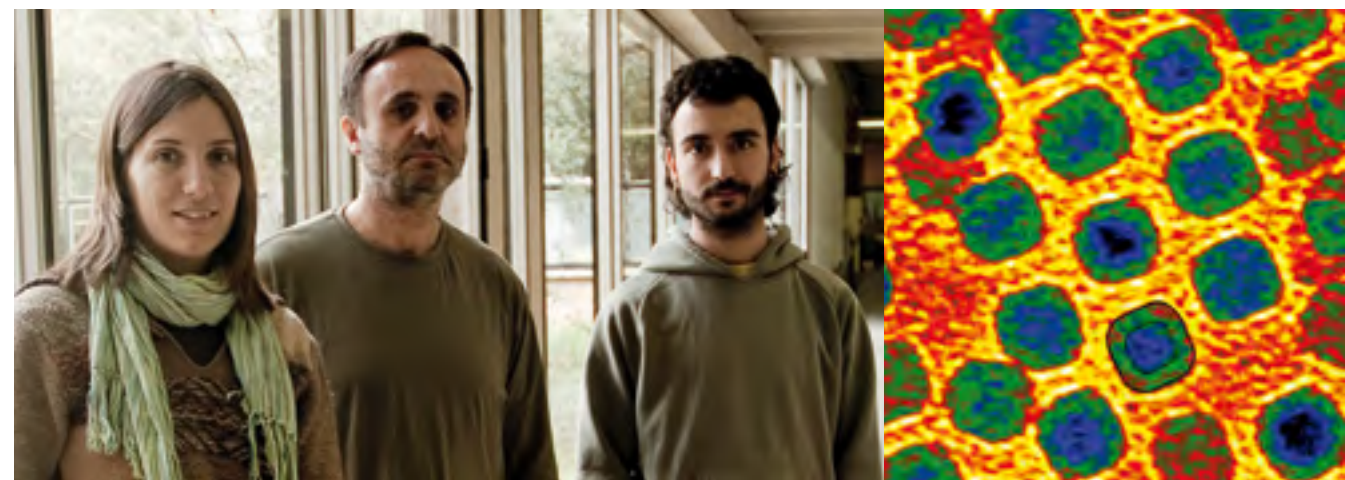
Reactivity of Engineered Inorganic Nanoparticles and Carbon Nanostructures in Biological Media, Neus G. Bastús, Eudald Casals, Socorro Vázquez-Campos, Victor Puentes, Nanotoxicology, 2 (3), 99-112 (2008)

OTHER ACTIVITIES

Creation of the communication initiative nanowiki.info officially lunched in July 2008, a collective blog observing the evolution of nanotechnology breakthrough by breakthrough, together with the social impact of its development.

In 2008 the group member Dr. Bastus successfully defended his first PhD.

Led by ICREA Prof. Josep Nogués, the Magnetic Nanostructures Group investigates different types of magnetic nanostructures with the aim of improving their functional properties. The group combines state of the art lithographic or chemical synthesis methods with structural, morphological and magnetic characterisation to focus on three areas; magnetic properties of lithographed magnetic nanostructures, magnetic nanoparticles and other magnetic systems.



From Left to Right: Marta Estrader, Josep Nogués, Alberto López Ortega
Absent: German Salazar

NEW PROJECTS & MILESTONES

In 2008, the Group worked on three different projects:

Using magnetic interactions to tailor the magnetic properties of nanostructured systems, MEC

The objective was to investigate different types of magnetic interactions in patterned magnetic nanostructures and nanoparticles, to tailor and improve the magnetic properties of magnetic composite nanostructured systems by making use of the extra degrees of freedom introduced by the interactions.

In particular, the Group focused on the correlation between structural (e.g., size, shape, distance, microstructure) and magnetic parameters (e.g., types of materials, anisotropies). For example, it was demonstrated that the magnetisation reversal of ferromagnetic/antiferromagnetic lithographed structures and nanoparticles can be controlled by shape and interface exchange interaction.

Further, the Group studied other effects such as the generation of magnetism in non-magnetic materials by ion irradiation.

New ultra-high density magnetic storage media, based on the self-assembly of multi-level nanoparticles, MEC

The Group synthesised core/shell and multi-shell nanoparticles with different magnetic layers, self-assembling them to create a potential high-density patterned media. The different magnetic layers were designed to exhibit different coercivities leading to the possibility to store several bits of information on each nanoparticle.

Exchange biased thin films, nanostructures and devices, SSF-Sweden

In collaboration with J. Åkerman (Royal Institute of Technology, Stockholm, Sweden), the project studied the coupling between hard and soft ferromagnets through non-magnetic spacers for spintronic applications.

KEY PUBLICATIONS AND INVITED TALKS 2008

Enhanced exchange bias effects in a nanopatterned system consisting of two perpendicularly coupled ferromagnets A. Bollero, B. Dieny, J. Sort, K.S. Buchanan, S. Landis, J. Nogués, *Applied Physics Letters* 92, 022508 (2008)

Patterning of magnetic structures on austenitic stainless steel by local ion beam nitriding. E. Menéndez ; A. Martinavicius; M. O. Liedke ; G. Abrasonis ; J. Fassbender ; J. Sommerlatte ; K. Nielsch ; S. Suriñach ; M. D. Baró ; J. Nogués ; J. Sort, *Acta Materialia*, 56, 4570-4576 (2008)

Cubic versus Spherical Magnetic Nanoparticles: The Role of Surface Anisotropy. G. Salazar-Alvarez ; J. Qin ; V. Sepelak ; I. Bergmann ; M. Vasilakaki ; K. N. Trohidou ; J. D. Ardisson ; W. A. A. Macedo ; M. Mikhaylova ; M. Muhammed ; M. D. Baró ; J. Nogués, *Journal of the American Chemical Society*, 130, 13234-13239 (2008)

Direct measurement of depth-dependent Fe spin structure during magnetisation reversal, Fe/MnF₂ exchange-coupled bilayers, W.A.A. Macedo, B. Sahoo, J. Eisenmenger, M.D. Martins, W. Keune, V. Kuncser, R. Röhlberger, O. Leupold, R. Ruffer, J. Nogués, K. Liu, K. Schlage, I. K. Schuller, *Physical Review B*, 78, 224401 (2008)

Direct nanoscale magnetic lithography in on FeAl alloys by means of ion irradiation, *Trends in Nanotechnology*, Oviedo, Spain, Sept. 1-5, 2008

Exchange bias in inverted antiferromagnetic-ferrimagnetic core -shell nanoparticles, *Villa Conference on Complex Oxide Heterostructures*, Orlando, USA, Nov. 2-6, 2008

Exchange biased vortices, *Asian Magnetism Conference*, Busan, Korea, Dec. 10-13, 2008

OTHER ACTIVITIES

Organiser, Oxide Composites Symposium, at International Conference on Composites and Nano Engineering (ICCE-16), Kunming, China (2008).

Organiser, Development of Oxide Nanocomposites - bulk, thin films and nano-structures Symposium, International Union of Materials Research Societies- International Conference on Advanced Materials (IUMRS-ICAM), Nagoya, Japan (2008).

Lectures, Nanostructured Magnetic Materials, Materials Science Master, Universitat Autònoma de Barcelona.

Led by ICREA Prof. Arben Merkoçi, the Nanobioelectronics and Biosensors Group works on the design of novel sensors and biosensors based on nanomaterials and their applications in fields like clinical analysis, environmental monitoring and other industries. Metallic nanoparticles modified with antibodies or DNA are used as electroactive labels to follow immunoreactions or hybridisations with interest for immunosensors and DNA sensors. In addition carbon nanotubes are also used as building blocks for sensing applications.



From Left to Right: A. Merkoçi, A. Puig, A. de la Escosura, S. Marín (UAB), G. Aragay(UAB), M. Guix (UAB), B.Pérez Absent: F. Airó, A. Ambrosi, M. Maltez da Costa, M. Sahin

NEW PROJECTS & MILESTONES

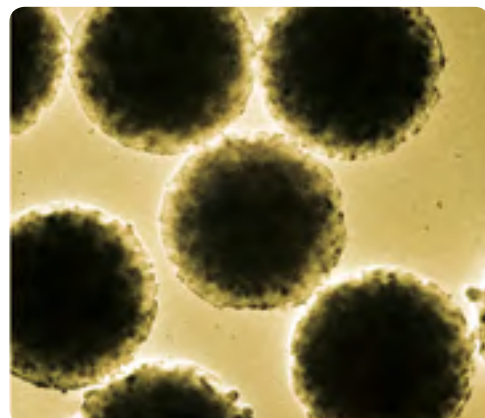
Most of the results in 2008 were related to preparation of electroactive nanoparticles, their modifications, characterisations and quantifications prior use in biosensors. The Group reported a novel direct ICPMS quantification method for gold nanoparticles with interest for biosensing including cells detections. The Group continued working on carbon nanotubes modification and integration into new polymeric matrix as shown also in our publications.

During 2008 the Group continued to work in the framework of **WARMER – Water Risk Management in EuRope FP6 Project** (with UAB) to develop heavy metal and phenol sensors for pollution control in collaboration with several EU partners. Important results in ongoing projects included the development of a new host-guest matrix based on carbon nanotubes and cyclodextrin for dopamine detection with interest for medical applications. Other interesting results were obtained

for biosensing applications based on cross-linking of carbon nanotubes and biological molecules.

Experimental results on nanoparticles based biosensing systems led to one patent being solicited:

PCT/ES2009/070489 – “Electrocatalytic quantification of gold nanoparticles based on their effect on the hydrogen evolution and application for DNA and protein analysis. Extension for the rapid identification of tumor cells”. (ICN, UV)



KEY PUBLICATIONS AND INVITED TALKS 2008

Deserving of mention is the publication of the article related to dopamine detection using carbon nanotubes and the review article about the applications of nanoparticles in electrochemical based biosensors in which the Group reviewed the recent tendencies in the field. During this year several invited lectures were given by Prof. Merkoçi, deserving special attention that given in Seville:

“**Enhanced host-guest electrochemical recognition of dopamine using cyclodextrin in the presence of carbon nanotubes**”, G. Alarcon-Angeles, B. Pérez-López, M. Palomar-Pardave, S. Alegret and A. Merkoçi, CARBON, 46, 898-906, 2008

“**Electrochemical analysis with nanoparticle based biosystems**”, A. de la Escosura-Muñiz, A. Ambrosi, A. merkoçi, Trends in analytical chemistry, 27, 568-584, 2008.

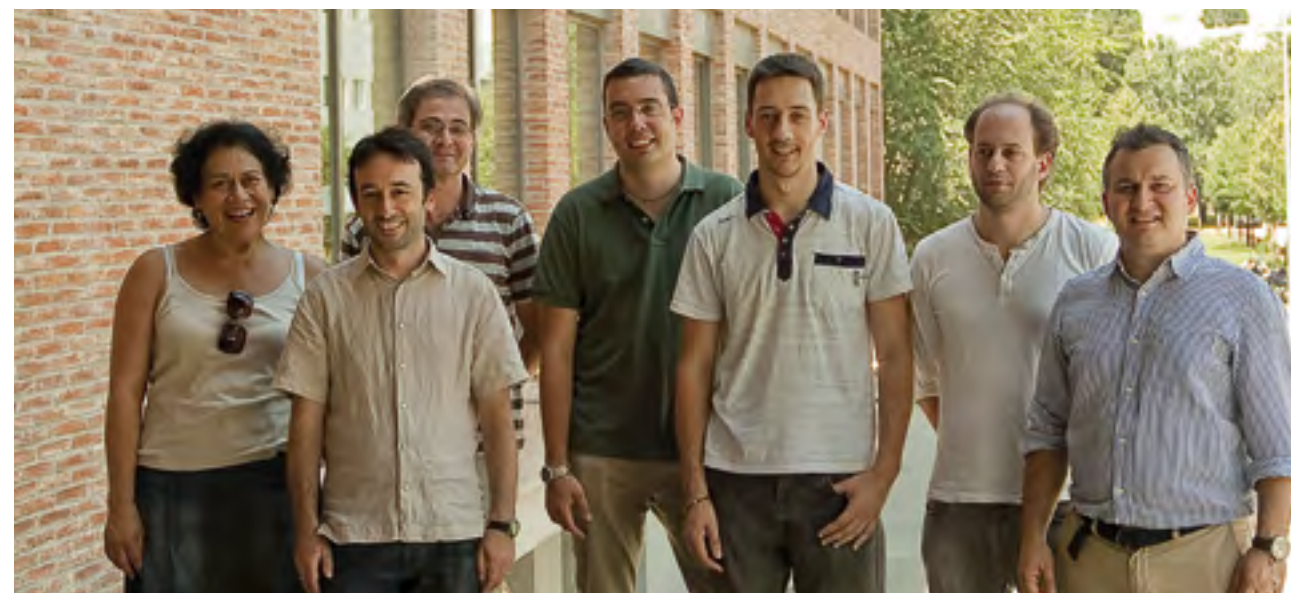
“**Sensing DNA and proteins via tagging with nanoparticles**”, A. Merkoçi, A. de la Escosura-Muñiz, A. Ambrosi. 59th Annual meeting of the international society of electrochemistry, 5-9 Sept., Seville, Spain 2009. Invited lecture.

OTHER ACTIVITIES

In 2008 the group successfully defended its first PhD candidates, Dr. Castañeda-Briones (UAB, Barcelona) and Dr. Alarcón-Ángeles (UAM Mexico).

In 2008 Prof. Merkoçi was involved as professor of “Electrochemical Biosensors Based on Nanomaterials” the short course at 213th Electrochemical Society (ECS) Meeting, Phoenix, AZ, USA.

Led by ICREA Prof. Dr. Clivia M. Sotomayor Torres, the Phononic and Photonic Nanostructures Group investigates the interaction of photons, phonons and electrons in nano-scale condensed matter underpinned by research in nanofabrication, especially nanoimprint lithography. The long term aim is to develop new information technology concepts where information processing is achieved with non-charged state variables.



From Left to Right: Clivia M. Sotomayor, T. Kehoe, F. Alsina, V. Reboud, J. Cuffe, P.O. Chapuis y N. Kehagias.
Absent: S. Kennedy, H. Tao and M. Schmidt.

NEW PROJECTS & MILESTONES

In 2008, the Group worked on two projects:

NANOICT, Nano-scale ICT Devices and Systems Coordination Action: the aim of which is to address one of the major limitations to continued performance increases in the semiconductor and power electronics industries, namely integration density and thermal management.

PhOREMOST, Nanophotonics to realise molecular scale technologies: a network of excellence in Nanophotonics consisting of 35 partners from industry, research organizations and universities.

The group secured funding for one additional project:

NAPANIL, Nanopatterning, Production and Applications based on Nanoimprinting Lithography:

developing processes, materials and tools, both for manufacturing and for control, for truly 3-dimensional nanosurfaces with feature dimensions ranging from 50 nm to several nm. Nanosurfaces will be realised using variants of nanoimprinting lithography. The dedicated application is to control light at nanostructured surfaces.

KEY PUBLICATIONS AND INVITED TALKS 2008

Low-dimensional, hinged bar-code metal oxide layers and free-standing, ordered organic nanostructures from turbostatic vanadium oxide, C. O. Dwyer, V. Lavayen, D. Fuenzalida, H. Lozano, M. A. Santa Ana, E. Benavente, G. González and C. M. Sotomayor Torres. *Small* 4, 990-1000 (2008)

Light-emitting diodes with semiconductor nanocrystals, A. Rogach, N. Gaponik, J M Lupton, C. Bertoni, D. E. Gallardo, S. Dunn, N. Li Pira, M. Paderi, P. M. Repetto, S. G. Romanov, C. O'Dwyer, C. M. Sotomayor Torres and A. Eychmüller. *Angewandte Chem. Int. Ed.* 47 (35), 6538-6549 (2008)

An investigation into the growth conditions and defect states of laminar ZnO nanostructures, J.S. Bendall, G. Visimberga, M. Szachowicz, N. O. V. Plank, S. Romanov, C. M. Sotomayor-Torres and M. E. Welland, *J. Materials Chemistry* 18 (43), 5259-5266 (2008)

Inelastic Light scattering by longitudinal acoustic phonons in thin silicon layers: from membranes to silicon-on-insulator structures. J. Groenen, F. Poinsotte, A. Zwick, C.M. Sotomayor Torres, M. Prunnila and J. Ahopelto. *Phys. Rev. B* 77, 045420 (2008)

Quantitative analysis of lattice ordering in thin-film opal-based photonic crystals, W. Khunsin, G. Kocher, S. G. Romanov, C. M. Sotomayor Torres, *Advanced Functional Materials* 18 (17) 2471-2479 (2008)

Chemosorption-related shift of photonic band gap in photoconductive ZnO, W. Khunsin, S. G. Romanov, M. Scharer, L. Agesen, R. P. H. Chang and C. M. Sotomayor Torres, *Optics Letters* 33 (5) 461-463 (2008)

Emerging Nanophotonics: a perspective from Europe. C. M. Sotomayor Torres. 4th Nanotechnology Conference on Communication and Cooperation, Tokyo, Japan, April 14-18, 2008. Invited talk.

Coupling of photons and plasmons in nanopatterned polymer photonic structures, C. M. Sotomayor Torres, *New Frontiers in Micro and Nano Photonics NFMNP Workshop and School*, Florence, Italy, 22-26 April, 2008. Invited talk.

Nanofabrication for nanophotonics: nanoimprint and self-assembly, C.M. Sotomayor Torres, *International School on Photonics and Molecular Photonics*, Universidad Internacional Menéndez Pelayo, Santander, Spain, 16-20 June 2008. Invited talk.

OTHER ACTIVITIES

Coordination of the EU Network of Excellence PhOREMOST on Nanophotonics, which produced the **Roadmap Emerging Nanophotonics 2008**.

Prof. Dr. Sotomayor Torres was appointed member of the Panel of Expert advising the French Agency of Research on RTB: a network of six national nanoscience and nanotechnology facilities in France.

She was also a member of the Experts Panel Evaluating the Swedish Microelectronics Research Programme

Finally, the profile of Prof. Dr. Sotomayor Torres was entered in the 2008 SPIE «Women in Optics» monthly planner.



Prof. Dr. Sergio O. Valenzuela

Led by ICREA Prof. Sergio O. Valenzuela, the Physics and Engineering of Nano-electronic devices Group focuses on the development of novel devices, primarily spintronics, specifically designed to gain insight into physical properties of materials at the nanoscale, combining state of the art lithographic and chemical methods with magnetic and electrical transport characterisation.

NEW PROJECTS & MILESTONES

In September 2008, the Group was created and a dedicated laboratory space started to be conditioned for sensitive transport experiments. The first piece of major equipment (a 4K helium cryostat)

arrived during December 2008 and the search for postdoctoral fellows and PhD students started, as well as the application for competitive research funding.

KEY PUBLICATIONS AND INVITED TALKS 2008

Quantum Phase Tomography of a Strongly Driven Qubit M.S. Rudner, A.V. Shytov, L.S. Levitov, D. M. Berns, W.D. Oliver, S.O. Valenzuela, and T.P. Orlando, *Phys. Rev. Lett.* 101, 190502 (2008)

Amplitude spectroscopy of a solid-state artificial atom D.M. Berns, M.S. Rudner, S.O. Valenzuela, K.K. Berggren, W.D. Oliver, L.S. Levitov, and T.P. Orlando. *Nature* 455, 51 (2008)

WE-Heraeus-Seminar on "Spin Hall Effect" at the Physikzentrum Bad Honnef, Germany.

XIX SLAFES, Latin American Symposium of Solid State Physics, Iguazú, Argentina.

ULT2008: Frontiers in Low Temperature Physics, Royal Holloway University of London.



OTHER ACTIVITIES

Condensed Matter Seminar, Princeton University, Princeton, NJ.

Physics Colloquium, University of Arizona, Tucson, AZ.

Low Energy Physics Seminar, University of Arizona, Tucson, AZ.

**3.7.1 Daniel Maspoch**

Functional Metal-Organic Nanotubes: Controlling the Composition, Dimensions and Shape through Template Synthesis.

The main focus of this project is the design, synthesis and study of metal-organic nanotubes (MONs) for which are envisioned a wide variety of properties and characteristics, ranging from magnetism to porosity and/or catalytic properties. The design and synthesis of MONs will be carried out through two novel template-based strategies, the so-called template synthesis and an approach based on a molecular template generated by Dip-Pen Nanolithography. Both techniques allow not only the control of composition but also of shape and dimensions (outside diameter, pore size, height, and thickness), which dictate the resulting magnetic, porous and catalytic properties.

HIGHLIGHTS 2008

Valence tautomeric metal-organic nanoparticles. I. Imaz, D. Maspoch, C. Rodríguez-Blanco, J. M. Pérez-Falcón, J. Campo, D. Ruiz-Molina. *Angew. Chem. Int. Ed.* 47, 1857-1860 (2008)

Superparamagnetic sub-5 nm Fe@C nanoparticles: isolation, magnetic properties, and directed assembly Y. Wang, W. Wei, D. Maspoch, J. Wu, V. Dravid, C. A. Mirkin. *Nano Lett.* 8, 3761-3765 (2008)

Electrically biased nanolithography with KOH coated AFM tips. J.-W. Jang, R. Sanedrin, D. Maspoch, S. Hwang, T. Fujigaya, Y. M. Jeon, R. Vega, X. Chen, C. A. Mirkin. *Nano Lett.* 8, 1451-1455 (2008)

**3.7.2 Ernest Mendoza**

During 2008 research was conducted on the functionalisation of carbon nanotubes as well as their utilisation as electrochemical immuno-sensors. In addition, the first virus sensor based on auto-assembled peptide nanotubes was developed.

Collaborations were also undertaken in the development of a method for the micro/nano-fabrication using wet lithography and in the study of the destiny of metallic nanoparticles in living organisms. Finally, a method for the synthesis of clusters of gold with very high catalytic activity was developed and patented.

HIGHLIGHTS 2008

Scalable fabrication of immunosensors based on carbon nanotube polymer composites E. Mendoza, J. Orozco, C. Jiménez-Jorquera, A. B. González-Guerrero, A. Calle, L. M. Lechuga and C. Fernández-Sánchez. *Nanotechnology* 19, 75102 (2008)

Steam purification for the removal of graphitic shells coating catalytic particles and the shortening of single-wall carbon nanotubes B. Ballesteros, G. Tobias, L. Shao, E. Pellicer, E. Mendoza and M.L.H. Green. *Small* 9, 1501 (2008)

Peptide nanotubes as building blocks for nanobiosensors: label-free electrical detection of viruses, R. de la Rica, E. Mendoza, L.M. Lechuga and H. Matsui. *Angewandte Chemie* 47, 9752 (2008)

Patent - Synthesis of catalytic subnanometric gold particles supported on superficies with amino groups.

**3.7.3 Fernando Moreno**

Construction of a combined optical and magnetic tweezers setup to study the activity of biomolecules at the single molecule level.

The objective is the construction of an experimental setup to perform biomolecular-interaction studies at the single-molecule level, such as the interaction of proteins with DNA. The experimental setup consists of a combination of magnetic and optical tweezers, allowing real-time manipulation and visualisation of nucleic acids and their interactions with proteins. This technique is complementary to atomic force microscopy (AFM) because the dynamic information supplied by the tweezers complements the structural information supplied by AFM. The combination of this knowledge with that of classical biochemical techniques will provide insight into the molecular bases that regulate function of biological nanomachines such as molecular motors.

HIGHLIGHTS 2008

Single molecule studies of AddAB: a molecular motor for repairing broken DNA. Best Poster Communication Award - 1st Portuguese-Spanish-British Joint Biophysics Congress, July 2008, Lisboa Portugal

SM-DNA-repair - New single-molecule techniques and their application in the study of DNA break repair - ERC Starting Grant awarded 2008

**3.7.4 Aitor Mugarza**

Study of the optoelectromechanical properties of individual molecules and the effect of the coupling of the electrodes and the interaction with other molecules in its integration into real devices.

This project is based on the simultaneous study of the electronic and conformational properties of individual molecules adsorbed on metallic surfaces. Scanning tunneling microscopy is used for imaging and performing local spectroscopy with atomic resolution. Molecules are manipulated in a controlled fashion to create a particular desired configuration by atomic doping, intermolecular bonding, or inducing chemical reactions. The fundamental properties studied this way will provide access to a detailed knowledge of the effect of the molecule-electrode contact on the electronic properties.

HIGHLIGHTS 2008

Adsorption of water on O(2x2)/Ru(0001): thermal stability and inhibition of dissociation by H₂O-O bonding A. Mugarza, T. K. Shimizu, P. Cabrera-Sanfelix, D. Sánchez-Portal, A. Arnau, and M. Salmeron, *Journal of Physical Chemistry C*, 112, 14052 (2008)

Surface species formed by the adsorption and dissociation of water molecules on Ru(0001) studied by scanning tunneling microscopy, T. K. Shimizu, A. Mugarza, J. I. Cerdá, M. Heyde, Y. Qi, U. D. Schwarz, D. F. Ogletree, M. Salmeron, *Journal of Physical Chemistry C*, 112, 7445 (2008).

Single-molecule chemistry of water on Ru(0001) by scanning tunnelling microscopy A. Mugarza, T. K. Shimizu, D. F. Ogletree, and M. Salmeron, V Reunion Nacional de Física del Estado Sólido, 6-8 February 2008, Santiago de Compostela. Invited talk

**3.7.5 Carlos Sanz**

Atomistic simulations of the design of nanostructures through deposition of atomic clusters onto solid surfaces.

Atomic clusters of a few tens of atoms play an important role as building blocks in many applications in nano-chemistry, nano-electronics and nano-biotechnology. Via atomistic simulations using reactive force fields or QM/MM methods, the project seeks to model metal cluster-based nanostructures for catalysis, immobilisation of individual proteins and as the skeleton of vaccine adjuvants. Work is also undertaken on the development of the methodology behind such simulations.

HIGHLIGHTS 2008

Molecular dynamics simulations of carbon-supported Ni clusters using the Reax reactive force field. Sanz Navarro, CF; Astrand, PO; Chen, D, et al. Journal of Physical Chemistry C, 112, 33, 12663-12668 (2008)

Molecular dynamics simulations of the interactions between platinum clusters and carbon platelets. Sanz-Navarro, CF; Astrand, PO; Chen, D, et al. Journal of Physical Chemistry A, 112, 7, 1392-1402 (2008)

ReaxFF: generic reactive force fields for general classes of molecules. Invited Talk. Nanoscale Physics Symposium, Birmingham (United Kingdom), 2008

**3.7.6 Albert Verdaguer**

Study of the influence of water adsorption on electrostatic properties of surfaces at nanometer scale using Scanning Polarization Force Microscopy (SPFM), Kelvin Probe Force Microscopy (KPFM) and Molecular Dynamics (MD) simulations.

Wetting phenomena are related to the contact between liquids and solids. The properties of the liquid-solid interface determine to a large extent the way the whole system interacts with the environment. Any surface under ambient conditions is covered by a thin film of water, from a monolayer to many molecular layers depending on the conditions and the substrate. The main objective of the project is to study the effect of these liquid films on the surface properties of different materials. One part of the project focuses on the study of water adsorption effects on ionic crystals. Various tools and methodologies (MD, SPFM, KPM, etc.) will be used to study the molecular mechanisms that could explain the experimental observations. Another part of the project will apply SPFM/KPM to two important questions in different scientific areas: the study of surface anion segregation on alkali halide solutions and the study of the degradation of self-assembled monolayers due to water adsorption on defects.

HIGHLIGHTS 2008

The environment of graphene probed by electrostatic force microscopy, Moser, J; Verdaguer, A; Jimenez, D, et al., Applied Physics Letters, 92 Issue: 12 Article Number: 123507 (2008)

Surface chemistry of Cu in the presence of CO₂ and H₂O Deng, XY; Verdaguer, A; Herranz, T, et al. LANGMUIR, 24 Issue: 17, 9474-9478 (2008)

Through the CIN2 collaboration with CSIC, the ICN has placed quite a number of young researchers in groups led by senior CSIC scientists. This form of collaboration serves to augment the capabilities of the research Groups, and enables the researchers to take advantage of the resources made available by both organisations.

In 2008, a total of 24 ICN funded researchers were collaborating with the following CSIC Research Groups;

- Nanostructured Functional Materials, led by Dr. Daniel Ruiz-Molina
- Nanobiosensors and Molecular Nanobiophysics, led by Dr. Laura Lechuga
- PLD and Nanoionics, led by Dr. Jose Santiso
- Quantum Nanoelectronics, led by Dr. Adrian Bachtold
- Small Molecules on Surfaces in Ambient and Pristine Conditions, led by Dr. Jordi Fraxedas
- Theory and Simulation, led by Dr. Pablo Ordejón

Some highlights of the scientific output of these research lines are:

HIGHLIGHTS 2008

• **Subnanometer Motion of Cargoes Driven by Thermal Gradients along Carbon Nanotubes.** A. Barreiro, R. Rurali, E.R. Hernández, J. Moser, T. Pichler, L. Forro and A. Bachtold. Science 320, 775 (2008)

• **Imaging mechanical vibrations in suspended graphene sheets.** D. Garcia-Sanchez, A.M. van der Zande, A. San Paulo, B. Lassagne, P.L. McEuen and A. Bachtold. Nano Letters 8, 1399 (2008)

• **Ultra Sensitive Mass Sensing with a Nanotube Electromechanical Resonator.** B. Lassagne, D. Garcia-Sanchez, A. Aguasca and A. Bachtold. Nano Letters 8, 3735 (2008)

• **PH-Responsive Fluorescent Nanoarrays Fabricated by Direct-Write Parallel Dip-Pen Nanolithography.** A. Martínez-Otero, J. Hernando, D. Ruiz-Molina and D. Maspoch. Small, 4 (12), 2131 (2008)

• **Catechol derivatives as fluorescent chemosensors for wide range pH detection.** E. Evangelio, J. Hernando, I. Imaz, G. G. Bardají, R. Alibés, F. Busqué and D. Ruiz-Molina. Chem. Eur. J., 14, 9754 (2008)





- Correlation between charge state of insulating NaCl surfaces and ionic mobility induced by water adsorption: a combined ambient pressure X-ray photoelectron spectroscopy and scanning force microscopy study. A. Verdaguer, J. J. Segura, J. Fraxedas, H. Bluhm and M. Salmeron. *J. Phys. Chem. C* 112, 16898–16901 (2008)

- Thin water films grown at ambient conditions on BaF₂(111) studied by scanning polarisation force microscopy. A. Verdaguer, M. Cardellach and J. Fraxedas. *J. Chem. Phys.* 129, 174705 (2008)



- Synthesis, X-Ray structure and Reactivity of a Sterically Protected Azobisphenol Ligand and its Co(III) Complex: on the Quest for New Multifunctional Active Ligands. E. Evangelio, J. Saiz, D. MasPOCH, K. Wurst, F. Busque and D. Ruiz-Molina. *European Journal of Inorganic Chemistry*, 2278 (2008)

- Discriminating the carboxylic groups from the total acidic sites in oxidised multi-wall carbon nanotubes by means of acid-base titration. González-Guerrero, A. B.; Mendoza, E.; Pellicer, E.; Alsina, F.; Fernández-Sánchez, C. and Lechuga, L.M. *Chemical Physics Letters*, 462, 256-259 (2008)

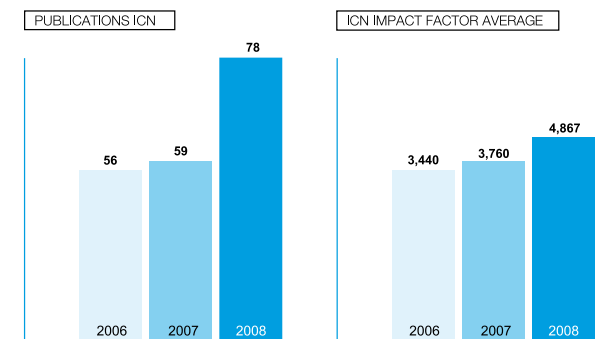
- Photonic Nanobiosensor platforms for label-free detection of single mutations in DNA. L. G. Carrascosa, B. Sepúlveda, K. Zinoviev, A. Calle, C. Domínguez and L.M. Lechuga. 2008 International Conference on Nanoscience and Nanotechnology. Melbourne (Australia), 25-29 February 2008

- Water/L-alanine interactions: hydrophilicity vs. Hydrophobicity (P). J. J. Segura, A. Verdaguer and J. Fraxedas. *Nanospain*. Braga (Portugal), April 2008.

- Devices and Physical Application. Poster Awarded by NT08 Conference - for Marius Zdrojek working at Quantum Nanoelectronics Group at ICN.

4.1 Publications

The number, quality and relevance of publications produced by the researchers that form the ICN continue to grow strongly year upon year as can be seen in the following graphs:



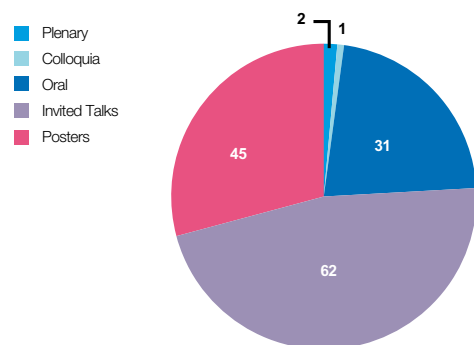
IMPACT FACTOR

Ranking Position	Journal Publication	Number of Papers	Impact Factor
1	Nature	1	28751
2	Science	1	28103
3	Angewandte Chemie International Edition	3	10879
4	Nanoletters	4	10371
5	Journal of the American Chemical Society	1	7885
6	Advanced functional Materials	2	7496
7	Physical Review Letters	2	6944
8	Small	5	6408
9	Trac - Trends in Analytical Chemistry	2	5827
10	Chemistry A - European Journal	1	5330
11	Chemical Communication	2	5141
12	Chemistry of Materials	1	4883
13	Journal of materials Chemistry	2	4339
14	Carbon	1	4260
15	Langmuir	2	4097
16	Applied Physics Letters	4	3726
17	Nanotoxicology	1	3720
18	Optics Letters	1	3711
19	Acta Materialia	1	3624
20	Journal of Physical Chemistry C	4	3396
21	Nanotechnology	1	3310
22	New Journal of Physics	2	3264
23	Dalton transactions	1	3212
24	Analytica Chimica Acta	2	3186
25	Physical Reviews B	5	3172
26	Journal of Chemical Physics	2	3044
27	Electroanalysis	1	2949
28	Journal of Physical Chemistry A	1	2871
29	European Journal of Inorganic Chemistry	1	2597
30	Journal of Nanoparticle Research	1	2338
31	Environmental Toxicology & Chemistry	1	2309
32	Chemical Physics Letters	2	2207
33	Journal of Applied Physics	3	2171
34	Journal of Nanoscience and nanotechnology	2	1987
35	Microchimica Acta	1	1959
36	Journal of Physics Condensed Matter	1	1886
37	J. of Optical A : Pure and Appl. Opt.	1	1752
38	Nanoscale Research Letters	1	1731
39	Inorganica Chimica Acta	2	1713
40	Microelectronic Engineering	2	1503
41	Jap. Journal of Applied Physics	1	1247
42	Physica status solidi B	1	1071
43	IEEE Transactions on Magnetics	1	959
44	Journal of Non-linear Optical Physics and Materials	1	667
45	Others	2	0

NUMBER OF INDEXED PUBLICATIONS: 78
IMPACT FACTOR AVERAGE: 4,867

4.2 Events Participation

During 2008 ICN researchers participated at various levels in 141 events related to Nanotechnology.



4.3 Events Organisation

• II Jornada AIN - Aplicaciones Industriales de la Nanotecnología

Casa Llotja de Mar, Barcelona - June the 3rd, 2008 .

206 participants, 14 oral contributions and 4 debates

• XIII Trobada Transfronterera sobre Sensors i Biosensors

Centre de Congressos d'Andorra la Vella, Andorra - September the 18th and 19th, 2008

80 participants, 7 invited talks, 16 oral contributions and poster session

• 2nd Spanish Workshop on Nanolithography

Hotel Sehns Campus, Bellaterra - November the 10th to 12th, 2008

152 participants, 3 plenary conferences, 9 invited talks, 21 oral contributions and poster session.

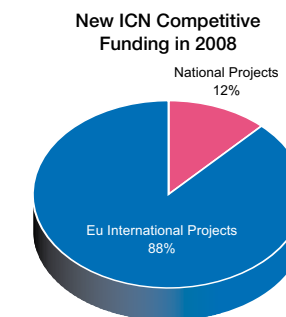
Success in winning competitive research funding is key not only for the financial growth of the ICN, but also as an indicator of the quality and international competitiveness of its research activities.

2008 was a particularly successful year in this regard with a number of FP7 projects awarded and two ICN researchers, ICREA Prof. Pietro Gambardella and Ramón y Cajal researcher Dr Fernando Moreno, receiving the highly prestigious ERC Starting Grants, which are awards of €1,5 million over 5 years to an individual researcher to enable them to consolidate a research group dedicated to a highly ambitious research project at the frontier of science.

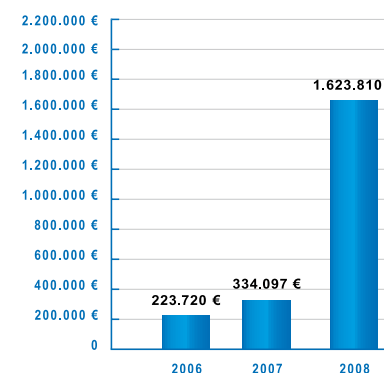
In addition to success in attracting European funds, 2008 marked another first for the ICN with the awarding of four small grants by the Catalan government for technology commercialisation projects, to help transfer ICN-developed technologies from the laboratory into a commercial setting.

As can be seen in the chart, the evolution of project funding has grown strongly since the ICN commenced operations in 2005. The ICN measures project funding growth using Average Annualised Funding, which is the sum of the total funds awarded in a project divided by each project lifespan, in order to account for fluctuations in grant concessions and varying project length.

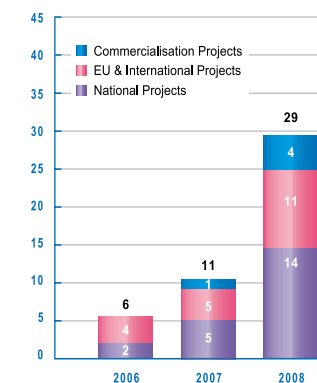
	2006	2007	2008
Average competitive Funds € (of active projects)			
EU	474.044	470.591	4.829.217
NATIONAL	483.253	572.189	1.351.993
COMERCIAL		30.000	319.633
TOTAL	957.297	1.072.780	6.500.842
Average project Length (years weighted by project funds)			
EU	3,8	3,4	4,3
NATIONAL	4,8	3,1	3,3
COMERCIAL		2,0	2,6
TOTAL	4,3	3,2	4,0
Average Annualised Funding			
ICN	223.720	334.097	1.623.810



ICN Average annualised approved competitive funding



Number of active ICN projects





From L. to R. - M. Pueyo, J. Reverter, S. Domene, B. Kogon, R. Juan, X. Ros, S. Veciana, J. Vela, A. de la Osa, J. Caño, O. Cardenal, O. Fernández and X. Borrisé. Absent - R. Cosialls, D. Tienda, F. García, C. Bértier and L. Solé.

order to meet this demand, prepare for future growth and comply with EU and national reporting requirements, a number of process improvement projects were launched, including implementation of SAP and a new timesheet system. In order to house new people and labs a new temporary module was commissioned, and various public tenders were run to acquire new equipment.

CIN2

The collaboration with CSIC is managed by Ramón Cosialls, and the CIN2 management team include a number of other ICN personnel covering administrative and communication roles. During 2008 the new CIN2 website www.cin2.es was launched.

External Services

A number of important functions, including legal, HR and senior financial reporting, are externalised to the FUAB, a foundation of the UAB which provides professional services to entities pertaining to the UAB. During 2008 the UAB began implementing the SAP accounting system, and via the FUAB this system was made available to the ICN, which commenced implementation towards the end of 2008.

The management and services team of the ICN performs a wide range of functions and provide numerous support services to the Research Groups. Management is led by the ICN Manager, Matias Pueyo, supported by the Strategy and Development Manager, Boaz Kogon, and comprises several departments;

Finance – responsible for daily accounting activities and travel bookings.

IT – responsible for all IT services both for ICN and CIN2.

General Services – responsible for building services and general maintenance both for ICN and CIN2.

Communication – responsible for internal and external communication and marketing activities.

Project Management – responsible for administrative management of competitive projects.

Technology Transfer – responsible for commercial relationships and patents.

During 2008 the ICN grew from 52 people to 83 people, representing a significant increase in administrative workload. In order

7.1 Financial accounts 2008:

The financial statements for 2008, are written in accordance with the Spanish General Accounting Plan 2007.

The operating budget of ICN is composed of contributions from public administrations and agencies, Competitive Grants, and income from companies (technology transfer).

These revenues, fund the operational activities of the Institute. The main items are personnel costs, general operating expenses and depreciation.

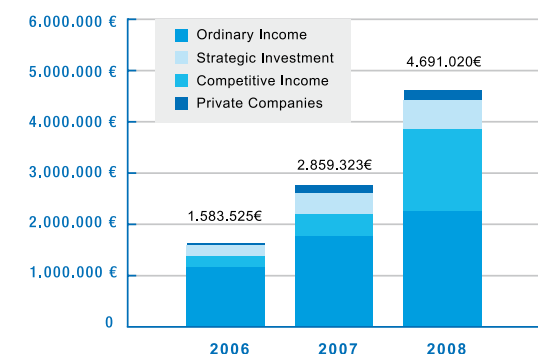
The annual result was a surplus of 747.053€

7.2 International competitiveness

A key objective of the ICN is to be highly competitive at the international level, both in the quality of science produced and the levels of competitive funding secured. To date the ICN has secured competitive funding from a number of entities, including the European Science Foundation, European Commission, North Atlantic Treaty Organisation (NATO), Spanish Ministry of Science and Innovation (MICINN), Spanish Ministry of Industry, Tourism and Commerce, Spanish Ministry of Environment, Rural and Marine, and the Catalan Agency of Support for Universities and Research (AGAUR).

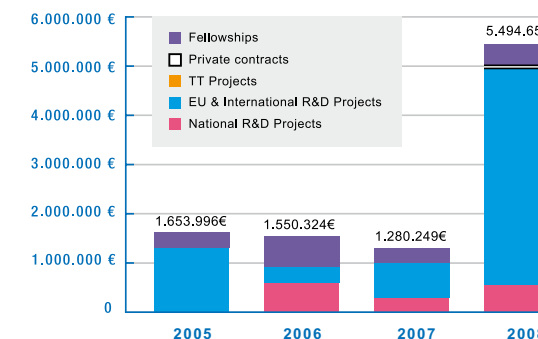
In 2008, a dramatic increase in European funding was achieved, due in large part to the awarding of two highly prestigious ERC Starting Grants to ICN researcher, Group Leader and ICREA Prof. Pietro Gambardella and Ramón y Cajal Researcher Fernando Moreno.

Evolution of ICN funds



	2.008
Ordinary Income:	2.370.146€
Strategic Investment:	646.612€
Competitive Income:	1.525.234€
Private Companies	149.028€
Total	4.691.020€

Competitive funds awarded



7.3 Income:

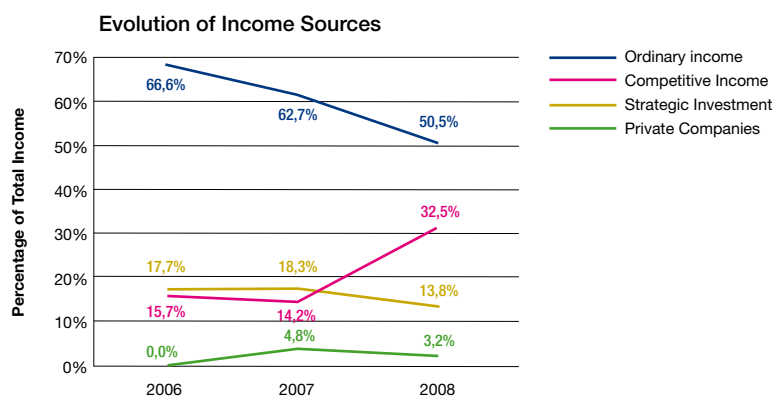
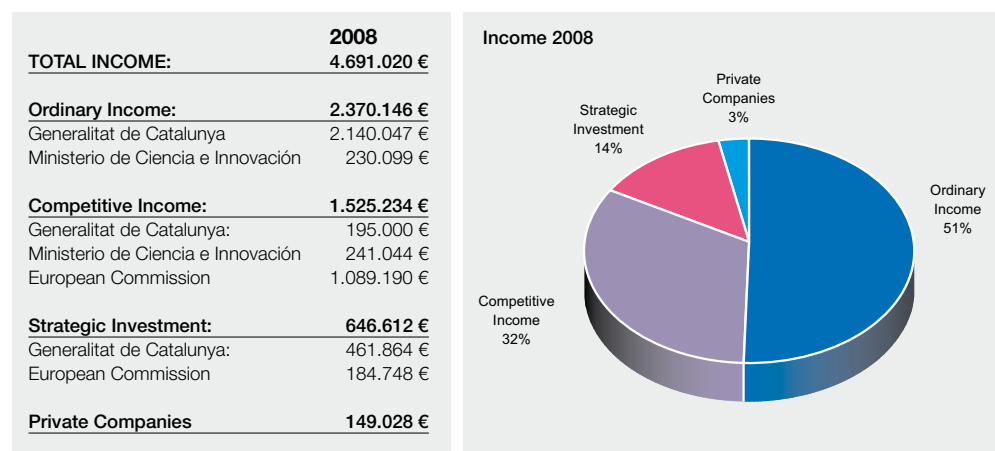
Total revenue for 2008: 4.691.020 euros, from 4 main sources.

Ordinary Income: Funds that finance management structure and services of the institute.

Competitive Income: Funds that finance research projects, which have been obtained in competitive funding from the European Union, Spanish ministries and the Catalan regional government.

Strategic Investment: Funds from the EU, or the Generalitat of Catalunya, which finance the Institute's technological infrastructure.

Private Companies: Funds from technology transfer, events, and activities funded by private companies.

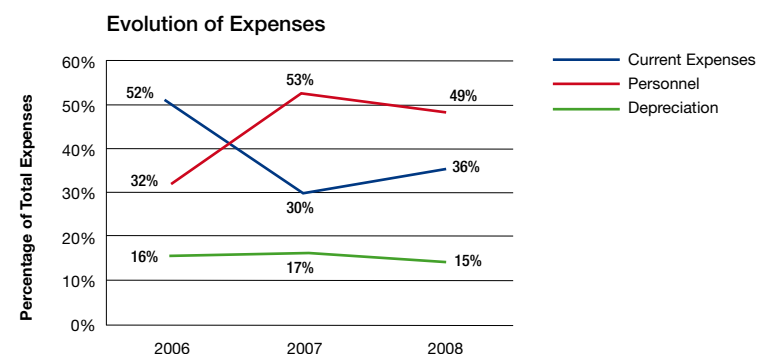
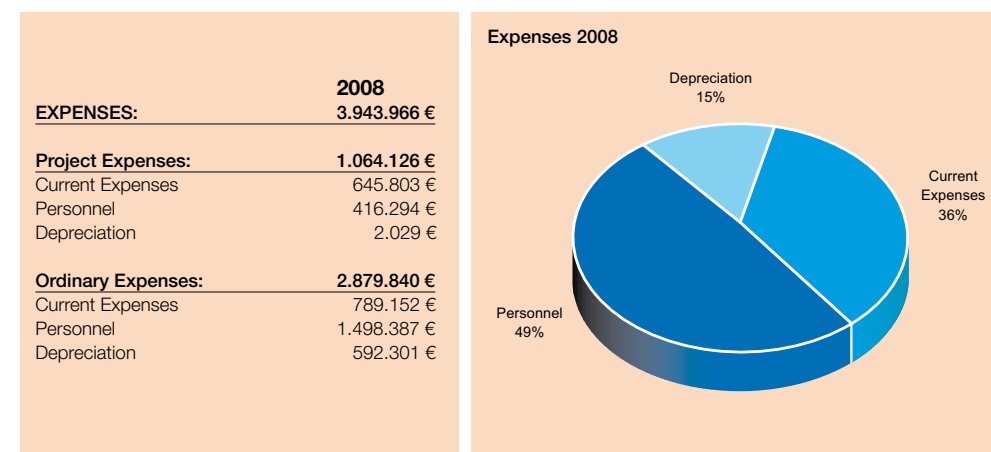


7.4 Expenses:

Total expenditures for the year were 3.943.966 euros. These are classified as follows:

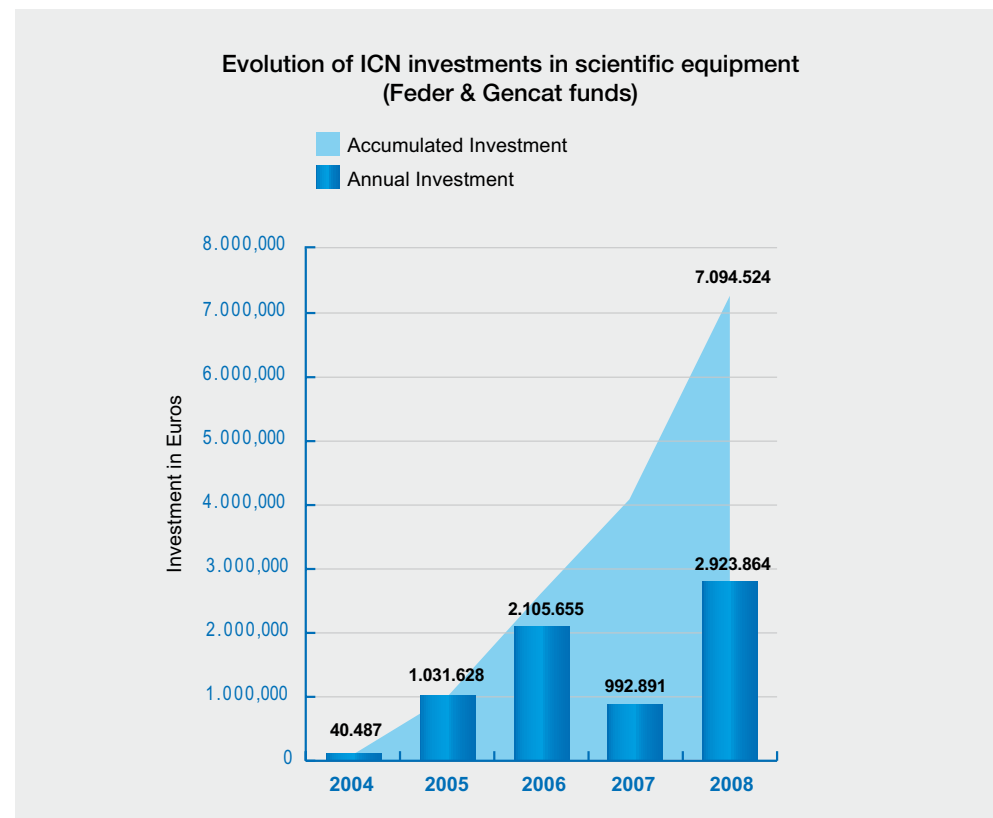
Project Expenses: Expenses necessary to implement research and technology transfer: these include current expenses, staff costs and depreciation of equipment and installations.

Ordinary Expenses: Expenses that fund management structure and services, the composition of spending is current expenditure, staff costs and depreciation.



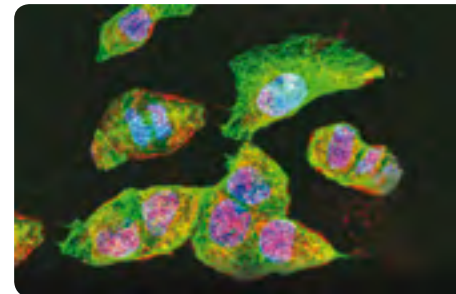
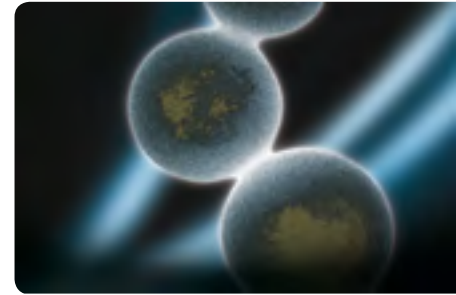
In 2008 the ICN finalised the application of its €5.6 million FEDER grant from the European Commission and the Generalitat of Catalunya to the purchase of core scientific equipment. Major purchases finalised or ordered during the year include E-beam Evaporators, XPS-UPS Spectrometers, X-Ray Diffraction System, Atomic Layer Deposition, Raman System, Ion Laser, and other equipment.

The ICN, as a public institute, adheres to the Law of Public Contracts and all purchases of equipment valued over €50.000 are conducted by tender process. In order to accommodate the increases in people and equipment, the ICN also erected a 2-storey prefabricated module in UAB grounds, very close to its existing facilities. This building will provide laboratories on the ground floor and offices on the first floor, until such time as the new home of the ICN, the CIN2 (ICN-CSIC) building being built by CSIC, is complete.



The development of the ICN technology transfer function has been slow yet steady. During 2008 only one part-time person (Dr. Jordi Reverter) was dedicated to technology transfer. Nevertheless a large number of activities were undertaken;

- Six new patents were filed and a seventh was evaluated but discontinued due to patentability issues.
- A number of CIDEM applications were made: 2 VALTECs, 1 VALCON approved and 3 other proposals rejected.
- A collaboration project with UAB called NANOCLEAN was applied for and approved by the Spanish Environmental Ministry.
- A private industry R&D project was formalised and a number of negotiations for similar contracts with other companies were initiated.
- The highly successful Industrial Applications of Nanotechnology (AIN) workshop, held in conjunction with ICN's sister institute in Zaragoza, INA, was repeated and numbers grew significantly on the previous year, with 298 attendees.



Department	Position
Jordi Pascual	Director
MANAGEMENT AND SERVICES	
Ramon Cosials	CIN2 Manager
Matias Pueyo	ICN Manager
Boaz Kogon	Project Manager
Rosa Juan	ICN Director Assistant
Dulce Tienda	CIN2 Director Assistant
Jordi Reverter	Head of Technology Transfer
Stella Veciana	European Project Manager
Ana de la Osa	ICN Communication Officer
Fran García	CIN2 Communication Officer
Inmaculada Caño	Travel
Sandra Domene	Accounts Payable
Judit Vela	Accountant
Céline Bértier	Assistant
Xavier Ros	General Services Manager
Oscar Cardenal	IT Systems Engineer
Oliver Fernández	IT Assistant
Xavier Borrís	Technical Engineering
Libertad Solé	Technical Engineering
ATOMIC MANIPULATION AND SPECTROSCOPY GROUP - ICREA Prof. Pietro Gambardella	
Pietro Gambardella	Principal Researcher
Gustavo Ceballos	Senior Researcher
Aitor Mugarza	Ramon y Cajal Researcher
Jerald Kavich	Postdoctoral Researcher
Sebastian Stepanow	Postdoctoral Researcher
Cornelius Krull	Predoctoral Student
Alberto Lodi Rizzini	Predoctoral Student
Marc Ollé	Predoctoral Student
INORGANIC NANOPARTICLES GROUP - ICREA Prof. Victor Puntès	
Víctor Puntès	Principal Researcher
Stephanie Lim	Postdoctoral Researcher
Socorro Vázquez	Postdoctoral Researcher
Eudald Casals	Predoctoral Student

Department	Position
Joan Comenge	Predoctoral Student
Lorena García	Predoctoral Student
Neus Gómez	Predoctoral Student
Edgar Emir González	Predoctoral Student
Pablo Guardia	Predoctoral Student
Miriam Varón	Predoctoral Student
MAGNETIC NANOSTRUCTURES GROUP - ICREA Prof. Josep Nogués	
Josep Nogués	Principal Researcher
Marta Estrader	Postdoctoral Researcher
German Salazar	Postdoctoral Researcher
Alberto López	Predoctoral Student
NANOBIOELECTRONICS AND BIOSENSORS GROUP - ICREA Prof. Arben Merkoçi	
Arben Merkoçi	Principal Researcher
Adriano Ambrosi	Postdoctoral Researcher
Alfredo de la Escosura	Postdoctoral Researcher
Federico Airo	Predoctoral Student
Marisa Maria V. Maltez	Predoctoral Student
Briza Pérez	Predoctoral Student
Melike Sahin	Predoctoral Student
Anna Puig	Technical engineer
PHYSICS AND ENGINEERING OF NANODEVICES - ICREA Prof. Sergio Valenzuela	
Sergio Valenzuela	Principal Researcher
PHONONIC AND PHOTONIC NANOSTRUCTURES GROUP - ICREA Prof. Dr. Clivia M. Sotomayor	
Clivia Sotomayor	Principal Researcher
Francesc Alzina	Postdoctoral Researcher
Pierre Olivier Chapuis	Postdoctoral Researcher
Nikolaos Kehagias	Postdoctoral Researcher
Timothy Kehoe	Postdoctoral Researcher
Sinead Kennedy	Postdoctoral Researcher
Vincent Reboud	Postdoctoral Researcher
Hai-Hua Tao	Postdoctoral Researcher
John Cuffe	Predoctoral Student
Michael Schmidt	Technical engineer

Department		Position
RAMÓN Y CAJAL RESEARCHERS		
Daniel Maspoch	Nanostructured Functional Materials	Ramón y Cajal Researcher
Ernest Mendoza	Nanobiosensors and Bioanalytica Applications	Ramón y Cajal Researcher
Fernando Moreno	Nanobiosensors and Bioanalytica Applications	Ramón y Cajal Researcher
Aitor Mugarza	Atomic Manipulation and Spectroscopy Group	Ramón y Cajal Researcher
Carlos Sanz	Theory and Simulation	Ramón y Cajal Researcher
Albert Verdagué	Small Molecules on Surfaces in Ambient and Pristine Conditions	Ramón y Cajal Researcher
RESEARCHERS IN COLLABORATIVE GROUPS		
Inhar Imaz	Nanostructured Functional Materials	Postdoctoral Researcher
Benjamin Lassagne	Quantum Nanoelectronics	Postdoctoral Researcher
Borja Sepúlveda	Nanobiosensors and Bioanalytical Applications	Postdoctoral Researcher
Mariusz Zdrojek	Quantum Nanoelectronics	Postdoctoral Researcher
Ester Añon	Nanobiosensors and Bioanalytical Applications	Predoctoral Student
Amelia Barreiro	Quantum Nanoelectronics	Predoctoral Student
Carlos Carbonell	Nanostructured Functional Materials	Predoctoral Student
Mar Cardellach	Small Molecules on Surfaces in Ambient and Pristine Conditions	Predoctoral Student
Daniel García	Quantum Nanoelectronics	Predoctoral Student
Ana Belén González	Nanobiosensors and Bioanalytical Applications	Predoctoral Student
Josh Malowney	Nanobiosensors and Bioanalytical Applications	Predoctoral Student
M. Alberto Martínez	Nanostructured Functional Materials	Predoctoral Student
Àlvar Nocete	Nanostructured Functional Materials	Predoctoral Student
Marinus Albertus Otte	Nanobiosensors and Bioanalytical Applications	Predoctoral Student
Eva Pellicer	Nanobiosensors and Bioanalytical Applications	Predoctoral Student
Miguel Ángel Pérez	Theory And Simulation	Predoctoral Student
Javier Saiz	Nanostructured Functional Materials	Predoctoral Student
Juanjo Segura	Small Molecules on Surfaces in Ambient and Pristine Conditions	Predoctoral Student
James Arturo Zapata	PLD & Nanoionics	Predoctoral Student

Most relevant publications (by impact factor)

Amplitude spectroscopy of a solid-state artificial atom, D.M. Berns, M.S. Rudner, S.O. Valenzuela, K.K. Berggren, W.D. Oliver, L.S. Levitov, and T.P. Orlando. *Nature* 455, 51 (2008)

Subnanometer Motion of Cargoes Driven by Thermal Gradients along Carbon Nanotubes A.Barreiro, R. Rurai, E.R. Hernandez, J. Moser, T. Pichler, L. Forro, and A. Bachtold. *Science*, 320, 775-778 (2008)

Light Emitting Diodes with Semiconductor Nanocrystals, A. Rogach, N. Gaponik, J M Lupton, C. Bertoni, D. E. Gallardo, S. Dunn, N. Li Pira, M. Paderi, P. M. Repetto, S. G. Romanov, C. O'Dwyer, C. M. Sotomayor Torres, A. Eychmüller. *Angewandte Chem. Int. Ed.* 47 (35) 6538-6548 (2008)

Valence tautomeric metal-organic nanoparticles, I. Imaz, D. Maspoch, C. Rodríguez-Blanco, J. M. Pérez-Falcón, J. Campo, D. Ruiz-Molina. *Angew. Chem. Int. Ed.* 47, 1857-1860 (2008)

Peptide nanotubes as building blocks for nanobiosensors: label-free electrical detection of viruses, R. de la Rica, E. Mendoza, L.M. Lechuga and H. Matsui . *Angewandte Chemie-International Edition*, 47, 9752 - 9759 (2008)

Imaging Mechanical Vibrations in Suspended Graphene Sheets , D. Garcia-Sanchez, A. M. van der Zande, A. San Paulo, B. Lassagne, P. L. McEuen, and A. Bachtold . *Nano Letters*, 8, 1399 (2008)

Electrically biased nanolithography with KOH coated AFM tips. J.-W. Jang, R. Sanedrin, D. Maspoch, S. Hwang, T. Fujigaya, Y. M. Jeon, R. Vega, X. Chen, C. A. Mirkin. *Nano Lett.* 8, 1451-1455 (2008)

Ultrasensitive Mass Sensing with a Nanotube Electromechanical Resonator, B. Lassagne, D. Garcia-Sanchez, A. Aguasca, and A. Bachtold. *Nano Letters*, 8, 3735 (2008)

Superparamagnetic Sub-5 nm Fe@C Nanoparticles: Isolation, Magnetic Properties, and Directed Assembly, Y. Wang, W. Wei, D. Maspoch, J. Wu, V. Dravid, C. A. Mirkin. *Nano Lett.* 8, 3761-3765 (2008)

Cubic versus Spherical Magnetic Nanoparticles: The Role of Surface Anisotropy. Salazar-Alvarez, G.; Qin, J.; Sepelak, V.; Bergmann, I.; Vasilakaki, M.; Trohidou, K. N.; Ardisson, J. D.; Macedo, W. A. A.; Mikhaylova, M.; Muhammed, M.; Baró, M. D.; Nogués, J. *Journal of the American Chemical Society*, 130, 13234-13239 (2008)

For a full list of publications during 2008, please visit our website www.icn.cat

EU/INTERNATIONAL PROJECTS

Project title: CARDEQ - Carbon Nanotube Devices at the Quantum Limit

Principal Researcher: Prof. Adrian Bachtold

Funding: European Commission - Sixth Framework Programme (FP6)

Project title: DIPNA - Development of an integrated platform for nanoparticle analysis to verify their possible toxicity and eco-toxicity

Principal Researcher: ICREA Prof. Víctor F. Puntès

Funding: European Commission - Sixth Framework Programme (FP6)

Project title: Marie Curie: QDCN – Quantum Devices based on Nanotubes

Principal Researcher: Dr. Marius Zdrojek

Funding: European Commission – Seventh Framework Programme (FP7)

Project title: Nano-ICT - Nano-scale ICT devices and systems coordination action

Principal Researcher: ICREA Prof. Dr. Clivia M. Sotomayor

Funding: European Commission – Seventh Framework Programme (FP7)

Project title: NANOPACK - Nano Packaging Technology for Interconnect and Heat Dissipation

Principal Researcher: ICREA Prof. Dr. Clivia M. Sotomayor

Funding: European Commission – Seventh Framework Programme (FP7)

Project title: NaPANIL - Nanopatterning, Production and Applications based on nanoimprinting lithography

Principal Researcher: ICREA Prof. Dr. Clivia M. Sotomayor

Funding: European Commission – Seventh Framework Programme (FP7)

Project title: NOMAD - Nanoscale magnetisation dynamic

Principal Researcher: ICREA Prof. Pietro Gambardella

Funding: European Commission – Seventh Framework Programme (FP7)

Project title: PHOREMOST – Nanophotonics to realise molecular-scale technologies

Principal Researcher: ICREA Prof. Dr. Clivia M. Sotomayor

Funding: European Commission - Sixth Framework Programme (FP6)

Project title: Quantum probes based on carbon nanotubes

Principal Researcher: Prof. Adrian Bachtold

Funding: European Science Foundation

Project title: SANMAG - Self-assembled nanoscale magnetic networks (SONS Programme)

Principal Researcher: ICREA Prof. Pietro Gambardella

Funding: European Science Foundation

Project title: SM-DNA-repair - New single molecule techniques and their application in the study of DNA break repair

Principal Researcher: Ramón y Cajal Researcher Dr. Fernando Moreno

Funding: European Commission – Seventh Framework Programme (FP7)

NATIONAL PROJECTS

Project title: Diagnostic system for detecting breast cancer

Principal Researcher: ICREA Prof. Arben Merkoçi

Funding: ACC1Ó (Generalitat of Catalonia)

Project title: Element- and spatially-resolved nonlinear magnetisation dynamics in ferrites

Principal Researcher: ICREA Prof. Pietro Gambardella

Funding: MICINN (Ministry of Science and Innovation)

Project title: Evaluation of the biocompatibility and toxicity of micro and nanoparticles.

Principal Researcher: Ramón y Cajal Researcher Dr. Daniel Maspoçh

Funding: ACC1Ó (Generalitat of Catalonia)

Project title: NANOBIONED Nanotechnologies in biomedicine

Principal Researchers: Ramón y Cajal Researcher Dr. E. Mendoza, ICREA Prof. A. Merkoçi, Dr. J. Pascual and ICREA Prof. V. F. Puntès

Funding: MICINN (Ministry of Science and Innovation)

Project title: NANOCLEAN Determination of the potential of different functionalised inorganic nanoparticles.

Principal Researcher: ICREA Prof. Víctor F. Puntès

Funding: MAA (Ministry of Environment Rural and Marine Affairs)

Project title: Study of controlled oxidation of graphene sheets using AF as a possible method to obtain carbon nanoribbons at nanoscale

Principal Researcher: Ramón y Cajal Researcher Dr. Albert Verdaguèr

Funding: MICINN (Ministry of Science and Innovation)

Project title: Study of the technical viability production of a recombinant hormone for use in veterinary applications

Principal Researcher: Ramón y Cajal Researcher Dr. Ernest Mendoza

Funding: MITC (Ministry of Industry, Tourism and Commerce)

Project title: Synthesis and manipulation of two-dimensional molecular spin networks

Principal Researcher: ICREA Prof. Pietro Gambardella

Funding: MICINN (Ministry of Science and Innovation)

Project title: Synthesis of nanoparticles and nanostructured materials by self-assembly

Principal Researcher: ICREA Prof. Víctor F. Puntès

Funding: MICINN (Ministry of Science and Innovation)

Project title: Using magnetic interactions to control the magnetic properties of nanostructured systems

Principal Researcher: ICREA Prof. Josep Nogués

Funding: MICINN (Ministry of Science and Innovation)

COMMERCIAL PROJECTS

Project title: Encapsulation of fragrances in metal-organic microsystems for controlled release in textiles

Principal Researcher: Ramón y Cajal Researcher Dr. Daniel Maspoçh

Funding: Commercial contract

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