

## Scientific highlights

line

### 'Fingerprinting' nanoscale objects and viruses

Scientists working at the nanoscale have long had to rely on chemical labeling or target objects to detect their presence and physical distribution, but labeling molecules can give misleading results about their properties. In July, IBEC scientists (CNB-CGIC) in Madrid Centro Nacional de Biotecnología (CNB-CGIC) in Madrid perfected a new technique that uses an electrostatic force microscope (EFM), a type of atomic force microscope, to unambiguously identify nano-objects with no need for labels.

All objects exhibit a characteristic 'dielectric constant', or permittivity, which gives an indication of how the material responds to an applied electric field. By measuring the way an object reacts to an applied electric field using EFM, the researchers applied the electric field to the nano-objects using the same tip, and measured the tiny amount of the laser induced by the dielectric response of the objects. "When we had quantified their dielectric measurement precisely, we were then able to use these as a 'signature' to discriminate objects of identical shape but different composition, which would otherwise be impossible to recognize without labeling," explains Laura Fernández, lead author on the study in *Nature Materials*.

The new technique for measuring the dielectric constant of nano-objects has several advantages over existing methods. It is a non-destructive technique that does not require labeling of the objects, and it can be used to measure the dielectric constant of a wide range of materials, including polymers, metals, and semiconductors. The technique is also highly sensitive, allowing for the detection of small changes in the dielectric constant of the objects being measured.

### Scientists discover a new type of wave in living tissues

When an organism awakens or feels stressed, its body temperature, heart rate and breathing rate increase. Despite decades of research, the underlying mechanisms of these responses remain unclear. In July, scientists at IBEC discovered the presence of a new type of wave in living tissues, which they call 'mechanical waves'. These waves are thought to play a role in the regulation of cellular processes and the overall health of the organism.

September

### Imaging the electrocatalytic activity of single nanoparticles

Researchers at IBEC have developed a new technique for imaging the electrocatalytic activity of single nanoparticles. This technique allows for the visualization of the catalytic activity of individual nanoparticles, providing valuable insights into the mechanisms of catalysis at the nanoscale.

# IBEC

in a nutshell

17  
research  
groups

270  
researchers  
and staff

20  
different  
countries

291  
media  
appearances

650 scientific  
publications

Clinical  
translation

19 patents

5 \*iCrea  
research professors

9  
erc  
grants

An interdisciplinary  
research centre focused on  
bioengineering for

- future medicine
- active ageing
- regenerative therapies

**IBEC**  
Institute for Bioengineering of Catalonia

[www.ibecbarcelona.eu](http://www.ibecbarcelona.eu)

## IBEC

The Institute for Bioengineering of Catalonia (IBEC) conducts excellent interdisciplinary research at the frontiers of engineering and life sciences in order to generate new knowledge by putting together fields like nanomedicine, biophysics, biotechnology, tissue engineering and the applications of health information technology.

IBEC was established in 2005 by the then Department of Innovation, Universities and Enterprises and the Department of Health of the Generalitat de Catalunya (Autonomous Government of Catalonia), the University of Barcelona (UB) and the Technical University of Catalonia (UPC). The governing body of IBEC is its Board of Trustees, composed of members of the four founding institutions. IBEC's Board of Trustees receives advice from the director of the institute and from the International Scientific Committee.

IBEC's International Scientific Committee plays a key role in the activities of the institute, focusing especially on the selection and evaluation processes of the research group leaders. The committee is composed of international renowned scientists in different bioengineering fields, as well as prestigious professionals in key areas within the activities of IBEC, such as research results valorization or medical technologies validation.

The IBEC is funded by its founding institutions, by national and international competitive funding sources for its research projects, and by R&D contracts with companies.

## Mission

IBEC is a research centre whose purpose is to carry out interdisciplinary research at the highest international quality level which, by creating knowledge, helps to improve health and quality of life and generate wealth.

## Location

IBEC is mainly situated within the Barcelona Science Park (PCB), the first science park created in Spain, which is one of the largest research clusters in the life sciences in southern Europe. This enables our researchers to carry out their work in a highly stimulating biomedical environment in close cooperation with both public and private sector organisations.

IBEC occupies approximately 2500m<sup>2</sup> of usable space, providing its researchers with extensive research facilities and a scientific-technical infrastructure, distributed in open and interdisciplinary lab spaces. In particular, IBEC owns the state-of-the-art Nanotechnology Platform, an accessible and versatile research facility featuring 150m<sup>2</sup> of class 10,000 cleanroom space and laboratories offering cutting-edge equipment for the fabrication and characterization of micro- and nanodevices and structures. Apart from this, access to other powerful technological facilities of the PCB and scientific services of the UB are available.



# Research at IBEC

IBEC has developed a new strategic plan for the period 2014-2017, which will play a decisive role in the development and consolidation of IBEC as a top-class research centre. The IBEC model is based on transformative interaction between scientific disciplines and technologies which are apparently separate from one another in order to create added value with the aim of finding engineering-led leading-edge solutions in health and life sciences.

The program's main objective is the better use of the salient features of IBEC: interdisciplinary and convergence technologies.

The knowledge that exists in the IBEC research groups is structured in three broad avenues of knowledge: nanomedicine, cellular and tissue engineering and ICT for health. These are placed at the service of science and society to progress in three major application areas, namely:

- **Bioengineering for future medicine**, with the aim of developing technology that goes beyond the existing paradigm of medical care in hospital to incorporate new areas such as photopharmacology, organs on chips and diagnosis based on the mechanical behaviour of cells and tissues.

- **Bioengineering for active ageing**, with the aim of developing assisted living technologies that support daily life with a remote link to a call-centre, and telehealth – remote monitoring, consultation and diagnosis – to help

support independent living at home, keeping patients out of hospital and residential care for longer.

- **Bioengineering for regenerative therapies**, with the aim of developing regeneration technology to allow the creation of implants able to bring about the regeneration of damaged tissues or organs and to develop cell therapies.

In short, the IBEC research programme for 2014-2017 represents a unique opportunity to take advantage of the underlying potential in the convergence of science and engineering for both doctors and patients. In particular this is a chance to assure the sustainability of quality, efficient healthcare under the pressure of current demographic changes, as well as fostering advances in other areas of life science to supply researchers with disruptive innovations in ways of observing and interacting with molecules, cells, tissues and organs.





## Events

Throughout the year, IBEC organises numerous scientific and other events, including regular seminars, project meetings, open doors days, the IBEC symposium, and outreach activities.

## Clinical translation

IBEC counts on the collaboration of medical doctors to provide input on the clinical aspects of its research, so that results are easily extended to clinical practice.

In this way, IBEC benefits from its privileged position as technological counterpart of the major hospitals in the Barcelona area, four of which (Hospital Clínic, Sant Pau, HSCSP and Bellvitge) are recognized as Biomedical Research Institutes of Excellence by the Spanish government. IBEC's framework agreements and collaborations with these nearby hospitals allow easy access to clinical samples and patients.

In addition, IBEC also has two of its groups physically located at the Hospital Universitari de Bellvitge, where they work on research projects alongside the clinicians.

## Technology transfer

IBEC actively pursues the establishment of research projects with industry partners who share its commitment to bringing high-quality health research and technologies to market and patients. These partnerships take full advantage of the IBEC groups' interdisciplinary expertise in various fields, as well as our state-of-the-art equipment and core facilities.

Our industry partners complement our abilities with their strong market expertise and presence and by pinpointing specific industrial needs that can be addressed by our scientific and technological support. These partnerships play a central role in achieving IBEC's mission of knowledge and technology transfer to the biomedical sector, and ensure that our research is guided by and addresses concrete problems and real-world requirements.



# Recent projects, inventions and patents

A new technology to combat dozing off when driving was developed by IBEC, the UB and industry partner Ficosa. Somnoalert® is a smart phone application that uses inertial sensors and GPS data to detect movements that are characteristic of nodding off at the wheel, such as deviation from the driving lane or sudden corrections, and incorporates biomedical sensors to analyze respiration data.



Highly-competitive ERC grants are considered Europe's most prestigious research awards, and during IBEC's life its researchers have been awarded nine so far. The research projects funded by the ERC focus on such topics as the therapeutic applications of light-regulated drugs, how to regenerate the mammalian kidney, and engineering complex intestinal epithelial tissue models.



A collaboration with Barcelona's Hospital Clínic led to the development of Dermoglass, a wound dressing which accelerates the regeneration of the skin in hard-to-heal skin ulcers. This project was the subject of IBEC's first venture into crowdfunding.

A joint unit of IBEC and the Barcelona Centre for International Health Research (CRESIB) is a collaborative initiative with the mission to develop new diagnostic and therapeutic systems for malaria. Specifically, they aim to demonstrate the feasibility of nanovectors as antimalarial drugs or carriers of other existing drugs, and have patented an approach that may become a new class of potent anti-malarial agents.



# Latest research highlights

## Descubren nuevos mecanismos para el control de la metástasis

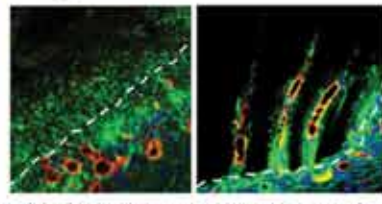
Investigadores del Instituto de Biogeniería de Cataluña abren una vía revolucionaria para entender mejor la propagación del cáncer

Los investigadores del Instituto de Biogeniería de Cataluña (IBEC) han descubierto un nuevo mecanismo de comunicación entre células que regula el crecimiento y la propagación del cáncer. Este descubrimiento abre una vía revolucionaria para entender mejor la propagación del cáncer.



IBEC researchers showed that the physics of communication between cells is as important as the chemistry behind it, opening up new possibilities for the control of metastasis.

## Un nuevo implante ayuda al cerebro a autoregenerarse



Las células gliales (verde) y los vasos sanguíneos (rojo) penetran en el tejido dañado y no en las fibras axonales (rayas blancas). IBEC

Investigación en regeneración de tejido del Instituto de Biogeniería de Cataluña (IBEC), de la Universidad de Barcelona (UB) y de la Universidad Politécnica de Cataluña (UPC) han desarrollado un implante que...

Researchers at IBEC, UB and the UPC developed an implant that could aid the regeneration of brain tissue, particularly in cases of pre- and postnatal injury.



## Descubren un mecanismo celular clave en la detección del cáncer de mama

El estudio científico fue impulsado por la Obra Social de La Caixa

A study in *Nature Materials* revealed how mammary cells detect tissue stiffening, which is key to the development of breast cancer.



## La ciencia avanza hacia fármacos que se activan cuando les da la luz

Los médicos farmacéuticos buscan por la luz para activar sus medicamentos



IBEC researchers and their collaborators announced the development of the first ever light-controlled drug whose effects focus specifically on the largest, most important class of drug target proteins.

## Investigadores españoles crean el primer bazo en un chip

Científicos del Instituto de Biogeniería de Cataluña crean a microescala las propiedades físicas de este órgano humano



Los investigadores del Instituto de Biogeniería de Cataluña (IBEC) han creado el primer bazo en un chip, un avance que permitirá estudiar mejor la función de este órgano humano.

Researchers from IBEC and CRESIB made a major breakthrough in the field of microengineered organs on chips, designing the first-ever functional 3D spleen capable of reproducing the function of the spleen.



IBEC researchers found that ribonucleotide reductases (RNRs) – enzymes that provide the building blocks for DNA replication in all living cells – play an important role in *Escherichia coli* virulence and infection, opening the way to developing targeted drugs against the condition.



A study published in *Cell* revealed a simple technique to eliminate mitochondrial mutations in mouse eggs or embryos at an early stage of development.



One of IBEC's newest groups focuses on the study of a broad range of phenomena occurring at the interface between materials and biology, culminating in the design of miniaturized devices such as self-propelled nanorobots for more accurate drug delivery.

## Institutional news



IBEC and Genomica create joint unit for research and development of diagnostic devices



IBEC receives Severo Ochoa Excellence Award



IBEC is a core partner in the winning proposal for the EIT's Knowledge and Innovation Community (KIC) on healthy living and active ageing, EIT Health



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