


# Biennial Report

2017-2018

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# Highlights

## IMB-CNM in the GSMA Mobile World Congress

A real-time sweat sensor, which can be integrated in smartwatches, patches or wearables, was presented by IMB-CNM at the Mobile World Congress 2017. The sensor is a low-cost system that can measure pH, glucose, lactate and the electrolytes (sodium, potassium calcium and chlorine) of sweat. These parameters provide useful information for sport training programs and to detect alarm situations (such as dehydration or exhaustion). The system is based on a microfluidic structure made on paper that takes the sweat and transports it to silicon microsensors. IMB-CNM was also showing an ISFET (ion-sensitive field-effect transistor) sensor for the measurement of pH and ions, similar to a strip sensor. It can be applied in health, environment and food industry. The development of both technologies was led by Dr. Antoni Baldi.



## IMB-CNM organized the 23<sup>rd</sup> Micromachine Summit 2017

IMB-CNM organized the 23<sup>rd</sup> Micromachine Summit on May 15-17, where national and supranational delegations worldwide reviewed the situation of Micro and Nanotechnologies in their territories.



## Manufacturing antimicrobial fabrics and devices at industrial scale

The European project PROTECT, involving IMB-CNM, and led by Universitat Politècnica de Catalunya (UPC), started in January 2017. It developed an ultrasound technology for industrial production of fabrics and surfaces coated with antimicrobial nanoparticles.



The role of IMB-CNM was to integrate within the final product a sensor technology in order to determine the end of the shelf life of the material. It was developed and patented by the team led by Dr. Xavier Muñoz-Berbel. This sensor technology uses bacterial metabolic indicators, molecules that change their state and colour in the presence of bacteria. When living bacteria are on the surface, their metabolism produces a change of colour on those molecules, which can be seen with the bare eye.

## Organization of the 43<sup>rd</sup> International Conference on Micro and Nano Engineering (MNE) 2017

IMB-CNM researchers co-organized the conference, which was held at the International Iberian Nanotechnology Laboratory (INL) in Braga, Portugal, from 18<sup>th</sup> to 22<sup>nd</sup> September 2017. The conference was the 43<sup>rd</sup> of the series and was attended by 741 participants. Prof. Francesc Pérez-Murano was Conference Co-Chair, Dr. Andreu Llobera Program Co-Chair, Prof. Joan Bausells Technical Co-Chair, Dr. Xavier Muñoz-Berbel was program chair of the topic “Micro/Nano Engineering for life sciences” and Dr. Gemma Rius was in charge of the coordination of the Short Courses.



## IMB-CNM and ICMAB participate in the project KardiaTool, on a Point-of-Care device to detect Heart Failure from saliva

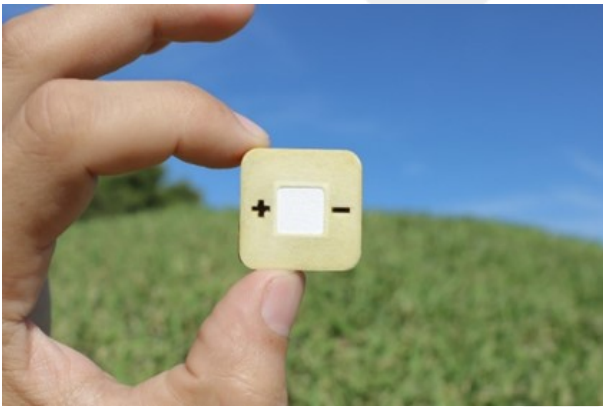
KardiaTool is a project funded by the European Commission within the Horizon 2020 Research and Innovation program. The objective is to achieve a personalized and improved therapy monitoring and health care for patients suffering from Heart Failure. The groups of Prof. Joan Bausells from IMB-CNM and Prof. Francesc Teixidor from ICMAB (CSIC) participate in the project, which includes 14 partners from 10 different countries.



Heart Failure is often associated with a bad diagnosis and frequent re-hospitalizations, which are a problem for patients and their families, and a great economic burden for the healthcare system. The KardiaTool platform includes a portable device, coupled to a disposable and low cost laboratory-on-a-chip to detect Heart Failure biomarkers from saliva samples. The team of IMB-CNM developed the silicon microelectronic sensors that detect these biomarkers, and collaborated in the design of the lab-on-chip.

## An IMB-CNM researcher received the Catalunya Ecodisseny 2017 Award

The award of the Catalan Agency of Residues for the category of “Product in Development” recognizes product prototypes designed to minimize their environmental impact over their whole lifecycle. The 2017 award was given to the PowerPad portable biodegradable batteries developed by Dr. Juan Pablo Esquivel.



## IMB-CNM researchers winners of the OE-A Competition at LOPEC 2018

The SPEED group, with Laura Ortega and Prof. Neus Sabaté, was awarded the Best Prototype/New Product prize at the LOPEC 2018 (Large-area, Organic & Printed Electronics Convention) trade fair and conference of the Organic and Printed Electronics Association (OE-A), for the development of a sweat patch for screening cystic fibrosis. The work was done in collaboration with the ICAS group.



## IMB-CNM participated in the 4<sup>th</sup> edition of the Imagenenano 2018, Bilbao.

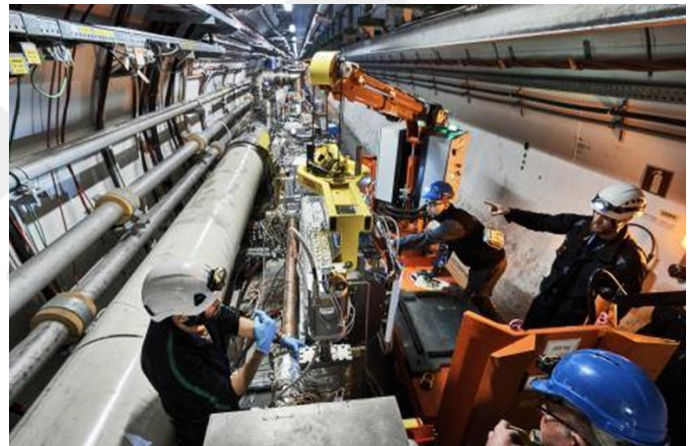
Imagenenano is the largest European Event in Nanoscience & Nanotechnology and in the 2018 edition IMB-CNM participated with a booth to promote the clean room facilities and the Nanoscience Foundries & Fine Analysis EU Platform (NFFA).

During the Industrial forum IMB-CNM contributed with two talks "The National Microelectronics Center and its Clean Room for Micro and Nano Research" carried out by Dr. Luis Fonseca and "FIB Processing using ELPHY " by Albert Guerrero.



## IMB-CNM participates in the High-Luminosity Large Hadron Collider of CERN

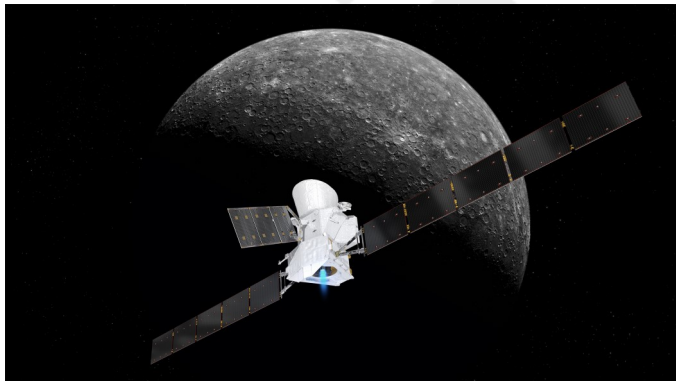
Works for the High-Luminosity Large Hadron Collider (HL-LHC) began at the European Particle Physics Laboratory (CERN) in 2018. By increasing the number of collisions in large experiments, this major update will improve the performance of the LHC from 2026, increasing the likelihood of discovering new physics phenomena. Some of the new sensors that will be installed in the ATLAS detector will be fabricated at IMB-CNM.



## Components designed and manufactured at IMB-CNM on travel to Mercury

Electronic components designed and manufactured at IMB-CNM travel to Mercury in the BepiColombo mission, launched on October 20<sup>th</sup>, 2018. It will arrive at Mercury in late 2025. This joint mission of the European Space

Agency (ESA) and the Japanese Space Agency (JAXA) comprises two spacecrafts, that include 700 protection diodes for the photovoltaic cells of the solar panels.



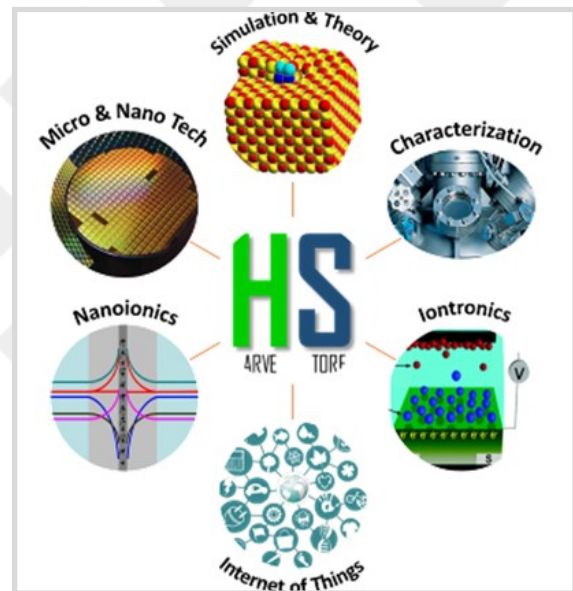
Artist's impression of the BepiColombo spacecraft in cruise configuration, with Mercury in the background. Copyright: spacecraft: ESA/ATG medialab; Mercury: NASA/JPL .

The 700 protection diodes will be exposed to very extreme temperatures, from 300 °C during “day” to -150 °C at “night”, and are located next to the solar panels to protect them in the event of a cell failure. In order for the devices to withstand these extreme conditions, the team led by Prof. Philippe Godignon developed the diodes with Silicon Carbide (SiC), a semiconductor that is replacing silicon in many applications of power electronics. ALTER Technology from Madrid has also participated in this project, carrying out tests and qualification for the diodes.



## IMB-CNM participates in the HARVESTORE project: Energy HarveStorers for Powering the Internet of Things

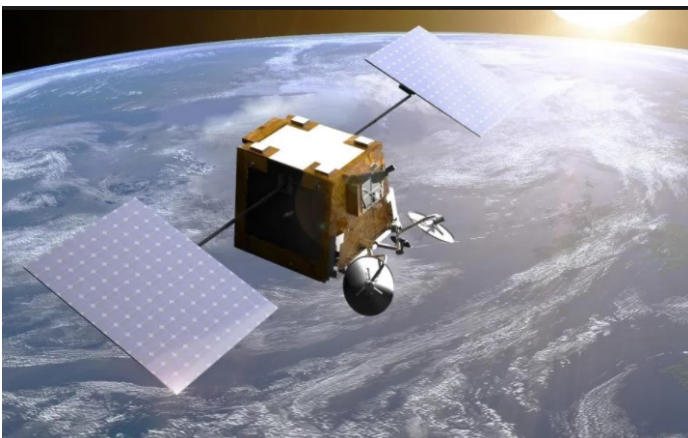
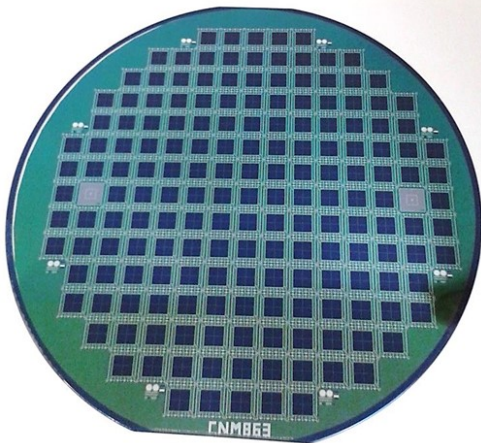
HARVESTORE is a project of the Future Emerging Technologies “FET-Proactive” programme of the European Union that started in December 2018. The project develops solid-state micro energy sources for the harvesting and storage of energy.



The objective is to contribute to fulfil the growing need of autonomous wireless sensing nodes for the Internet of Things. The IMB-CNM activity is led by Dr. Luis Fonseca.

## Silicon Photodiodes for OneWeb satellites

The IMB-CNM clean room has fabricated the photodiodes that are placed on the sun sensors of the OneWeb constellation of satellites to provide worldwide internet connectivity. The silicon photodiodes were supplied in cooperation with D+T Microelectrónica A.I.E. to the OneWeb subcontractor SolarMEMS Technologies S.L.. The devices were fabricated in 2017-2018. The first 24 diodes in 6 satellites were launched at the beginning of 2019.



Artist image of a OneWeb satellite (Credit: TechCrunch)



# Research

The research activities of IMB-CNM are dedicated to **Micro/Nano Integrated Systems**: miniaturized electronic systems which include sensing and/or actuating capabilities in addition to electronic information processing, power management and external interfaces.

The core of the IMB-CNM research can be included into the "More than Moore" and the "Heterogeneous integration" internationally established technology domains, although some of the activities can be integrated into the "Beyond CMOS" and "More Moore" areas.

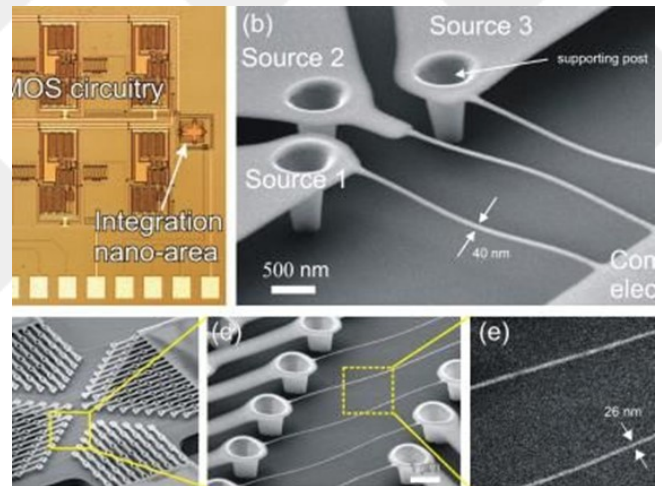
## Advanced Thin Dielectric Films Group (ATDF)

The aim of the group is the investigation of the properties of thin dielectric films for silicon-based micro / nanoelectronic applications. Within this general framework, the group is currently working in the field of memristor devices based on the resistive switching-phenomenon in high-k dielectrics deposited by Atomic Layer Deposition. Research activities cover from the development of memristor fabrication technologies, the electrical characterization of resistive switching devices and their study as electronic synapses for neuromorphic applications.



## Nanofabricacion and Nanomechanical Systems Group (NANONEMS)

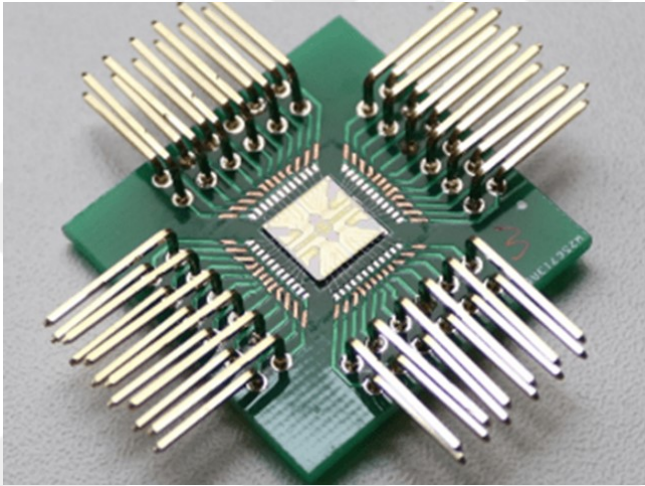
The group explores the electronic and electromechanical properties of nanostructures that can provide new or improved features to nanodevices and nanosystems. It also performs research and development of advanced nanofabrication methods, preferably those that can be applied to devices used in miniaturized integrated systems. These activities cover two of the Key Enabling technologies (KETS): nanotechnology and micro-nanoelectronics.



## MicroEnergy Sources and Sensor Integration Group (MESSI)

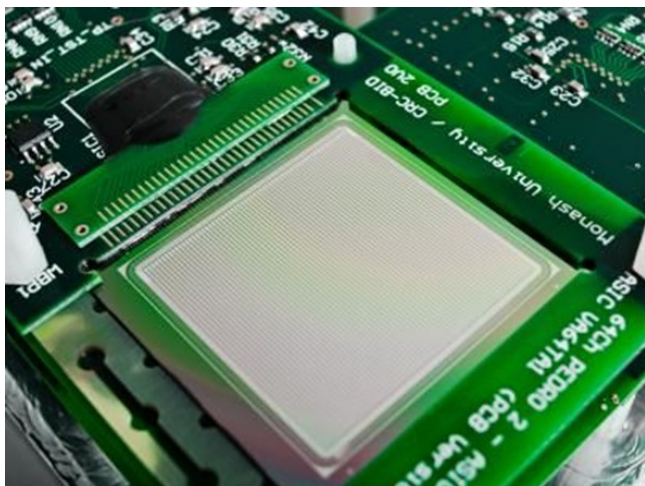
The aim of the group is to contribute with new micro-energy and smart sensing devices to important long-term challenges such as "Healthier Citizens" and "Net Zero Human Impact". Within this general framework, different lines of research are addressed: In the micro-energy field, we cover harvesting (thermoelectricity) and generation/storage (micro-fuel cells / biodegradable batteries) activities. In the sensing field, we focus on systems that allow

identifying gases or biomarkers. The microintegration feasibility of both sensors and energy sources to achieve autonomous systems is another interest of the group, using standard silicon technologies and rapid prototyping and additive manufacturing.



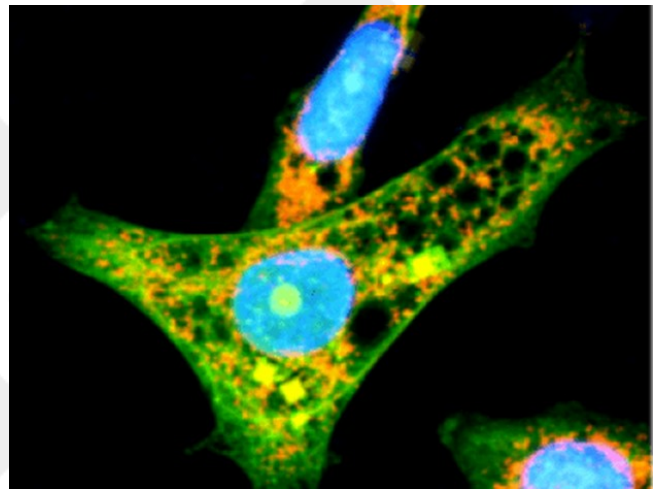
## Radiation Detectors Group(RDG)

The aim of the RDG is to contribute to the research and development of advanced technologies and applications of radiation detectors. The R&D activity of the group rest on the expertise of its members in layout design, simulation, fabrication and characterization of semiconductor radiation sensors; microelectronics devices; interconnections; implementation of complete systems and study of the radiation effects on components and systems. The fields of application of the RDG activity are: particle physics, nuclear physics, medical imaging and dosimetry, synchrotron and nuclear fusion facilities, space applications, instrumentation for civil security and societal challenges.



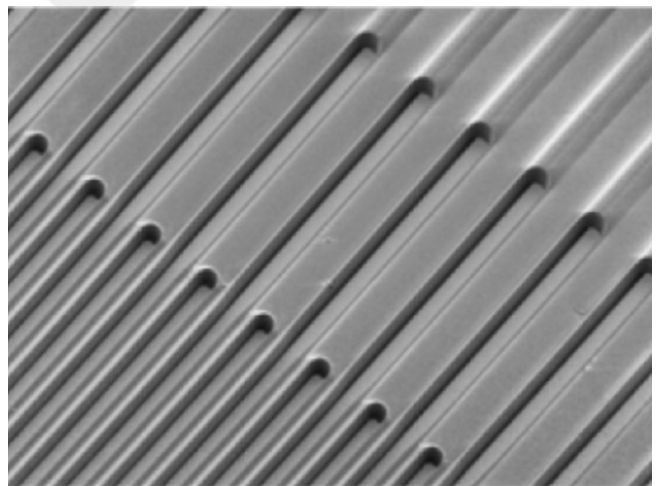
## Micro and Nanotools Group (MNTL)

"Contributing to lay the foundations of micro- and nanosystems of the future". The research line of the group is focused on the development of new Micro- and NanoTools to explore new applications or functionalities for MEMS and NEMS.



## BioMEMs Group

The main activity of the group addresses the design and development of novel micro and nanosensors and complex and compact miniaturized systems for biological and biomedical applications.



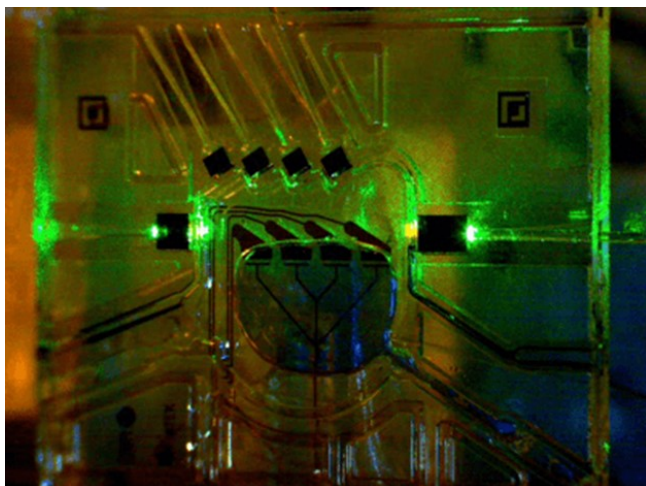
## Biomedical Applications Group (GAB)

The Biomedical Applications Group (GAB) mission is to provide clinicians with advanced tools, based on micro and nano-technologies, to tackle the medical challenges of the future.



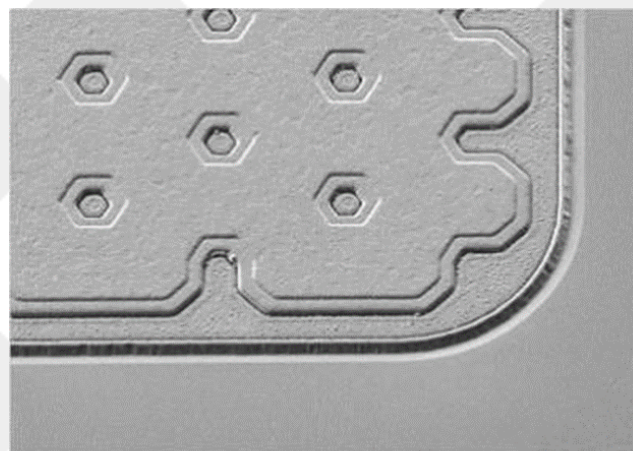
## Chemical Transducers Group (GTQ)

The group activities are focused on applied research on the development of application-specific analytical systems (ASAS): Ad-hoc analytical tools for the measurement of chemical parameters in (biological) liquid fluids. We aim at offering market solutions to analytical needs in the environment, health and food fields and contributing to some of the sustainable development goals set by the UN to address the social, environmental and economic challenges of our time.



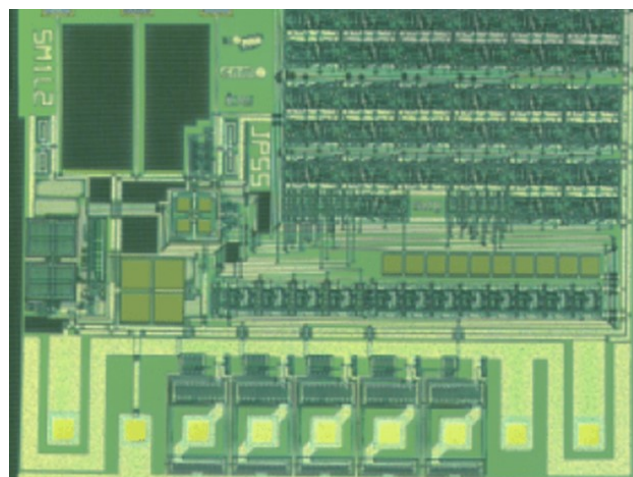
## Power Devices and Systems Group (PDS)

The Power Devices and Systems Group focuses on the design, fabrication, characterization and integration of power semiconductor devices, optimized for developing reliable and energy efficient converters and electronic systems, operating even in harsh environments (high temperature, radioactive environments, etc.).



## Integrated Circuits and Systems Group (ICAS)

The essence of this group has been always the design of application specific integrated circuits (ASICs). Currently, ICAS R&D is focused on ultra low-power analog, mixed and RF integrated circuits, organic/printed microelectronics, short range RF communications with remote power systems, digital integrated circuits in nano-electronics and multi-technological HDL-AMS modeling. The group also supports electronic system design for the ICAS itself as well as for other R&D groups of IMB.



# Facilities



## Micro and Nanofabrication Clean Room

The Micro and Nanofabrication Clean Room (SBCNM) is a Singular Scientific and Technological Infrastructure (ICTS) dedicated to the development and application of innovative technologies in the field of Microelectronics together with other emerging Micro/Nanotechnologies.

SBCNM is an open access facility that aims at helping national and international research groups to carry out R&D activities thanks to the availability of a set of complete micro and nanotechnologies and processes housed in a highly specialised Clean Room environment devoted to R&D&i of excellence, and driven by an expert team. Such support ranges from technology awareness to the development of basic demonstrators, or small series of prototypes.

Since 2014, the ICTS-SBCNM it is one of the three nodes of the MICRONANOFABS ICTS Network, the Large Scale Facility supported by the Spanish Ministry of Science and Innovation (MICINN), together with the Clean-Room from ISOM-UPM and the one from NTC-UPV.



Red Española  
de Salas Blancas  
de Micro y Nano  
Fabricación



**1,500 m<sup>2</sup>**  
Total area

**40**  
staff

**190**  
Equipment units

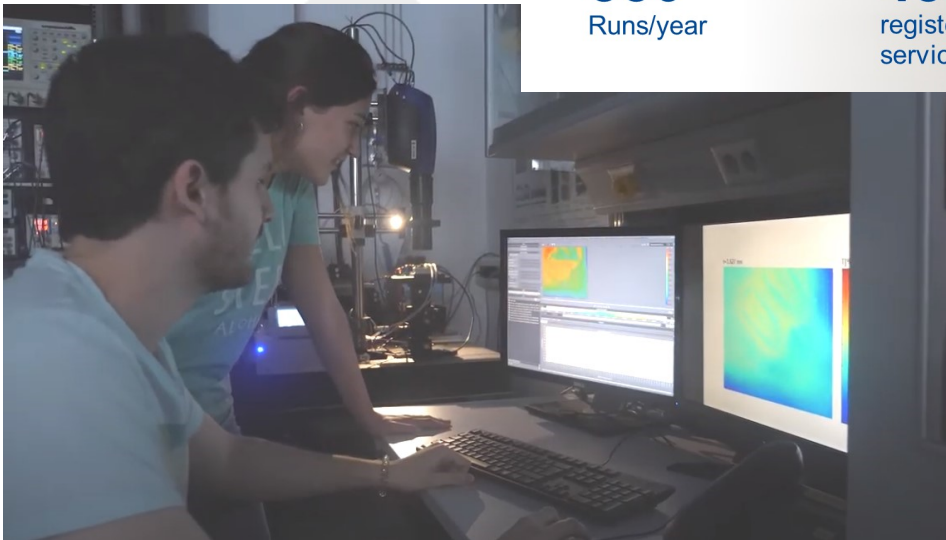
**40**  
self service

**3000**  
Wafers/year

**2500**  
Hours self service

**550**  
Runs/year

**450**  
registered self  
service licenses



Within the MICRONANOFABS structure, the CSIC's Clean-Room at IMB-CNM offers its know-how on:

- Fabrication of devices and electronic circuits.
- Physical and electrical characterisation of electronic components, MEMS/NEMS, sensors, actuators, Lab-on-Chip, integrated circuits and smart systems.
- Packaging of electronic components.
- Training activities on micro and nanoelectronics.
- Dissemination and outreach on micro and nanoelectronics.

The IMB-CNM Integrated Clean Room includes equipment for micro and nanofabrication processes mainly based on silicon technologies for wafers of 100 mm and 150 mm, but can also operate with substrates of different materials and sizes on demand. Its structure allows flexible operation, which makes it especially suitable for R+D+i.

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

- Advanced Packaging Laboratory
- Biosensors Laboratory
- Characterisation of Microsystems Laboratory
- Chemical Transducers Laboratory
- Design & CAD Service
- Electronic Systems Laboratory
- General Chemistry Laboratory
- Integrated Circuits and Systems Testing
- Integrated Optics Laboratory
- Micro/nano systems Laboratory
- Packaging Service
- Power Devices Laboratory
- Printed Electronics Laboratory
- Prototyping Laboratory
- Radiation Detectors Laboratory
- Reverse Engineering Laboratory
- SAM/SEM Laboratory
- Thermal Characterisation
- Wafer Electrical Characterisation Service

# Publications

IMB-CNM has published 104 and 84 scientific papers in 2017 and 2018, respectively, in journals included in the Science Citation Index. The complete list of publications in scientific journals is available at the IMB-CNM website. The specific pages can be accessed through these QR codes:

2017



2018



## Some publication highlights:

### Electromechanical Nanogenerator–Cell Interaction Modulates Cell Activity.

G. Murillo, A. Blanquer, C. Vargas-Estevez, L. Barrios, E. Ibáñez, C. Nogués, J. Esteve.

Advanced Materials, vol. 29 (2017) 1605048

Impact factor (JCR 2017): 21.950

<https://doi.org/10.1002/adma.201605048>

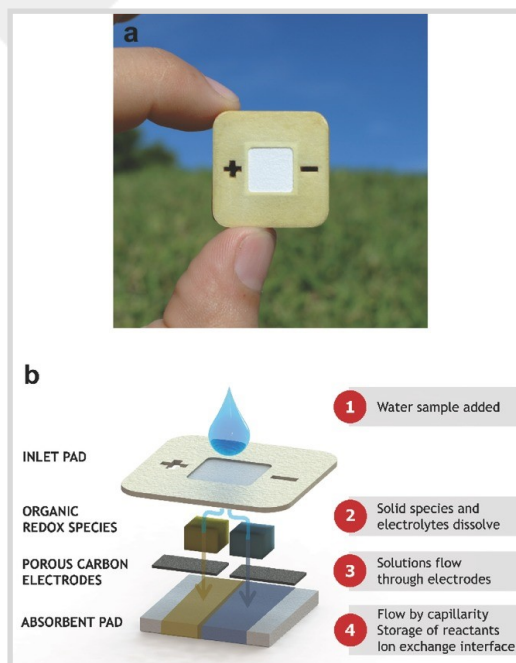
### A Metal-Free and Biotically Degradable Battery for Portable Single-Use Applications.

J.P. Esquivel, P. Alday, O.A. Ibrahim, B. Fernández, E. Kjeang, N. Sabaté.

Advanced Energy Materials, vol. 7 (2017) 1700275.

Impact factor (JCR 2017): 21.875

<https://doi.org/10.1002/aenm.201700275>



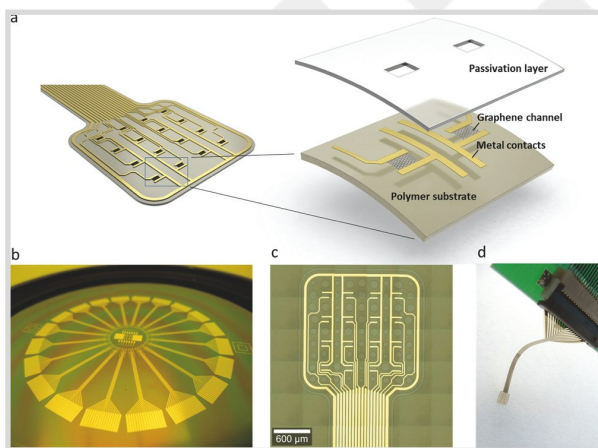
## Flexible Graphene Solution-Gated Field-Effect Transistors: Efficient Transducers for Micro-Electrocorticography

C. Hébert, E. Masvidal-Codina, A. Suarez-Perez, A. Bonaccini Calia, G. Piret, R. Garcia-Cortadella, X. Illa, E. Del Corro Garcia, J.M. De la Cruz Sanchez, D. Viana Casals, E. Prats-Alfonso, J. Bousquet, P. Godignon, B. Yvert, R. Villa, M.V. Sanchez-Vives, A. Guimerà-Brunet, J.A. Garrido.

Advanced Functional Materials, vol. 28 (2018) 1703976.

Impact factor (JCR 2018): 15.621

<https://doi.org/10.1002/adfm.201703976>



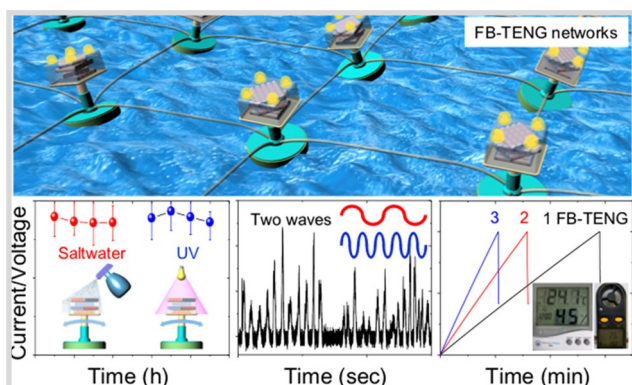
## Floating buoy-based triboelectric nanogenerator for an effective vibrational energy harvesting from irregular and random water waves in wild sea.

D.Y. Kim, H.S. Kim, D.S. Kong, M. Choi, H.B. Kim, J.-H. Lee, G. Murillo, M. Lee, S.S. Kim, J.H. Jung.

Nano Energy, vol. 45 (2018) 247-254.

Impact factor (JCR 2018): 15.548

<https://doi.org/10.1016/j.nanoen.2017.12.052>



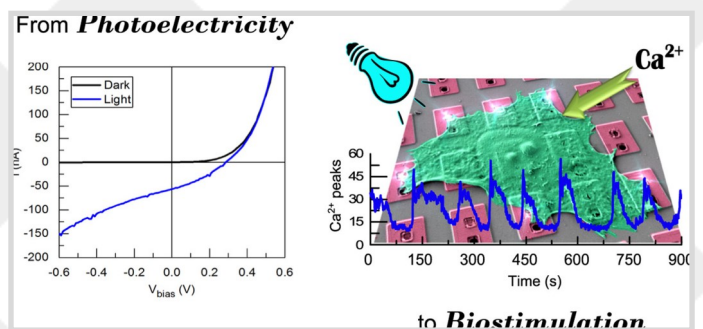
## Electrical stimulation of cells through photovoltaic microcell arrays.

C. Vargas-Estevez, A. Blanquer, G. Murillo, M. Duque, L. Barrios, C. Nogués, E. Ibañez, J. Esteve.

Nano Energy, vol. 51 (2018) 571-578.

Impact factor (JCR 2018): 15.548

<https://doi.org/10.1016/j.nanoen.2018.07.012>



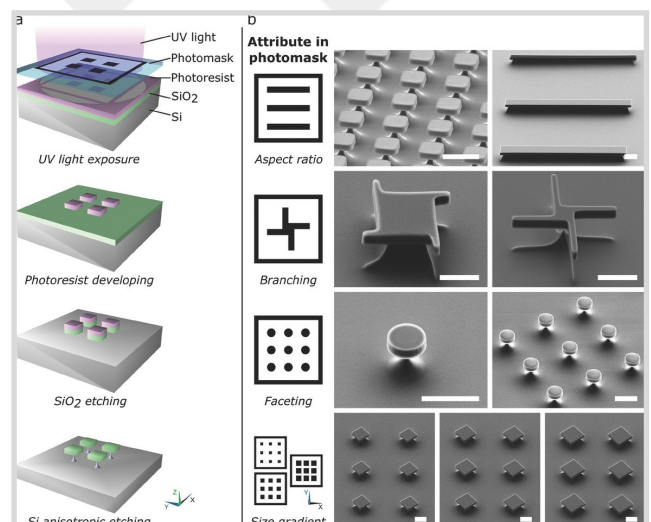
## Highly Anisotropic Suspended Planar-Array Chips with Multidimensional Sub-Micrometric Biomolecular Patterns.

J.P. Aguil, N. Torras, M. Duch, J. Esteve, L. Pérez-García, J. Samitier, J.A. Plaza.

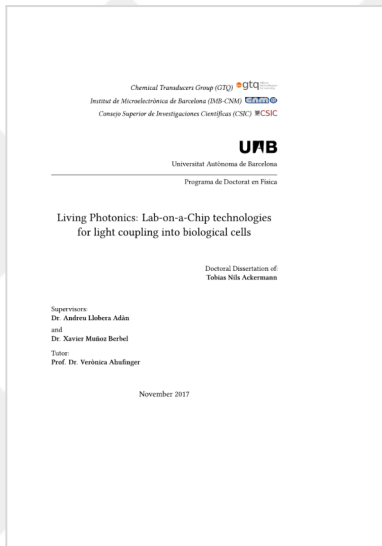
Advanced Functional Materials, vol. 27 (2017) 1605912.

Impact factor (JCR 2017): 13.325

<https://doi.org/10.1002/adfm.201605912>



# Ph.D. Thesis



**Ackermann, Tobias Nils**

*Living photonics: lab-on-a-chip technologies for light coupling into biological cells.*

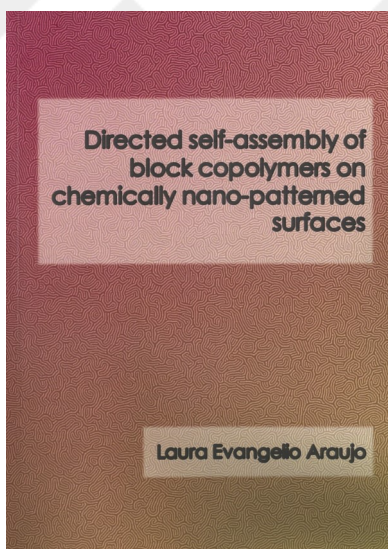
F.X. Muñoz-Berbel, A. Llobera (dirs.).  
Universitat Autònoma de Barcelona,  
Ph.D. in Physics, 2017.



**Baez Faxiola, Martha Raquel**

*Integración de sensores electroquímicos basados en nanomateriales funcionales para la detección de contaminantes en aguas.*

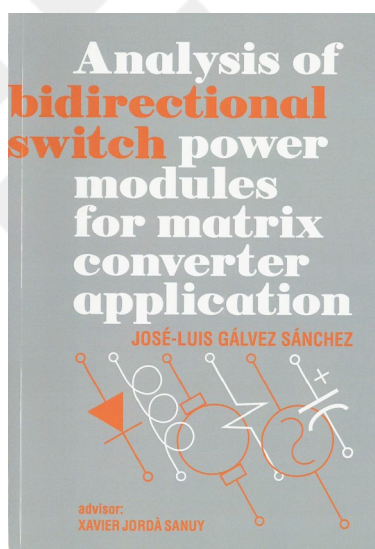
C. Fernández-Sánchez, E. Mendoza (dirs.).  
Universitat Politècnica de Catalunya,  
Ph.D. in Materials Science and Engineering, 2017.



**Evangelio Araujo, Laura**

*Directed self-assembly of block copolymers on chemically nano-patterned surfaces.*

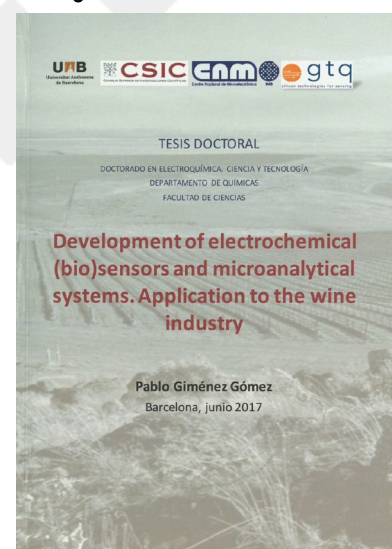
F. Pérez-Murano, J. Fraxedas (dirs.).  
Universitat Autònoma de Barcelona,  
Ph.D. in Materials Science, 2017.



**Gálvez Sánchez, José Luis**

*Análisis de módulos interruptor bidireccional de potencia de aplicación en convertidores matriciales.*

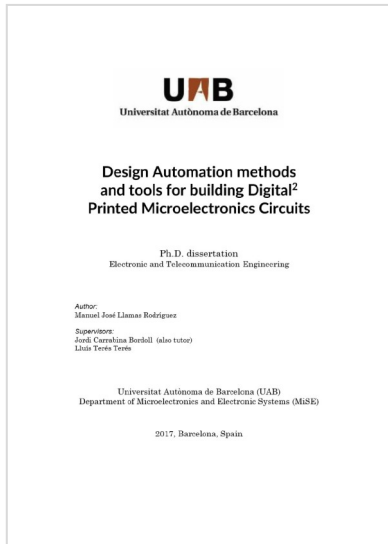
F.X. Jordà (dir.).  
Universitat Autònoma de Barcelona,  
Ph.D. in Electronic and Telecommunication Engineering, 2017.



**Giménez Gómez, Pablo**

*Development of electrochemical (bio)sensors and microanalytical systems. Application to the wine industry.* M. Gutiérrez-Capitán, C. Jiménez-Jorquera (dirs.).  
Universitat Autònoma de Barcelona,  
Ph.D. in Electrochemistry. Science and Technology, 2017.



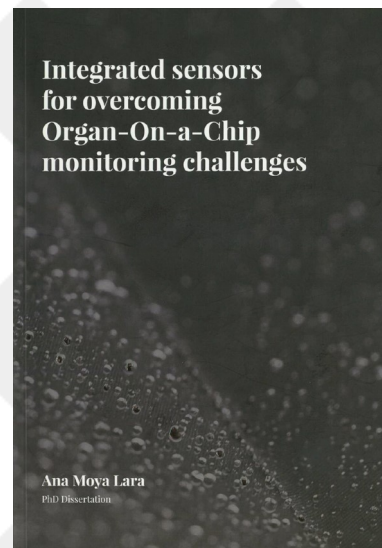


**Llamas Rodríguez, Manuel José**

*Design automation methods and tools for building digital printed electronics circuits.*

LI. Terés, J. Carrabina (dirs.).

Universitat Autònoma de Barcelona, Ph.D. in Electronic and Telecommunication Engineering, 2017.

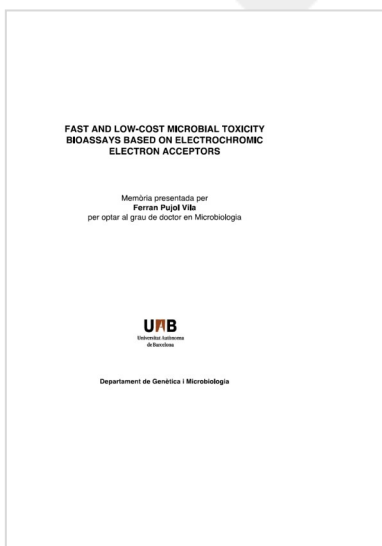


**Moya Lara, Ana**

*Integrated sensors for overcoming organ-on-a-chip monitoring challenges.*

E. Ramon, G. Gabriel (dirs.).

Universitat Autònoma de Barcelona, Ph.D. in Electronic and Telecommunication Engineering, 2017.

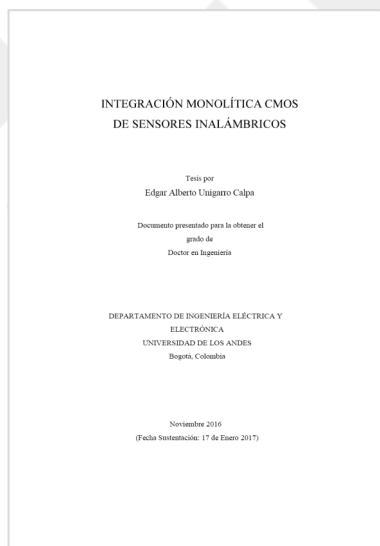


**Pujol Vila, Ferran**

*Fast and low-cost microbial toxicity bioassays based on electrochromic electron acceptors.*

F.X. Muñoz-Berbel, J. Mas (dirs.).

Universitat Autònoma de Barcelona, Ph.D. in Microbiology, 2017.

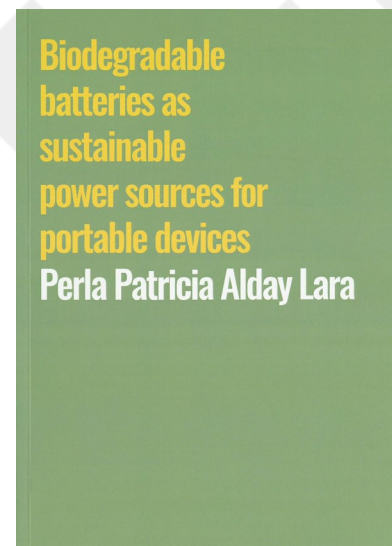


**Unigarro Calpa, Edgar Alberto**

*Integración monolítica CMOS de sensores inalámbricos.*

J. Sacristán (dir.).

Universidad de los Andes, Colombia, Ph.D. in Engineering, 2017.

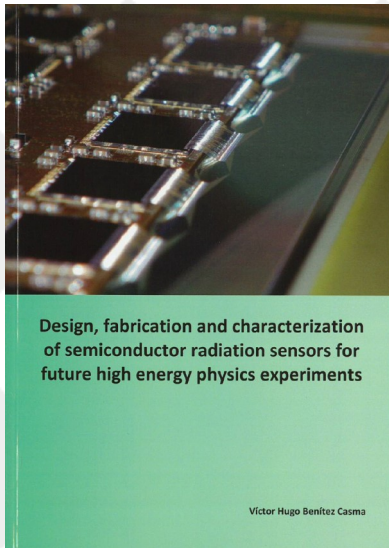


**Alday Lara, Perla Patricia**

*Biodegradable batteries as sustainable power sources for portable devices.*

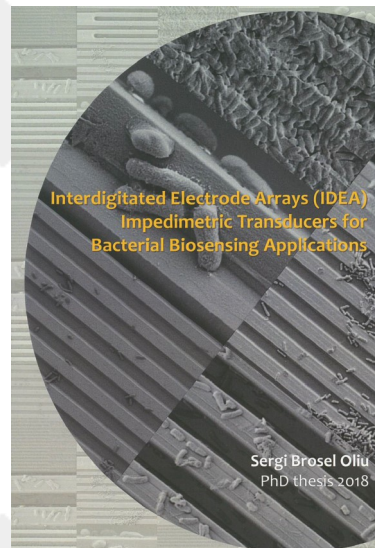
N. Sabaté, J.P. Esquivel (dirs.).

Universitat Autònoma de Barcelona, Ph.D. in Materials Science, 2018.



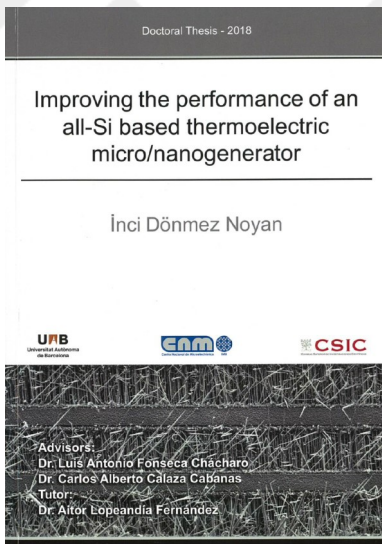
**Benítez Casma, Victor Hugo**

*Design, fabrication and characterization of semiconductor radiation sensors for future high energy physics experiments.*  
 M. Ullán (dir.).  
 Universitat Autònoma de Barcelona, Ph.D. in Electronic and Telecommunication Engineering, 2018.



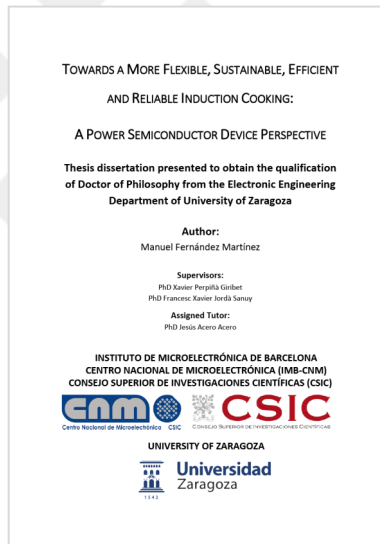
**Brosel Oliu, Sergi**

*Interdigitated electrode arrays (IDEA) impedimetric transducers for bacterial biosensing applications .*  
 N. Abramova, N. Uria, A. Bratov (dirs.).  
 Universitat Autònoma de Barcelona, Ph.D. in Biotechnology, 2018.



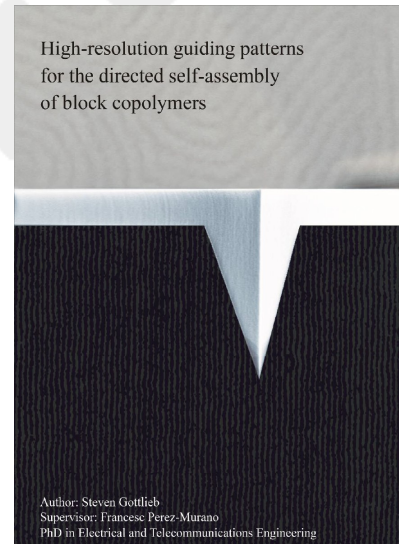
**Donmez Noyan, İnci**

*Improving the performance of an all-Si based thermoelectric micro/nanogenerator.*  
 L. Fonseca, C. Calaza (dirs.).  
 Universitat Autònoma de Barcelona, Ph.D. in Materials Science, 2018.



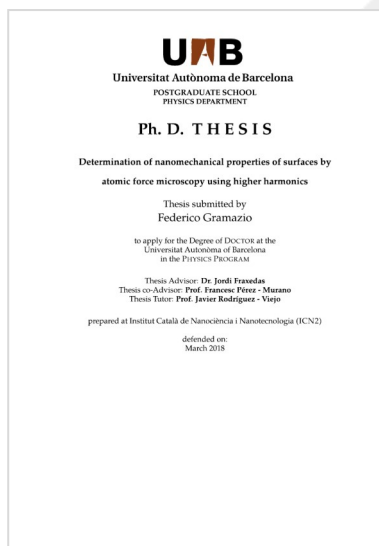
**Fernández Martínez, Manuel**

*Towards a more flexible, sustainable, efficient and reliable induction cooking: a power semiconductor device perspective .*  
 F.X. Jordà, X. Perpiña (dirs.).  
 Universidad de Zaragoza, Ph.D. in Electronic Engineering, 2018.



**Gottlieb, Steven**

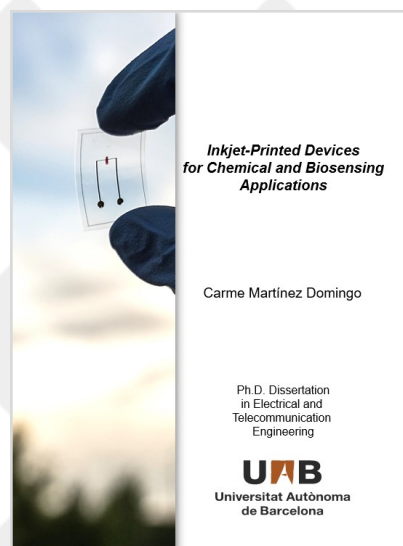
*High-resolution guiding patterns for the directed self-assembly of block copolymers .*  
 F. Pérez-Murano (dir.).  
 Universitat Autònoma de Barcelona, Ph.D. in Electronic and Telecommunication Engineering, 2018.



**Gramazio, Federico**

*Determination of nanomechanical properties of surfaces by atomic force microscopy using higher harmonics .*

F. Pérez-Murano, J. Fraxedas (dirs.).  
Universitat Autònoma de Barcelona,  
Ph.D. in Physics, 2018.



**Martínez Domingo, Carme**

*Inkjet-printed devices for chemical and biosensing applications .*

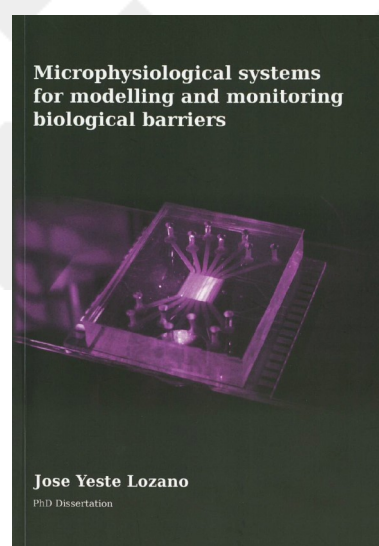
E. Ramon, A. Merkoçi (dirs.).  
Universitat Autònoma de Barcelona,  
Ph.D. in Electronic and Telecommunication Engineering, 2018.



**Rodríguez Fernández, Alberto**

*Analysis and modeling of filamentary conduction in HfO<sub>2</sub>-based structures.*

M. Bargalló, E. Miranda (dirs.).  
Universitat Autònoma de Barcelona,  
Ph.D. in Electronic and Telecommunication Engineering, 2018.



**Yeste Lozano, José**

*Microphysiological systems for modelling and monitoring biological barriers .*

X. Illa, R. Villa (dirs.).  
Universitat Autònoma de Barcelona,  
Ph.D. in Electronic and Telecommunication Engineering, 2018.

# 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.

Researchers of IMB-CNM have collaborated in the recent years to create Spin-Offs for the valorisation of ideas and products partially or fully developed within the research groups of the institute:



**Alibava Systems** ([www.alibavasystems.com](http://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.

way to monitorize single cell alive. SPACHips are intracellular silicom microchips for monitoring extraordinarily small volumes as a single cell. Established in 2018.



**BLB (Barcelona Liver Bioservices)** ([liver.barcelona](http://liver.barcelona))

Design and development of pre-clinical studies in the field of liver diseases and hepatotoxicity. The system allows human liver cells to be kept in culture for long periods of time and in better conditions than conventional culture methods, much as if they were in the liver. This allows in vitro studies of drug efficacy and toxicity in a microenvironment very similar to that of the human liver. Established in 2017.



**A4CELL (Arrays for Cell Nanodevices)**

([www.a4cell.com](http://www.a4cell.com))

A4CELL develops New technology named SPACHip (Suspended Planar-Array Chips) offering a perfect



**CALY Technologies** ([caly-technologies.com](http://caly-technologies.com))

CALY Technologies' SiC products offer unrivaled protection and superior performance than silicon devices in Transportation & EV applications. Its protection products are used in battery packs and power converters to limit the inrush or short-circuit current.



**EnergIoT Devices** ([www.energiot.com](http://www.energiot.com))

EnergIoT develops microgenerators to harvest ambient energy for smart wireless sensors, making possible a self-powered Internet of Things (IoT). EnergIoT can also create customized monitoring solutions to enable predictive maintenance for applications in other utility services such as water and gas distribution.



**FUELIUM** ([www.fuelium.tech](http://www.fuelium.tech))

Spin-off from CSIC established in 2015 to commercialize the research activity on fuel cells. It offers paper batteries capable of powering a variety of single-use

devices, such as portable diagnostic, and being discarded without recycling. Fundación Repsol Entrepreneurs Fund Award (2016).



**FutureSiSens** ([www.futuresisens.com](http://www.futuresisens.com))

Spin-off company from IMB-CNM and the Autonomous University of Barcelona (UAB) established in 2016 that designs, develops and manufactures thermoelectric micro-sensors that are capable of detecting very small flows and flow variations autonomously. Fundación Repsol Entrepreneurs Fund Award (2016).



**Smalle Technologies** ([smalletec.com](http://smalletec.com))

Energy Harvesting Company. 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. Fundación Repsol Entrepreneurs Fund Award (2013).

# Outreach

IMB-CNM 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.

## IMB-CNM participated in YoMo, a festival to promote technologies among young people

IMB-CNM participated in the 2017 (first) and 2018 editions of the "Youth Mobile Festival Barcelona" (YoMo), which is a satellite event of the GSMA Mobile World Congress.

YoMo is targeted to young people aged 10 to 16, and aims to inspire young people and help them get to know the professional careers of the STEAM (Science, Technology, Engineering, Arts and Mathematics) sector. At the interactive stand of IMB-CNM visitors could explore the basic components of mobile phones: chips. They could also discover clean rooms, dress with clean room clothes and photograph with a clean room background.



YoMo included educational exhibitions, live performances, interactive workshops, conferences and a broad agenda of practical activities. In 2017 (2018) it had a total attendance of 14415 (14138), of which 11153 (10035) were young people and 3262 (3074) educators.

## Las Científicas Cuentan

Prof. Neus Sabaté participated in September 2018 in the project "Las científicas Cuentan" (*Women Scientists Speak up!*) to bring basic or fundamental science to the general public, through the story of 15 scientists who obtained a project from the European Research Council. Neus described the SUPERCELL project through a short video and a talk.



## Pint of Science

Dr. Eli Prats presented her research on graphene microelectrodes in the cafeteria of the Casa Orlandai

Civic Center in Barcelona, within the international “Pint of Science” festival in May 2018.



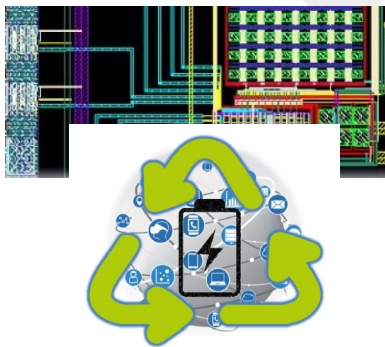
allow free and guided entry to the Institute's “Zenón Navarro” Microelectronics Museum Space and to the Integrated Clean Room of Micro and Nanofabrication.

## FOTCIENCIA

Dr. Gemma Rius and Dr. Gonzalo Murillo presented the exhibition of science photographs held in Barcelona during the Science Week in November 2018, corresponding to the 15<sup>th</sup> national contest FOTCIENCIA.

## Mondays of Science

Three IMB-CNM researchers participated in a series of talks for the general public in Barcelona on Research in Microelectronics (June 2018): Dr. David Quirion (Detectors for particle physics), Dr. Rosa Villa (Neural interfaces) and Dr. Luis Fonseca (Energy harvesting for the Internet of Things).



## Inspiraciencia

IMB-CNM participated in the organization of Inspiraciencia 2017 and 2018, a contest on science-based stories, organized by CSIC.

## Science and Technology Week

In November, the 22<sup>nd</sup> (2017) and 23<sup>rd</sup> (2018) Science Week in Catalonia / Science and Technology Week in CSIC was held, which included a whole series of scientific dissemination activities such as open days, exhibitions, talks, games, scientific workshops, etc. IMB-CNM joined it with different activities, with the aim of bringing microelectronics research closer to society.

Throughout the week, the center organized open days to



## Escolab

In February 2017 IMB-CNM started workshop activities for High School students on “Electrochemical detection of C vitamin with thick film sensors”, within the ESCOLAB programme of the Barcelona City Council.



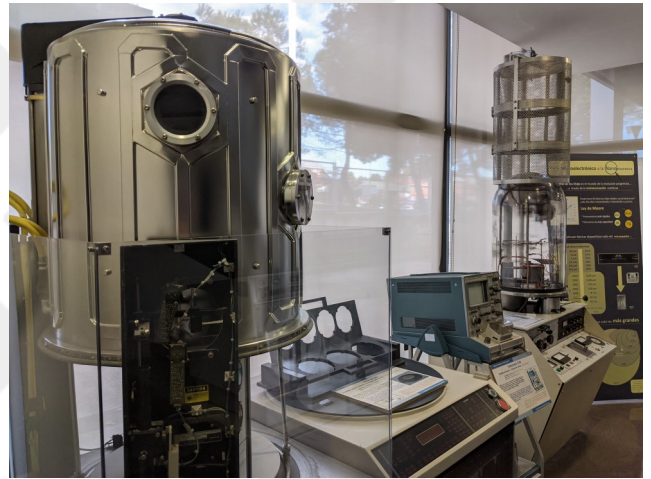
## Microelectronics Museum Area

The “Zenon Navarro” Microelectronics Museum area was 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

Guided visits to the IMB-CNM and the museum area are organized for student groups, from high schools or universities. More than 300 students visit the institute annually.





# 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 includes more than 500 researchers.



<http://www.bnc-b.net/>

**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.

<http://www.dtm.es>

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.



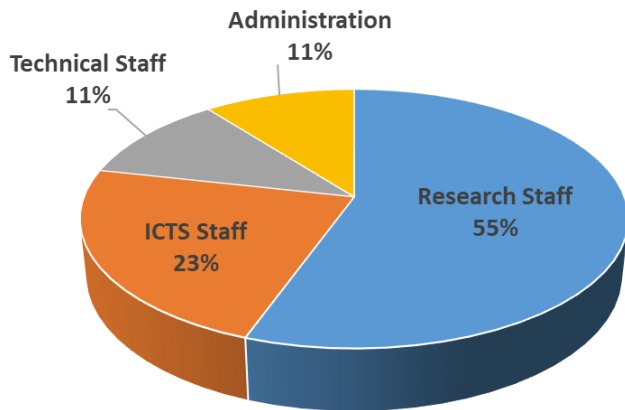
<https://www.uab.cat/parc-recerca/>

In addition, IMB-CNM is member of more than 20 national and international clusters, technological platforms, industrial associations and research networks.

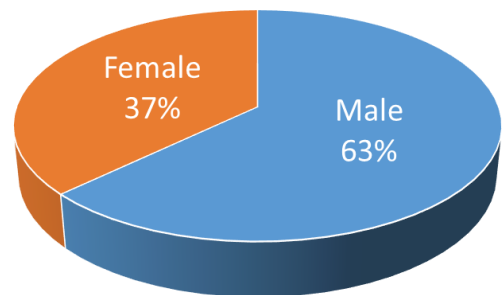
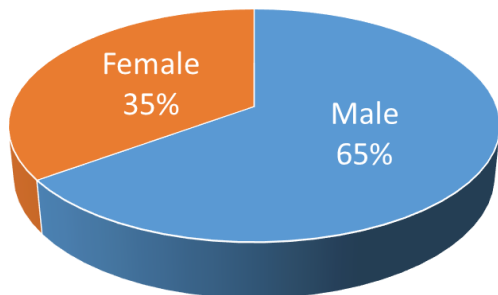
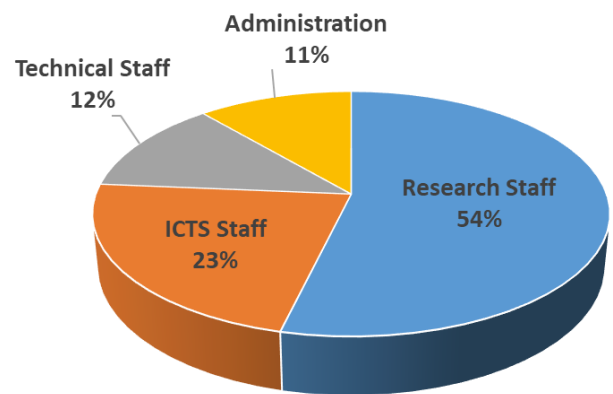
# Key Figures

## Staff

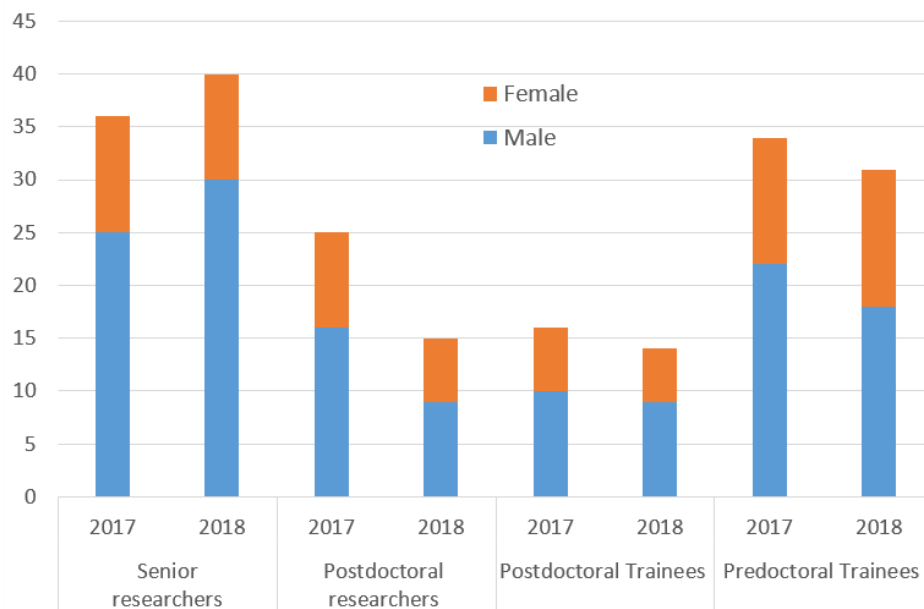
2017 - Total staff 200



2018 - Total staff 186

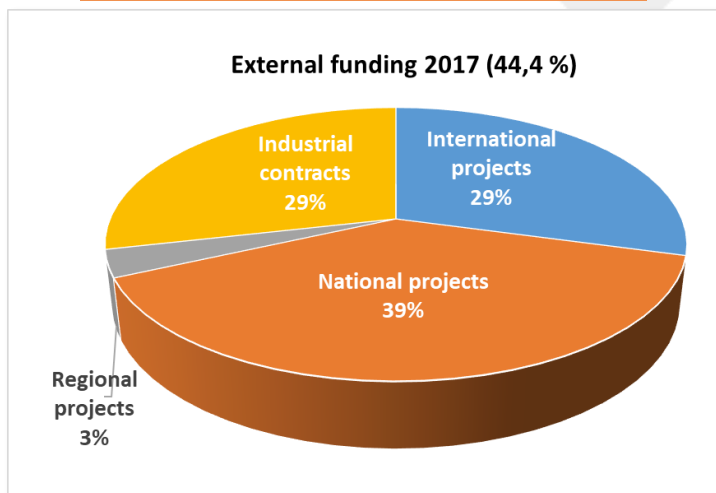


Research Staff Composition

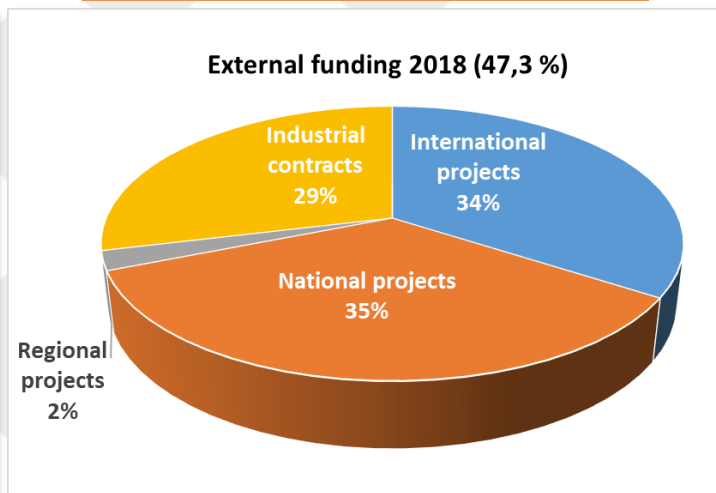


## Budget

**Total Budget 2017 11,128 M€**

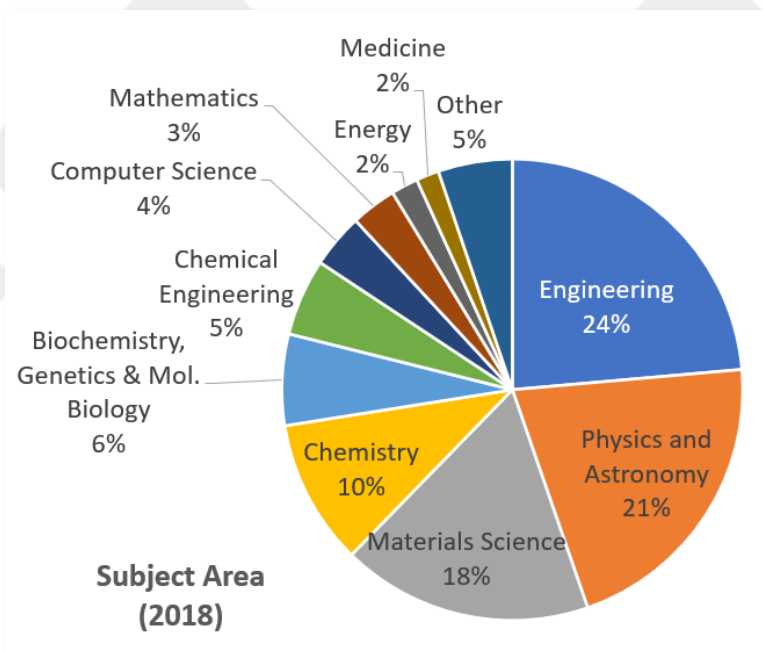


**Total Budget 2018 11,692 M€**



## Publications

	2017	2018
<b>Journal papers</b>	104	84
Q1 (SJR) percentage	75	79
D1 (SJR) percentage	38	37
Conference presentations	163	141



## Technology Transfer

	2017	2018
Registered patents	5	18
Licensed patents	2	2

[www.imb-cnm.csic.es](http://www.imb-cnm.csic.es)



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