IMB-CNM Instituto de Microelectrónica de Barcelona - Centro Nacional de Microelectrónica

Biennial Report

2013-2014

CSIC
Consejo Superior de Investigaciones Científicas

Centro Nacional de Microelectrónica IMB

Contents

Foreword

This report summarizes the main results achieved in the biennium 2013-2014 at the Institute of Microelectronics of Barcelona (IMB), part of the Centro Nacional de Microelectrónica (CNM-CSIC).

This period coincides with the beginning of the Horizon-2020 Framework Programme of the European Commission and with the Spanish State Plan of R&D&I, and this means that a big effort has been made to adapt the research and innovation activity of the institute to the new objectives of such Framework Programmes.

Looking at the results achieved we can now conclude that IMB-CNM (CSIC) is well positioned to be a good partner both for the development of new Micro and Nano Technologies, Components and Systems (which are considered Key Enabling Technologies -KET's- by the European Commission) and also for the application of such technologies to the solution of the Societal Challenges that the European citizens are facing now.

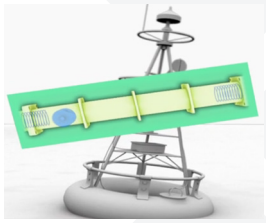
We hope that the summary will be of your interest and we thank you for your collaboration if you are already one of our well-appreciated partners in the field. If not yet, we invite you to visit us and our laboratories in Bellaterra, an important R&D cluster located very close to Barcelona. My colleagues and I will be very pleased to host you.

Carles Cané
Director

Research highlights

Repsol Foundation Award 2013

The project of Smalle Technologies was one of the eight winners of the Entrepreneurs Fund of the Repsol Foundation in 2013. It is a microgenerator which produces electrical energy from mechanical energy, coming from the random oscillations produced by sea waves. Smalle Technologies is a spin-off created with the participation of Prof. Jaume Esteve and Dr. M.Cruz Acero.



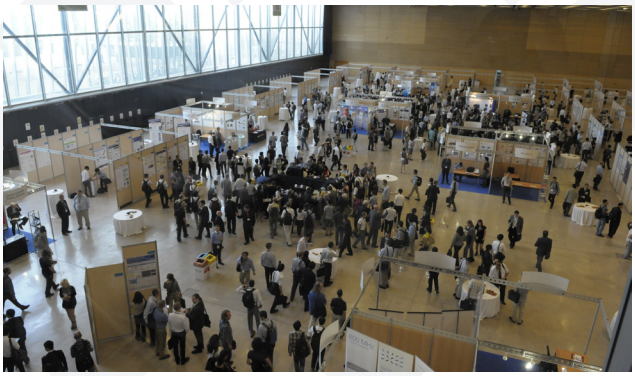
smalle Technologies

IMB-CNM researchers awarded at the ECS 2014 Electrochemical Energy and Water Summit

The PowerPAD concept, a biodegradable electrochemical power source presented by Neus Sabaté and Juan Pablo Esquivel was awarded $50,000 at the Electrochemical Energy and Water Summit organized by the Electrochemical Society (ECS) in Cancun, Mexico on October 5th-9th, 2014. In its first "Science for Solving Society's Problems Challenge," ECS partnered with the Bill & Melinda Gates Foundation to leverage the brainpower of the many scientists in electrochemistry and solid state science and technology that regularly attend ECS meetings. ECS awarded $210,000 of seed funding to four innovative research projects addressing critical technology gaps in water, sanitation, and hygiene challenges being faced around the world. A team composed by Dr. N. Sabaté, Dr. J.P. Esquivel and Dr. E. Kjeang assessed the Monitoring and Measurement challenge by proposing the development of a non-toxic portable source of power for water measuring and monitoring systems, which will not require recycling facilities. Using inexpensive materials such as paper, nanoporous carbon electrodes and organic redox species, they will strive to create a biodegradable and even compostable power source.

Transducers 2013

The 17th International Conference on Solid-State Sensors, Actuators and Microsystems (Transducers 2013) was held in Barcelona, Spain, from June 16th to June 20th, 2013. Transducers is the world's premiere conference in MEMS sensors, actuators and integrated micro and nano systems, showcasing major technological, scientific and commercial breakthroughs in mechanical, optical, chemical and biological devices and systems using micro and nanotechnology. Several IMB-CNM researchers were involved in the organization committee: Prof. J. Bausells (Sponsoring and Promotion Chair), Prof. C. Cané (Industrial and Commerzialization Chair), Prof. J. Esteve (Short Course Chair) and Prof. F. Pérez-Murano (Publication Chair).



The 17th International Conference on Solid-State Sensors, Actuators and Microsystems

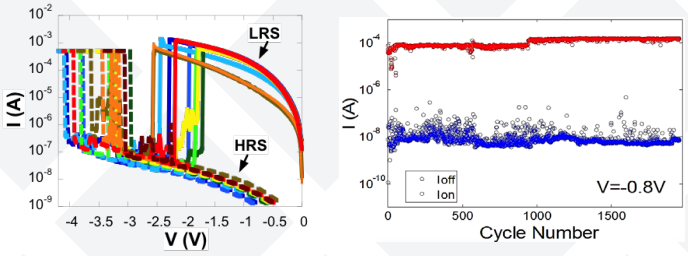
TRANSDUCERS '2013 barcelona & EUROSENSORS XXVII

HfO_2-based devices as RRAM memory cells

Electrically programmable Resistive Random Access Memories (RRAM) based on metal-insulator-metal configurations are considered a promising candidate for next generation non-volatile memory devices, because of their fast operation speed, low power consumption, high scalability and high density 3-D integration. Within this framework, the

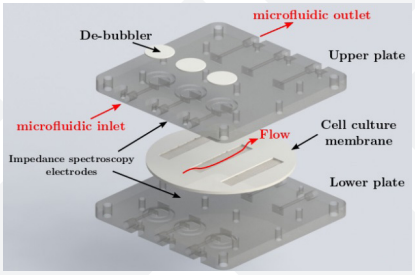
Research highlights

Advanced Thin Dielectric Films Group designs and fabricates MIS and MIM capacitors based on ALD dielectrics, as the base structure for RRAM memory cells. The statistical physics, the impact of the processing conditions and electrode/dielectric material combinations on the switching properties are investigated. Results on Ni/HfO_2-based structures show a unipolar resistive switching behavior with a large window between the Low Resistance State (LRS) and High Resistance State (HRS) currents and good cycle-to-cycle variability. This work has been published in IEEE Trans. Device and Materials Reliability, 14, 769 (2014).



Biomedical applications

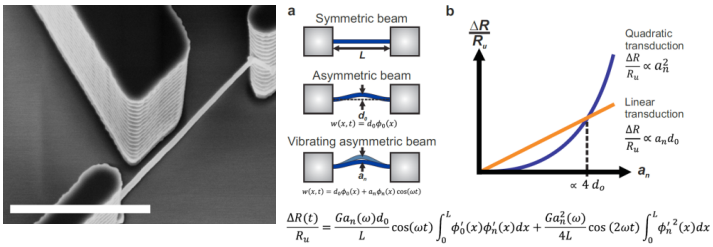
The Biomedical Applications Group (GAB) has enhanced its research lines on “Organ on a chip” and on graphene-based neurodevices. The membership to CIBER-BBN has allowed the integration on the Graphene Flagship through the project Neurographene which GAB coordinates.



Organ in chip: microfluidic system for monitoring the permeability of the hematoencephalic barrier.

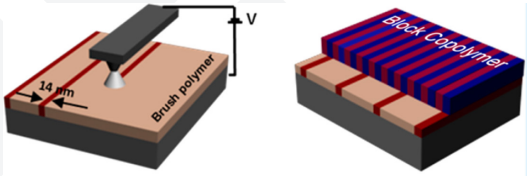
NEMS and nanofabrication

The NANONEMS group has made relevant contributions on nanoelectromechanical systems. A new phenomena has been discovered in the piezoresistive transduction of silicon nanowires, which results in an increased sensitivity in the detection of the oscillation in mechanical resonators. This finding can be applied to sensors with a higher sensitivity and integration.



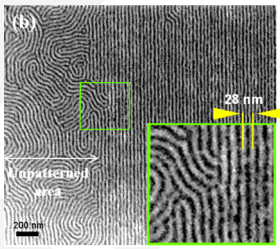
Images from M. Sansa et al., High-sensitivity linear piezoresistive transduction for nanomechanical beam resonators, Nature Communications 5 (2014) 4313.

Relevant results have also been obtained in the nanofabrication area. The group participates in three European projects for the development of lithography methods for the fabrication of electron devices with sub-10 nm critical dimensions. These are focused on the directed self-assembly of polymers for the large scale fabrication of high-resolution features. This technology is currently being considered as a complement for the standard optical lithography to allow the continuation of Moore’s law in the microelectronics industry.



Guiding patterns by AFM nano-lithoghaphy

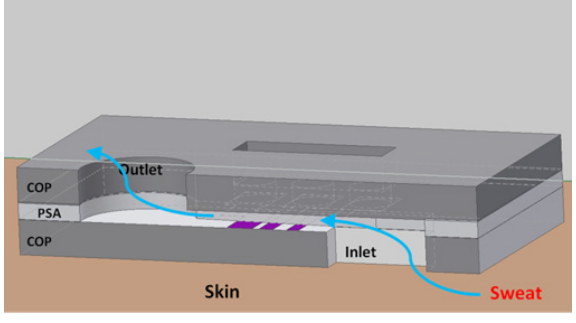
Block co-polymer directed self-assembly



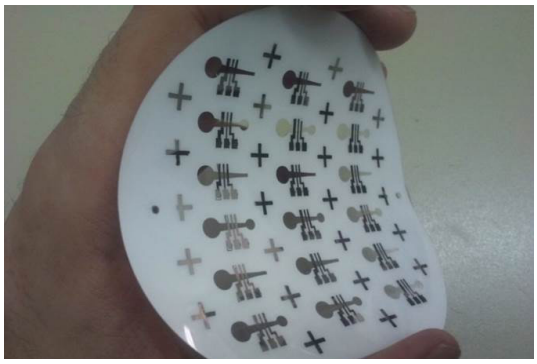
Images from M. Fernández-Regúlez et al., Sub-10 nm resistless nanolithography for directed self-assembly of block copolymers, ACS Applied Materials & Interfaces 6 (2014) 21596.

Non-invasive biomedical devices for sweat test

Lactate is a biomarker of cellular fatigue, a waste product of anaerobic glucose breakdown (occurs under high intensity exercise or oxygen delivery impaired). Lactate concentration in blood is an interesting biomedical parameter for wellness monitoring. Endurance of sportspersons can be improved by lactate measurements. The BioMEMS

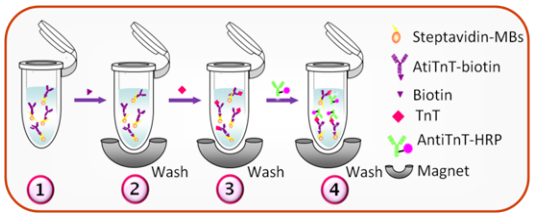


group developed a non-invasive biomedical device for lactate monitoring in sweat.



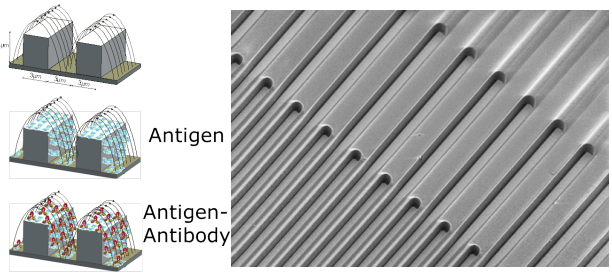
Microfluidic biodevices

This work addresses two important types of diseases that are leading cause of deaths worldwide (infectious and cardiovascular diseases). To detect the disease biomarkers, the BioMEMS group has developed a cyclo-olefin polymer (COP) microfluidic chip that integrates a series of channel microband electrodes, and a capture zone in which functionalized magnetic particles are used as carriers.



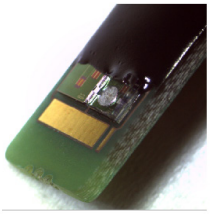
KIT-Alzheimer

To contribute to the study of the Alzheimer disease, the BioMEMS group has achieved the determination and quantification of biomarkers (protein tau, tau phosphorilated, peptide beta amyloid 1-40, 1-42…) in cerebrospinal fluid (CSF) using an immunosensor based on a patented 3D - impedimetric transducer.



pH sensor patent licensed

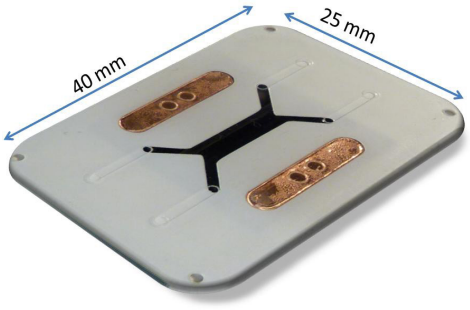
The Chemical Transducers Group has developed a new low-cost ISFET-REFET pH sensor. The patented technology has been licensed to the startup company DEVICARE, which is bringing to the market a self-monitoring device for kidney stone patients based on this sensor. Different technological challenges related to packaging, ESD sensitivity, and REFET microfluidics had to be overcome in order to achieve the required reliability, usability, and life-time.



Pyrolized bioelectrodes for micro-fluidic fuel cells

A novel glucose micro-biofuel cell (GBF) featuring pyrolyzed photoresist film (PPF) electrodes has been developed. The PPF electrodes are made on silicon wafers using a rapid thermal process, and they are subsequently encapsulated in a double Y-shaped microchannel entirely made of polymeric material. The electrodes were modified with MWCNT/laccase/TEBAB-Nafion for the biocathode and GOx/Fc-C6-LPEI for the bionanode.

In a microfluidic fuel cell, fuel and oxidant streams flow in parallel in the same channel without mixing. This avoids the need of a separation membrane reducing internal losses. Glucose is the fuel oxidised at the anode and oxygen is the oxidant reduced at the cathode employing enzymes to catalyse the chemical reactions. This opens the path of using the sample under test itself as the energy source for the sensing. In this way, pyrolyzed photoresist films, PPFs, are introduced for the first time as a suitable electrode material for the development of enzyme-based microfluidic fuel cells. The microfluidic device is fabricated using laminated polymers and it is compatible with low cost and roll-to-roll mass manufacturing techniques. This work was awarded with a Best Poster Award in the Bioelectrochemistry 2013 conference.



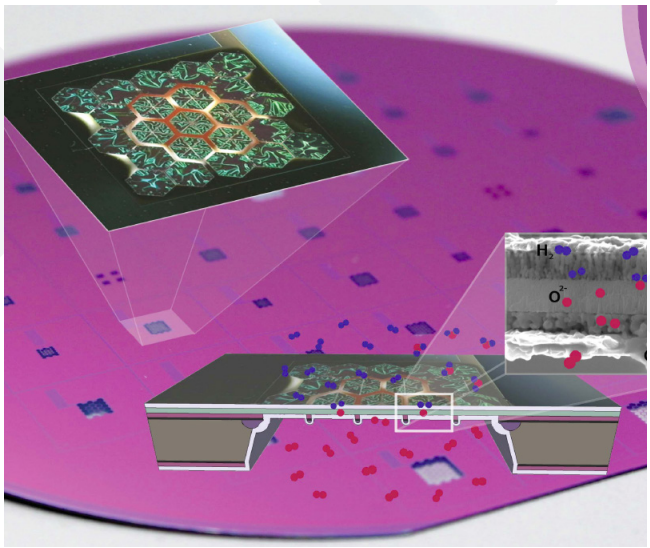
Research highlights

Full ceramic micro solid oxide fuel cells: towards more reliable MEMS power generators operating at high temperatures

A full ceramic large area (2 mm^2) µSOFC has been presented for the first time. These fuel cells have been achieved at wafer level. Using silicon micro and nanofabrication techniques self-supported membranes were fabricated on which the ceramic layers were deposited afterwards by Pulsed Laser Deposition at IREC. A porous LSC thin film was used as the cathode, a dense membrane of YSZ as the electrolyte, and a porous CGO thin film as the anode.

The thermo-mechanical stability of the resulting membrane was proved up to 750°C, well beyond the up-to-now reported operating temperatures of µSOFCs (<550°C)

A maximum power density of 100 mW/cm^2 was measured at 750°C, under pure H_2 as a fuel and synthetic air as an oxidant, for a total power per cell of 2 mW. The (self-sustained) high temperature of operation permits the use of more complex fuels (alcohols and hydrocarbons) in this type of fuel cell. This work in collaboration between CNM and IREC merited the journal cover of the Energy and Environmental Science journal number on which it was published (November 2014)



Intracellular chips

In 2013, we demonstrated the first intracellular chip, a mechanical sensor, which can detect pressure changes inside living cells and transmits the information without any physical contact. The devices were fabricated by silicon-based technologies and photolithographic processes which allowed the fabrication of millions of devices on a 100 mm diameter silicon wafer. The chip, with dimensions 6 µm x 4 µm x 400 nm, consists of two 50 nm thick polysilicon mechanical membranes separated by a vacuum gap of 300 nm to form a Fabry–Pérot resonator. An external pressure bends the membranes, which changes the gap and shifts the spectrum of the optical resonator. Thus, the pressure changes can be quantified from the intensity of the reflected light. These NanoOptoMechanical Systems (NOMS) were internalized inside living HeLa cells without affecting the cell viability. We demonstrated that extracellular hydrostatic pressure is transmitted into HeLa cells and that these cells can endure hypo-osmotic stress without significantly increasing their intracellular hydrostatic pressure.

Research activities

Integrated circuits and systems

The ICAS group research and development activities are in the framework of microelectronics and devoted to three main domains with different expertise key-words:

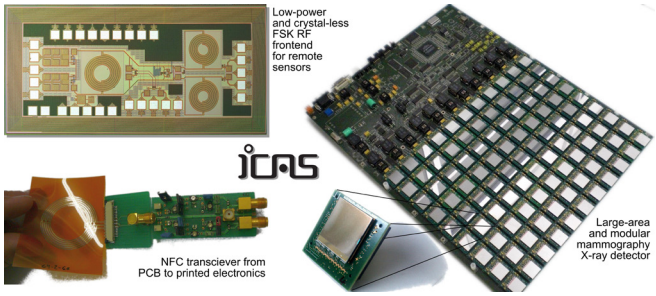
1. Integrated Circuits and Systems
   a. Very low-power analog, mixed and RF CMOS circuit design.
   b. Massive multi-channel sensing systems.
   c. Inductively powered systems.
   d. Low-range RF transceivers.
   e. Specific analog design for digital CMOS technology.

2.Flexible and Organic Printed Electronics
   a. Technology characterization and design kits development.
   b. Circuits and cell libraries design.
   c. EDA components development and design flows/tools customization.

3.Electronic Systems and Platforms
   a. Flexible platform based design.
   b. Multi-technological modeling and simulation.
   c. Digital SoC platform based design and IP integration.

There is a close cooperation among those activity lines and expertise, as well as other R&D groups, in order to improve, apply and exploit the micro/nano-technologies for advanced applications like:

- Visible, infrared and X-ray analog & digital imagers.
- Integrated sensor and actuator N/MEMS interfaces.
- Multi-technological modeling and simulation.
- Low-power RF frontends for wireless sensors.
- Remote-powered and body-implantable systems.
- SoC & System electronics based on flexible platforms.
- NFC modules based on std. PCB or flexible/organic printed electronics.
- Library cells & design kits for Silicon or Flexible/Organic based technologies.



Research activities

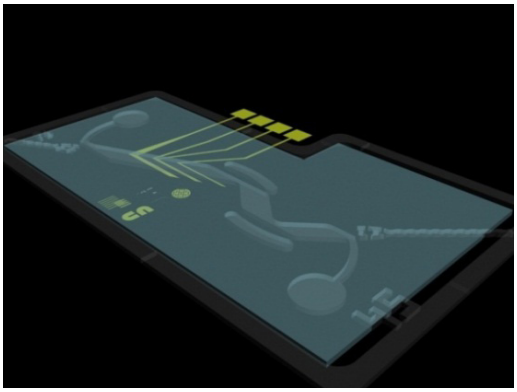
Lab on a Chip (LoCs) based on (bio) chemical transducers

The activity of the Chemical Transducers Group (GTQ) is devoted to the development of new microanalytical systems and Lab on a Chip (LoCs) based on (bio)chemical transducers and new concepts of fluidic structures. Different transduction principles and/or signal propagation media are used: electrochemical devices and photonic/ integrated optical devices. Electrochemical devices used are ISFET sensors, metal thin film microelectrodes for voltammetric and impedimetric detection (IDE). Besides, biosensors are developed –immunosensors and enzymatic sensors- modifying the sensing area with nanomaterials and biorecognition elements. Regarding optical systems different components (lens, filters, emitters and waveguides) are monolithically integrated to achieve photonic systems for spectral response, dispersion and phase change variation. Multisensor arrays based on several transducers are also developed for multiparametric detection.

The technology approach for LoC fabrication is adapted to the final application and integrates in a monolithic and/or hybrid way the different elements (sensors, microfluidic passive and active elements). This technology goes from silicon to micromachining, micro milling processes and soft lithography and uses materials like PDMS, SU8, hybrid xerogels, PMMA and waxes.

The main objective is to achieve the complete automation of all processes (analysis, sampling, counting, etc.) within a microsystem and the consumption of low sample and reactive volumes. For that, different technologies and designs are proposed:

- LoCs fabricated with PMMA and silicon chips for multiparametric analysis of waters and wines integrating electrochemical sensors for detection.
- LoCs based on PDMS and optofluidics including filters, waveguide structures, emitters, microreactors and channels applied to cell content.
- LoCs integrating silicon chips and microfluidic structures made of polymers for detection of metabolites in cell cultures.
- Microarray readers for DNA and protein detection.

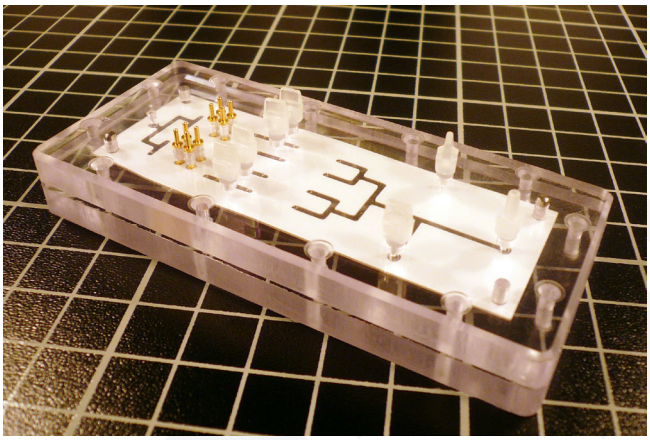


Micro-nano-bio systems

Design and development of novel micro and nanosensors and complex and compact miniaturized systems for biological and biomedical applications. The various steps of device design, characterization, encapsulation and packaging, as well as customized electronic instrumentation are approached from the initial conception to the final biodevice in order to generate knowledge, micro-nano devices and complete systems with high added value.

Activities include the development of new technologies and tools for the detection, identification, quantification, and monitoring of molecules, cells and tissues of clinical and biomedical relevance. Research focuses in:

- Micro-Nano systems for diagnosis.
- On-chip environmental health monitoring.
- Nano-Bio-Electronic Interfaces.
- NanoBioFuel cells.
- Nanobioelectrochemistry.



Application of a three dimensional interdigitated electrode array as a transducer for label free immunochemical analysis. Development of a miniaturised system for determination of 4 protein biomarkers of Alzheimer disease and biomarkers (tryptophan-kynurenine-serotonine) of other neurodegenerative diseases (Huntington disease and several mental disorders, such as the major depressive disorder, sleep disorders or schizophrenia).

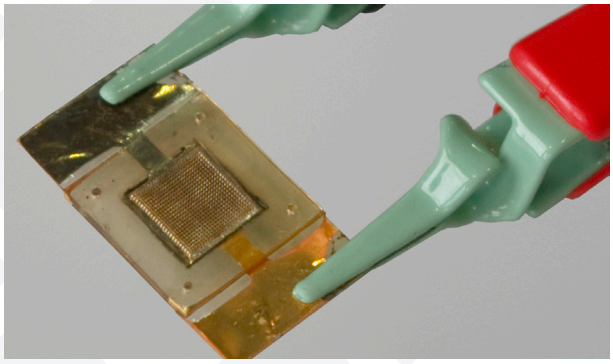
Application of ion-sensitive field effect transistors (ISFETs) for biochemical analysis. Development of a semiautomatic system for rapid determination of calcium ion level in bovine blood samples for medical diagnostic purposes.

Micro-nanotechnologies

The general objective is the advanced research and development on new processes, devices and sensors for Integrated Circuits, MEMS, NEMS and Smart Systems, mainly using silicon based micro nano technologies. More specifically, the work includes research at different levels of integration such as design, simulation, fabrication, characterization and optimization tasks for:

· Processes and micro-nanoelectronic technologies and their integration (More Moore approach).
· Sensors and micronanosystems (More than Moore approach).
· Application-oriented smart systems and subsystems for fields such as medical, environment, food, energy, telecom, particle physics, space, etc.

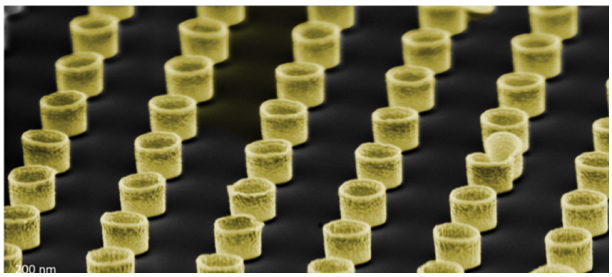
Specific topics addressed are: high-k dielectrics, reliability of devices and technologies, CMOS-MEMS, SOI-MEMS, micronanotools, MOMS/NOMS, 3-D heterogeneous integration and 3-D architectures that may be used for radiation sensors, thermally isolated micronanostructures for gas sensors, or power MEMS (microfuel cells and energy harvesting based on nano-thermoelectricity and piezoelectricity).



Nanofabrication and nanostructures

This activity is dedicated to research on electronic and electromechanical properties of nanostructures, with potential to provide new or enhanced functions to nanodevices and nanosystems, as well as advanced methods for nanofabrication. The main research topics are:

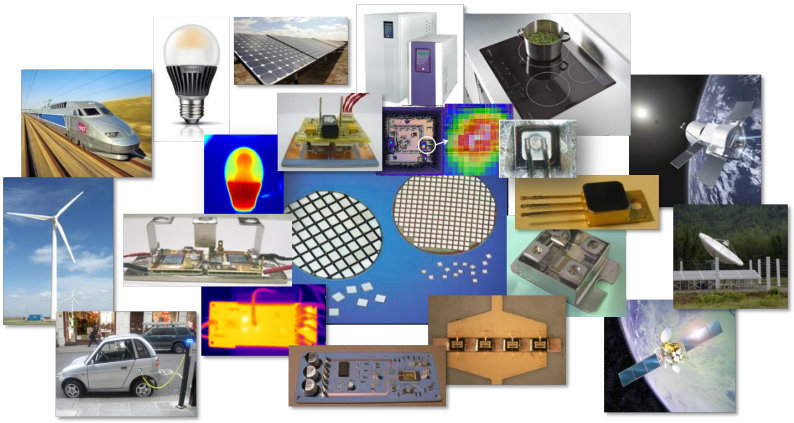
· Study of the performance and applicability of nanoelectromechanical systems (NEMS): development of manufacturing methods, transduction methods, system integration and applications. Application of NEMS as nanomechanical sensors, especially in the field of biomedicine.
· Study of the performance and applicability of nanoelectronic devices for applications in circuits and sensors.
· Development of new nanofabrication methods based on top-down techniques (AFM, e-beam, FIB, NIL) and bottom-up synthesis (nanotubes and nanowires). Nanostructure fabrication guided by self-assembled block copolymers. Combination of methods top-down and bottom-up for the future development of micro/nano electronics.
· Development of AFM methods for (i) the functional characterization of nanoelectromechanical systems and (ii) characterization of electromechanical properties of nanostructures and surfaces.



Power Devices and Systems

The activities include research on innovative and breakthrough technologies of power devices and systems for efficiency improvements and energy consumption reduction, with special emphasis on automotive, transport, aerospace, renewable energy and energy distribution applications. Specifically:

1. Silicon Based Power Devices: Design and fabrication of application oriented power devices (IGBT, VDMOS, LDMOS, Super-Junction MOSFETs). Radiation effects on power devices and their use as detectors in high energy physics.
2. Wide Band Gap Semiconductor Devices: Modelling and set up of optimized technologies for Wide Band Gap semiconductor (SiC, GaN, Diamond, Graphene on SiC) processing, design and implementation of novel power devices.
3. Power Systems Integration and Reliability: Development of new technologies for improving power systems integration. Main activities focused on Thermal Management, Power Packaging, Electro-thermal Characterization and Reliability.



Main projects

RUE: Wide band gap advanced devices for the Rational Use of Energy

Coordinator: José Millán (IMB-CNM)

Dates: December 2009 to December 2014.
Reference: CSD2009-00046
Funding Agency: MICINN-DG Investigación (Consolider-Ingenio 2010 Programme)
Total Project funding: 4.560.000 €
IMB-CNM funding: 1.112.869 €

Participants

- IMB-CNM (CSIC): Coordinator
- Universidad de Oviedo, Spain
- Universidad Politécnica de Madrid, Spain
- Universidad de Zaragoza, Spain
- Universitat Rovira i Virgili, Spain
- Fundación Robotiker (ROBOTIKER TECNALIA), Spain
- Universitat Politècnica de Catalunya, Spain
- Universidad de Valencia, Spain

Summary

The Project is focused on the development of power devices using the outstanding properties of wide band gap semiconductor materials: Silicon carbide (SiC) and Gallium Nitride (GaN). The main objective is the development of a first generation of new wide band gap power semiconductor devices. These would lead to an important improvement in the performances of existing converters and the development of new converters, achieving in both cases a more rational use of electrical energy. The improvements are due to the exceptional properties of the SiC and GaN materials, which show a very favorable tradeoff between their theoretical electrical behavior (high capacity for voltage blocking, high temperature operation and high frequency commutation) and the commercial availability of starting substrates (wafers) added to the level of development of their technological processes.

HIP-LAB: High-throughput integrated photonic lab-on-a-DVD platforms

Coordinator: Andreu Llobera (IMB-CNM)

Dates: October 2008 to September 2013
Reference: 209243
Funding agency: European Union (Support for frontier research - ERC Starting Grant)
Total project funding (IMB-CNM): 1.717.200 €

Summary

The main aim of the proposed research line is to develop high-throughput ultrasensitive photonic lab-on-a-DVD for multiple parallel analyses with an extremely high degree of integration. The already existing high-throughput platforms only use the CD platform as a substrate without any given functionality. Conversely, in this research line, the DVD platform will integrate the following elements:

(i) Polymeric photonic components (high-sensitivity Mach-Zehnder interferometers, diffraction gratings and hollow structures). (ii) Polymeric microfluidics (hydrophobic valves and mixers). (iii) Chemical modification of the surface with functional groups prone to interact with the specific analyte and (iv) the necessary information storage in the DVD tracks related to the parameters required (spin speed, position and number of photonic systems, etc) for the measurement in a modified DVD reader. Additionally, a new setup will be mounted, in which a second DVD-header will be incorporated, in such a way that simultaneous high-throughput measurements could be easily performed with the different photonic elements included in the platform.

As compared to the existing platforms, the presented research line requires the establishment of a dynamic multidisciplinary group comprising experts of photonics, microfluidics, (bio) chemistry and electronics. The results obtained herein will allow the definition of an advanced photonic high-throughput lab-on-a-DVD platform that will definitely have a large number of application fields, ranging from molecular diagnosis to analytical chemistry or proteomics.

REWARD: Real Time Wide Area Radiation Surveillance System

Coordinator: Manuel Lozano (IMB-CNM)

Dates: December 2011 to November 2014
Reference: 284845 (FP7 SEC-2011.1.5-1 IP)
Funding agency: European Union (Collaborative Project-IP)
Total project funding: 3.020.795 €
IMB-CNM funding: 661.013 €

Participants

- IMB-CNM (CSIC): Coordinator
- Sensing & Control Systems SL, Spain
- Instituto Tecnologico Nuclear, Portugal
- Albert Ludwigs University Freiburg, Germany
- X-Ray Imaging Europe GmbH, Germany
- EDISOFT-Empresa de Servicios e Desenvolvimento de Software SA, Portugal
- Giunta Regionale della Catania, Italy

Main Projects

Summary

We propose a novel mobile system for real time, wide area radiation surveillance. The system is based on the integration of new miniaturized solid-state radiation sensors: a CdZnTe detector for gamma radiation and a high efficiency neutron detector based on novel silicon technologies. The sensing unit will include a wireless communication interface to send the data remotely to a monitoring base station which also uses a GPS system to calculate the position of the tag.

The system will also incorporate middleware and high level software to provide web-service interfaces for the exchange of information, and that will offer top level functionalities as management of users, mobile tags and environment data and alarms, database storage and management and a web-based graphical user interface. Effort will be spent to ensure that the software is modular and re-usable across as many architectural levels as possible. Finally, an expert system will continuously analyze the information from the radiation sensor and correlate it with historical data from the tag location in order to generate an alarm when an abnormal situation is detected. The system will be useful for many different scenarios such as nuclear terrorism, lost radioactive sources, radioactive contamination or nuclear accidents. It will be possible to deploy in emergency units and in general in any type of mobile or static equipment, but also inside public/private buildings or infrastructures. The sensing units will be highly portable thanks to their low size and low energy consumption. The complete system will be scalable in terms of complexity and cost and will offer very high precision on both the measurement and the location of the radiation. The modularity and flexibility of the system will allow for a realistic introduction to the market. Authorities may start with a basic low cost system and increase the complexity of it based on the latest needs and also on the budget.

◆ LIPHOS: Living Photonics: Monitoring light propagation through cells

Coordinator: Andreu Llobera (IMB-CNM)

Dates: November 2012 to October 2015
Reference: 317916
Funding agency: European Union (FP7-2011-7 ICT-SME)
Total project funding: 3.200.000 €
IMB-CNM funding: 631.473 €

Participants

- IMB-CNM: Coordinator
- Rijksuniversiteit Groningen, The Netherlands
- Aarhus Universitet, Denmark
- Dublin City University, Ireland
- iXscient Limited, United Kingdom
- Cellix Ltd., Ireland
- LIONIX BV, The Netherlands

Summary

The objective of the LIPHOS project is to apply cell-based photonic systems to study cardiovascular diseases (CVD). The high incidence of CVD - responsible for around 48% of the deaths every year in EU- brings consequences not only to the health care systems of the countries, but on their global economy. Overall CVD costs are estimated to be €192 billion/year for the EU economy. LIPHOS project provides with a realistic, however disruptive possibility of reducing the CVD impact in the society and in the global economy, as well as providing with huge market possibilities to the companies involved. These objectives are assured with the cutting-edge research profile of the consortium.

◆ GreenFETs: GaN based Power Semiconductor Devices

IMB-CNM IP: Philippe Godignon

Dates: July 2009 to December 2013
Funding: ON Semiconductor Belgium BVBA
IMB-CNM contract funding: 596.800 €

Summary

The objective of this contract is to develop GaN-based power transistors for high voltage (i.e. above 650V) power switching applications. The strategy is to develop GaN-on-silicon wafers on 4 inch substrates, with a clear development roadmap to 6 inch material at the end of the project for cost-effectiveness. The main focus will be on a lateral HEMT design. Specific device developments are planned for making normally-off lateral HEMTs, as well as vertical transistors.

◆ WIDESENS: Water Network Sensors for widespread use

IMB-CNM IP: Cecilia Jiménez-Jorquera

Dates: September 2013 to November 2015
Reference: 605802
Funding agency: European Union (FP7-SME-2013-1: Research for SMEs)
Total project funding: 911.012 €
IMB-CNM funding: 561.275 €

Coordinator: Wellnes Telecom (Spain).

Summary

WIDESENS aims to design and develop a prototype analytical drinking water probe and its

complementary applications for in-pipe water quality measurement with ideal specifications for a wide deployment. These sensors will be based on microelectronic technologies (ISFET, IDEs and microelectrodes). As a first approach they will measure pH, conductivity, bio-fouling, oxidative reduction potential (ORP) and chlorine. Also special mechanics and electronics will be fabricated to achieve self-calibration and maintenance procedures, long lifetimes and remote monitoring. Finally, leak-detection will also be enabled through pressure sensors.

SINERGY: Silicon friendly materials and device solutions for microenergy applications

Coordinator: Luis Fonseca (IMB-CNM)

Dates: November 2013 to October 2016
Reference: 604169-1
Funding agency: European Union (FP7-NMP-2013-SMALL-7)
Total project funding: 3.794.913 €
IMB-CNM funding: 920.607 €

Participants

IMB-CNM: Coordinator.
- Confindustria Emilia Romagna, Italy.
- ELECTROLUX Italia S.P.A., Italy.
- Institut de Recerca en Energia de Catalunya (IREC), Spain.
- Interuniversity Microelectronics Centre (IMEC), Belgium.
- IMEC (NL), The Netherlands.
- Università di Milano Bicocca, Italy.

Summary

The project addresses the development of energy harvesting and storage materials suitable for solving energy autonomy issues of devices working in low-power and/or pulsed regimes (nano/microdevices, medical implants, smartcards, sensor networks, etc). Its focus is on the microdomain to obtain small size devices with high energy density features, and on the silicon technology friendliness of those materials (and approaches) to assure the eventual manufacturability, integratability and cost effectiveness of the related devices/solutions. IMB-CNM contributes technologically with thermoelectric devices and mechanical energy harvesters integrating nanomaterials (Silicon nanowires and ZnO nanowires & nanosheets, respectively).

SNM: Single Nanometer Manufacturing for beyond CMOS devices

IMB-CNM IP: Francesc Pérez-Murano

Dates: January 2013 to December 2016
Reference: 318804
Funding agency: European Union (FP7-ICT-2011-8)
IMB-CNM funding: 517.046 €

Coordinator: Technische Universitaet Ilmenau, Germany.

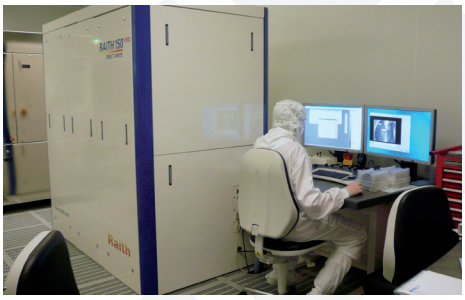
Summary

To extend beyond existing limits in nanodevice fabrication, new and unconventional lithographic technologies are necessary to reach Single Nanometer Manufacturing (SNM) for novel “Beyond CMOS” devices. Two approaches are considered: scanning probe lithography (SPL) and focused electron beam induced processing (FEBIP). The project tackles this challenge by employing SPL and FEBIP with novel small molecule resist materials. The goal is to work from slow direct-write methods to high speed step-and-repeat manufacturing by Nano Imprint Lithography (NIL), developing methods for precise generation, placement, metrology and integration of functional features at 3 - 5 nm by direct write and sub-10nm into a NIL-template. The project will first produce a SPLtool prototype and will then develop and demonstrate an integrated process flow to establish proof-of-concept “Beyond CMOS devices” employing developments in industrial manufacturing processes (NIL, plasma etching) and new materials (Graphene, MoS_2). By the end of the project: (a) SNM technology will be used to demonstrate novel room temperature single electron and quantum effect devices; (b) a SNM technology platform will be demonstrated, showing an integrated process flow, based on SPL prototype tools, electron beam induced processing, and finally pattern transfer at industrial partner sites. An interdisciplinary team (7 Industry and 8 Research/University partners) from experienced scientists will be established to cover specific fields of expertise: chemical synthesis, scanning probe lithography, FEBIP-Litho, sub-3nm design and device fabrication, single nanometer etching and step-and-repeat NIL and novel alignment system.

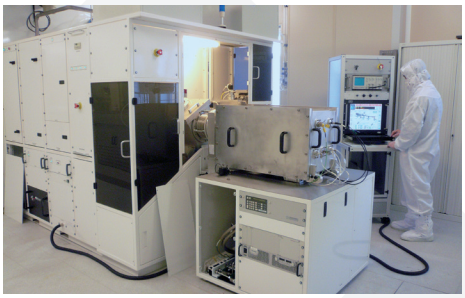
Facilities

General view

Matallization and RIE area



Electron beam lithography system



Ion implantation system

Advanced packaging laboratory

Electrical characterization laboratory

The IMB-CNM large scale facility (ICTS – Singular Scientific and Technological Facility)(1) includes a clean room for integrated micro and nanofabrication, a test and characterization service and a packaging service.

The clean room (total surface 1500 m^2) integrates microelectronic fabrication processes, microsystem technologies and nanofabrication equipment, such as electron beam lithography, nanoimprint lithography and focused ion beam. A complete CMOS integrated circuit fabrication line is available. In addition, microsystems-dedicated equipment allows working with materials such as metals or etching solutions that could contaminate CMOS-dedicated machines. The whole set of processes runs on 100 mm diameter silicon wafers, and there is a partial capability for 150 mm diameter wafers.

Two access modalities are available for users: order of process runs which are performed by the clean room personnel, and qualified self-service, which is available for specific equipment.

An external access programme (GICSERV) has been available from 2006 to 2012, with funding from the Spanish Ministry of Science and Innovation, to allow academic external users to access the ICTS services for free, for projects of limited complexity. Up to 282 projects have been funded in this way from Spain, the European Union and (since 2010) Latin-American countries.

In addition to the ICTS facilities, IMB-CNM has a number of research laboratories dedicated to specific fields:

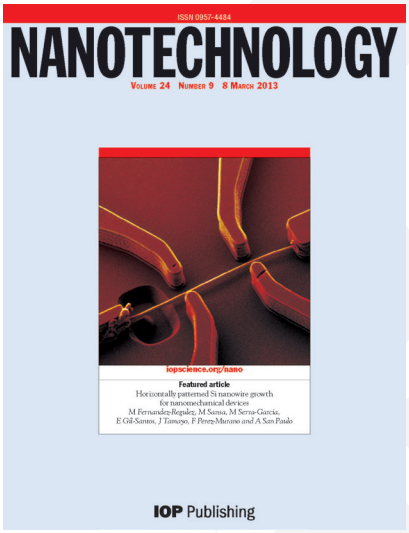
- Microsystems: electrical characterization / sensor characterization.
- Chemical transducers / general chemistry.
- Biochemical systems characterization.
- Power devices / thermal characterization.
- Engineering of electronic systems / test of integrated circuits and systems.
- Integrated optics.
- Radiation detectors.
- Reverse engineering.
- Advanced packaging.
- 3D rapid prototyping.

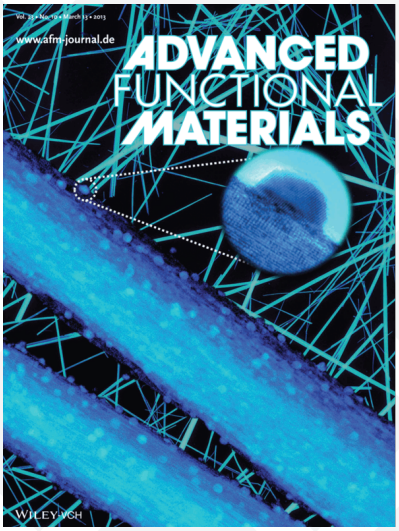
(1) ICTS is an official label given by the Spanish Ministry of Economy and Competitiveness to the Spanish large scale scientific facilities

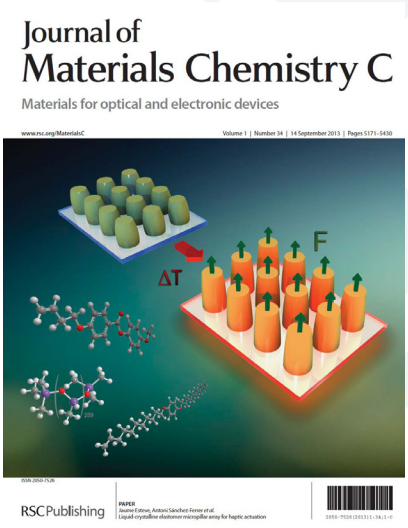
Publications

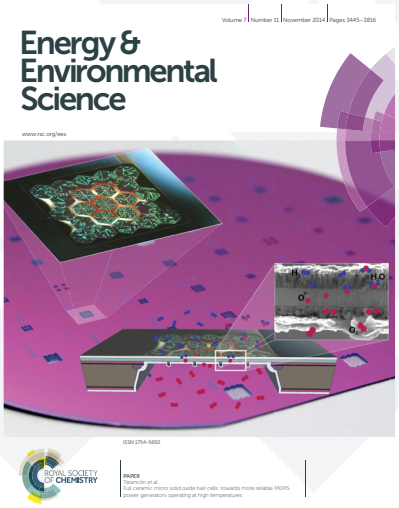
PUBLICATIONS

IMB-CNM has published a total of 111 scientific papers in 2013 and 102 in 2014 in journals included in the Science Citation Index.



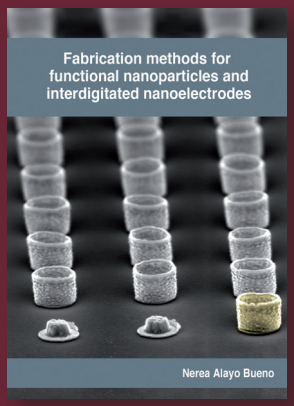




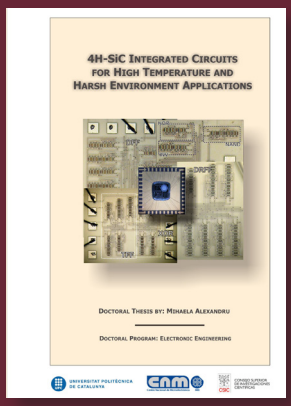


The complete list of publications in scientific journals is available at the IMB-CNM web. The specific page can be accessed through this QR code:

Ph. D. Thesis

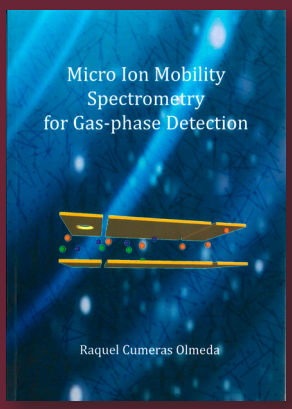


Alayo, Nerea
Fabrication methods for functional nanoparticles and interdigitated nanoelectrodes.
F. Pérez-Murano (dir.), M. del Valle (tutor).
Universitat Autònoma de Barcelona,
Ph.D. in Materials Science, 2013.

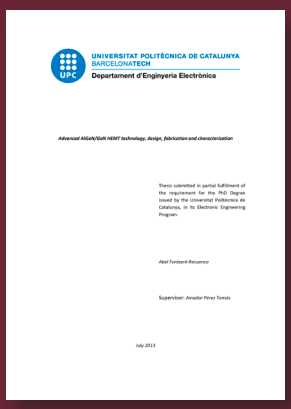


Alexandru, Mihaela
4H-SiC integrated circuits for high temperature and harsh environment.
Ph. Godignon (dir.), F.J. Guinjoan (tutor).
Universitat Politècnica de Catalunya,
Ph.D. in Electronic Engineering, 2013.

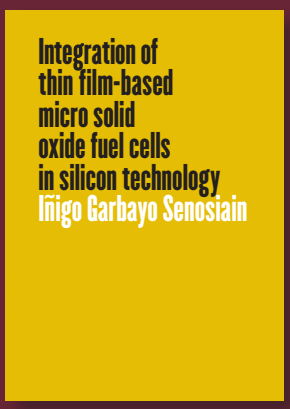
Bonilla, Diana L.
Sistema de lectura eléctrica de microarrays proteómicos.
C. Fernández-Sánchez, A. Baldi (dirs.), J. Sacristán (tutor).
Universitat Autònoma de Barcelona, Ph.D. in Electronic Engineering, 2013.



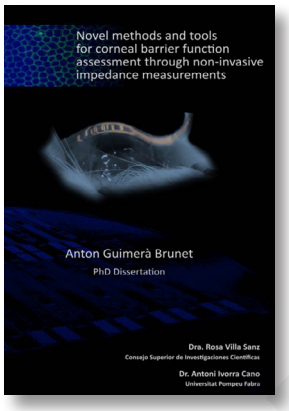
Cumeras, Raquel
Micro ion mobility spectrometry for gas-phase detection.
I. Gràcia, E. Figueras (dirs.), F. Pi (tutor).
Universitat Autònoma de Barcelona,
Ph.D. in Physics, 2013.



Fontserè, Abel
Advanced AlGaN/GaN HEMT technology, design, fabrication and characterization.
A. Pérez Tomás (dir.), R. Alcubilla (tutor).
Universitat Politècnica de Catalunya,
Ph.D. in Electronic Engineering, 2013.



Garbayo, Iñigo
Integration of thin film-based micro solid oxide fuel cells in silicon technology.
A. Tarancón, N. Sabaté (dirs.), F. Peiró (tutor).
Universitat de Barcelona, Ph.D. in Nanoscience, 2013.



Guimerà, A.
Novel methods and tools for corneal barrier function assessment through non-invasive impedance measurements.
R. Villa, A. Ivorra (dirs.), J. Aguiló (tutor).
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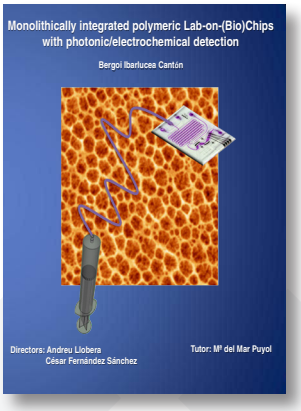
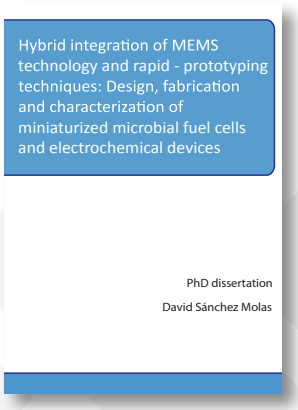
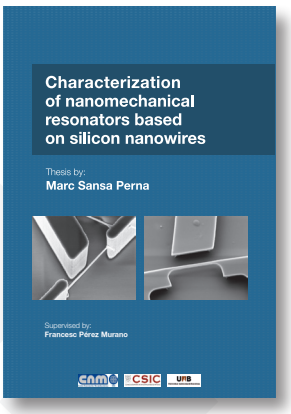


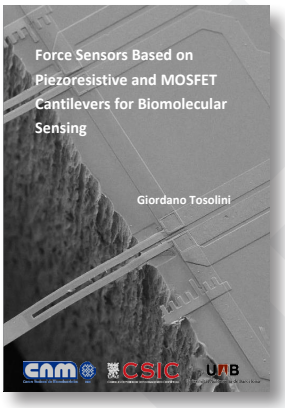
Ibarlucea, Bergoi
Monolithically integrated polymeric lab-on-(bio)chips with photonic/electrochemical detection.
A. Llobera, C. Fernández-Sanchez (dirs.), M.M. Puyol (tutora).
Universitat Autònoma de Barcelona,
Ph.D. in Chemistry, 2013.



Sánchez-Molas, David
Hybrid integration of MEMS technology and rapid-prototyping techniques: ...
F.J. Muñoz Pascual, F.J. Del Campo (dirs.), M.A. Uranga (tutora).
Universitat Autònoma de Barcelona, Ph.D. in Electronic Engineering, 2013.



Sansa, Marc
Characterization of nanomechanical resonators based on silicon nanowires.
F. Pérez-Murano (dir.), N. Barniol (tutor).
Universitat Autònoma de Barcelona,
Ph.D. in Electronic Engineering, 2013.



Tosolini, Giordano
Force sensors based on piezoresistive and MOSFET cantilevers for biomolecular sensing.
J. Bausells (dir.).
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Birhane, Yigezu Mulugeta
Development of conductive SPM probes for applications in biology.
J. Bausells (dir.).
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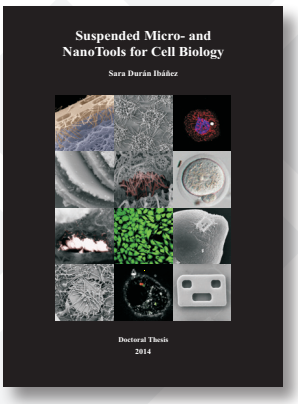
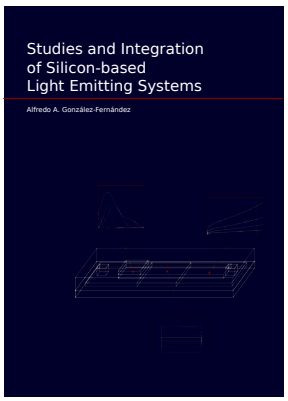
Ph.D. in Electronic Engineering, 2014.

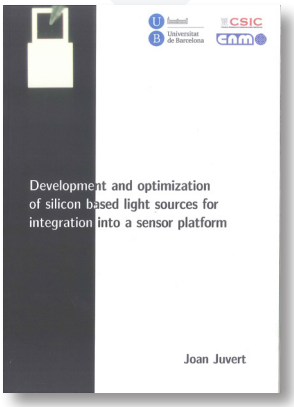


Durán, Sara
Suspended micro- and nano tools for cell biology.
J.A. Plaza (dir.), J. Alonso (tutor).
Universitat Autònoma de Barcelona,
Ph.D. in Chemistry, 2014.

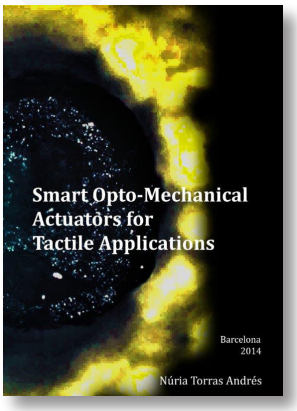
Fernández-Martínez, Pablo
Diseño, fabricación y optimización de detectores con multiplicación (LGAD) para experimentos de física de altas energías.
D. Flores, S. Hidalgo (dirs.).
Universitat Autònoma de Barcelona,
Ph.D. in Electronic Engineering, 2014.



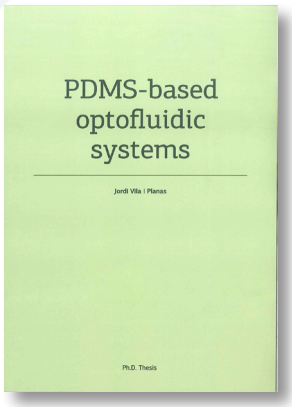
González-Fernández, Alfredo A.
Studies and integration of silicon-based light emitting systems.
C. Domínguez, M. Aceves (dirs.), B. Garrido (tutor).
Universitat de Barcelona, Ph.D. in Physics, 2014.



Juvert, Joan
Development and optimization of silicon based light sources for integration into a sensor platform.
C. Domínguez (dir.), B. Garrido (tutor).
Universitat de Barcelona, Ph.D. in Physics, 2014.



Torras, Núria
Smart Opto-mechanical actuators for tactile applications.
J. Esteve, J. Roig (dirs.).
Universitat Autònoma de Barcelona,
Ph.D. in Microelectronics and Electronic Systems, 2014.



Vila-Planas, Jordi
PDMS-based optofluidic systems.
A. Llobera, X. Muñoz-Berbel (dirs.), J. Mompart (tutor).
Universitat Autònoma de Barcelona, Ph.D. in Physics, 2014.

Technology transfer

Micro and nano electronics, photonics and smart systems have been identified as a fundamental part of the Key Enabling Technologies, which are the basis for the development and the improvement of the innovation capability of the European industry. These technologies have a high economic potential and the capability to contribute to solve the current societal challenges.
The mission of IMB-CNM is, in addition to improve the knowledge in the micro and nano electronics fields, to contribute to the implementation of solutions based in these technologies in industrial products. It has therefore a strong focus on technology transfer activities, which mainly include the creation of spin-off companies and the development of patents.

SPIN OFFS

A number of spin-off companies have been created from the research done at IMB-CNM over the last decade. They are described in this section.

MIRAKONTA SL

www.mirakonta.es

Mirakonta SL has arisen in order to offer and market a hardware-software system universal remote water meter reading by images:
- Remote water meter reading imaging
- Optimization and traceability of waste collection
- Control System Street Cleaning Equipment
- K-Speed, control system for sporting events

X-RAY IMATEK

www.xray-imatek.com

X-Ray Imatek is a company focused on research, development and marketing of X/Gamma-Ray detectors based on Photon Counting technology. They are applied in a large number of sectors such as Medical Imaging, Non-destructive Testing (NDT) or Scientific Research.

MICRO4ENER

www.micro4ener.com

Micro4ener develops, manufactures and markets microsystems for the detection and control of microorganisms.
Fast and low cost bacterial concentration control in water treatment process, reducing the water consumption and increasing the efficiency.
Micro4Ener was one of the seven winners of the first Repsol Entrepreneurs Fund awards (2012) of the Repsol Foundation, to support the best start-up companies providing solutions for energy saving and efficiency.

ALIBAVA SYSTEMS

www.alibavasystems.com

Compact System for Radiation Sensor Characterisation. The Alibava system is conceived to measure ionising radiation with semiconductor detectors, providing high sensitivity to low signals, high position resolution and high speed.

SMALLE TECHNOLOGIES

www.smalletec.com

Energy Harvesting Company. Smalle Technologies has developed an electromagnetic harvester device for scavenging ambient mechanical energy with slow, variable and randomness nature. It has applications in sailboats, oceanographic and navigation buoys.
Smalle Technologies was one of the eigth winners of the second Repsol Entrepreneurs Fund awards (2013) of the Repsol Foundation, to support the best start-up companies providing solutions for energy saving and efficiency.

PATENTS

The intellectual property rights (IPR) of the research results of IMB-CNM are managed according to the rules of CSIC. Initially a patent application is issued at the Spanish level. This corresponds to the section "New patents" below. After a period of time, the patent can be extended to other countries, typically under the PCT (Patent Cooperation Treaty) rules. The corresponding patents are listed under the "International patents" section. The owner of the patents is CSIC, unless otherwise specified.

New patents

Title : Micro-sonda neuronal y procedimiento de fabricación de la misma.
Authors : Sánchez-Vives, M., Godignon, P., Prats, E., Gabriel, G., Villa, R.
Ref.: Spain, appl. P201331895, 2013.

Title: Dispositivo o microbrida útil para la determinación y monitorización de la sección de una estructura.
Authors: Llobera, A., Rodríguez-Rodríguez, R., Muñoz-Berbel, X.
Ref.: Spain, appl. P201331181, 2013.

Title: Procedimiento para ajustar las propiedades ópticas de nanopartículas plasmónicas.
Author: Nsoyani, B.
Ref.: Spain, appl. P201330594, 2013.

Title: Sensor electroquímico de estado sólido y procedimiento para su fabricación.
Authors: Morata, A., Garbayo, I., Tarancón, A., Sabaté, N., Fonseca, L., Salleras, M., Morante, J.R.
Ref.: Spain, appl. P201331791, 2013.

Title: Sistemas optofluídicos y su aplicación en estudios de cristalización de moléculas pequeñas.
Authors: Gómez-Morales, J., Llobera, A., García-Ruiz, J.M., Rodríguez-Ruiz, I.
Ref.: Spain, appl. P201331570, 2013.

Title: Método de preparación de superficies previo al crecimiento epitaxial de grafeno sobre carburo de silicio.
Authors: Godignon, P., Mestres, N., Rius, G.
Ref.: Spain, appl. (Know how) 1340/2014.

Title: Dispositivo multiplicador de electrones micromecanizado y apilable para detección de partículas ionizantes y método de fabricación del mismo.
Authors: Campabadal, F., Lozano, M., Cabruja, E., Esteve, J., Brant, J., Cerqueira, G., Pessoa, H.
Ref.: Spain, appl. P201430176, 2014.

Title: Bioreactor for cell co-culture.
Authors: Illa, X., Villa, R., Massip, M., Peralta, C., Gracia-Sancho, J., Bosch, J.
Ref.: European Patent, appl. EP14157145.5, 2014.

Title: Device for measuring the trans-layer electrical impedance in an in vitro model of a cell barrier.
Authors: Yeste, J., Guimerà, A., Illa, X., Villa, R.
Ref.: European Patent, appl. EP14170509.5, 2014.

Title: Método de obtención de un array de micropartículas planares con multiplexados, molecular superficial array obtenido y su uso.
Authors: Esteve, J., Plaza, J.A., Duch, M., Torras, N., Perez-Garcia, M.L., Agusil, J.P.
Ref.: Spain, appl. P201430864, 2014.

Title: Dispositivo con capacidad de reaprovechamiento de hidrogeno y pila de combustible para reaprovechamiento de hidrogeno.
Authors: Sabaté, N., Esquivel, J.P., Del Campo, F.J., Buser, J.
Ref.: Spain, appl. P201430145, 2014.

Title: Microdosímetro basado en estructuras 3D de semiconductor.
Authors: Guardiola, C., Quirion, D., Fleta, C., Lozano, M., Pellegrini, G., Gómez, F.
Ref.: Spain, appl. P201430099, 2014.

Title: Sistema modular de análisis de haces de luz.
Authors: Llobera, A., Muñoz-Berbel, X., Vila-Planas, J., Zappe, H., Müller, P., Kopp, D.
Ref.: Spain, appl. P201430628, 2014

Title: Sistema optofluídico para reacciones biocatalíticas con cristales de enzimas entrecruzados.
Authors: Garcia-Ruiz, J.M., Gomez-Morales, J., Llobera, A., Gavira, J.A., Rodríguez-Ruiz, I.
Ref.: Spain, P201430058, 2014.

International patents (PCT)

Title: Fuel cell and analysis device that comprise it.
Authors : Sabaté, N., Esquivel, J.P.
Ref.: Spain, appl. P201230960, 2012; PCT, appl. PCT/ES2013/062718, 2013; US, appl. US1641.1058/32972-0017, 2014.

Title: Fluidically controlled optical router.
Authors: Kopp, D., Müller, P., Zappe, H., Llobera, A., Vila-Planas, J., Muñoz-Berbel, X.
Ref.: PCT, appl. PCT/EP13/067033, 2013.

Title: Composite material comprising a porous matrix of amorphous carbon and binanoparticles, which can be obtained using a sol-gel method, production method thereof and use of same.
Authors: Fernández-Sánchez, C., Gich, M., Roig, A., Cotet, L.C.
Ref.: Spain, appl. ES201231869, 2012; PCT, appl. PCT/ES13/070780, 2013.

Title: Liquid-semiconductor neutron detector.
Author: Guardiola, C., Lozano, M., Fleta, C., Pellegrini, G., Quirion, D.
Ref.: Spain, appl. P201231769, 2012; PCT, appl. PCT/ES13/070778, 2013.

Title: Method for depositing thick layers of boron.
Authors: Guardiola, C., Calvo, J., Lozano, M., Fleta, C., Pellegrini, G.
Ref.: Spain, appl. P201231604, 2012; PCT, appl. PCT/ES13/070690, 2013.

Title: Micro-sonda neuronal y procedimiento de fabricación de la misma.
Authors: Sánchez-Vives, M., Godignon, P., Prats, E., Gabriel, G., Villa, R.
Ref.: Spain, appl. P201331895, 2013; PCT, appl. PCT/ES14/070940, 2014.

Title: Dispositivo o microbrida útil para la determinación y monitorización de la sección de una estructura.
Authors: Llobera, A., Rodríguez-Rodríguez, R., Muñoz-Berbel, X.
Ref.: Spain, appl. P201331181, 2013; PCT, appl. PCT/ES14/070609, 2014.

Patents Licensed

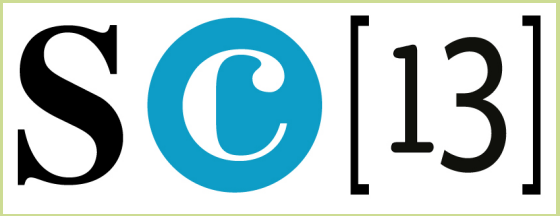
Title: Microagujas de SU-8 para la monitorización y la estimulación neuronal.
Authors: Fernandez, L.J., Berganzo, J., Tijero, M., Altuna, A., Menéndez de la Prida, L., Villa, R., Guimerà, A.
Ref.: Spain, appl. P200930430, 2009; Licensed 07/10/2013.

Title: Interferometer and sensor based on bimodal optical waveguide and sensing method.
Authors: Zinoviev, K., Lechuga, L.M., Domínguez, C.
Ref.: Spain, appl. EP2017602 (A1), 2007; PCT, appl. PCT/ES2008/070142, 2009; Licensed 01/04/2014.

Title: Sensor de iones basado en medida diferencial y método de fabricación.
Authors: Fernández-Sánchez, C., Vera, F., Cadarso, A., Baldi, A., Jimenez-Jorquera, C., Burdallo, I., Merlos, A., Domínguez, C., Llobera, A.
Ref.: Licensed 27/02/2014.

Outreach

IMB has a sustained activity in outreach events aiming at promoting the social awareness of the benefits of science and technology, and the public support to them. A program of visits from high-school students is aimed at encouraging young people to follow science and technology careers. IMB participates in the annual Science and Technology Week which is organized at the Spanish and Catalan levels, and regularly presents the results of its research activities in the public media.



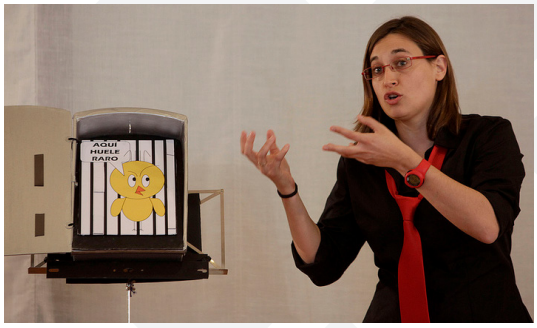
Science and Technology Week

Inspiraciencia

Participation in the organization of Inspiraciencia (2013 and 2014), a contest on science-based stories, organized by CSIC.

FAMELAB Spain 2014

Dra. Elisabet Prats-Alfonso was semifinalist (and 1st reserve for the final) in the 2014 Spanish edition of FAMELAB, the top international competition of scientific talks organized by FECYT and the British Council (www.famelab.es).



Barcelona Science Fair

The Chemical Transducers Group if IMB-CNM participated in the Festival of Science, Technology and Innovation (June 2014) in Barcelona, with the workshop "From prototype to product: avoid kidney stones with a new self-diagnostic device".

Education Fair 2014

IMB-CNM participated in the with other CSIC institutes in the Science Space of the Education Fair in March 2014 in Barcelona.

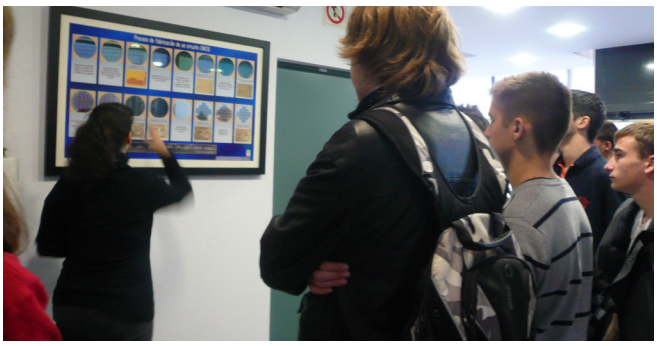
Microelectronics Museum Area

The "Zenon Navarro" Microelectronics Museum area has been created to make micro and nanoelectronics technology and applications known to the general public. The museum displays equipment used for the design, fabrication and measurement of electronic devices. It describes what the silicon chips are and how they are made, by using static displays, multimedia material and device prototypes.

The Museum is dedicated to Zenon Navarro Garriga (1947-2007), physicist, who in the early 1980s built the UAB clean room that was used by CNM during its initial years. He later managed the construction and installation of the IMB-CNM clean room and during many years he was the photolithography process manager.

Student visits

As part of the public outreach activities of IMB-CNM, guided visits to the institute and the museum area are organized for student groups, from high schools or universities. The museum area is visited annually by around 300 students.



Partnerships

The scientific and technological challenges of today's society are complex and interdisciplinary, and cannot be addressed by a single institution. Cooperative innovation is therefore a key issue, and for this reason IMB-CNM has specific partnerships and collaborations with industry, universities and research centres.

IMB-CNM is a member of the Barcelona Nanotechnology Cluster-Bellaterra (BNC-b). BNC-b is a scientific and industrially oriented virtual entity, grouping the capabilities and expertise in nanoscience and nanotechnology of a number of research centres and companies located in the Research Park of Universitat Autònoma de Barcelona (UAB) at Bellaterra. It currently includes more than 500 researchers. Its members, excluding CNM, are:

bnc-b
BARCELONA NANOTECHNOLOGY CLUSTER-BELLATERRA

· Institut Català de Nanociència i Nanotecnologia, ICN2
· Institut de Ciència de Materials de Barcelona, ICMAB (CSIC)
· Various Departments of Universitat Autònoma de Barcelona, UAB
· MATGAS 2000, A.I.E.
· D+T Microelectrónica, A.I.E.

www.bnc-b.net

The UAB Research Park is a non-profit private foundation, created in 2007 by three research institutions, the Autonomous University of Barcelona (UAB), the Spanish Research Council (CSIC) and the Agrofood Research and Technology Institute of Catalonia (IRTA), as a basic tool to promote the transfer of knowledge and technology between the academic community and the industry. It gathers the research capabilities located at the UAB campus, and it currently includes more than 30 research centres and institutes with more than 4000 researchers.

CSIC
IRTA
UAB
Parc de Recerca
UAB

parc.uab.cat

D+T Microelectrónica A.I.E. is an Association of Economic Interest which provides access for industry (especially SMEs) to the micro and nanotechnologies of IMB-CNM. It is located in the IMB-CNM building, and its mission is to facilitate the inclusion of microelectronic technologies in industrial products, by designing, developing and manufacturing chips and microsystems tailored to specific needs.

D+T Microelectrónica, A.I.E.

www.cnm.es/dt

Associated Units

CNM-IMB has special collaborations with research groups from Spanish Universities and technological centres, through "Associated Unit" agreements with the Spanish Research Council (CSIC). Historically there have been agreements with various institutions, such as the University of Barcelona (UB), the Autonomous University of Barcelona (UAB), the Polytechnical University of Catalonia (UPC) or the Polytechnical University of Madrid (UPM). At the end of the reporting period the following Associate Units were active:

- Hardware-Software Prototypes and Solutions Lab (CEPHIS), Autonomous University of Barcelona (UAB).
- Group of Micro-Nano Systems and Applications, Department of Microelectronics and Electronic Systems, Autonomous University of Barcelona (UAB).

Research consortiums

IMB-CNM participates in international research consortiums and in public-private partnerships within the framework of European initiatives such as the ECSEL Joint Undertaking, the Framework Programmes for research and technological development of the European Union, pan-European networks such as EUREKA and other initiatives such as the European Research Council.

IMB-CNM (as CSIC) is a member of the AENEAS industrial association on nanoelectronics and has been a member of the Council of EURIPIDES (the EUREKA initiative for packaging and integration of microdevices and smart systems).

IMB-CNM is a member of EPoSS (the European Technology Platform on Smart Systems Integration), Photonics 21 (the Technology Platform for Photonics in Europe) and EPIC (the European Photonics Industry Consortium). It is a member of PLANETIC (the Spanish technological platform for electronics, information and communications technologies) and of Fotónica 21, the Spanish technological, platform on photonics.

IMB-CNM is one of the members of the local cluster PEC4 for printed electronics. Researchers from IMB-CNM are members of CERES (Studies and Research Center for Space) of UAB, which is a unit of IEEC (Institute for Space Studies of Catalonia).

National collaborative research projects are performed within the framework of the National Plans for R+D+I.

Two research groups (Chemical Transducers and BioMEMS) of IMB-CNM are members of the TECNIO network of applied research and technology transfer centers in Catalonia, and funded by ACCIÓ, the agency of the Catalan Regional Government for company competitiveness.

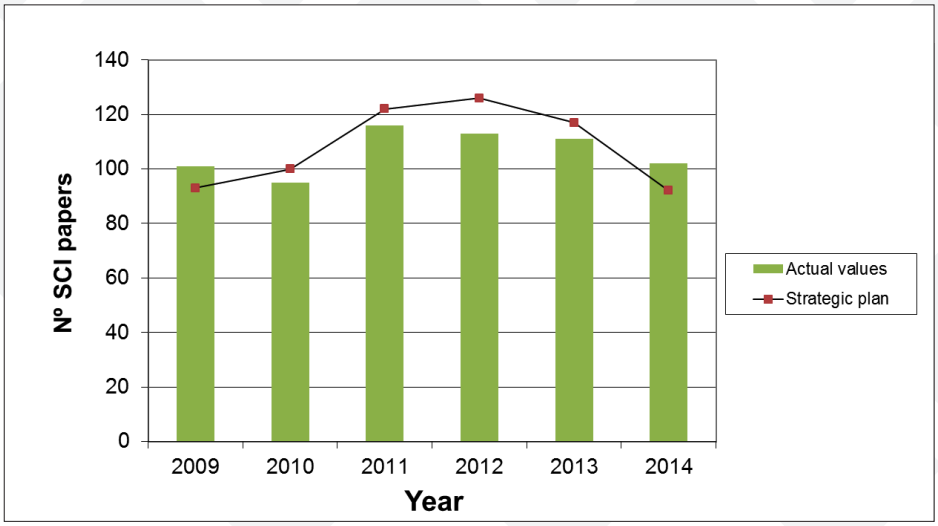
Key Figures

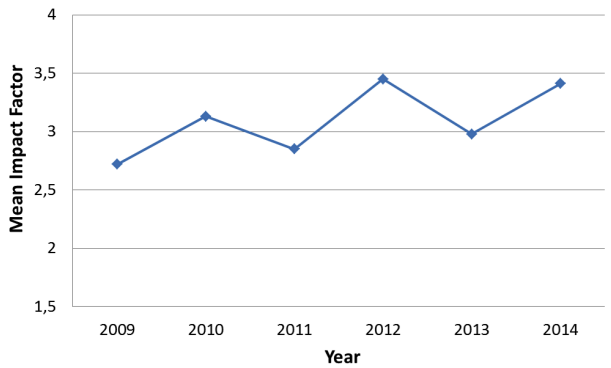
Key figures

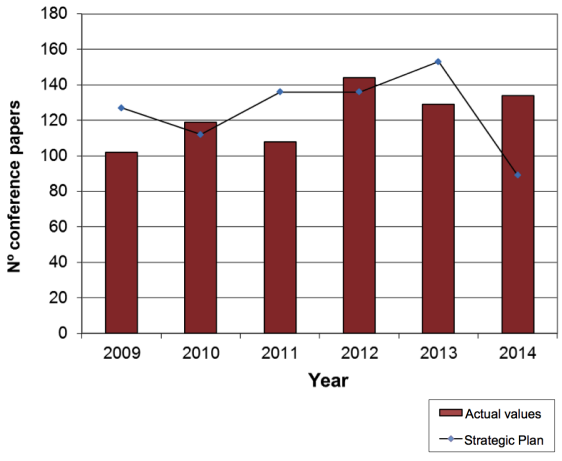
In the period 2013-2014 the Institute has still suffered the severe national R&D budget constraints resulting from the global economic downturn started in 2008. This is reflected in the staff and budget figures. However, in 2014 a budget consolidation was achieved by CSIC, which provided the basis for an improved situation for the following years. The external funding from competitive public projects has been affected at the National level by the reduced research budget, and at the European level the transition from the 7th Framework Programme to the Horizon 2020 Programme has resulted in some fluctuations within an overall positive situation.

Publications

The graphs show the total number of scientific papers published in SCI indexed journals, the mean impact factor per year and the number of presentations made at scientific conferences. The strategy concerning journal publications prioritizes increasing their impact rather than their number. The decline in the number of estimated publications reflects the anticipated reduction in budget and staff in 2013-2014. The actual values have declined less than the estimated numbers.





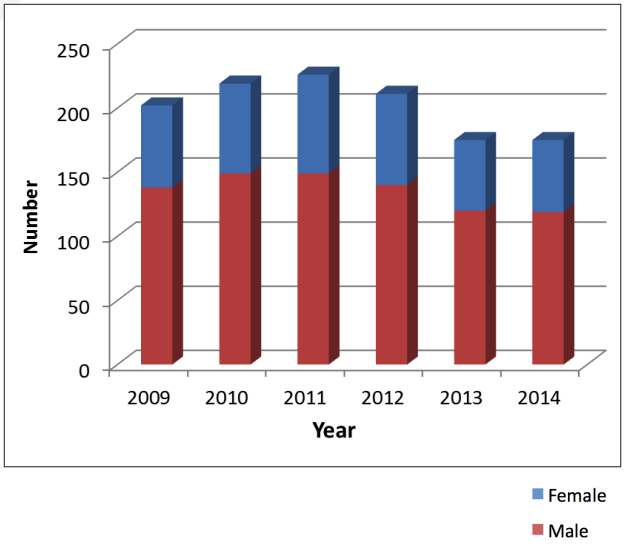


Key figures

Staff

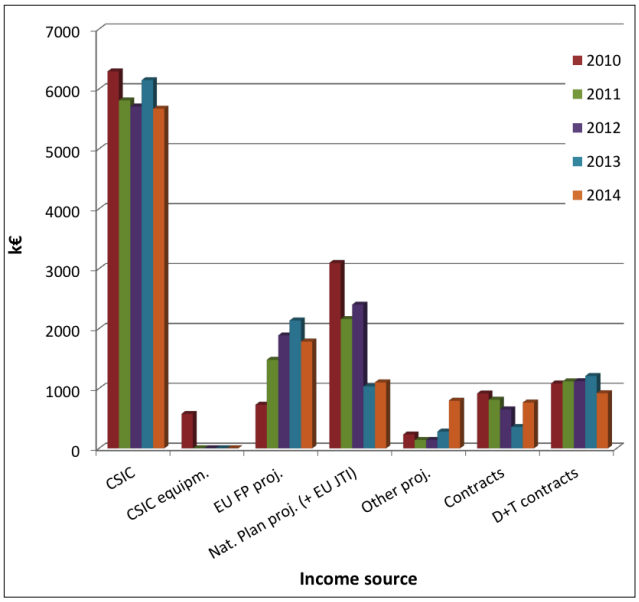
The expansion in offices, laboratories and clean room area that was completed in the period 2007-2009 resulted in a growth of human resources to a maximum of about 220-225 persons in 2010 and 2011. In 2012 and 2013 the trend was a reduction in staff due to budget limitations. The number stabilized in 2014.

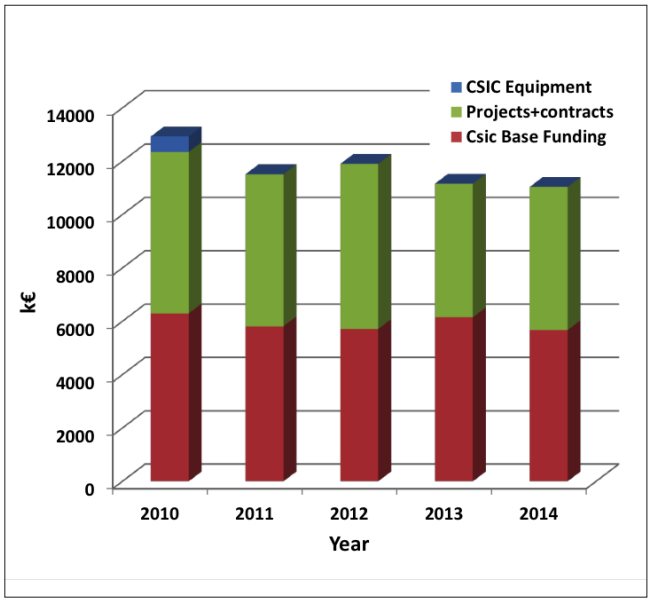
STAFF - End 2014	Female	Male	Total
Researchers	17	48	65
Ph.D. students	6	19	25
Clean room facility	16	23	39
Support services	4	20	24
Administration & general services	13	9	22
TOTAL	**56**	**119**	**175**



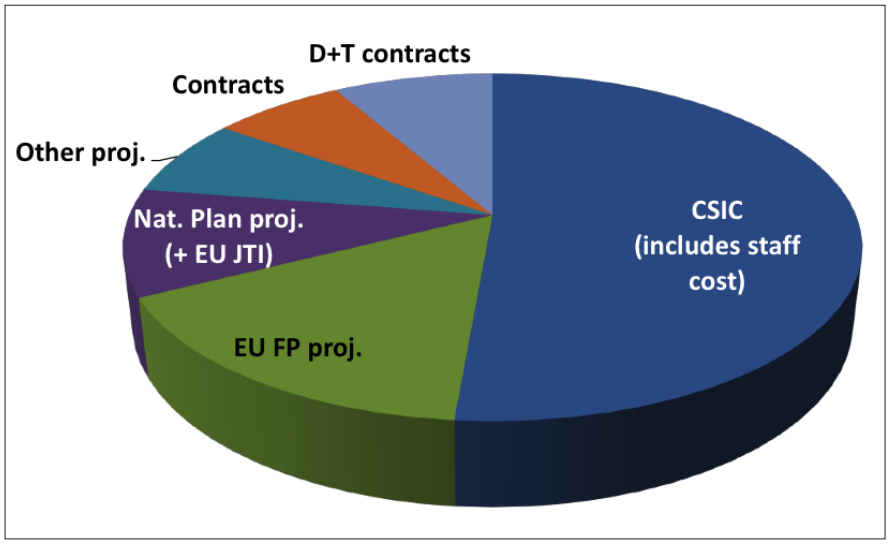
Budget

The main income sources are CSIC, which includes base funding and the cost of permanent staff, public funded competitive research projects and industrial contracts.



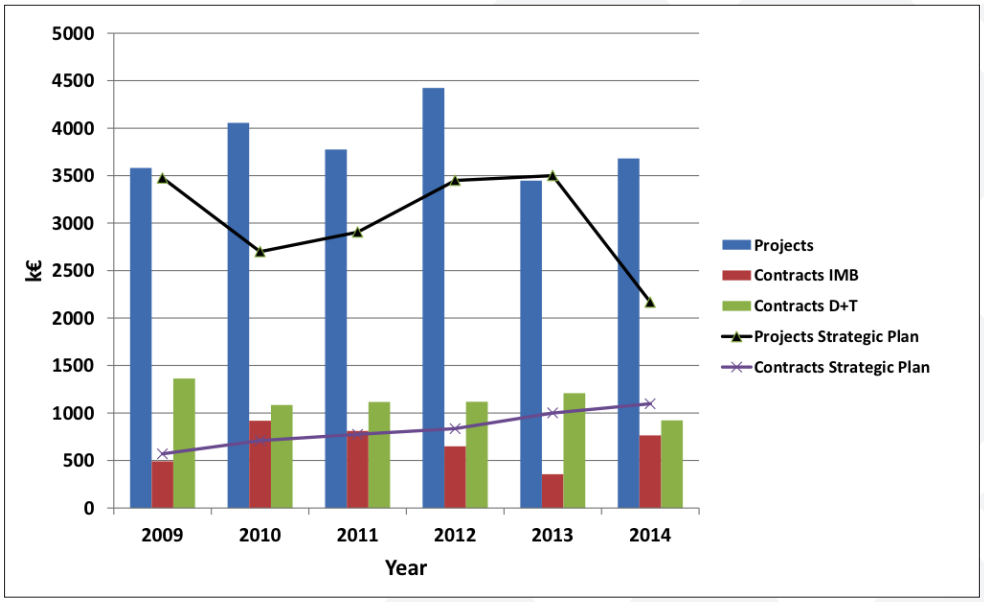


Budget distribution 2014



External funding

External funding from competitive public projects and from industrial contracts. Actual values and objectives of the 2010-2013 and 2014-2017 Strategic Plans.



www.imb-cnm.csic.es

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Consejo Superior de Investigaciones Científicas

Centro Nacional de Microelectrónica
IMB

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