2014

ACTIVITY REPORT

Institut de Nanociència
i Nanotecnologia
de la Universitat de Barcelona

Universitat de Barcelona

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IN²UB
Annual Report 2014

FOREWORD

It is with great pleasure that the Institut de Nanociència i Nanotecnologia de la Universitat de Barcelona (IN²UB) presents the 2014 Annual Report. This report completes the mandate of Dr. Amilcar Labarta who has been the Director of the Institute since its foundation. Under the leadership of Dr. Labarta the IN²UB has grown, providing a seminal platform where researchers with different skills and background can build collaborative projects at the frontier of the classical fields of knowledge. During this period the IN²UB has maturated, becoming prepared to undertake new challenges as transversal research projects seeking out the excellence, transference of knowledge to the productive sector, and keeping a definite commitment with research and teaching as the same body of the learning process at the University. Noteworthy, the University of Barcelona (UB) belongs to the consortium of the League of European Research Universities (LERU).

Since its creation in 2006 the IN²UB has been scientifically thriving, gathering a heterogeneous community of researchers from the Faculties of Physics, Biology, Chemistry, Medicine and Pharmacy, all of them working in different research lines, from modeling and manipulation of materials at atomic, molecular and macromolecular level, to the design characterization and production of engines and systems at the nanoscale. Presently, the IN²UB is formed by 227 researchers from the UB that are integrated in 41 different groups within our six lines of research. The following pages contain a summary of the current research lines, together with a list of the publications appeared during 2014 along Grants, activities and a list of members of the IN²UB. These outcomes achieved during 2014 reflect the continuous effort of our devoted scientists not only for increasing the impact of our publications but for improving the teaching based on research activity and transfer of knowledge. Nowadays, UB as member of the LERU is offering a Master in Nanoscience and Nanotechnology, and a Ph.D. program in Nanoscience where our Faculty members are deeply involved.

IN²UB continued success will be shaped by a new Director, Dr. Jordi Borrell and the elected members of the new advisory board with the same collaborative effort involving every line of research. Working together, and with foresight and determination, we will fulfill of a strategic plan that contemplates the teaching-research public university as an institution committed to the public good and its special obligation to the community.

ORGANIZATION

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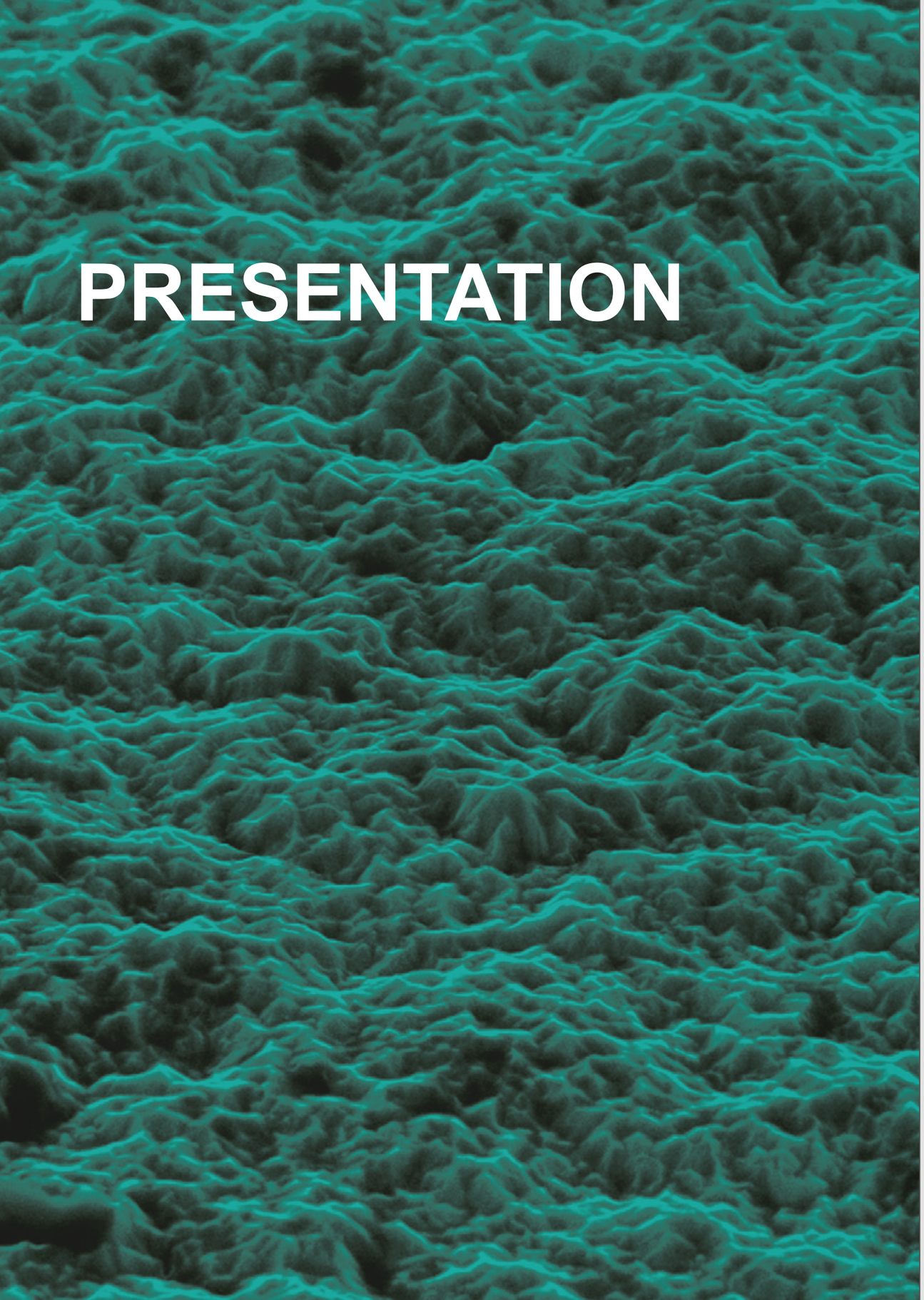
CONTENT LIST

Institut de Nanociència i Nanotecnologia
de la Universitat de Barcelona



PRESENTATION

A thorough understanding of the behaviour of matter at both the atomic and the molecular scales is possible nowadays thanks to the wide background of theories and models existing to this end. This is also true for the behaviour of matter at microscopic level. There is, however, an entire field yet to be explored just in the middle, where systems present dimensions of about, or below, 100 nanometers. A large number of processes and phenomena, such as the ones which take place during catalysis, or the ones observable in molecular biology, electronics, magnetism, or optics, present similar lengths as well. A wide range of properties having their origins in the processes which take place in such scale lengths can be modified just by controlling the structure of systems at nanometric scale. The manufacturing and the study of nanosystems which may offer alternative functional properties are therefore the biggest challenges which nanoscience and nanotechnology set before us today, and we can face these challenges with the help of the wide knowledge we already have in these disciplines and of a large choice of methodologies.

The great expectations existing nowadays about the application of new technologies based on the development of nanostructured materials, as well as of new tools aimed at an accurate handling of the nanoscale, have pebbled the way for a research field which is now experiencing a decisive growth: nanotechnology. The various applications of nanotechnology can be seen and felt each day with higher intensity, and its impact on everyday life shall not definitely stop growing in the near future. Nanotechnology can in fact be applied to almost every field of research nowadays and, without doubt, it shall be at the basis of most technologies of the future.

The University of Barcelona created in 2006 the Institute of Nanoscience and Nanotechnology (IN^{2}UB), which has as an aim to coordinate multidisciplinary research activities carried out by several research groups of this institution. The IN^{2}UB wants to contribute to the progress of science and innovation while spurring, at the same time, industrial excellence. Researchers who are members of the IN^{2}UB come from different scientific disciplines, such as Physics, Chemistry, Pharmacy Science, Biochemistry and Medicine. In this framework, the IN^{2}UB aims at promoting, both internally and internationally, the collaboration among different groups and research centers by strengthening interdisciplinary activities which integrate both basic and applied research. The IN^{2}UB is thus participating in national strategic programs and in several international projects and actions as well.

The institute integrates six different research lines:

- Modeling and Simulation of Systems and Properties of Matter in the Nanoscale
- Nanobiotechnology
- Nanopharmacotherapy
- Nanomagnetism, nanoelectronics and nanophotonics
- Nanostructured Materials
- Nanoenergy

Since its creation, the researchers and staff at the Institute of Nanoscience and Nanotechnology have been working intently to favour the most suitable synergies among researchers by encouraging interdisciplinary activities that shall result in new frontier-knowledge projects and to encourage relationships between researchers and those corporations with an interest in the different applications of nanotechnologies, by stimulating the implementation of joint projects that shall suit the technologically challenging requirements of the business sector.

Besides, the University of Barcelona offers the Master in Nanoscience and Nanotechnology, and a Doctoral Studies Programme in Nanosciences, which aim at providing students with a deep and oriented training in both the nanoscience and nanotechnology fields. Teaching is based on research activity, transfer of knowledge and the sharing of experiences and procedures. The academic staff belonging to the IN^{2}UB has a most singular role in these studies' teaching activities.

Research lines at the IN²UB

1. Modelling and Simulation of Systems and Properties of Matter at Nanoscale:

- Confinement-related phenomena: reactivity, magnetism, optoelectronics and quantum photonics.
- Transport and conduction.
- Surface effects.
- Electronic structure and excitations.
- Bose-Einstein condensates and quantum confined gases.

2. Nanobiotechnology:

- Functionalization of surfaces.
- Cellular and molecular biomechanics.
- Biomimetic structures and systems.
- Nanofluidics and nanorobotics. Nanomotors.
- Diagnosis in nanomedicine: marking and molecular observation.
- Nanobiosensors; DNA and potein chips; lab on chip.

3. Nanopharmacotherapy:

- Nanostructured systems for controlled drug release. Nanocapsules.
- Nanoestructured systems interaction with biological strucures.
- Bioavailability, toxicity and therapeutic efficiency of nanostructured systems.
- Non-viral vectors. Gene therapy. Pharmacogenomics and nutrigenomics.
- Molecular internalization. Molecular marking. Detoxification.

4. Nanomagnetism, Nanoelectronics and Nanophotonics:

- Magnetic nanoparticles and unimolecular magnets.
- Dynamic processes in nanomagnetism. Interaction with microwaves.
- Magnetoelectronics.
- NEMS (nanoelectromechanical systems).
- Electronic, optoelectronic and photonic nanodevices, nanosensors and nanosystems. Photonic crystals.

5. Nanostrucured Materials:

- Synthesis, nanomanufacturing and nanomanipulation.
- Thin layers, nanostructured multilayers and coatings.
- Nanoparticles, gels, nanofibres, nanorods and nanotubes.
- Nanoestructured metallic oxydes.
- Nanocompounds.
- Mesoporous materials and nanopatterns.

6. Nanoenergy: Production, Storage and Environment

- Catalyic nanostructures for energy production. Fuel cells.
- Nanomaterials for solar cells and photocatalytic processes.
- Nanoestructured systems for energy storage.
- Functional nanorods and nanothreads.
- Nanosensors for pollution and gas detection.

Annual Report 2014
PRESENTATION

Facts and figures at the IN²UB

Established in	2006	
Staff statistics (2014)	Teaching and research staff	143 (of which: 7 RyC)
	Fellows and administrative and service staff	22
	Number of nationalities represented among the staff	8
	Gender distribution of the staff (% of women)	36.97%
Research indicators (2009-2013)	ISI publications	1719
	% of ISI publications in 1st quartile	68.18%
	Financing secured	23,781,431 €
	Number of ERC grants	1 ERC Advanced Grant (2011); 3 ERC Starting Grants (2011 and 2014)
Transfer indicators (2009-2013)	Patents (2009-2013): 19 priority patents, 29 PCT/EUR/USA patents and 3 trade secrets; 3 spin-offs	
Director	Amílcar Labarta	in2ub@ub.edu, amilcar.labarta@ub.edu

SOURCE
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SCIENTIFIC ACTIVITY

INSTITUT DE NANOCIÈNCIA I NANOTECNOLOGIA

1.1. Modeling and simulation of systems and properties of matter in the nanoscale

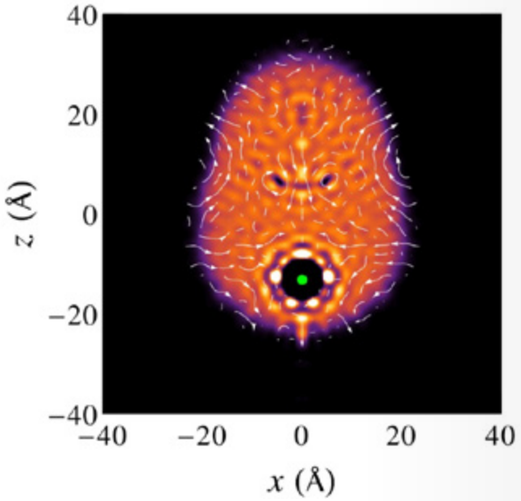
The activities carried out within the Theoretical Physics of Nanoscopic Systems Group can be grouped into two main areas:

Bose-Einstein condensates: We have addressed the long range and the anisotropic character of the dipolar interaction in ultracold dipolar gases in two different regimes:

1. In the mean-field Gross-Pitaevskii description we have studied the pro, Pagation of excitations between non-overlapping dipolar condensates.
2. In the strongly correlated regime we have studied the anisotropic effects of the dipolar interaction in the phase diagram of a triple-well system within the Bose-Hubbard aproach.

Quantum liquids: We have addressed:

1. Dynamics of the photo desorption of heavy alkali metal atoms (Rb & Cs) from the surface of a helium nanodroplet.
2. Capture the heliophobic Cs atom by a helium nanodroplet.
3. Softlanding and spreading of a helium nanodroplet over a graphene surface.
4. Vortex arrays formation in a rotating superfluid ^{4}He nanocylinder.
5. Picosecond solvation dyamics of heavy akali cations in superfluid ^{4}He nanodroplets.



Snapshop of the density of a superfluid 4He1000 nano droplet doped with a Ba+ cation (in green) produced by photoionization of the neutral Ba atom sitting at the droplet surface. It displays the density 45 ps after Ba+ starts to sink into the droplet, showing the appearance of a localized structure around the cation ("snowball") and the cross section of a quantized ring vortex (two dark spots in the middle of the droplet). The circulation lines of the superfluid are represented in white. Nucleation of quatized vortex rings in 4He nanodroplets. By: David Mateo; Anonio Leal; Alberto Hernando; Manuel Barranco; Martí Pi; et al. The Journal of Chemical Physics; Volume: 140; issue:13; Article Number: 131101. Published: April 3 2014

The Nanosystems Statistical Physics Group has been focusing on the study of several non-equilibrium-related phenomena and has explored different research lines:

1. An analysis of the magnetisation dynamics of nanoparticles at very short time scales has been performed. This analysis has led to predicting a new regime by which magnetisation performs a nutational motion which could be observed experimentally.
2. It has been shown that thermodynamic quantities such as temperature cannot be defined consistently enough at very short length scales, and a lower limit for a thermodynamic description has been established.
3. Optimal resting-growth strategies of microbial populations in fluctuating environments have been studied.
4. An analysis of the protein crystal growth under non-isothermal conditions has been performed.
5. An analysis of the cooperative motion of molecular motors and has identified a significant speed-up in the collective displacement of molecular motors due to the coupling through the embedding solvent. This speed up sets up a net luid motion and the measured flow is consistent with the observed cytoplasmatic streaming in cells.
6. A study of the structure of sedimenting active suspensions. The analysis has shown that the intrinsic activity of the moving particles leads to new types of emerging patterns. Depending on the origin of colloid activity, we have classified oth the development of structures analogous to a Wigner crystal, or to the development of large clusters, reminiscent of the clusters of chemical colloids observed experimentally.
7. A new mode of collective ratcheting in Brownian particles has been identified. This new kind of rectification emerges due to the interplay between variable constrictions and the intrinsic motion that keeps a Brownian particle out of equilibrium. Cooperative rectification can be relevant for driven colloids or molecular motors moving in highly confined geometries with variable cross section. We have also analyzed its implications in the transport of charged particles and the possibility that confinement leads to particle segregation or negative mobility.
8. A study of the role of the solid hydrophobicity in the stability of forced thin films. We have identified the interplay between the displacement of the contact line and the forced front to identify the critical capilllary number beyond which the forced fluid filament starts to emit drops. The instability is highly sensitive to the hydrophilic or hydrophobic properties of the solid substrate.

Selected Publications

Mateo, D.; Leal, A,; Hernando, A.; Barranco, M.; Pi, M.; Cargnoni, F.; Mella, M.; Zhang, X.; Drabbels, M. ***Nucleation of quantized vortex rings in helium-4 nanodroplets.*** *Journal of Chemical Physics. Vol: 140 (2014)*

María Pilar de Lara-Castells, Hermann Stoll, Bartolomeo Civalleri, Mauro Causà, Elena Voloshina. Alexander O. Mitrushchenkov, and Martí Pi. ***A combined periodic density functional and incremental wave-function-based approach for the dispersion-accounting time-resolved dynamics of 4He nanodroplets on surfaces: 4He/graphene.*** *Journal of Chemical Physics. Vol: 141 (2014)*

Francesco Ancilotto, Martí Pi, and Manuel Barranco. ***Vortex arrays in a rotating superfluid He4 nanocylinder.*** *Physical Review B. Vol: 90 (2014)*

Antonio Leal, David Mateo, Alberto Hernando, Martí Pi, Manuel Barranco, Alessandro Ponti, Fausto Cargnoni, and Marcel Drabbels. ***Picosecond solvation dynamics of alkali cations in superfluid He4 nanodroplets.*** *Physical Review B. Vol: 90, Pag: 224518-1-224518-11 (2014)*

Antonio Leal, David Mateo, Alberto Hernando, Martí Pi and Manuel Barranco ***Capture of heliophobic atoms by 4 He nanodroplets: the case of cesium.*** *Physical Chemistry Chemical Physics. Vol: 16, Pag: 23206-23213 (2014)*

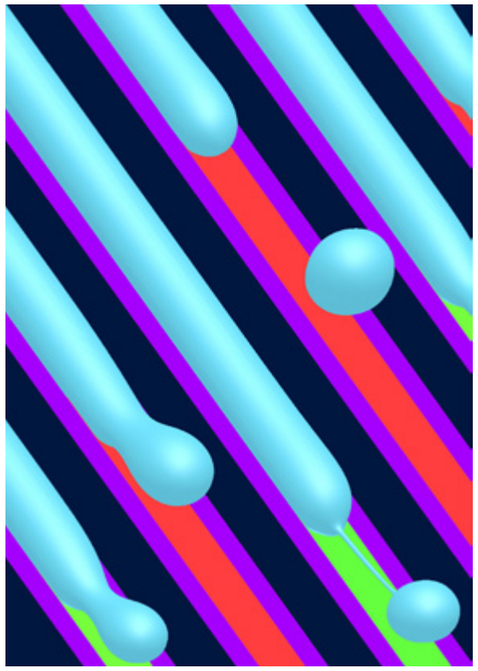
Lázaro, G.R.; Hernández-Machado, A.; , Pagonabarraga, I. Rheology of red blood cells under flow in highly confined microchannels: I. ***Effect of elasticity.*** *Soft Matter. Vol: 10, Pag: 7195- (2014)*

Lázaro, G.R.; Hernández-Machado, A.; , Pagonabarraga, I. Rheology of red blood cells under flow in highly confined microchannels: II. ***Effect of focusing and confinement.*** *Soft Matter. Vol: 10 , Pag: 7207- (2014)*

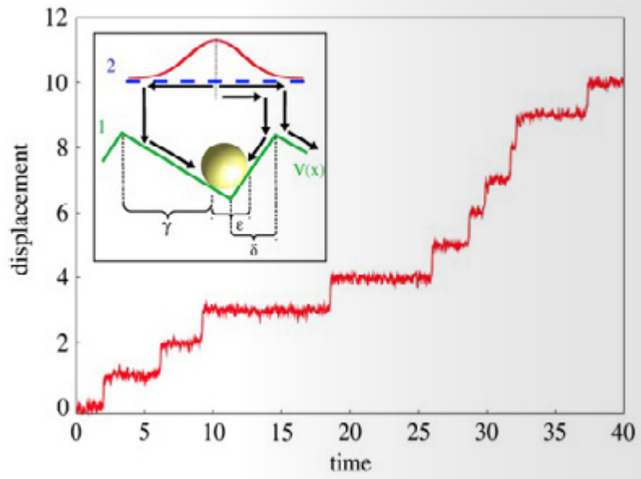
Acevedo, M; Zuriguel, I.; Maza, D.; , Pagonabarra, I.; Alonso-Marroquín, F.; Hidalgo, R.C. ***Stress transmission in systems of faceted particles in a silo: the roles of filling rate and particle aspect ratio.*** *Granular Matter. Vol: 16, Pag: 411- (2014)*

Zuriguel, I.; Parisi, D.; Hidalgo, R.C.; Lozano, C.; Janda, A.; Gago, P.A.; Peralta, J.P.; Ferrer, M.; Pugnaloni, L.A.; Clement, E.; Maza, D.; , Pagonabarraga, I.; Garcimartin, A. ***Clogging transition of many-particle systems flowing through bottlenecks.*** *Scientific Reports. Vol: 4, Pag: 7324- (2014)*

Malgaretti, P.; Pagonabarraga, I.; Rubí, J.M. ***Entropic electrokinetics: recirculation, particle separation and negative mobility.*** *Physical Review Letters. Vol: 113, Pag: 128301 (2014)*



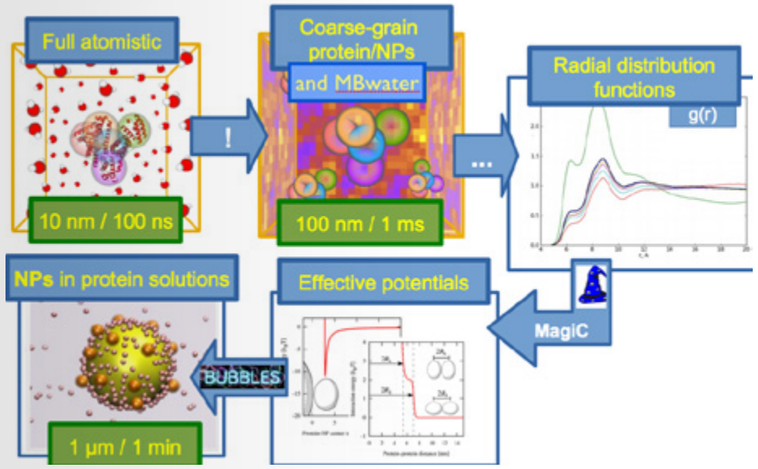
Drop emission on driven liquid filaments controlled by substrate wetting properties. The solid substrate is patterned with different degree of hydrophobicity. The green and red stripes correspond to more hydrophobicity than the dark blue substrate. The violet stripes are more hydrophobic and contribute to stabilize small fluid filaments. These filaments destabilize and emit drops periodically. Both the size of the drops and the emission periodicity can be controlled by the substrate properties and the degree of forcing. The image shows the results of computer simulations and the computational predictions have been validated experimentally (R. Ledesma-Aguilar et al., Nature Materials 10, 367 (2011))



Typical trajectory generated by a two-state ratchet description of a molecular motor. The inset displays the different steps that characterize the molecular motor and identify the region around the minimum of the bounding potential (green curve) where the motor makes the transition to the less bound state (dashed blue curve). The curve, obtained through a mesoscopic numerical method, agrees with the experimental observation of how molecular motors displace along a biofilament. The model has been used to study the collective dynamics of weakly coupled molecular motors (P. Malgaretti and I. Pagonabarraga, Phys. Rev. Lett. 109, 168101 (2012)

Also within the Nanosystems Statistical Physics Group, the Complex Matter Group has developed BUBBLES ("BUBBLES is a User-friendly Bundle for Bio-nano Large-scale Efficient Simulations") a set of tools designed to simulate the interactions and kinetics of nanoparticles in protein solutions (https://github.com/bubbles-suite/BUBBLES).

The unit has applied a multi-scale approach to study the nanoparticle interaction with blood plasma, from the scale of the nanoparticles atoms, the water molecules and the protein aminoacids, to the macromolecular scale of protein-protein and protein-nanoparticle interactions. In synergy with experiments, calculations allow the research team to make predictions about the formation of nanoparticle-protein complexes (protein corona). The unit has revealed the fundamental role that water at organic and inorganic interfaces has in the stability of these complexes and in protein stability against unfolding. To this goal fully atomistic Molecular Dynamics or Monte Carlo simulations for coarse-grained models have been used.



Schematic representation of the BUBBLES multi-scale approach for the simulation of the protein-corona formation.

Selected Publications

*Buldyrev, S.V.; Franzese, G. T**wo types of dynamic crossovers in a network-forming liquid with tetrahedral symmetry.** Journal of non-Crystalline Solids. Vol: 407, Pag: 392-398 (2014)*

*Leoni, F.; Franzese, G. **Structural behavior and dynamics of an anomalous fluid between attractive and repulsive walls: Templating, molding, and superdiffusion.** Journal of Chemical Physics. Vol: 141, Pag: 174501 (2014)*

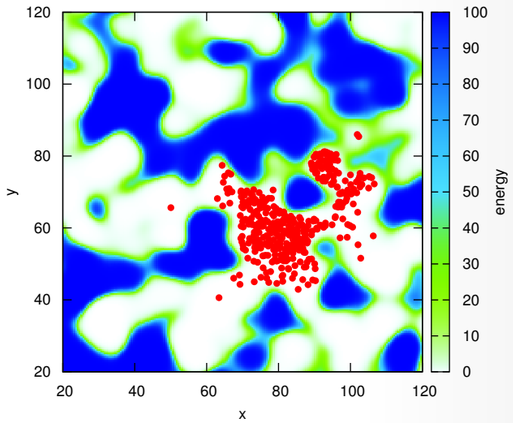
*Bianco, Valentino; Franzese, Giancarlo. **Critical behavior of a water monolayer under hydrophobic confinement.** Scientific Reports. Vol: 4, Pag: 1-10 (2014)*

1.2. Nanobiotechnology

The research carried out by the Non-linear Physics in Nanobiophysics Group can be summarized as follows:

As far as the biophysics area is concerned, we have studied dynamical models to understand how cells differentiate coordinately forming spatial patterns of different cell types. These patterns appear as a result of cell-to-cell communication through the molecular signaling pathway of Notch receptor. This communication is established through the binding of a ligand anchored in a cell membrane to a receptor anchored in an adjacent cell. This binding releases a signal within the cell harboring the receptor. Recent experimental evidences point out that binding of the receptor with the ligand can occur within the same cell and drive signaling as well. We have evaluated the effect of this signaling (cis-signaling) on pattern formation. We have also established and characterized mechanisms for dynamical pattern selection.

With regard to Brownian motion, we present a numerical study of the anomalies in transport and diffusion of overdamped[1] and underdamped[2] Brownian particles in totally disordered potential landscapes in one and in two dimensions. The anomalous regimes (subtransport, subdiffusion and superdiffusion) are characterized by the time exponents that exhibit the statistical moments of the ensemble of particle trajectories, we have also concluded that they are caused by the random character of the barrier crossing events between locked and running states which is manifested in the spatial distributions. Besides, the underdamped approach reveals that the role of the velocities is small because the particles quickly thermalize into locked or running states. Finally, we have also inquired into the Brownian motion under the action of a spatio-temporal colored noise remodeled so as to approximate an environment with dynamic obstacles. In the former scenario, only anomalies of subtransport and subdiffusive are observed because Brownian motion is hindered by barriers, yet particles can't be trapped for long.

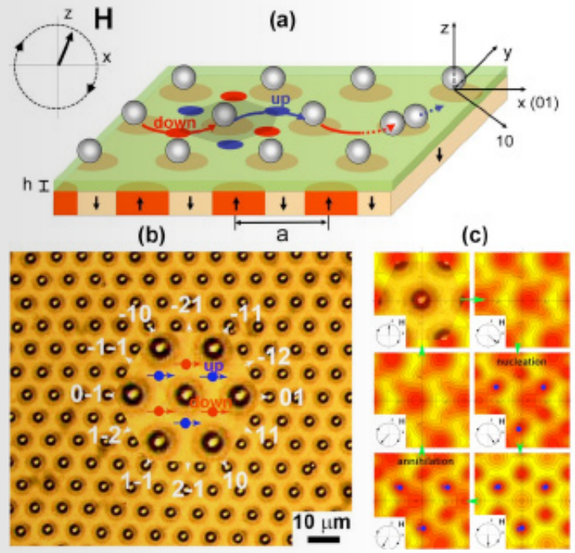


Brownian particles at time τ=3 on an environment with big obstacles of slow dynamics, which comes out of a random potential with isotropic Gaussian spatial correlation and characteristic length λ=5. Particles were initially distributed uniformly between ±λ in a region centered at coordinates (80,67). Thermal energy is T=1. Time, length and energy units are dimensionless.

[1] M. Suñé, J. M. Sancho and K. Lindenberg, Phys. Rev. E 88, 062105 (2013)
[2] M. Suñé, J. M. Sancho and K. Lindenberg, Eur. Phys. J. B 88, 50295 (2014)

The Magnetic Soft Matter Group has focused on studying the dynamics of interacting paramagnetic colloids transported via a magnetic ratchet effect above a periodic bubble lattice.

It was found that, upon application of an external rotating magnetic field the direct ratchet current rises in integer and fractional steps with the field amplitude. The stepwise increase was caused by excluded volume interactions between the particles, which form composite clusters above the bubbles with mobile and immobile occupation sites. Transient energy minima located at the interstitials between the bubbles cause the colloids to hop from one composite cluster to the next with synchronous and period doubled modes of transport. The colloidal current may be polarized to make selective use of type up or type down interstitials.



Schematic (a) and image (b) of the magnetic garnet film with paramagnetic colloids. (c) Magnetic potential energy of a paramagnetic particle during different phases of the applied field (inset). Published in Phys. Rev. Lett. Vol. 112 , Page 048302 (2013).

Selected Publications

Ramirez-Piscina, L. ; Sancho, J. M. ***Molecular Na-channel excitability from statistical physics.*** *EPL. Vol: 108 (2014)*

Skaug, M.J.; Lacasta, A.M.; Ramirez-Piscina, L.; Sancho, J.M.; Lindenberg, K.; Schwartz, D.K. ***Single-molecule diffusion in a periodic potential at a solid-liquid interface.*** *Soft Matter. Vol: 10, Pag: 753-759 (2014)*

Suñé, M.; Sancho, J.M.; Lindenberg, K. ***Transport and Diffusion of underdamped Brownian particles in random potentials.*** *European Physical Journal B. Vol: 87 (2014)*

Alert, R.; Casademunt, J.; Tierno, P. ***Landscape-Inversion Phase Transition in Dipolar Colloids: Tuning the Structure and Dynamics of 2D Crystals.*** *Physical Review Letters. Vol: 113, Pag: 19831 (2014)*

Tierno, P.; Johansen, T. H.; Fischer, T. M. ***Fast and rewritable assembly of colloidal crystals via field-synchronized particle swapping.****. Applied Physics Letters. Vol: 104, Pag: 174102 (2014)*

Straube, A. V.; Tierno, P. ***Tunable interactions between paramagnetic colloidal particles driven in a modulated ratchet potential.*** *Soft Matter. Vol: 10, Pag: 3915-3925 (2014)*

Tierno, P. ***Magnetic assembly and annealing of colloidal lattices and superlattices.*** *Langmuir. Vol: 30, Pag: 7670 (2014)*

Alert, R; Casademunt, J; Tierno, P. ***Landscape-Inversion Phase Transition in Dipolar Colloids: Tuning the Structure and Dynamics of 2D Crystals.*** *Physical Review Letters. (2014)*

Selected Publications

Alemany, A.; Ritort, F. ***Determination of the elastic properties of short ssDNA molecules by mechanically folding and unfolding DNA hairpins.*** *Biopolymers. Vol: 101, Pag: 1193-1199 (2014)*

Ribezzi-Crivellari, M.; Ritort, F. ***Free-energy inference from partial work measurements in small systems.*** *Proceedings of the National Academy of Sciences of the United States of America - PNAS. Vol: 111, Pag: E3386-E3394 (2014)*

During this year, the Small Biosystems Lab Group has focused on several projects related to nanotechnologies. As a matter of fact DNA has long been identified as a promising material for nanotechnology applications. DNA origami and DNA computing are two flourishing research fields which exploit the remarkable physico-chemical properties of such molecule. One expertise of the Small Biosystems Lab is the precision measurement of the physical-chemistry of DNA such as the base-pairing free energies or the mechanical properties of single DNA molecules. Building up on previous experience (NAR, gkt1089 (2013)), this year we have proposed a novel approach to measurement of the elastic properties of very short (~40 bp) single-stranded DNA molecules (Biopolymers 101 (2014) pp. 1193-1199). Studying such short molecules is challenging from the experimental point of view but opens the exciting possibility of addressing the scale dependence of DNA mechanics, which is involved in both fundamental problems, such as gene regulation, and technological applications such as the folding of DNA origami.

A second research pursued in 2014 concerns the application of fundamental non-equilibrium statistical mechanics results, the so-called “Fluctuation Theorems” to to extract useful and otherwise inaccessible information about irreversible processes in small systems via an inference process (PNAS, 111 (2014) E3386-E3394). In a nanotechnological perspective such methods can be applied to characterize energy transfer at the nanoscale in processes such as the mechano-chemical coupling of molecular motors.

Selected Publications

Fillat, A.; Romea, P.; Urpí, F.; Pastor, F.I.J.; Diaz, P. ***Improving enantioselectivity towards tertiary alcohols using mutants of Bacillus sp. BP-7 esterase EstBP7 holding a rare GGG(X)-oxyanion hole.*** *Applied Microbiology and Biotechnology. Vol: 98, Pag: 4479-4490 (2014)*

Estupiñán, M.; Diaz, P.; Manresa, A. ***Unveiling the genes responsible for the unique Pseudomonas aeruginosa oleate-diol synthase activity.*** *Biochimica et Biophysica Acta-Molecular and Cell Biology of Lipids. Vol: 1842, Pag: 1360-1371 (2014)*

Cesarini, S.; Haller, R.F.; Diaz, P.; Nielsen, P.M. ***Combining phospholipases and a liquid lipase for one-step biodiesel production using crude oils.*** *Biotechnology for Biofuels. Vol: 7, Pag: 29 (2014)*

Sainz-Polo, M.A.; Valenzuela, S.V.; Pastor, F.I.J.; González, B.;Sanz-Aparicio, J. ***Structural analysis of glucuronoxylan-specific Xyn30D and its attached CBM35 domain gives insights into the role of modularity in specificity.*** *Journal of Biological Chemistry. Vol: 289, Pag: 31088-31101 (2014)*

Ciolacu, D.; Chiriac A.I.; Pastor, F.I.J.; Kokol, V. ***The influence of supramolecular structure of cellulose allomorphs on the interactions with cellulose-binding domain, CBD3b from Paenibacillus barcinonensis.*** *Bioresource Technology. Vol: 157, Pag: 14-21 (2014)*

During the last year, the group of Microbial Enzymes for Industrial Application carried out the development and evaluation of new enzymes for the hydrolysis, synthesis and/or biotransformation of natural polymers and chemical compounds. New glycosil hydrolases of families scarcely known before have been isolated and new lipases with interesting properties for fine chemistry or for production of fuels such as bioethanol or biodiesel have been cloned and characterised. For some of these enzymes, improvement by means of directed evolution or rational design, relating aspects like structure-function and sequence, have been carried out. With the new isolated enzymes or the enzymatic improved variants, the group has carried out studies of bleaching of non woody paper fibres and has evaluated the influence of the enzymatic treatments on the reactivity of eucalyptus fibres. In this sense xylanases from previously described and from the new family 30 have been tested. On the other hand, the behaviour of different lipases regarding their immobilisation on different economic supports has been evaluated for their use in biodiesel production. The new lipases, both in immobilized or in soluble form, have been assayed for production of fatty acid methyl esters (FAMEs; biodiesel). It has been shown that the new lipase Callera Trans L, used in soluble form and in presence of a 3-5% water, shows an excellent performance when crude oils are used. Moreover, these results induced the development of a new multienzymatic system that allows synthesis of biodiesel in a single step by means of enzymatic removal of gums followed by esterification of the released free fatty acids. By means of this process it is possible to obtain a high quality biodiesel from non refined oils that up to now could not be used for this purpose. The new system developed will result in a strong cost reduction regarding the raw materials, which don’t need to be refined, as well as in the enzyme, that does not need to be immobilized, thus reducing the costs of the support and the immobilisation itsef, very important for industrial scaling up. Therefore, an innovative, more economic and sustainable one-pot process has been set up for greener biodiesel production.

Selected Publications

Moreno-Càceres, J.; Caja, L.; Mainez, J.; Mayoral, R.; Martín-Sánz, P.; Moreno-Vicente, R.; Del Pozo, M.Á.; Dooley, S.; Egea, G.; Fabregat, I. ***Caveolin-1 is required for TGF- β-induced transactivation of the EGF receptor pathway in hepatocytes through the activation of the metalloprotease TACE/ ADAM17.*** *Cell Death and Disease. Vol: 5 (2014)*

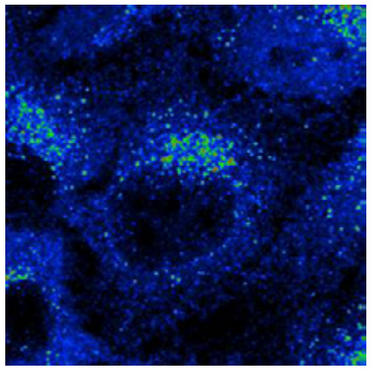
Sicart A., Katan M., Egea G, Sarri E* (*co-corresponding authors)* ***Phsopholipase Cgamma 1 is involved in post-Golgi transport and DAG production triggered by cargo arrival at the Golgi complex.*** *Traffic. Vol: 16, Pag: 250-266 (2014)*

Egea G and Serra-Peinado C ***'Golgi apparatus", finally mechanics comes to play in the secretory pathway.*** *Current Biology. Vol: 18, Pag: R741-R743 (2014)*

Along the past two years, the group of the Intracellular Compartments and Membrane Trafficking Lab has demonstrated that PAP2b (also known as LPP3) is the family member of phosphatidic acid phosphatases (PAPs) involved in membrane trafficking events that involves diacylglycerol in the early secretory pathway. In this same line of research, we have showed that PLCγ1 participates in the production of diacylglycerol associated to signaling events at the Golgi apparatus. We have also published a review that collects the most significant and recent data about the structural and functional significance of actin and actin binding/regulatory proteins in the Golgi apparatus of a variety of organisms of the animal and plant kingdoms, as well as critical comment about the high impact of a recent manuscript in Curr. Biol. (Egea and Serra-Peinado). Finally, we demonstrated that vascular smooth muscle cells from aortic aneurysms associated to Marfan syndrome show phenotypic changes that definitively contribute to aortic stiffness and to the subsequent aortic rupture.

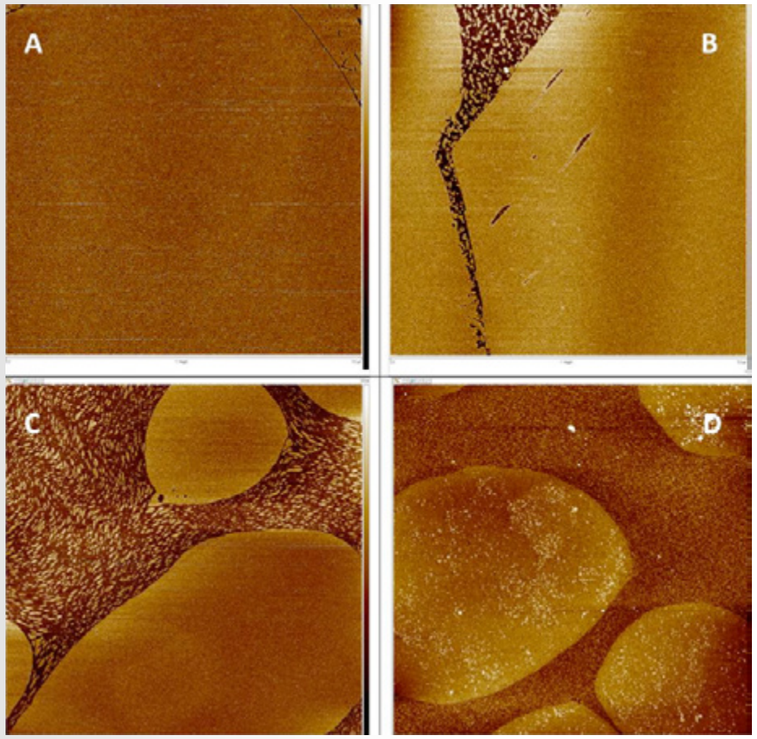
We have collaborated with Isabel Fabregat's laboratory (IDIBELL, Bareclona) in the study of membrane trafficking followed by CXCR4 receptor in hepatocellular carcinoma cells and about the role of TGF-β for the transactivation of the EGF receptor in the same cancer cell model.

Our current goals are focused on the pathophysiology of vascular cells in Marfan syndrome, a cardiovascular genetic disorder that severely perturbs the extracellular matrix and TGF-β signaling. We are highly interested in the assembly of ECM lattice and signaling responses when cells are subjected to mechanical stretching in an aortic bioreactor that mimics what occurs *in situ* in the aorta.



Subcellular localization of LPP3 in the Golgi apparatus and vesicular carriers in HeLa cells examined under the confocal microscope. Picture taken by Enric Gutiérrez-Martínez

Currently Peptides and Proteins: Physicochemical Studies Group is developing its activity in two research lines a) The study of surface active GBV-C peptides as potential inhibitors of HIV-1 FP peptide and b) The performance of biophysical and microbiological studies of multifunctional polycationic peptide constructions with membrane activity. Concerning HIV-1 FP inhibition, its research has been focused specifically on using lipid nano-assemblies in order to know how this process takes place. Findings suggest that putative GBV-C peptides interact with HIV-1 FP providing a kind of peptide-peptide complex that avoid the HIV-1 FP action at membrane level. Figure shows the AFM images of LB films obtained for a GBV-C peptide: E1 P8-12.



AFM images for A: DPPC/DPPG (2:1), B: DPPC/ DPPG (2:1) + HIV-1 FP (5% mol), C: DPPC/ DPPG (2:1) + E1P8-12 (5% mol), D: DPPC/ DPPG (2:1) + E1P8-12 + HIV-1 FP (2:1) (5% mol). Monolayers were transferred onto mica sheets at 6 mN m-1. Data scale: 5x5 µm. Z-scale: 4.0 nm, 4.0 nm, 1.3 nm and 5.8 nm for A, B, C and D respectively.

Selected Publications

R. Galatola; A. Cruz; M.J. Gómara; J. Prat; M. A. Alsina; I. Haro; M. Pujol. ***Surface behavior of peptides from E1 GBV-C protein: Interaction with anionic model membranes and importance in HIV-1 FP inhibition.*** *Biochimica et Biophysica Acta-Biomembranes. Vol: 1848, Pag: 392-407 (2014)*

Grau-Campistany A.; Pujol M.; Marqués A.M.; Manresa A.; Rabanal F.; Cajal Y. ***Membrane interaction of a new synthetic antimicrobial lipopetide sp-85 with broad spectrum activity.*** *Colloids and Surfaces A-Physicochemical and Engineering Aspects. (2014)*

Galatola, R.; Vasconcelos, A.; Pérez, Y.; Cruz, A.; Pujol, M.; Alsina, M.A.; Gómara, M.J.; Haro, I. ***A cyclic GB virus C derived peptide with anti-HIV-1 activity targets the fusion peptide of HIV-1.*** *European Journal of Medicinal Chemistry. Vol: 86, Pag: 589-604 (2014)*

Domènech, O.; Ortiz, A.; Pujol, M.; Haro, I.; Muñoz, M.; Alsina, M.A.; Prat, J.; Busquets, M.A.; Girona, V. ***Modification of FP-HIV activity by peptide sequences of GB virus C: A biophysical approach.*** *Biochimica et Biophysica Acta-Biomembranes. Vol: 1838, Pag: 1274-1280 (2014)*

The line of research on new antibiotic lipopeptides has developed new candidate molecules with MICs in the micromolar range for both Gram positive and Gram negative bacteria (patents WO2010/029196, WO2011/110716, PCT/ES2014/070286). Biophysical studies with model membranes in combination with flow cytometry and TEM observation in susceptible bacteria are indicative of a membrane-based mechanism of action. The project is part of the European consortium ENABLE (European Network for AntiBiotic Lead Engine). This is the one only project in Europe to develop new antibiotics against Gram negative bacteria funded by the Innovative Medicines Inititiave (IMI) (7th framework program and EFPIA, the European Federation of Pharmaceutical Industries and Associates; see http://www.imi.europa.eu/content/enable).

The Nanobioengineering Group is a truly multidisciplinary team composed by researchers coming from very diverse backgrounds (chemistry, physics, material science, electronic engineering, pharmacy and molecular biology) and working together in applying nanotechnology to the development of new biomedical systems and devices, mainly for diagnostic purposes. The main activities of the group involve the surface functionalization of materials integrated with microfluidics systems for the study of biomolecule and cell interactions to develop Organ on Chip or for the development of new biosensors that will be integrated in lab-on-a-chip devices. The goal is to fabricate microsystems containing living cells that recapitulate tissue and organ level functions in vitro and new portable diagnosis devices that can be used as Point-of-Care systems. The projects carried out by the group are focused on clinical and industrial problems and are related to four convergent research lines:

1. **Biosensors and Lab-on-a-chip for clinical diagnosis and food safety applications**

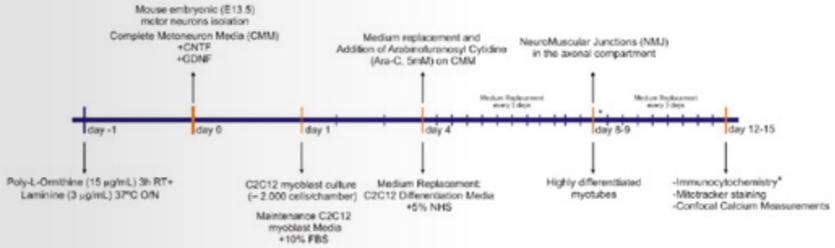
- DNA sensors and platform arrays for cancer biomarker detection
- Antibody-based sensors for pathogenic microorganisms' detection
- Sensor array for in-vivo Ischemia Monitoring
- Sensors to mimic the chemical detection of plant roots for robotic applications.
- Microfluidic chip for reagent handling in POC diagnosis devices
- Microfluidic chip using hydrodynamic focusing for bacteria counting and sorting

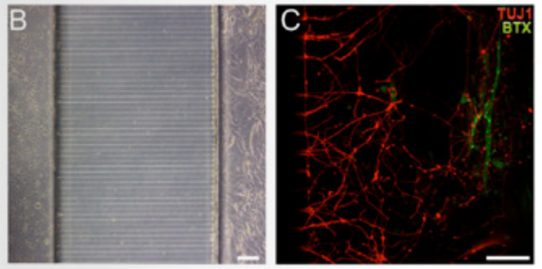
2. **Nanotechnology applied to biomolecule interaction studies and micro/nano-environments for regenerative medicine applications**

- Design, production and characterization of micro/nanoenviroments with different biocompatible materials for cell behavior studies (adhesion, proliferation, differentiation)
- Design, production and characterization of scaffolds with a topography and chemical composition controlled at the nanoscale for regenerative therapies based on stem cells
- Biophysical description of cellular phenomena (cell migration, differentiation) using micro/nanotechnologies, cell biology tools and soft matter physics.
- Magnetic nanoparticles-biomolecules interactions and their applications

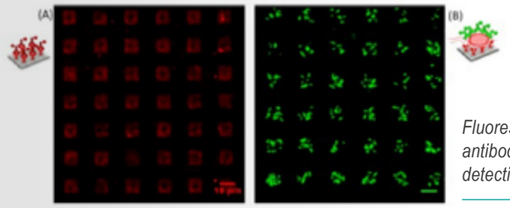
3. **Microfluidic systems for biological studies and Organ-on-Chip devices**

- Microfluidic chip for blood/plasma filtering
- Spleen on a Chip development
- Nanoporous based systems for kidney on chip developments.
- Engineering microfluidic platforms for neurobiological studies.





Neuro Muscular Junction formation in compartmentalized microfluidic devices



Fluorescence images of anti-E.coli O157 antibody pattern before and after bacteria detection

Sensor array for in vivo Ischemia detection

Selected Publications

Tong, Z.; Seira, O.; Casas, C.; Reginensi, D.; Homs-Corbera, A.; Samitier, J.; Del Río; J. A. Engineering a functional neuro-muscular junction model in a chip. RSC. Advances. Vol: 4, Pag: 54788-54797 (2014)

Comelles, J.; Caballero, D.; Voituriez; Hortigüelaa, V.; Wollrab, V.; Godeau, A.L.; Samitier, J.; Martínez, E.; Riveline, D. Cells as active particles in asymmetric potentials: Motility under external gradients. Biophysical Journal. Vol: 107, Pag: 1513-1522 (2014)

Van Heirstraeten, L.; Spang, P.; Schwind, C.; Drese, K.S.; Ritzi-Lehnert, M.; Nieto, B.; Camps, M.; Landgraf, B.; Guasch, F.; Corbera, A.H.; Samitier, J.; Goossens, H.; Malhotra-Kumar, S.; Roeser, T. Integrated DNA and RNA extraction and purification on an automated microfluidic cassette from bacterial and viral pathogens causing community-acquired lower respiratory tract infections. Lab On a Chip. Vol: 14, Pag: 1519-1526 (2014)

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Prieto-Simón, B.; Samitier, J. 'signal off' aptasensor based on enzyme inhibition induced by conformational switch. Analytical Chemistry. Vol: 86, Pag: 1437-1444 (2014)

Lagunas, A.; Castano, A.G.; Artes, J.M.; Vida, Y.; Collado, D.; Perez-Inestrosa, E.; Gorostiza, P.; Claros, S.; Andrades, J.A.; Samitier, J. Large-scale dendrimer-based uneven nanopatterns for the study of local arginine-glycine-aspartic acid (RGD) density effects on cell adhesion. Nano Research. Vol: 7, Pag: 399-409 (2014)

Selected Publications

J. Puigmartí-Luis, W. J. Saletra, A. González, D. B. Amabilino, L. Pérez-García. ***Bottom-up assembly of a surface-anchored supramolecular rotor enabled using a mixed self-assembled monolayer and pre-complexed components.*** *Chemical Communications. Vol: 50, Pag: 82-84 (2014)*

A.C. Aragonès, N. Darwish, W.J. Saletra, L. Pérez García, F. Sanz, J. Puigmartí Luis, D.B. Amabilino, I. Díez Pérez. ***Highly Conductive Single-Molecule Wires with Controlled Orientation by Coordination of Metalloporphyrins.*** *Nano Letters Vol: 14, Pag: 4751-4756 (2014)*

O. Penon, D. Siapkas, S. Novo, S. Durán, G. Oncins, A. Errachid, L. Barrrios, C. Nogues, M. Duch, J.A. Plaza, L. Perez-Garcia. ***Optimized immobilization of lectins using self-assembled monolayerson polysilicon encoded materials for cell tagging.*** *Colloids and Surfaces B: Biointerfaces. Vol:116, Pag: 104-113 (2014)*

M. Rodrigues, A.C. Calpena, D.B. Amabilino, M.L. Garduno-Ramirez, L. Perez-Garcia. ***Supramolecular gels based on a gemini imidazolium amphiphile as molecular material for drug delivery.*** *Journal of Materials Chemistry B. Vol: 2 , Pag: 5419-5429. (2014)*

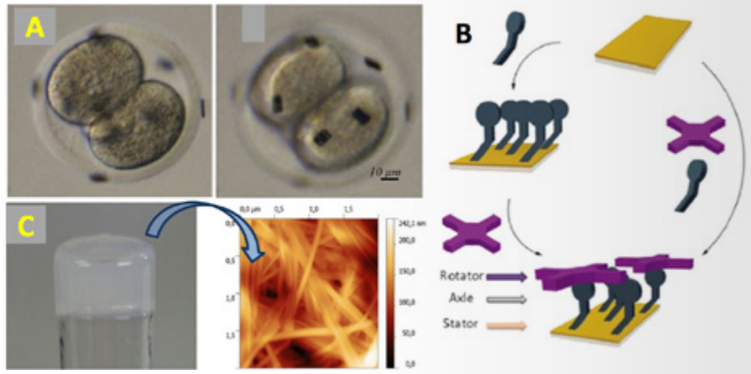
M. Rodrigues, A.C. Calpena, D.B. Amabilino, D. Ramos Lopez, J. de Lapuente, L. Perez-Garcia. ***Water-soluble gold nanoparticles based on imidazolium gemini amphiphiles incorporating piroxicam.*** *RSC Advances. Vol: 4 , Pag: 9279-9287. (2014)*

Supramolecular Systems in Nanomedicine is a multidisciplinary group which develops complex nanostructured materials to be mainly used in nanomedicine. Some examples of our work include:

1. Immobilization of wheat germ agglutinin on polysilicon microparticles, through self-assembled monolayers. The process was optimized in order to achieve micro-barcodes for tagging of bovine and human embryos during assisted reproduction (Figure 1A).

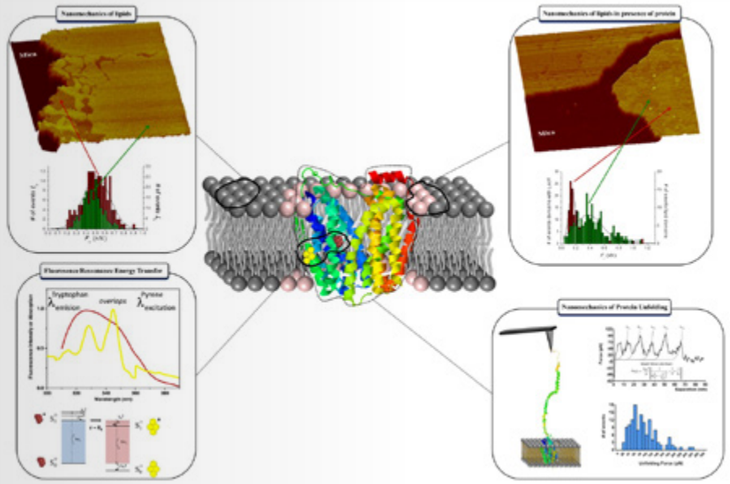
2. Porphyrins, which can be used for molecular recognition of aliphatic amines, were developed. Through molecular coordination, these porphyrins could be successfully immobilized on gold surfaces for the construction of supramolecular rotors (Figure 1B) and molecular wires, the later with good properties to be used in nanoelectronics.

3. Imidazolium-containing amphiphiles were synthesized and used to form Au(I) carbenes. These amphiphiles are capable of recognizing anions and were successfully used to obtain two distinct types of supramolecular assemblies: gold nanoparticles, and supramolecular gels through the formation of intertwined fibbers (Figure 1C). Its anion recognition ability allowed its use as vehicle for the delivery of anionic drugs.



A) photographs of embryos with functionalized barcodes attached B) schematic representation bottom-up strategies to form porphyrin-based rotors on surfaces; C) photograph and AFM image of a supramolecular gel.

The research of the Nanostructure of Biomembranes Group is focused in the study of in-plane lateral lipid segregation and in the effects of phospholipids on structural and functional activity of transmembrane proteins (TMPs). To this end we work with lactose permease (LacY) of Escherichia coli (a paradigm model for TMPs) and model bilayers formed with biomimetic phospholipids (named PE and PG). In the last year our group has characterised by AFM and force spectroscopy (FS) the properties of the PE:PG system and a phase diagram AFM-based to predict the composition of the laterally segregated PE:PG domains in supported lipid bilayers (SLBs), was build. We have also demonstrated by means of FS, the self-segregation of LacY into fluid lipid domains; by using Förster resonance energy transfer (FRET) the preference of LacY for PE; and established a distance of ~3 nm between PE and the centre of the protein.



LacY embedded into a bilayer and experimental approaches to investigate lipid-LacY interactions:(A) Example of SLBs composed of PE:PG (3:1, mol/mol) showing fluid and gel phase domains; and histograms presenting the distribution of forces of fluid (red) and gel (green) domains shown in the topographic image; (B) topographic image of a proteolipid sheet obtained by reconstitution in plane of LacY into PE:PG and histograms showing the distribution of forces of domains with (higher) and without (lower) protein; (C) Overlapped spectra of single tryptophan mutant (W151) of LacY and pyrene labeled phospholipids; (D) force retraction curves corresponding to the unfolding spectra of LacY from a PE:PG and histogram showing its distribution.

The AFM-based Single-Molecule Force Spectroscopy (SMFS) based on the recognition between the AFM tip and the LacY has yield new information on the nanomechanics behind the lipid-protein assembly. In this particular we have: (i) established the experiment conditions to pull up LacY with the AFM tip; and (ii) investigated the influence of different phospholipid matrices on the force required to unfold LacY. These experiments have demonstrated the direct implication of the lateral pressure exerted by the phospholipids on the force required to extract LacY with the AFM tip.

Selected Publications

Vázquez Gonzáles, M.L.; Bernad, R.; Domènech, O.; Montero, M.T.; Calpena, A.C.; Hernández Borrell, J. ***Improving ex vivo skin permeation of non-steroidal Anti-inflammatory drugs: enhancing estemporaneous trnasformation of liposomes into planar lipid bilayers.*** *International Journal of Pharmaceutics.Vol: 461, Pag: 427-436 (2014)*

Suárez-Germà, C.; Hernández-Borrell, J.; Prieto, M.; Loura, L.M. ***Modeling FRET to investigate the selectivity of lactose permease of Escherichia coli for lipids. Molecular Membrane Biology.*** *Vol: 31, Pag: 120-130 (2014)*

Ballesté-Delpierre, C.; Solé, M.; Domènech, Ô.; Borrell, J.; Vila, J.; Fàbrega, A. ***Molecular study of quinolone resistance mechanisms and clonal relationship of Salmonella enterica clinical isolates.*** *International Journal of Antimicrobial Agents. Vol: 43, Pag: 121-125 (2014)*

Suárez-Germà, C.; Dommènech, O.; Montero, M.T.; Hernández-Borrell,J. ***Effect of lactose permesase presence on the strucure and nanomechanics of two-component supported lipid bilayers.*** *Biochimica et Biophysica Acta-Biomembranes. Vol: 1382, Pag: 842-852 (2014)*

Selected Publications

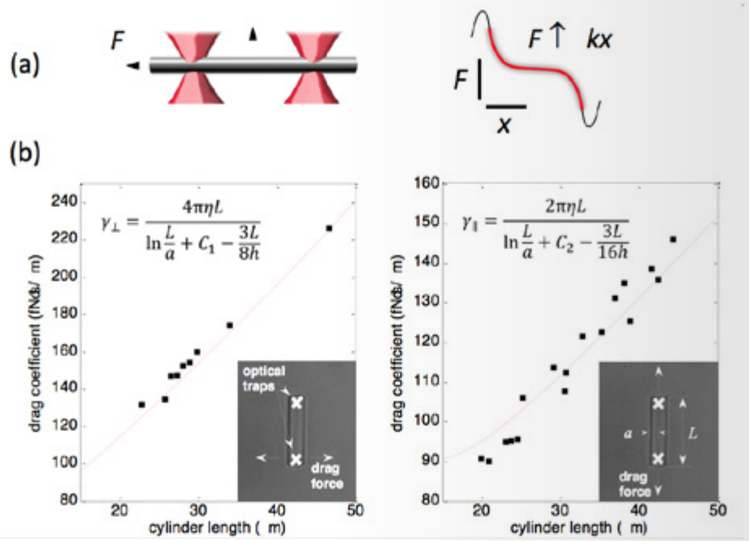
López-Quesada, C., A.-S. Fontaine, A. Farre, I. Llop-Tous, M. Joseph, J. Selva, G. Egea, M.D. Ludevid, E. Martín-Badosa, M. Montes-Usategui ***Artificially-induced organelles are optimal targets for optical trapping experiments in living cells.*** *Biomedical Optics Express. Vol: 5, Pag: 1993-2008 (2014)*

Faigle, C.; Lautenschläger, F.; Whyte, G.; Homewood, P.; Martín-Badosa, E.; Guck, J. ***A monolithic glass chip for active single-cell sorting based on mechanical phenotyping.*** *Lab On a Chip. Vol: 15, Pag: 1267-1275 (2014)*

Kreysing, M.; Ott, D.; Schmidberger, M. J.; Otto, O.; Schürmann, M.; Martín-Badosa, E.; Whyte, G.; Guck, J. ***Dynamic operation of optical fibres beyond single-mode regime facilitates the orientation of biological cells.*** *Nature Communications. Vol: 5 (2014)*

This year the group Optical Trapping Lab - Grup de Biofotònica (BiOPT) has focused on the measurement of optical forces by means of optical tweezers in samples or environments in which traditional methods are not applicable. In these methods, the force is determined through an indirect route, by assuming a linear relation with the sample position. This linear relation is described by the trap stiffness k, which is calibrated by analyzing the Brownian motion of a trapped micro-sphere. Since k depends strongly on the microscopic features of the sample, such as the micro-bead diameter and refractive index, or the viscosity and temperature of the medium, the calibration must be carried out every time an experiment is to be performed. Such micro-beads are often used as microscopic handles to interact with the sample of interest.

Together with the spin-off Impetux Optics SL, we developed a method to directly measure optical forces based on the changes of light momentum, which is not constrained to a linear dependence between the force and the displacement, and can be used with irregular beams and samples, surrounded by heterogeneous and non viscous media, such as the cytoplasm of the cell.



(a) Cylindrical samples are held with two holographic optical traps and drag forces are applied to them in the transversal and longitudinal directions. In these cases, the relationship between the force and the displacement of the particles is generally non linear and traditional force measurement methods cannot be used. (b) We measured the force from light momentum changes to assess the transversal (left) and longitudinal (right) drag coefficients for several cylinders of varying lengths. Red lines correspond to the theoretical hydrodynamic model described by the equations.

On the one hand, we validated our approach inside A549 lung epithelial cells by comparison with the fluctuation-dissipation calibration method and through extensive simulations of the light scattering in the intracellular environment. Our results clearly indicate that the momentum method is more reliable and precise than previous approaches. The main drawback is the unavailability of positional and rheological information of the samples and the cytoplasm, which we will be addressing this coming year.

We also proceeded to measure stall forces of molecular motors kinesin and dynein in these cells. A very clear picture of the complexity of the intracellular space has emerged in our experiments, which makes these results difficult to compare with the simplified single-molecule assays in vitro. A plethora of phenomena that does not show up in vitro takes place simultaneously here: cooperation and antagonism between motors, a viscoelastic cytoplasm that drags on the vesicles, and roadblocks such as MAPs (microtubule associated proteins) or filament intersections that totally determine motility. Further work will be necessary to crack down all this complexity into meaningful information.

On the other hand, we showed that forces on irregular particles and beams can be measured with optical traps by simultaneously applying a force in the same direction to multiple holographically-trapped micro-beads through a constant flow. Also, we satisfactorily measured forces exerted on non-spherical objects such as micro-cylinders in order to assess their transversal and longitudinal drag coefficients.

The research activity of the Laser Processing Group is focused on the study and development of laser microfabrication techniques. Along the 2013-14 period our research has been focused on two main areas: 1) high-speed laser microprinting and 2) submicron-resolution surface modification of transparent materials.

1. The interaction between two adjacent bubbles generated simultaneously through laser irradiation has been investigated. The particular jetting dynamics (Figure) resulting from such interaction impacts dramatically the outcome of a printing event. A good understanding of such dynamics is crucial in high-speed laser microprinting applications.

2. In the 2012-13 report we already emphasized the importance of the correct focusing of the laser beam waist on the sample surface for the generation of submicron features on transparent materials, and we presented a method based on transmittance measurements which successfully allowed achieving that aim. However, this requires detecting radiation through the sample, something usually not possible in many laser microfabrication setups. Along the present period we have developed a new method based on reflectance measurements which overcomes the problem and even results in a substantially better accuracy.

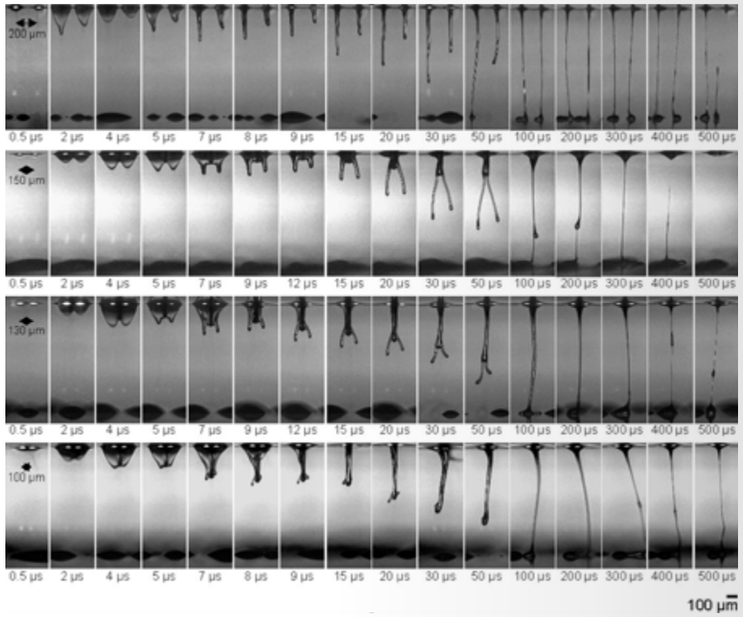
Selected Publications

Biver, E.; Rapp, L.; Alloncle, A.P.; Serra, P.; Delaporte, P. ***High-speed multi-jets printing using laser forward transfer: time-resolved study of the ejection dynamics.*** *Optics Express. Vol: 22 , Pag: 17122-17134 (2014)*

Patrascioiu, A.; Florian, C.; Fernández-Pradas, J.M.; Morenza, J.L.; Hennig, G.; Delaporte, P.; Serra, P. ***Interaction between jets during laser-induced forward transfer.*** *Applied Physics Letters. Vol: 105 (2014)*

Patrascioiu, A.; Fernández-Pradas, J.M.; Palla-Papavlu, A.; Morenza, J.L.; Serra, P. ***Laser-generated liquid microjets: correlation between bubble dynamics and liquid ejection.*** *Microfluidics and Nanofluidics. Vol: 16, Pag: 55-63 (2014)*

Palla-Papavlu, A.; Patrascioiu, A.; Di Pietrantonio, F.; Fernández-Pradas, J.M.; Cannatà, D.; Benetti, M.; D'Auria, S.; Verona, E.; Serra, P. ***Preparation of surface acoustic wave odor sensors by laser-induced forward transfer.*** *Sensors and Actuators B-Chemical. Vol: 192, Pag: 369-377 (2014)*



Jetting dynamics of two adjacent bubbles generated simultaneously through laser irradiation of a thin liquid film. Each series corresponds to a different separation between the bubbles (indicated in the first frame). Each frame displays the delay time after laser pulse impingement, and the acquisition time is 100 ns.

Selected Publications

Moles, E., Urbán, P., Jiménez-Díaz, M.B., Viera-Morilla, S., Angulo-Barturen, I., Busquets, M.A., Fernàndez-Busquets, X. ***Immunoliposome-mediated drug delivery to Plasmodium-infected and non-infected red blood cells as a dual therapeutic/prophylactic antimalarial strategy.*** *J. Control. Release. Vol: 210, Pag: 217-229 (2015)*

Movellan, J., Urbán, P., Moles, E., de la Fuente, J.M., Sierra, T., Serrano, J.L., and Fernàndez-Busquets, X. ***Amphiphilic dendritic derivatives as nanocarriers for the targeted delivery of antimalarial drugs.*** *Biomaterials. Vol: 35, Pag: 7940-7950 (2014)*

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The current activity of the Nanomalaria Group is focused on the development of nanomedicine-based systems to be applied to malaria prophylaxis, diagnosis and therapy.

Malaria is arguably one of the main medical concerns worldwide because of the numbers of people affected, the severity of the disease and the complexity of the life cycle of its causative agent, the protist *Plasmodium spp*. The clinical, social and economic burden of malaria has led for the last 100 years to several waves of serious efforts to reach its control and eventual eradication, without success to this day. With the advent of nanoscience, renewed hopes have appeared of finally obtaining the long sought-after magic bullet against malaria in the form of a nanovector for the targeted delivery of antimalarial drugs exclusively to *Plasmodium*-infected cells. Nanotechnology can also be applied to the discovery of new antimalarials through single-molecule manipulation approaches for the identification of novel drugs targeting essential molecular components of the parasite. Finally, methods for the diagnosis of malaria can benefit from nanotools applied to the design of microfluidic-based devices for the accurate identification of the parasite's strain, its precise infective load, and the relative content of the different stages of its life cycle, whose knowledge is essential for the administration of adequate therapies. The benefits and drawbacks of these nanosystems have to be considered in different possible scenarios, including economy-related issues that are hampering the development of nanotechnology-based medicines against malaria with the dubious argument that they are too expensive to be used in developing areas.Unfortunately, it is true that the application of nanoscience to infectious disease has been traditionally neglected, with most resources overwhelmingly biased towards pathologies prominent in the developed world. Thus, extra ingenuity is demanded from us: malaria-oriented nanomedicines not only have to work spotless as, say, cancer and Alzheimer's therapies; they have to do so in a cost-efficient way because they will have to be deployed in low-income regions.

The driving force of the Nanomalaria group is our personal commitment to applying nanomedicine to infectious diseases of poverty though our current research lines: **(i)** Exploration of different types of encapsulating structure (liposomes, synthetic and natural polymers), targeting molecule (protein, polysaccharide, nucleic acid), and antimalarial compound (e.g. new structures derived from marine organisms and antimicrobial peptides) for the assembly of nanovectors capable of delivering their drug cargo with complete specificity to diseased cells. **(ii)** Development of DNA aptamers as cell targeting agents capable of replacing antibodies. **(iii)** Study of metabolic pathways present in *Plasmodium* but absent in humans, with the aim of identifying specific enzymes as therapeutic targets. **(iv)** Use of single-molecule force spectroscopy strategies for the biodiscovery of new antimalarial and antibiotic agents. **(v)** Design of new methods for the targeted drug delivery to *Plasmodium* stages in the mosquito vector. **(vi)** Investigation of novel drugs against insect-borne diseases working through radically new mechanisms. **(vii)** Extension of our activities to new pathologies including leishmanisasis, Chagas disease, and tuberculosis. Our current efforts are being focused on the engineering of innovative therapeutic strategies requiring minimal clinical assays and thus able to be applied in the field in years instead of decades.

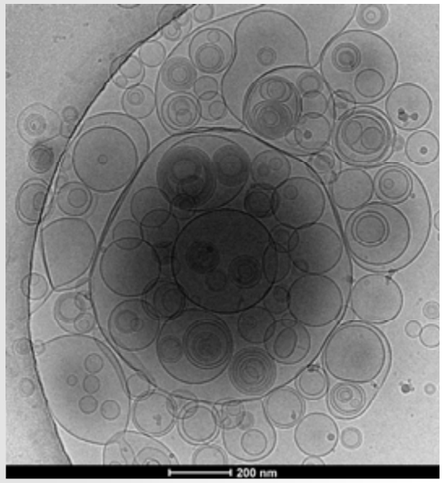
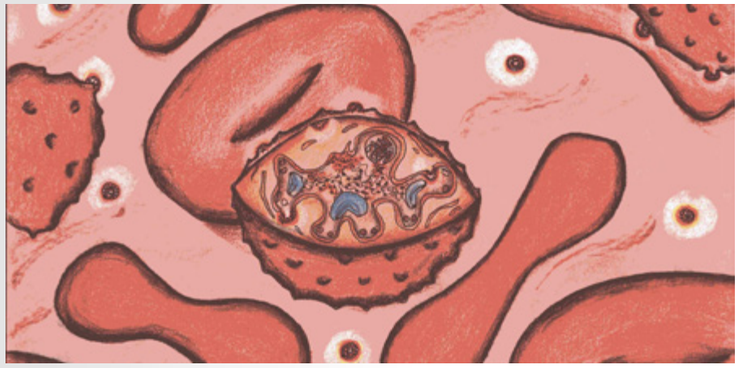


Fig. 1 (left). Cyro-transmission electron microscope image of liposomes being assayed for the encapsulation of drugs specifically targeted to red blood cells infected by the malaria parasite Plasmodium falciparum.

Fig. 2. Artistic rendering of the specific targeting of liposomes (small structures surrounded by a white envelope representing a polyethylene glycol layer designed to confer increased blood residence time) to red blood cells infected by the malaria parasite Plasmodium falciparum.
The parasitized cell in the center is represented open to show intracellular pathogen-derived organelles and liposomes delivering their cargo. Drawing by Elisabet Baró.



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Marques, J., Moles, E., Urbán, P., Prohens, R., Busquets, M.A., Sevrin, C., Grandfils, C., and Fernàndez-Busquets, X. ***Application of heparin as a dual agent with antimalarial and liposome targeting activities toward Plasmodium-infected red blood cells.*** *Nanomedicine: NBM. Vol:10, Pag: 1719-1728 (2014)*

Urbán, P., Valle-Delgado, J.J., Mauro, N., Marques, J., Manfredi, A., Rottmann, M., Ranucci, E., Ferruti, P., and Fernàndez-Busquets, X. ***Use of poly(amidoamine) drug conjugates for the delivery of antimalarials to Plasmodium.*** *J. Control. Release. Vol:177, Pag: 84-95. (2014)*

Valle-Delgado, J.J., Urbán, P., and Fernàndez-Busquets, X. ***Demonstration of specific binding of heparin to Plasmodium falciparum-infected vs non-infected red blood cells by single-molecule force spectroscopy.*** *Nanoscale. Vol: 5, Pag:3673-3680 (2013)*

Selected Publications

Di Pietro, O.; Pérez-Areales, F.J.; Juárez-Jiménez, J.; Espargaró, A.; Clos, M.V.; Pérez, B.; Lavilla, R.; Sabaté, R.; Luque, F.J.; Muñoz-Torrero, D. ***Tetrahydrobenzo[h][1,6] naphthyridine-6-chlorotacrine hybrids as a new family of anti-Alzheimer agents targeting beta-amyloid, tau, and cholinesterase pathologies.*** *European Journal of Medicinal Chemistry. Vol: 84, Pag: 107-117 (2014)*

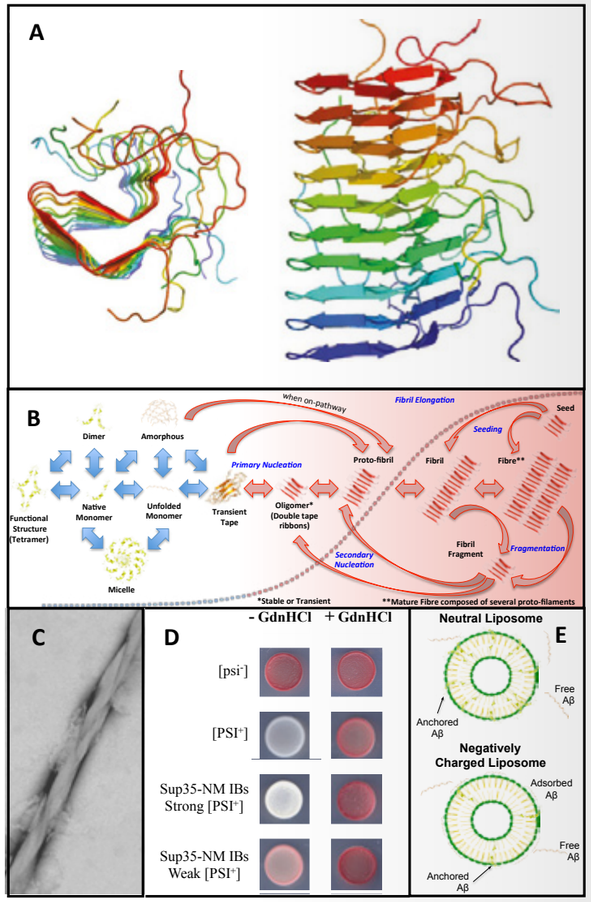
Pouplana, S.; Espargaró, A.; Galdeano, C.; Viayna, E.; Sola, I.; Ventura, S.; Muñoz-Torrero, D.; Sabate, R. ***Thioflavin-S staining of bacterial inclusion bodies for the fast, simple, and inexpensive screening of amyloid aggregation inhibitors.*** *Current Medicinal Chemistry. Vol: 21 , Pag: 1152-1159 (2014)*

Pérez-Areales, F. J.; Di Pietro. O.; Espargaró, A.; Vallverdú-Queralt, A.; Galdeano, C.; Ragusa, I. M.; Viayna, E.; Guillou, C.; Clos, M. V.; Pérez, B.; Sabaté, R.; Lamuela-Raventós, R. M.; Luque, F. J.; Muñoz-Torrero, D. Shogaol-huprine hybrids: ***Dual antioxidant and anticholinesterase agents with beta-amyloid and tau anti-aggregating properties.*** *Bioorganic & Medicinal Chemistry. Vol: 22, Pag: 5298-5307 (2014)*

Viayna, E.; Sola, I.; Bartolini, M.; De Simone, A.; Tapia-Rojas, C.; Serrano, F. G.; Sabaté, R.; Juárez-Jiménez, J.; Pérez, B.; Luque, F. J.; Andrisano, V.; Clos, M. V.; Inestrosa, N. C.; Muñoz-Torrero, D. ***Synthesis and multi-target biological profiling of a novel family of rhein derivatives as disease-modifying anti-Alzheimer agents.*** *Journal of Medicinal Chemistry. Vol: 57 6 , Pag: 2549-2567 (2014)*

Sabate, R. ***When amyloids become prions.*** *Prion. Vol: 8 (2014)*

The Conformational Diseases Group has focused on the problems that may occur in the protein fold and which may result in misfolded species that can disturb the essential cellular processes. Protein misfolding entailing polypeptide aggregation into amyloid structures has been ass ociated with dozens of human diseases as Alzheimer, Parkinson or prion diseases, and recent studies have shown that the amyloid aggregation process is not limited to disease-related proteins, but appears to be a generic property of the proteins in both eukaryotic and prokaryotic cells. The possibility that the amyloid formation is a universal and omnipresent process common to all life organisms could imply important consequences in biology.



Amyloid aggregation. (A) High resolution structure of HET-s prion forming domain in its fibrillar and infective conformation. (B) Scheme of the amyloid aggregation process. (C) Transmission electronic microscopy image of PrP prion protein. (D) Sup35 prion protein infectivity. (E) Membrane interaction of amyloid beta peptide.

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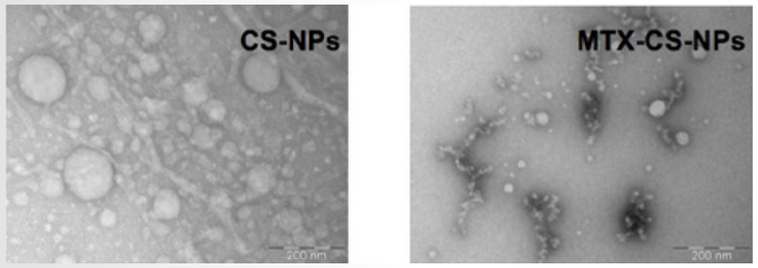
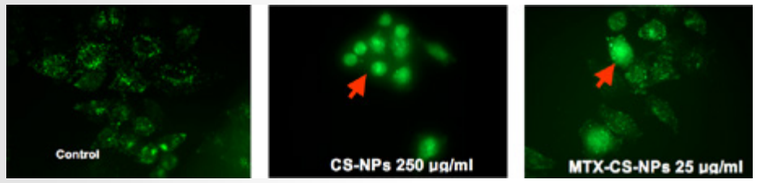
The Surfactants and Cell Membrane Interactions Group is developing its research in the Department of Physiology of the Faculty of Pharmacy and is an Associated Unity of the Institute of Advanced Chemistry of Catalonia (IQAC-CSIC).

The research activities of the group are focused in the development of in vitro methods to evaluate the cytotoxicity of surfactants and surfactants-based nanoparticles and nanovesicles for drug delivery. The increase use of nanomaterials supposes a potential risk to the human health and it is necessary to ensure the safety of these materials before marketing. There is an especial interest in the adaptation of the present methods to study the cytotoxicity of small particles given that their toxicity is affected by the exposition area. The potential interference of these particles with the classical cytotoxicity endpoints makes necessary the search of new endpoints. The present activity of the group is the search of assessment methods of the irritant and/or sensitization capacity of nanoparticles developed for transdermal drug delivery. The group obtain particles with higher loading efficiency and loading capacity and high biocompatibility as promising DNA vehicles to be used as non-viral gene delivery systems. Another area of interest is the study of the interactions of metal oxide nanoparticles with erythrocytes and plasma proteins and the coagulation process.



TEM of chitosan-nanoparticles.



Nanoparticles internalization.

Selected Publications

Balboa, E.M.; Soto, M.L.; Nogueira, D.R.; González-López, N.; Conde, E.; Moure, A.; Vinardell, M.P.; Mitjans, M.; Domínguez, H. ***Potential of antioxidant extracts produced by aqueous processing of renewable resources for the formulation of cosmetics.*** *Industrial Crops and Products. Vol: 58 , Pag: 104-110 (2014)*

Rubert Nogueira, D.; Morán, M.C.; Mitjans, M.; Pérez, L.; Ramos, D.; de Lapuente, J.; Vinardell, M.P. ***Lysine-based surfactants in nanovesicle formulations: the role of cationic charge position and hydrophobicity in in vitro cytotoxicity and intracellular delivery.*** *Nanotoxicology. Vol: 8 , Pag: 404-421 (2014)*

Morán, M.C.; Jorge, A. F.; Vinardell, M.P. ***Sustainable DNA release from chitosan/protein based-DNA gel particles.*** *Biomacromolecules. Vol: 15 , Pag: 3953-3964 (2014)*

Rubert Nogueira, D.; del Carmen Morán, M.; Mitjans, M.; Pérez, L.; Ramos, D.; de Lapuente, J.; Vinardell, M.P. ***Lysine-based surfactants in nanovesicle formulations: the role of cationic charge position and hydrophobicity in in vitro cytotoxicity and intracellular delivery.*** *Nanotoxicology. Vol: 8 , Pag: 404-421 (2014)*

Morán, M.C.; Vinardell, M.P.; Infante, M.R.; Miguel, M.G.; Lindman, B. ***DNA gel particles: An overview. Advances in Colloid and Interface Science.*** *Vol: 205, Pag: 240-256 (2014)*

1.3. Nanopharmacotherapy

Selected Publications

Manca, ML; Castangia, I; Caddeo, C; Pando, D; Escribano, E; Valenti, D; Lampis, S; Zaru, M; Fadda, AM; Manconi M. ***Improvement of quercetin protective effect against oxidative stress skin damages by incorporation in nanovesicles.*** *Colloids and Surfaces B-Biointerfaces. Vol: 123, Pag: 566-574 (2014)*

The Drug Design and Response-evaluation within Pharmaceutical Nanostructured and self-ordered Systems Group has focused on three different studies: first, the *in vivo* evaluation of analgesic and anti-inflammatory effects of indomethacin magneto liposomes (developed by the Physicochemical department, Faculty of Pharmacy, UB) on carrageenan-induced edema in rats. Secondly, the performance of skin permeation studies of nano emulsions and nanostructured lipid carriers (developed by the Institute of Advanced Chemistry of Catalonia (IQAC-CSIC) of a polyphenol (0.3% wt.) present in tomatoes; topical anti-inflammatory effect is also studied in mice. And finally, the influence of emulsion droplet size on the skin penetration of a diterpen present in an extract of a medicinal plant in collaboration with the CSIC was also studied. With this aim two nano emulsions (0.075% wt.) were prepared by the Institute of Advanced Chemistry of Catalonia (IQAC-CSIC), and after a stability study, they were assayed respect to their permeability capacity through human skin.

Selected Publications

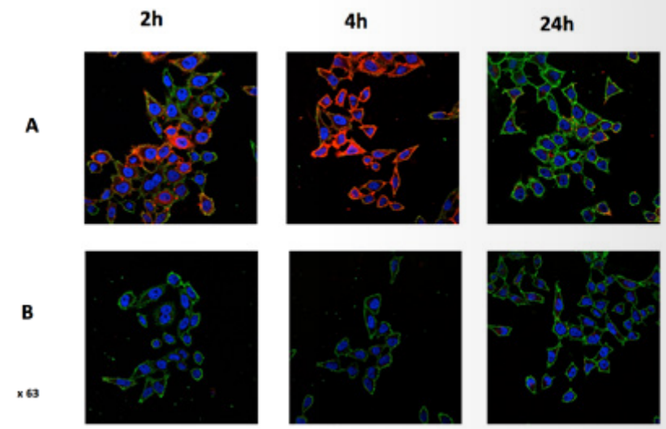
Barbosa-Barros, L.; García-Jimeno, S.; Estelrich, J. ***Formation and characterization of biobased magnetic nanoparticles double coated with dextran and chitosan by layer-by-layer deposition.*** *Colloids and Surfaces A-Physicochemical and Engineering Aspects. Vol: 450C, Pag: 121-124 (2014)*

Busquets, M. A., Sabaté, R., Estelrich, J. ***Potential applications of magnetic particles to detect and treat Alzheimer's disease.*** *Nanoscale Research Letters. Vol: 9 (2014)*

Pujol, A., Urbán, P., Riera, C., Fisa, R., Molina, I., Salvador, F., Estelrich, J., Fernàndez-Busquets, X. ***Application of Quantum Dots to the Study of Liposome Targeting in Leishmaniasis and Malaria.*** *International Journal of Theoretical and Applied Technology. Vol: 2, Pag: 1-8 (2014)*

The work of the Colloids Group is mainly focused in the design, synthesis and characterization of iron oxide nanoparticles coated through a layer-by-layer approach, and magnetoliposomes (MLs), mainly for theranostic applications. For that purpose, plain; sterically-stabilized and biologically targeted MLs labeled with RGD peptide were obtained and, their toxicity and uptake has been studied in 3T3 and HeLa cellular lines. On another hand, the ability of MLs as T2 contrast agents in Magnetic Resonance Imaging (MRI) has been analyzed. For this purpose, MLs of different lipid composition were studied to evaluate the influence of bilayer physical state as well as acyl chain saturation in such parameter.

The Group is collaborating with other members of the IN²UB belonging to the Departments of Physiology and Pharmacy and Pharmaceutical Technology of the Faculty of Pharmacy.



Confocal microscopy analysis of HeLa cells incubated with magnetoliposomes bearing the RGD peptide for three times: 2 h, 4 h, and 24 h. Green fluorescent signals indicate the cellular membranes, blue signals, the nucleus, and red signals, the nanoparticles.

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Selected Publications

Abrego, G.; Alvarado, H.L.; Egea, M.A.; Gonzalez Mira, E.; Calpena, A.C.; Garcia, M.L. ***Design of nanosuspensions and freeze-dried PLGA nanoparticles as a novel approach for ophtalmic delivery of pranoprfen.*** *Journal of Pharmaceutical Sciences. Vol: 103, Pag: 3153-3164 (2014)*

Domínguez Villegas, V.; Clares Naveros, B.; García López, M.L.; Calpena Campmany, A.C.; Bustos Zagal, P.; Garduño Ramírez, M.L. ***Development and characterization of two nano-structured systems for topical application of flavanones isolated from Eysenhardtia platycarpa.*** *Colloids and Surfaces B-Biointerfaces. Vol: 116, Pag: 183-192 (2014)*

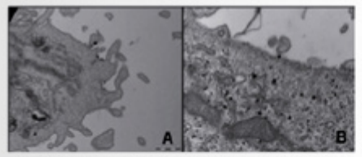
Rodrigues, M.; Calpena, A.; Amabilino, D.B.; Ramos-Lopez, D.; de Lapuente, J.; Pérez-Garcia, L. ***Water-soluble gold nanoparticles based on imidazolium gemini amphiphiles incorporating piroxicam.*** *RSC Advances. Vol: 4, Pag: 9279-9287 (2014)*

Amores, S.; Lauroba, J.; Calpena, A.; Colom, H.; Gimeno, A.; Domenech, J. ***A comparative ex vivo drug permeation study of beta-blockers through porcine buccal mucosa.*** *International Journal of Pharmaceutics. Vol: 468, Pag: 50-54 (2014)*

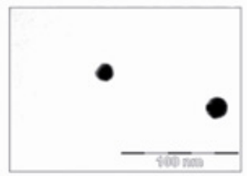
Pujol-Brugués, A; Calpena-Campmany, A.C.; Riera-Lizandra, C.; Halbaut-Bellowa, L; Clares-Naveros, B. ***Development of a liquid chromatographic method for the quantification of paromomycin. Aplication to in vitrorelease and exvivo permeation studies.*** *Spectrochimica Acta Part A-Molecular and Biomolecular Spectroscopy. Vol: 133, Pag: 657-662 (2014)*

The Biopharesbcn Group is a multidisciplinary team composed of pharmacists, chemists, doctors and veterinaries. Research activities within this year have been focused on developing nanostructured drug delivery systems for their application in the nanomedicine field, in particular, for the transdermal and transmucosal delivery in order to increase drug bioavailability through skin/mucosa and to reduce potential side effects. The work carried out by our group can be summarized as follows:

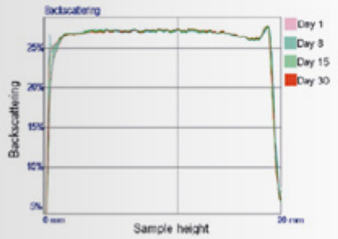
Several lipid nanocarriers loading retinyl palmitate have been developed such as liposomes, nanoemulsions, solid lipid nanoparticles. Ibuprofen liposomes have also been prepared, as well as gold-nanoparticles incorporating piroxicam. Additionally, biocompatible and biodegradable PLGA-based nanoparticles entrapping pranoprofen or flavanones have been elaborated.



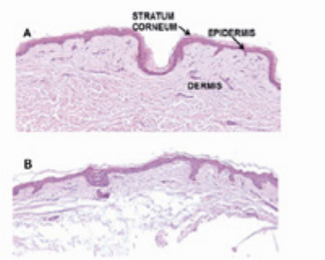
Cell internalization of gold-nanoparticles



TEM micrograph of gold-nanoparticles



Stability study of freeze-dried PLGA naoparticles loading pranoprofen by Turbiscan® Lab Expert

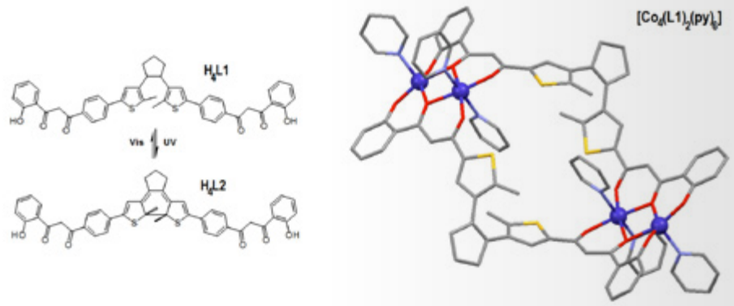


Photomicrographs of untreated skin (A) and skin treated with liposomes (B)

Both, physico-chemical and biopharmaceutical characterizations of those nanostructured drug carriers have been carried out including morphological, rheological and/or stability studies. In addition, in vivo evaluations such as anti-inflammatory activity of formulations have also been performed in some cases. The results of the work done to date have been satisfactory and suitable for their intended purposes.

1.4. Nanomagnetism, nanoelectronics and nanophotonics

The Magnetism and Functional Molecules Group (GMMF) has during the period 2013-2014 received funding from the European Union (ERC Starting Grant), the Spanish Ministry (Plan Nacional) and the Generalitat de Catalunya (Premi ICREA Acadèmia). Some of the most relevant highlights for 2013-2014 are **i)** Advances on the study of cooperativity within Spin Crossover compounds (See Coord. Chem. Rev. 2014, 269, 13-31; Dalton Trans., 2014, 43, 729–737; J. Am. Chem. Soc. 2014, 136, 3869−3874), **ii)** The preparation of design coordination clusters for Quatum computing (eg, J. Am. Chem. Soc. 2014, 136, 14215−14222), **iii)** The preparation of multifunctional coordination complexes and nanostructuration (Chem., Eur. J. 2014, 20, 10439 – 10445; Inorg. Chem. 2014, 53, 3290−3297), **iv)** The preparation of photochromic ligands for the construction of photomagnetic systems.



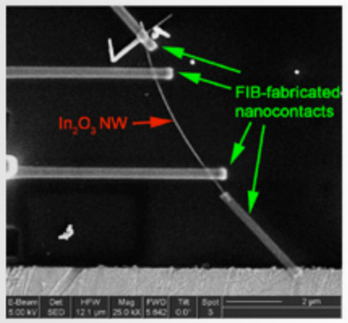
Newly synthesized photochromic ligand and one of its coordination assemblies, with photomagnetic properties.

The research of Micro-nanoengineering and Nanoscopies for photonic and electronic Devices Group (MIND) is organized into the following fields: Micro and Nanotechnology, Optoelectronics and Photonics, Nanoscopy and Modelling.

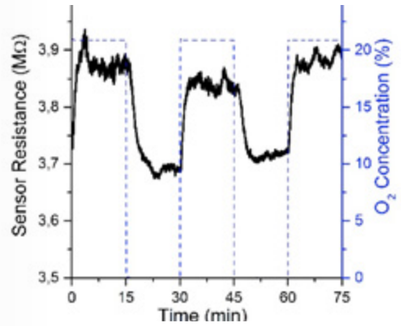
FIELD OF MICRO AND NANOTECHNOLOGY

The aims achieved in this field have been not only the consolidation of the synthesis and manufacturing but also the development of new technologies which complement and expand the previous ones and, thus, enables the design and the fabrication of new advanced devices that cover the fields of electronics, photonics and chemical analysis.

Development of nanodevices and systems based on nanostructures
The group has long experience in nanotechnology in the field of nanostructured materials (nanoparticles, nanowires and nanotubes), and especially on metal oxides, as active materials for advanced electronic devices. The work carried out have covered aspects of the synthesis of these materials with different chemical techniques (VLS, carbothermal growth, sol-gel synthesis in nanomold…), as well as manipulation and placement of theses nanostructures in predetermined positions of microelectronic substrates, fabrication of contacts on individual nanostructures using Focused Ion Beam (FIB) technique and electronic lithography and the measurement of their electrical behavior in presence of light, gases and at different temperatures. Currently the group has begun extending the technology to other semiconductors non-based on metal oxides, opening up new applications.



SEM image showing a CVD-synthesized In_2O_3 NW contacted using FIB techniques.



Resistance variation of the NW under UV illumination and alternating pulses of N_2 and dry air, showing the gas response.

Chemical sensors thematic has received and will receive special attention in the future because it is working very actively and productively in the synthesis of nanostructured materials and in the functionalization bio-inspired of the nanomaterials in order to adjust their properties to detect certain gases, to miniaturize these devices and to substantially reduce their consumption, under various research projects. This is opening the doors to the development of autonomous and “zero” consumption detection systems. This research, internationally pioneering and led by MIND, is done in collaboration with several European laboratories.

Some specific issues on which we are working are the manipulation and alignment by electric fields (dielectrophoresis, especially) and the localized and oriented growth of 1D nano-objects, working with advanced micromachined substrates, deposit of catalytic metals ad-hoc and localized growth through located heating. The final aim of this thematic is the manufacture of smart micro and nanosystems that integrate the devices with the control electronics and measurements as appropriate.

Development of microsystems for chemical sensors based on micro and nanotechnologies
Manufacture and test of integrated analytical microsystems for the detection of liquids or gases have been and are object of the research activities on micro and nanotechnologies. We are also working on silicon and polymers with special emphasis on set-up of techniques for micro and nanofabrication of polymers for the manufacture of chromatographic devices, using nanoprinting techniques and combining them with lithography and metallization, necessary for the implementation of electrical detection techniques in chromatographic channels.

Selected Publications

Ghosh, S.; Aromi, G.; Gamez, P.; Ghosh, A. ***The Impact of Anion-Modulated Structural Variations on the Magnetic Coupling in Trinuclear Heterometallic Cu-II-Co-II Complexes Derived from a Salen-Type Schiff Base Ligand.*** *European Journal of Inorganic Chemistry. Vol: 21, Pag: 3341-3349 (2014)*

Aguilà, D.; Barrios, L.A.; Velasco, V.; Roubeau, O.; Repollés, A.; Alonso, P.J.; Sesé, J.; Teat, S.J.; Luis, F.;Aromi, G. ***Heterodimetallic [LnLn'] Lanthanide Complexes: Towards a Chemical Design of 2-Qubit Molecular Spin Quantum Gates.*** *Journal of the American Chemical Society. Vol: 136, Pag: 14215-14222 (2014)*

Craig, G.A.; Roubeau, O.; Aromí, G. ***Spin state switching in 2,6-bis (pyrazol-3-yl)pyridine (3-bpp) based Fe(II) complexes.*** *Coordination Chemistry Reviews. Vol: 269, Pag: 13-31 (2014)*

Craig, G.A.; Sánchez-Costa, J.; Roubeau, O.; Teat, S.J.; Shepherd, H.J.; Lopes, M.; Molnár, G.; Bousseksou. A.; Aromí, G. ***High-temperature photo-induced switching and pressure-induced transition in a cooperative molecular spin-crossover material.*** *Dalton Transactions. Vol: 43, Pag: 729-737 (2014)*

Craig, G.A.; Schütze, M.; Aguilà, D.; Roubeau, O.; Ribas, J.; Vela, S.; Teat, S.J.; Aromí, G. ***Linear or cyclic Clusters of Cu(II) with a Hierarchical Relationship. Inorganic Chemistry.*** *Vol: 53, Pag: 3290-3297 (2014)*

Eljarrat, A.; López-Conesa, L.; López-Vidrier, J.; Hernández, S.; Garrido, B.; Magen, C.; Peiró, F.; Estrade S. ***Retrieving the optoelectronic properties of silicon nanocrystals embedded in a dielectric matrix by low-loss EELS.*** *Nanoscale. (2014)*

Hernández, S.; López-Vidrier, J.; López-Conesa, L.; Hiller, D.; Gutsch, S.; Ibáñez, J.; Estradé, S.; Peiró, S.; Zacharias, M.; Garrido, B. ***Determining the crystalline degree of silicon nanoclusters/SiO2 multilayers by Raman scattering.*** *Journal of Applied Physics. (2014)*

*Hoffmann, M.W.G.; Prades, J. D.; Mayrhofer, L.; Hernandez-Ramirez, F.; Järvi, T.T.; Moseler, M.; Waag, A.; Shen, H. Highly Selective SAM–****Nanowire Hybrid NO2 Sensor: Insight into Charge Transfer Dynamics and Alignment of Frontier Molecular Orbitals.*** *Advanced Functional Materials. Vol: 24, Pag: 595-602 (2014)*

Yedra, L.; Eljarrat, A; Rebled, J.M.; López-Conesa, L.; Dix, N.; Sánchez, F.; Estradé, S.; Peiró, F. ***EELS tomography in multiferroic nanocomposites: from spectrum images to the spectrum volume.*** *Nanoscale. Vol: 6, Pag: 6646-6650 (2014)*

López-Vidrier, J.; Hernández, S.; Hiller, D.; Gutsch, S.; López-Conesa, L.; Estradé, S.; Peiró, F.; Zacharias, M.; Garrido, B. ***Annealing temperature and barrier thickness effect on the structural and optical properties of silicon nanocrystals/SiO2*** *superlattices. Journal of Applied Physics. Vol: 116, Pag: 133505-1-133505-7 (2014)*

Given the known reliability of silicon devices, we are also working, in collaboration with IMB-CNM-CSIC, in the design, manufacture and test of the chromatography components on silicon, performing complementary tasks of manufacture in the clean room of IMB-CNM-CSIC. The integration of components, in order to manufacture the microsystem, is the ultimate goal, which will include both the hybrid integration of the components as the integrated realization of the whole system.

Microdevices based on monolithic ceramic technology
Ceramics cover a spectrum of complementary applications to standard silicon technology (harsh environments, aerospace, radio frequencies...). It is proposed as an aim the extreme miniaturization of microdevices based on LTCC and HTCC monolithic ceramic of sizes of the order of 1mm. Among these it will be especially considered the development of passive electronic devices embedded in ceramic and also embedded active devices for flip-chip to achieve system-on-chip for radio frequency applications and the development of sensors that incorporate channels inside.

Printed electronics for electronic devices
The development of advanced printing systems in recent years has allowed to extend this technology to devices and systems. These developments have two immediate applications: electronics in surfaces with no functionality until now (interior part of appliances, seats, doors, glass) and flexible electronics. The first goal will be aimed primarily at the industry, offering the opportunity to make more profitable the space and the location of an industrial piece or equipment. In the case of flexible electronics, the target lies in the development of advanced electronic components: diodes and transistors, leading to new application scenarios.

To carry out the objectives proposed in flexible electronics, advanced materials, such as graphene, will be used. In this sense we will make a special effort to develop technologies for implementing chemical graphene (such as electrospray or InkJet), to study its compatibility with CMOS technology and to develop electronic devices (MOSFETs) and sensors (gas, radiation).

Knowledge Transfer / Internationalization
Due to the industrial and applied aspect of this area it has been developed and are being developed industrial projects (CENIT INNPACTO ...). In fact, a researcher of the group has achieved an ERC-Starting Grant Project, funded by the EU and it is already preparing proposals for research projects in the Horizon 2020 program.

FIELD OF OPTOELECTRONICS AND PHOTONICS

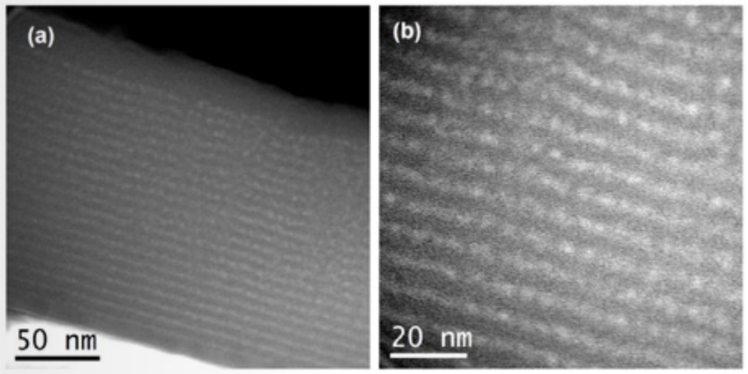
The activities are structured in three main fronts: i) Development of integrated light emitting devices LED for applications in lighting and sensors; ii) Research on new materials and nanostructures for tandem solar cells and improvement of absorption with “photon management” techniques; iii) Research on the integration of electronic and photonic devices in the field of integrated silicon photonics.

The silicon optoelectronics and photonics are branches of science and technology that promote the development of devices that manipulate light and are manufactured in silicon using processes compatible with current microelectronic technology. In fact, also the development of integrated LEDs can be seen as this option and even silicon solar cells are a variant of silicon technology for light applications. So light and electrons, silicon and integration are the backbone of this area.

This technology has a great potential, since, once a level of maturity in all its aspects is reached, it would develop in photon level the whole features and applications that it have already been implemented successfully in the field of microelectronics. In fact, to choose Si as the technology platform ensures technological processes and materials now available, providing a facility to the large-scale production and very low costs, in addition the possibility to combine the new developed photonic functions with the electronic ones, integrated on the same chip.

Materials with optoelectronics and photonics properties and its characterization
The aim is to progress in scientific and technological knowledge heterogeneous nanostructured materials based on silicon, giving more importance to the study of the electro-optical, opto-electronic and photonic properties from the micro- to the nanoscale. We will focus on studying the properties of all materials related to silicon that can be used as active materials in the devices under development, such as super-luminescent diodes and lasers, light amplifiers or modulators. The history of the group shows a high experience in the past on these issues. This knowledge will be crucial to address the research toward the improvement of the electro-optical properties desired for each application.

Design and manufacture of advanced devices compatible with CMOS
With these type of materials, new devices with silicon technology (CMOS) will be designed, fabricated and characterized: i) light sources (LEDs and lasers), ii) waveguides and active interferometers (optical amplifiers, optical switches, optical logic gates) and iii) Miniaturizable detectors (PIN, APD). All these devices are the basic elements that are still lacking for the monolithic integration on silicon. The work will be developed in parallel with the optimization of active material and will have as indicators of quality the emission efficiency, the assembly guide, the detection sensitivity, reliability and scalability.



Multilayers of silicon oxide and silicon nanocrystals.

Optoelectronic integrated systems for telecommunications, sensors and lighting
These devices will be monolithically integrated in platforms designed for specific applications: i) Telecommunications (transducers of optical to electric signal and vice versa, interconnects, routing and on-chip optical amplification); ii) integrated systems for optical sensing (biosensors, monitoring analytes in industrial areas and environmental health). What we want to achieve is the demonstration that discrete devices developed can be combined effectively in the same chip, resulting a device monolithically integrated, compact and fabricated in a large-scale CMOS production. In this sense, iii) we intend open new ways for the implementation of the integrated LEDs with their drivers for light and control applications (smart lighting).

Knowledge Transfer / Internationalization
The actions taken in recent years have prompted the interest of companies in optoelectronic and lighting devices, which has led to the application for a patent. The research in this area may lead to other results with the possibility to patent.

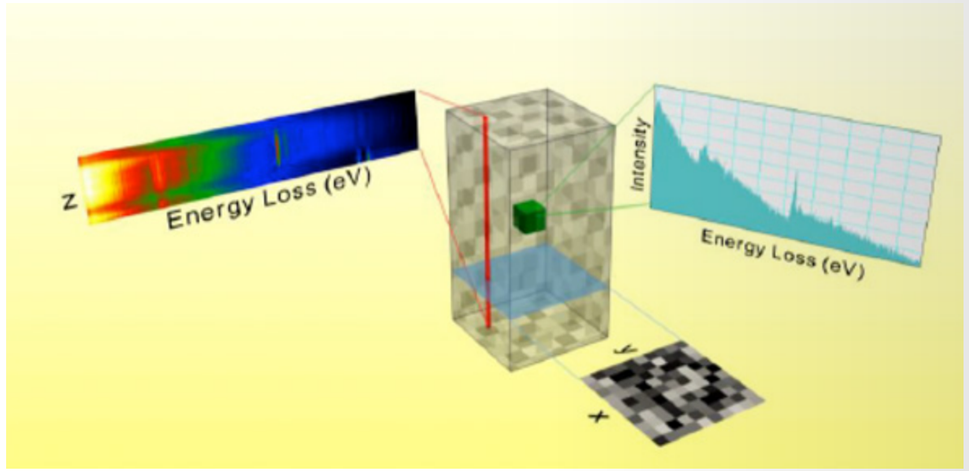
Stays at research centers are common in the group. The coordination of tasks of the recently completed project Nascent, has put us in contact with various laboratories, groups and companies with which we are initiating collaborations that will allow the preparation of projects for Horizon 2020 program.

FIELD OF NANOSCOPY

With the correction of spherical and chromatic aberration, transmission electron microscopy (TEM) has reached levels below Angstrom resolution. To obtain maps of chemical composition at atomic resolution is now almost a routine in national and international laboratories. In Catalonia, there is still no such microscope. However, the line of LENS (Laboratory of Electron Nanoscopies) of MIND group has been leading the development of work methodologies in TEM characterization of nanostructured materials and devices for applications in electronics, optoelectronics, spintronics and energy, not only in Catalonia, but also internationally as it is evidenced by the recent goals (internationally cutting-edge results) achieved by the group:

• Discovery that electronic precession improves the signal noise ratio of the EELS (electron energy loss spectroscopy) signal and X-ray spectroscopy (EDS) with a patent application in 2012.

• Combination of electron tomography and EELS spectroscopy to obtain three-dimensional reconstructions with chemical composition. This combination has been successfully applied to 3D reconstruction of mesoporous materials and nanocomposites of ferroic materials.



Scheme of the 3D reconstruction of EELS spectra.

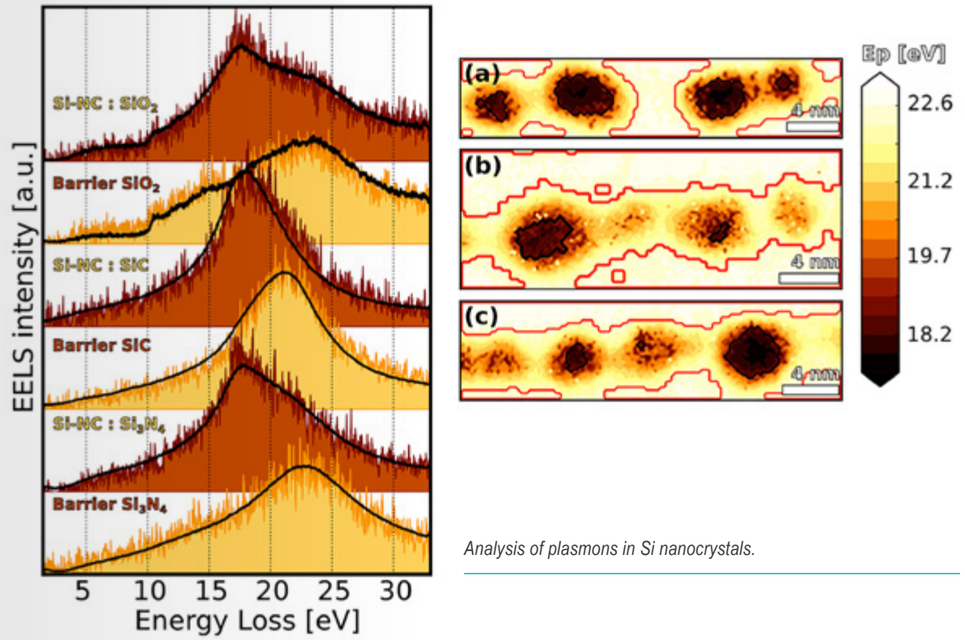
• Developing protocols for a systematic quantification of metal oxidation states.

We propose lines of action covering from theoretical aspects to experiments closely linked to technological developments.

Depth study of theoretical aspects of EELS
Quantification of EELS spectra in the region of low loss and programming algorithms for massive data treatment to calculate the dielectric function of complex materials of interest.

Modelisation of channeling on EELS spectra in order to understand the effects of the electronic precession on the angular distribution of the inelastic scattering.

Development of the software needed to build a volume spectrum from the acquisition of a serial of spectra, so that each voxel contains a spectrum.



Analysis of plasmons in Si nanocrystals.

Tasks of technological development
Contribution to the instrumental development related to the patent for the synchronized acquisition of EELS sectra with electronic precession, in collaboration with companies Nanomegas and APP Five.

Development of methods for sample preparation and in-situ electrical measurements of nanowires and memristors to elucidate the mechanisms of variation in the resistance of these devices.

Application of TEM-EELS to materials and devices of interest
To achieve the 3D reconstruction of plasmon modes in hybrid semiconductor metal nanoparticles.

To obtain maps of composition and oxidation states from the EELS spectra quantification of core loss region.

To reconstruct a 3D volume of oxidation states for the differentiation of the structure core-layer in magnetic nanoparticles.

Selected Publications

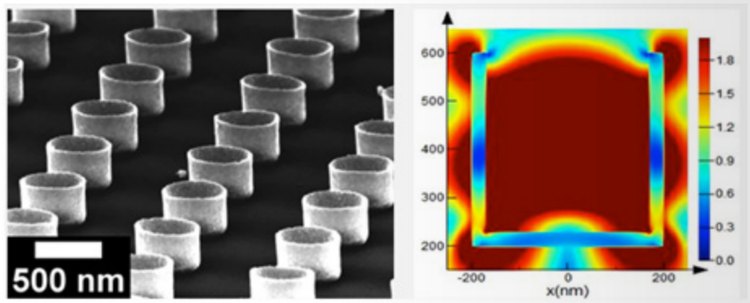
Balan, A.; Derlet, P.M.; Fraile Rodríguez,A.; Bansmann, J.; Yanes, R.; Nowak, U.; Kleibert, A.; Nolting, F. Direct ***Observation of Magnetic Metastability in Individual Iron Nanoparticles.*** *Physical Review Letters. Vol: 112 (2014)*

Chandra, S.;Frey, N.; Phan. M. H.; Srinath, S.; García, M.A.; Lee, Y.; Wang, C.; Sun,S.; Iglesias, O.; ***Srikanth, H. Exchange bias in Au-Fe$_2$O$_3$ composite nanoparticles. Nanotechnology.*** *Vol: 25 (2014)*

Morales, R.; Kovylina, M.; Schuller, I.K.; Labarta, A.; and Batlle, X. ***Antiferromagnetic/ ferromagnetic nanostructures for multidigit storage units.*** *Applied Physics Letters. Vol: 104 (2014)*

The Magnetic Nanomaterials Group is working on the production of cylindrical metallic nanostructures (nanocups) by a novel fabrication route, combining nanoimprint lithography (NIL) with non-directional metallization. The fabrication of the nanocups starts from the definition of a SiO2 hard mask embedded in between two resist layers, polymethyl methacrylate (PMMA) 950k MW (molecular weight) on top of the substrate and PMMA 75k MW above the SiO2.This top PMMA layer is patterned by thermal NIL. In the next stage, reactive ion etching in C4F8 is used to remove the residual PMMA layer and to pattern the SiO2. Then, oxygen plasma is performed to etch the bottom PMMA layer through the SiO2 mask. Since the oxygen plasma etches PMMA isotropically, an undercut is formed allowing the lift-off in acetone after the non-directional Au metallization by RF magnetron sputtering.

Finite Difference Time Domain (FDTD) simulations have been used to obtain the spectra and the spatial distribution of the electrical field of Au nanocups. The most remarkable aspect is the Optical Near Field Enhancement (ONFE) at the higher energy peak for nanocups with an external diameter and a height of 400 nm and a base and wall thickness of 30 nm, resulting from the excitation of a strong cavity mode coupled to Surface Plasmon Polariton (SPP) modes. When λi/2 > di and λi/2 > hi, ONFE is only associated with SPP modes in the upper part of the internal cavity because of the surface plasmon excitation in the upper rim and upper wall, due to the evanescent regime of incident electromagnetic wave pro, Pagation inside the cavity. In contrast, when λi/2 <di and λi/2 <hi cavity modes can be excited inside the nanocup, whose intensity and order depend on the strength of their coupling to SPP modes and the ratio of λi to hi .Since, in this case, the dimensions of the cavity are of order λi/2, the incident wave creates and couples to a dipole surface plasmon along the internal wall of the cavity, producing strong ONFE that is homogeneous along the height of the cavity because the cylindrical axis of symmetry is parallel to the wave pro, Pagation vector. This optical nanoresonator behavior opens up the possibility for new types of applications since the nanocup could serve as both container and field intensifier.

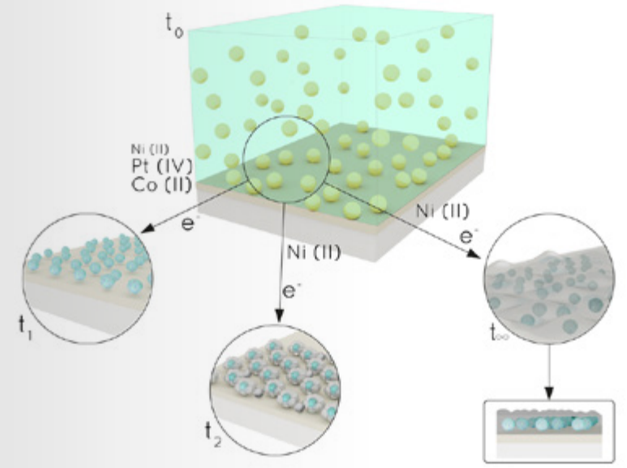


Au cylindrical nanocup: a geometrically tunable optical nanoresonator

In conclusion, we have developed a versatile fabrication route which permits obtaining large patterned areas at low cost with precise control over the nanocup composition, dimensions, position, and combination of isolated nanocups of different sizes and in different arrangements. Besides, cylindrical Au nanocups allow tunability of its surface plasmons and optical near-fields as a function of geometrical parameters. By changing the nanocup size and incident wavelength, different spatial field distributions can be obtained, ranging from near-field enhancement on the outside surfaces, including the upper rim, to the excitation of strong cavity modes. The optical nanoresonator behavior of the latter is due to a combination of cylindrical symmetry and the geometric matching of cavity dimensions to surface plasmon half wavelength. This, together with the secondary wave emission, turns nanocups into attractive elements for technological applications.

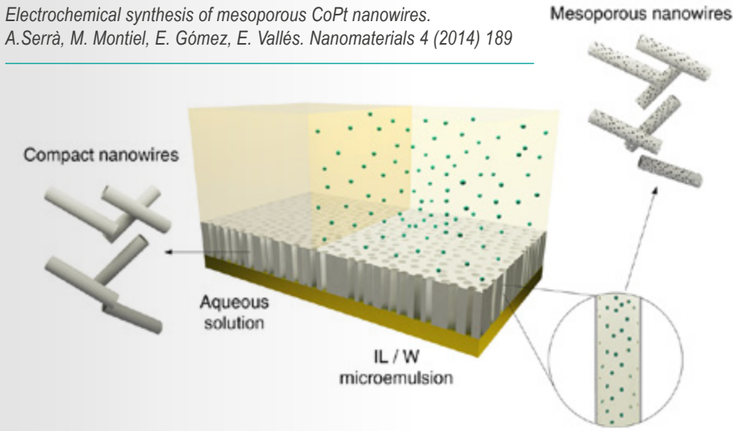
1.5. Nanostructured Materials

The Thin-film and Nanostructures Electrodeposition Group (Ge-CPN) is working in the development, by using electrochemical techniques, of nanometric films, micro and nanoparticles, nanowires and nanotubes and new structures of metals and alloys with magnetic or electrocatalytic properties. The electrodeposition in hard- (polycarbonate or alumina templates) or soft- (micro or nanoemulsions) templates allowed us to grow 0D and 1D nanostructures of metals and alloys, with controllable magnetic properties and potential application in fuel cells or biomedicine. The use of ionic liquids as solvents or components of the microemulsions in the electrodeposition processes allows us to obtain new metallic nanostructures, as mesoporous nanowires or 2D composites.



2D composites preparation from one-step electrodeposition in water and ionic liquid. A. Serrà, E. Gómez, E. Vallés Electrochemistry Communications 46 (2014) 79

Electrochemical synthesis of mesoporous CoPt nanowires. A.Serrà, M. Montiel, E. Gómez, E. Vallés. Nanomaterials 4 (2014) 189



Selected Publications

Serrà, A.; Gómez, E.; López-Barbera, J.F.; Nogués, J.; Vallés, E. ***Green electrochemical template synthesis of CoPt nanoparticles with tunable size, composition and magnetism from microemulsions using an ionic liquid (bmimPF6).*** *ACS Nano 8 4630-4639 (2014)*

Serrà, A.; Gómez, E.; Vallés, E. ***One-step electrodeposition from ionic liquid and water as a new method for 2D composites preparation.*** *Electrochemistry Communications. Vol: 46, Pag: 79-83 (2014)*

Sebastian, P.; Vallés, E.; Gómez, E. Copper electrodeposition in a Deep Eutectic Solvent. ***First stages analysis considering Cu(I) stabilization in chloride media.*** *Electrochimica Acta. Vol: 123, Pag: 285-295 (2014)*

Serrà, A.; Gómez, E.; Vallés, E. ***Electrosynthesis method of CoPt Nanoparticles in percolated microemulsions.*** *RSC Advances. Vol: 4, Pag: 34281-34287 (2014)*

Serrà, A.; Montiel, M.; Gómez, E.; Vallés, E. ***Electrochemical synthesis of mesoporous CoPt nanowires for methanol oxidation.*** *Nanomaterials. Vol: 4, Pag: 189-202 (2014)*

Selected Publications

Amade, R.; Vila-Costa, M.; Hussain, S.; Casamayor, E.O.; Bertran, E. ***Vertically aligned carbon nanotubes coated with manganese dioxide as cathode material for microbial fuel cells.*** *Journal of Materials Science. Vol: 50, Pag: 1214-1220 (2014)*

Molina, R.; Gomez, M.; Kan, C.W.; Bertran, E. ***Hydrophilic-oleophobic Coatings on cellulosic materials by plasma assisted polymerization in liquid phase and fluorosurfactant complexation.*** *Cellulose. Vol: 21, Pag: 729-739 (2014)*

Arteaga, O.; Freudenthal, J.; Nichols S.; Canillas, A.; Kahr, B. ***Transmission ellipsometry of anisotropic substrates and thin films at oblique incidence. Handling multiple reflections.*** *Thin Solid Films. (2014)*

Arteaga, O.; Baldrís, M.; Antó, J.; Canillas, A.; Pascual, E.; Bertran, E. ***Mueller matrix microscope with a dual continuous rotating compensator setup and digital demodulation.*** *Applied Optics. Vol: 53, Pag: 2236-2245 (2014)*

During the last period, the Physics and Engineering of Nanostructured and Amorphous Materials Group (FEMAN) has developed:

1. A new technology for deposition of high quality of bidimensional dendrites of one or two graphene layers on copper (Fig.1). This technology is based on continuous and pulsed flows of precursor gases for CVD (project BIOGRAPH and patents ES2511315A1 and WO2014/174133 A1).

2. Results have been obtained for the applications of carbon nanotubes in the energy field (supercapacitors) and in the field of environment concerning the extremely high-surface nanostructured materials aimed at trapping specific pollutants.

3. Characterization of homogenous depolarizing media based on Mueller matrix differential decomposition and optical characterization on achiral-to-chiral transition.

4. Development of a Mueller matrix microscope.

5. Photonic Characterization and VACNTs grown on Langmuir-Blodgett self-assembled monolayers of colloidal silica particles (Fig. 2).

The results of development of new materials have been reported in two doctoral thesis entitled: “Carbon Nanotubes Deposited by Hot Wire Plasma CVD and Water Assisted CVD for Energetic and Enviromental Applications” by Shahzad Hussain (November 2014) and “Fabrication and Characterization of Macroscopic Graphene Layers on Metallic Substrates” by Víctor-Manuel Freire Soler (November 2014), resulting from the projects NANOTRAPPING and BIOGRAPH respectively.

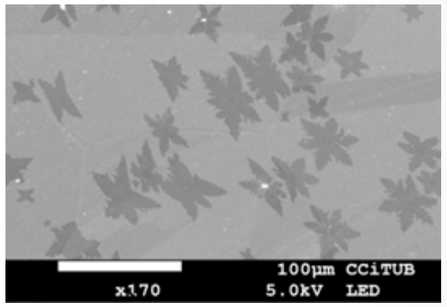


Fig.1. Bidimensional dendrites of one or two graphene layers grown on a high purity polycrystalline copper foil using methane hydrogen decomposition by CVD.

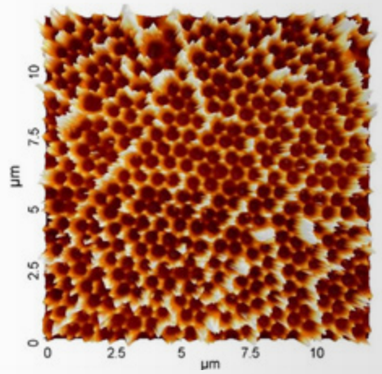
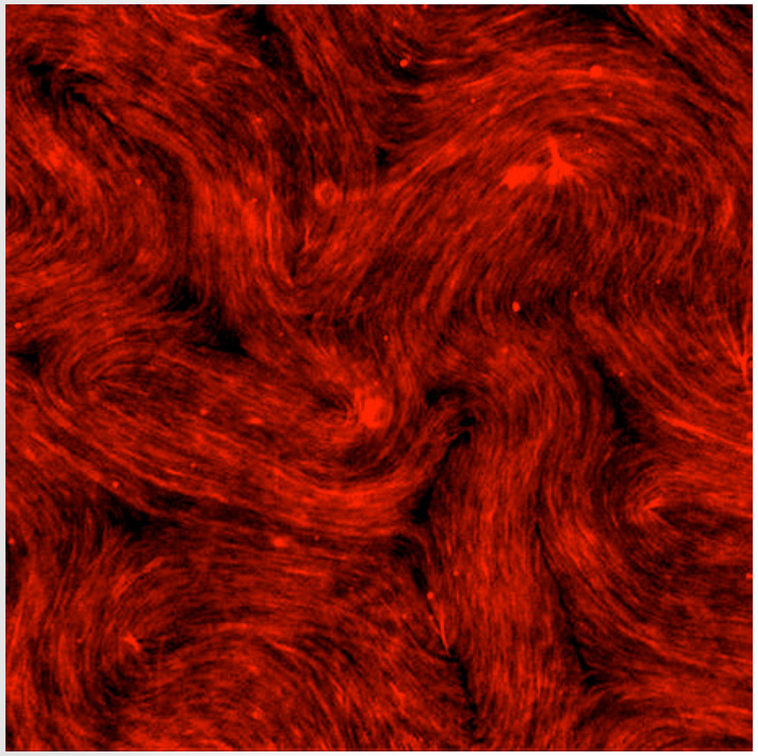


Fig. 2. Topography obtained by AFM of the VACNTs patern at 480 ºC and 40-min growth time. The hexagonal patern formed by the CNTs is clearly well defined. The vacances formed by the SiO2 particles after the lift-off process appear clear.

The Self-organised Complexity and self-assembling Materials Group (SOC&SAM) performs basic research in the field of soft Nanotechnology, combining experimental research in liquid crystals, colloidal systems and soft active materials. A significant part of our work has been devoted to the study of mixed systems in which anisotropic fluids (liquid crystals) are organized by contact with ordered surfactant monolayers or by the presence of colloidal inclusion. In this context, we have developed a strategy to command the self-assembly and to drive ensembles of microscale solid or liquid inclusions in confined geometries. This is achieved by using non-linear electrophoresis mediated by a liquid crystal medium as driving force, and light-induced control of the local mesogen to steer the moving colloids. In the context of active soft materials, we study the aqueous gel that forms in-vitro when the molecular motor protein kinesin is combined with self-assembled microtubules of the cytoskeleton protein tubulin. In the presence of ATP, and when depleted on an interface with an immiscible liquid, the system self-assembles into dynamic bundles with two-dimensional long-range orientational order.



Fluorescence image of active microtubule bundles self-assembled at the interface with a hydrophobic phase. The filaments spontaneously fold and buckle forming structures found in liquid crystalline materials. The image is 200µm wide.

Selected Publications

Hernàndez-Navarro, S.; Tierno, P.; Farrera, J.A.; Ignés-Mullol, J.; Sagués, F. ***Reconfigurable swarms of nematic colloids controlled by photoactivated surface patterns.*** *Angewandte Chemie-International Edition. Vol: 53, Pag: 10696-10700 (2014)*

Guillamat, P.;Sagués, F.;Ignés-Mullol, J. ***Electric-field modulation of liquid crystal structures in contact with structured surfactant monolayers.*** *Physical Review E. Vol: 89 (2014)*

Petit-Garrido,N.;Trivedi, R.P.;Sagués, F.;Ignés-Mullol, J.;Smalyukh, I. ***Topological defects in cholesteric liquid crystals induced by monolayer domains with orientational chirality.*** *Soft Matter. Vol: 10, Pag: 8163-8170 (2014)*

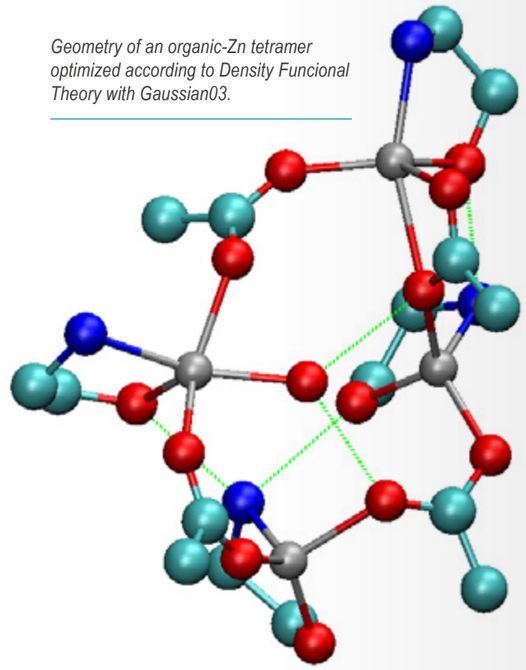
Dong, H.;Ignés-Mullol, J.;Claret, J.;Pérez, L.;Pinazo, A.;Sagués, F. ***Interfacial chiral selection bu bulk species. Chemistry-A European Journal.*** *Vol: 20, Pag: 7396 (2014)*

Selected Publications

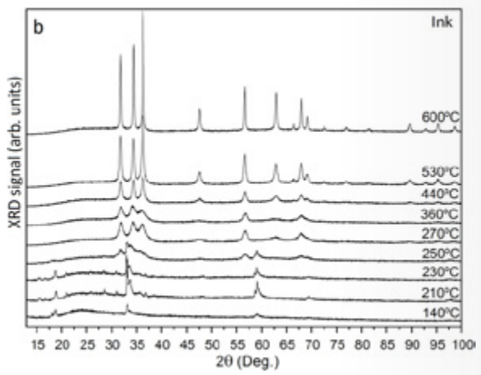
Vilà, A.; Vilella, E.; Alonso, O.; Diéguez, A. ***Crosstalk-free single photon avalanche photodiodes located in a shared well.*** *IEEE Electron Device Letters. Vol: 35, Pag: 99-101 (2014)*

Vilà, A.; Gómez, A.; Portilla, L.; Morante, J.R. ***Influence of In and Ga additives onto SnO2 inkjet-printed semiconductor.*** *Thin Solid Films. Vol: 553, Pag: 118-122 (2014)*

The research group on Systems for Intrumentation and Control, has been working in printed electronics since 2006, developping its own inks for printing functional semiconductors, conductors and isolants. Recently, the group has developed new eco-friend processes for optimizing low-temperature ZnO nanosized films functionalized for biocompatible applications as sensors, supercapacitors and energy-harvesting devices.



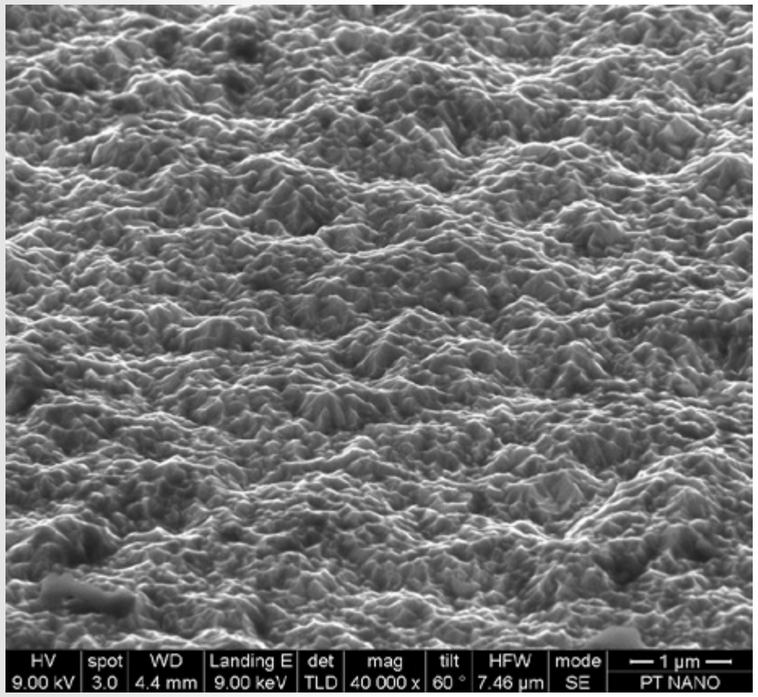
Geometry of an organic-Zn tetramer optimized according to Density Funcional Theory with Gaussian03.



Crystal evolution of our ZnO ink heated ex situ.

1.6. Nanoenergy: production, storage and environment

Within the scope of nanoenergy, The Solar Energy Group has focused its research on the improvement of silicon-thin-film-based solar cells. In particular, all the relevant aspects in order to optimize light absorbtion by the devices have been considered, such as the development of transparent conductive oxides for front and back contacts, the introduction of nanometric layers as optical couplers between the front transparent conducting oxide and the amorphous silicon device, the development of textures on the glass substrate to enhance light scattering or the introduction of rare-earth based up-converters for widening the spectral response of the devices.



Transparent conducting oxide layer (ZnO:Al) deposited on aluminium induced textured glass, that combines micro- and nanostructures, and increases light absorption in active layers of thin film solar cells.

Annual Report 2014
SCIENTIFIC ACTIVITY

Selected Publications

Krishnaprasad, P.S.; Antony, A.; Rojas, F.; Bertomeu, J.; Jayaraj, M.K. ***Domain matched epitaxial growth of Bi 1.5 Zn 1 Nb 1.5 O 7 thin films by pulsed laser deposition.*** *Journal of Alloys and Compounds. Vol: 586, Pag: 524-528 (2014)*

Nos, O.; Frigeri, P.A.; Bertomeu, J. ***Real-time monitoring of the silicidation process of tungsten filaments at high temperature used as catalysers for silane decomposition.*** *Materials Chemistry and Physics. Vol: 143, Pag: 881-888 (2014)*

Marsal, A.; Carreras, P.; Puigdollers, J.; Voz, C.; Galindo, S.; Alcubilla, R.; Bertomeu, J.; Antony, A. ***Compositional influence on the electrical performance of zinc indium tin oxide transparent thin-film transistors.*** *Thin Solid Films. Vol: 555, Pag: 107-111 (2014)*

Lluscà, M.; López-Vidrier, J.; Antony, A.; Hernández, S.; Garrido, B.; Bertomeu, J. ***Up-conversion effect of Er- and Yb-doped ZnO thin films.*** *Thin Solid Films. Vol: 562, Pag: 456-461 (2014)*

Selected Publications

M. Morales, J.J. Roa, J.M. Perez-Falcon, A. Moure, J. Tartaj, F. Espiell, M. Segarra. ***Correlation between electrical and mechanical properties in $La_{1-x}Sr_xGa_{1-y}Mg_yO_{3-\delta}$ ceramics used as electrolytes for solid oxide fuel cells.*** *Journal of Power Sources Vol: 246 Pag: 918-925 (2014)*

M. Morales, F. Espiell, M. Segarra. ***Performance and stability of $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ perovskite as catalyst precursor for syngas production by partial oxidation of methane.*** *Int. J. Hydrogen Energ. Vol: 39 Pag: 6454-6461(2014).*

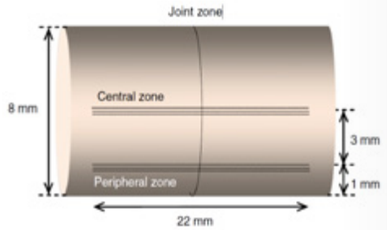
M. Morales, J.M. Perez-Falcon, A. Moure, J. Tartaj, F. Espiell, M. Segarra. ***Performance and degradation of $La_{0.8}Sr_{0.2}Ga_{0.85}Mg_{0.15}O_{3-\delta}$ electrolyte-supported cells in single-chamber configuration.*** *Int. J. Hydrogen Energ. Vol: 39 Pag: 5451-5459 (2014)*

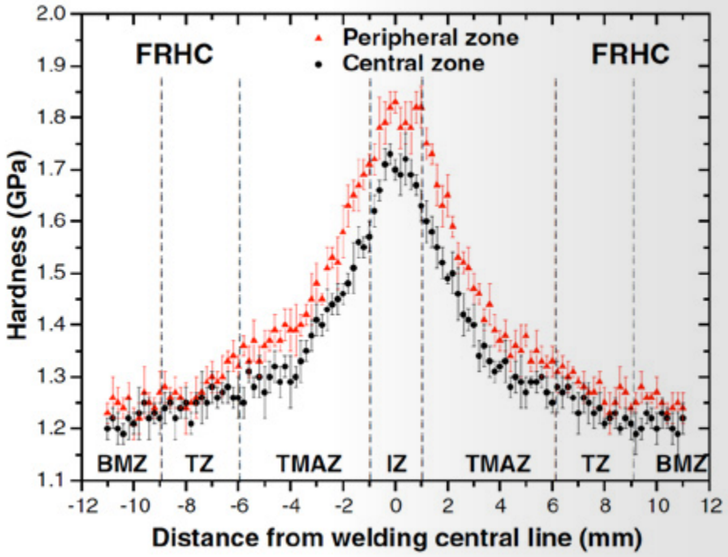
M. Morales, J.M. Chimenos, F. Espiell, M. Segarra. ***The effect of temperature on mechanical properties of oxide scales formed on a carbon steel in a simulated municipal solid waste incineration environment.*** *Surf. Coat. Tech. Vol: 238 Pag: 51-57 (2014)*

The research activity at DIOPMA group in the Nanotechnology field contains the following points:

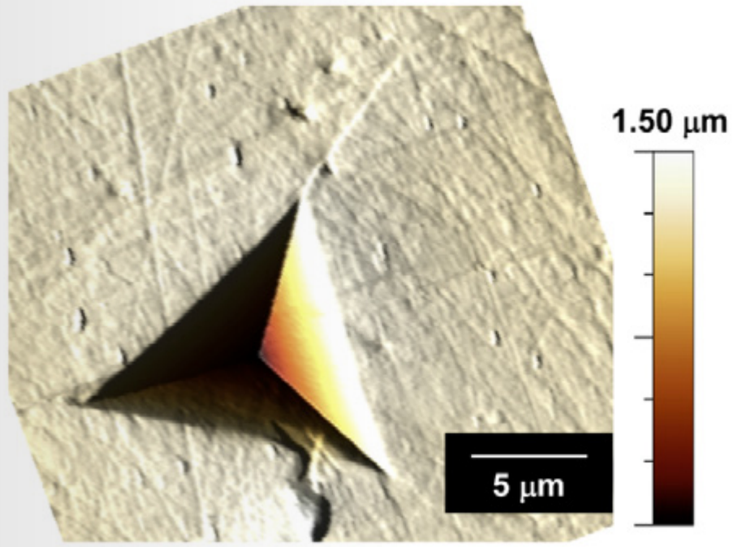
1. Synthesis of nanostructured materials used for processing of components (electrolyte and electrodes) for Solid Oxide Fuel Cells, and superconductors by the method of combustion of polyacrylamide gels. In addition, synthesis of nanoparticles via conventional route, by reduction in aqueous media using surfactants, and characterization of nanoparticles by Transmission Electron Microscopy (TEM). Synthesis of nanoparticles by magnetic separation.

2. Mechanical characterization of different electrolytes for SOFCs, such as LSGM (perovskites based on lantanum, estrontium, gallium and magnesium); copper-copper wires joined by friction welding, magnesium phosphates cements, oxide layers in steels... using Nanoindentation technique. Mechanical properties (Young modulus (E), hardness (H) and fracture toughness (K_{IC})), as well as the different fracture mechanisms activated during the indentation process, using both the Nanoindentation technique and Atomic Force Microscopy (AFM), are determined.





Hardness profiles in the perpendicular direction to the weld interface of FRHC-FRHC. (FRHC, Fire-refined high-conductivity)



AFM image of an indentation imprint corresponding to a LSGM electrolyte. Radial cracks activated during the indentation process were identified as the fracture mechanism.

Appendix 1

List of publications

In 2014, researchers from IN²UB have shown a great capacity to develop their scientific activity in main research outcomes: scientific publications, translation of knowledge and innovation by creating some patents, capacity to get research funds and being deeply envolved in teaching activities.

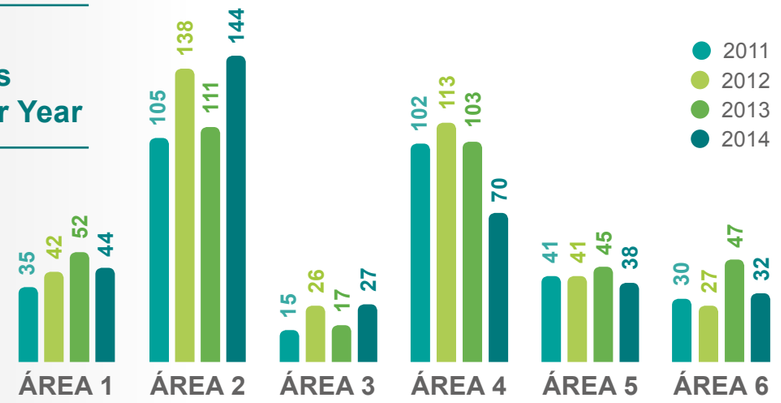
As scientific publication concers, a table indicating scientific production is shown. Indicators are divided into groups intended to reflect output (number of publications) and quality (total impact factor, mean impact factor and %Q1)

PAPERS STATISTICS

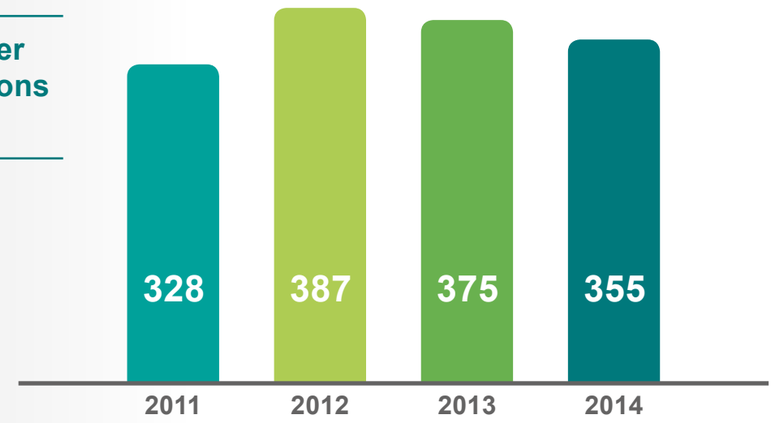
Year	Output	Total IF	Mean IF	%Q1
2014	355	1514.86	4.27	72.96
2013	375	1514.56	4.04	65.07
2012	387	1659.30	4.29	69.51
2011	328	1283.22	3.91	68.9

2011-2014 number and quality of the publications.
Output *– Total number of documents published, data from UB_GREC_Data Base.*
Total IF *– Accumulated impact factor of all the scientific publications.*
Mean IF *– Mean impact factor of all the scientific publications.*
%Q1 *– % of publications published in journals ranked in the first quartile (top 25%).*

Number of Publications per Area per Year



Total Number of Publications per Year



Find below a list of other selected publications with main contributing authors from IN²UB during 2014

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6. NANOENERGY: PRODUCTION, STORAGE AND ENVIRONMENT

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Cai, W.; de la PiscinaRamirez, P.; Homs, N. **Oxidative steam reforming of bio-butanol for hydrogen production: effects of noble metals on bimetallic CoM/ZnO catalysts (M = Ru, Rh, Ir, Pd).** Applied Catalysis B-Environmental. Vol: 145, Pag: 56-62 (2014)

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Schuster, F., Laumer, B., Zamani, R.R., Magén, C., Morante, J.R., Arbiol, J., Stutzmann, M. **P-GaN/n-ZnO heterojunction nanowires: Optoelectronic properties and the role of interface polarity.** ACS Nano. Vol: 8, Pag: 4376-4384 (2014)

Manzanares, M., Fàbrega, C., Oriol Ossó, J., Vega, L.F., Andreu, T., Morante, J.R. **Engineering the TiO2 outermost layers using magnesium for carbon dioxide photoreduction.** Applied Catalysis B: Environmental. Vol: 150-151, Pag: 57-62 (2014)

Espíndola Rodríguez, M.; Sylla, D., Sanchez, Y., López-Marino, S.; Fontané, X.; López-García, J.; Placidi, M.; Pérez-Rodríguez, A.; Vigil-Galán, O., Saucedo, E **Pneumatically sprayed Cu2ZnSnS4 films under Ar and Ar-H2 atmosphere.** Journal of Physics D-Applied Physics. Vol: 47 (2014)

Dimitrievska, M.; Fairbrother, A.; Fontané, X.; Jawhari, T.; Izquierdo-Roca, V.; Saucedo, E.; Pérez-Rodríguez, A. **Multiwavelength excitation Raman scattering study of polycrystalline kesterite Cu2ZnSnS4 thin films.** Applied Physics Letters. Vol: 104 (2014)

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León, M.; Levcenko, S.; Serna, R.; Bodnar, I.V.; Nateprov, A.; Guc, M.; Gurieva, G.; Lopez, N.; Merino, J.M.; Caballero, R.; Schorr, S.; Perez-Rodriguez, A.; Arushanov, E. **Spectroscopic ellipsometry study of Cu2ZnSnSe4 bulk crystals.** Applied Physics Letters. Vol: 105 (2014)

Yerman, Luis; Homs, Narcis; Pereira, Evandro Brum; Ramirez de la Piscina, Pilar **H2 production from oxidative steam reforming of 1-propanol and propylene glycol over yttria-stabilized supported bimetallic Ni-M (M = Pt, Ru, Ir) catalysts.** International Journal of Hydrogen Energy. Vol: 39, Pag: 5225-5233 (2014)

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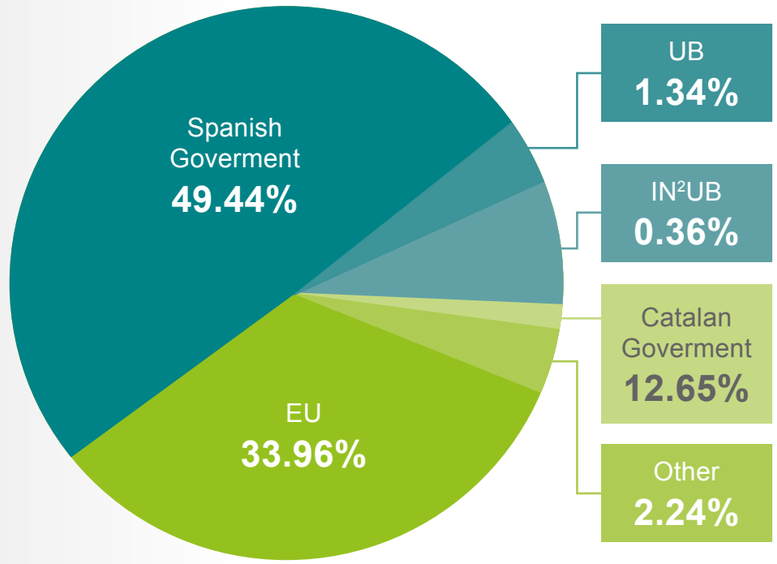
Cai, W.; Homs, N.; Ramírez de la Piscina, P. **Renewable hydrogen production from oxidative steam reforming of bio-butanol over CoIr/CeZrO2 catalysts: Relationship between catalytic behaviour and catalyst structure.** Applied Catalysis B-Environmental. Vol: 150-151, Pag: 47-56 (2014)

Appendix 2

List of funding projects

IN²UB Competitive Funding Sources 2014



Find below a list of competitive funding projects which IN²UB researchers are Principal Investigators during 2014.

1. MODELING AND SIMULATION OF SYSTEMS AND PROPERTIES OF MATTER IN THE NANOSCALE

Principal Investigator: FRANZESE , GIANCARLO Title: Interacciones entre sistemas nanoscópicos y macromoléculas biológicas en presencia de agua Reference: FIS2012-31025 Institution: Ministerio de Economia y Competitividad

Principal Investigator: FRANZESE , GIANCARLO Title: Modelling basis and kinetics of nanoparticle interaction with membranes, uptake into cells, and sub-cellular and inter-compartmental transport (NanoTransKinetics) Reference: NMP4-SL-2011-266737 Institution: Unió Europea

Principal Investigator: MAÑOSA CARRERA, LLUIS Title: Subvenció per a la contractació d'investigadors dins del Programa Ramon y Cajal. Reference: RYC-2011-09500 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: MAÑOSA CARRERA, LLUIS Title: Materiales Calóricos Gigantes para aprovechamiento de energía y refrigeración sostenible Reference: PRI-PIBIN-2011-0780 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: MAÑOSA CARRERA, LLUIS Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Reference: 008649 Institution: Universitat de Barcelona

Principal Investigator: MAYOL SANCHEZ, RICARDO Title: Research topics in the structure and dynamics of atomic, nuclear and electronic systems Reference: FIS2011-28617-C02-01 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: PAGONABARRAGA MORA, IGNACIO Title: Pulsatile Viscus and Viscoelastic Micrfluidics (MICROPULSATILE) Reference: PIIF-GA-2011-301214 Institution: Unió Europea

Principal Investigator: PAGONABARRAGA MORA, IGNACIO Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2013. Reference: 008571 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: PAGONABARRAGA MORA, IGNACIO Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Segona convocatòria 2014. Reference: 008860 Institution: Universitat de Barcelona
Principal Investigator: PAGONABARRAGA MORA, IGNACIO Title: Ajut d'accés al Barcelona Supercomputing Center de la Red Española de Supercomputación Reference: FI-2013-3-0007 Institution: Red Española de Supercomputació
Principal Investigator: REGUERA LOPEZ, DAVID Title: Virología Física y Aplicaciones Innovadoras Reference: EUIN2013-50990 Institution: Ministerio de Economia y Competitividad

Principal Investigator: RUBI CAPACETI, JOSE MIGUEL Title: Física Estadística Reference: 2014SGR922 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: RUBI CAPACETI, JOSE MIGUEL Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2010. Reference: 007292 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: RUBI CAPACETI, JOSE MIGUEL Title: FORMACIÓN, TRANSPORTE Y ENERGÉTICA EN SISTEMAS MULTIDISCIPLINARES EN LA MESOESCALA Reference: FIS2011-22603 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: RUBI CAPACETI, JOSE MIGUEL Title: Red de física estadística de no equilibrio y sus aplicaciones multidisciplinares Reference: FIS2014-57117-REDT Institution: Ministerio de Economia y Competitividad

Principal Investigator: VIVES SANTA-EULALIA, EDUARD Title: Dinámica de materiales bajo campos externos: respuesta discontínua y multicalórica Reference: MAT2013-40590-P Institution: Ministerio de Economia y Competitividad

Principal Investigator: VIVES SANTA-EULALIA, EDUARD Title: Dinámica de materiales bajo campos externos: respuesta discontínua y multicalórica Reference: 001788 Institution: Universitat de Barcelona

2. NANOBIOTECHNOLOGY

Principal Investigator: ALSINA ESTELLER, M.ASUNCION Title: Estudio de la interacción de péptidos sintéticos del virus GBV-C con capacidad de inhibición del FP HIV-C en sistemas péptido/péptido y lípido/péptido a escala nanométrica Reference: CTQ2012-37589-C02-02 Institution: Ministerio de Economia y Competitividad

Principal Investigator: BASTIDA ARMENGOL, JAIME Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Reference: 008616 Institution: Universitat de Barcelona

Principal Investigator: BORRELL HERNÁNDEZ, JORDI Title: Nanobioenginyeria i Bioelectrònica. Refernce: 2014SGR1442 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca, AGAUR. Generalitat de Catalunya.

Principal Investigator: BORRELL HERNÁNDEZ, JORDI Title: Desarrollo de capas planas de lípidos para aplicación tópica. Refernce: 306499 (FBG) Institution: Labiana Life Sciences, S.A.U

Principal Investigator: CASADEMUNT VIADER, JAUME Title: Subvenció per a la contractació d'investigadors dins del Programa Ramon y Cajal. Reference: RYC-2011-07605 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: CASADEMUNT VIADER, JAUME Title: Materia blanda forzada, activa y viva Reference: FIS2013-41144-P Institution: Ministerio de Economia y Competitividad

Principal Investigator: CASADEMUNT VIADER, JAUME Title: Injection of nucleate-boiling slug flows into a heat exchange chamber Reference: FA8655-12-1-2060 Institution: Air Force Office of Scientific Research (USA)

Principal Investigator: CASADEMUNT VIADER, JAUME Title: Materia blanda forzada, activa y viva Reference: 001744 Institution: Universitat de Barcelona

Principal Investigator: EGEA GURI, GUSTAVO Title: Regulación y alteración en el tráfico de membranas, ensamblaje de la matrix extracelular y señalización del TGF-b en modelos celulares del síndrome de Marfan Reference: BFU2012-33932 Institution: Ministerio de Economia y Competitividad

Principal Investigator: FARRE VENTURA, RAMON Title: Effects of intermitent hypoxia on tumor malignancy in young and old mice in a mouse model of sleep apnea. Reference: 2010 BP_A2 00023 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: FARRE VENTURA, RAMON Title: Clinical tRials fOr elderly patients with MultiplE Disease (CHROMED) Reference: 306093 Institution: Unió Europea

Principal Investigator: FARRE VENTURA, RAMON Title: Biongeniería del pulmón mediante cultivo de células madre en la matriz descelularizada del órgano: efecto de los estímulos biofísicos en la optimización del bioreactor Reference: SAF2011-22576 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: FERNANDEZ TIBURCIO, ANTONIO Title: Genetics of temperature modulation of plant immunity (DISEASENVIRON) Reference: PCIG10-GA-2011-303568 Institution: Unió Europea

Principal Investigator: FERNANDEZ TIBURCIO, ANTONIO Title: Subvenció per a la contractació d'investigadors dins del Programa Ramon y Cajal. Reference: RYC-2011-07847 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: FERNANDEZ TIBURCIO, ANTONIO Title: Bases moleculares, bioquímicas y genéticas de la señalización mediante amino oxidasas en las respuestas a sequía, salinidad y temperaturas bajas Reference: BIO2011-29683 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: GOMILA LLUCH, GABRIEL Title: Nanotomografía eléctrica basada en microscópia de escaneo de proximidad para nanomateriales y muestras biológicas Reference: TEC2013-48344-C2-1-P Institution: Ministerio de Economia y Competitividad

Principal Investigator: HERNANDEZ MACHADO, AURORA Title: Dinámica interfacial en la micro y nano escala: biomembranas y microfluidica. Reference: FIS2013-47949-C2-1-P Institution: Ministerio de Economia y Competitividad

Principal Investigator: LOUSA RODRIGUEZ, ARTURO Title: Estrategias de funcionalización mediante tratamientos superficiales de aleaciones CoCrMo para la mejora del rendimiento de prótesis articulares Metal-sobre-Metal. Reference: MAT2011-29698-C03-03 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: MARTÍN BADOSA, ESTELA Title: Medida precisa de fuerzas con pinzas ópticas holográficas: dispositivo de manipulación, cuantificación y visualización tridimensionales Reference:FIS2010-16104 Ministerio de Ciencia e Innovación

Principal Investigator: MORENZA GIL, JOSE LUIS Title: Contractació d'un tècnic de suport a la recerca de la UB del Grup 1. Referència del grup de recerca consolidat 2009SGR1538 Reference: 008406 Institution: Universitat de Barcelona

Principal Investigator: NAVAJAS NAVARRO, DANIEL Title: Mechanical pathways in cells: from molecular mechanisms to cell function (MecPath) Reference: PCIG10-GA-2011-303848 Institution: Unió Europea

Principal Investigator: NAVAJAS NAVARRO, DANIEL Title: Grupo de Biomecánica Respiratoria y Celular de la Universidad de Barcelo. (Grupo asociado al CIBER-BBN) Reference: 008892 Institution: Ministerio de Educación

Principal Investigator: NAVAJAS NAVARRO, DANIEL Title: Enfermedades Respiratorias Reference: CB06/06/0026 Institution: Ministerio de Sanidad y Consumo

Principal Investigator: ORTIN RULL, JORDI Title: Física no lineal Reference: 2014SGR878 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: ORTIN RULL, JORDI Title: Subvenció per a la contractació d'investigadors dins del Programa Ramon y Cajal. Reference: RYC-2011-07685 Institution: Ministerio de Economia y Competitividad

Principal Investigator: PASTOR BLASCO, FCO.I.JAVIER Title: Nuevas enzimas y productos microbianos para la biomodificación del papel Reference: CTQ2013-48995-C2-2-R Institution: Ministerio de Economia y Competitividad

Principal Investigator: PASTOR BLASCO, FCO.I.JAVIER Title: Nuevas enzimas y productos microbianos para la biomodificación del papel Reference: 001765 Institution: Universitat de Barcelona

Principal Investigator: PEREZ GARCIA, M. LUISA Title: Funcionalización de micronanoherramientas para ciencias de la vida Reference: TEC2011-29140-C03-02 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: RITORT FARRAN, FELIX Title: High-resolution tweezers for DNA replication and sequence identification (MagRepS) Reference: 267862 Institution: Unió Europea

Principal Investigator: RITORT FARRAN, FELIX Title: Information, Fluctuations, and Energy Control in Small Systems (INFERNOS) Reference: 308850 Institution: Unió Europea

Principal Investigator: RITORT FARRAN, FELIX Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2008. Reference: 006683 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: RITORT FARRAN, FELIX Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2013. Reference: 008572 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: RITORT FARRAN, FELIX Title: Fluctuaciones de energía libre y contenido de información en evolución molecular: Teoría y Experimentos Reference: FIS2013-47796-P Institution: Ministerio de Economia y Competitividad

Principal Investigator: RITORT FARRAN, FELIX Title: Bioingenieria, Biomateriales y Nanomedicina Reference: CB06/01/0045 Institution: Ministerio de Sanidad y Consumo

Principal Investigator: RITORT FARRAN, FELIX Title: Small Biosystem Lab Reference: 2014SGR1379 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: ROCA-CUSACHS SOULERE, PERE Title: Estudio de las vías moleculares mecánicas celulares Reference: BFU2011-23111 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: ROCA-CUSACHS SOULERE, PERE Title: Estudio de las vías moleculares mecánicas celulares Reference: BFU2011-23111 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: SABATE LAGUNAS, RAIMON Title: Subvenció per a la contractació d'investigadors dins del Programa Juan de la Cierva,2012. Reference: JCI-2012-12193 Institution: Ministerio de Economia y Competitividad

Principal Investigator: SAMITIER MARTI, JOSEP Title: Desenvolupament de processos d'encapsulació en liposomes de materials biològics. Refernce: 307089 (FBG) Institution: IUCT-Technological Services

Principal Investigator: SAMITIER MARTI, JOSEP Title: Contractació d'un tècnic de suport a la recerca de la UB del Grup 3. Referència del grup de recerca consolidat 2009SGR505 Reference: 008411 Institution: Universitat de Barcelona

Principal Investigator: SANCHO HERRERO, JOSE MARIA Title: Stochasticity in nonlinear complex systems Reference: FIS2012-37655-C02-02 Institution: Ministerio de Economia y Competitivida

Principal Investigator: SANZ CARRASCO, FAUSTO Title: La electroquímica fina herramienta para la preparación de películas para aplicaciones de conversión de energía Reference: CTQ2011-25156 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: SANZ CARRASCO, FAUSTO Title: La electroquímica fina herramienta para la preparación de películas para aplicaciones de conversión de energía Reference: CTQ2011-25156 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: SANZ CARRASCO, FAUSTO Title: Bioingenieria, Biomateriales y Nanomedicina Reference: CB06/01/0081 Institution: Ministerio de Sanidad y Consumo

Principal Investigator: SERRA COROMINA, PEDRO Title: DigiPRINT: Large Area High Resolution Digital Printing for Organic Thin Film Transistor Fabrication Reference: RDNET12-2-0002 Institution: Unió Europea

Principal Investigator: SERRA COROMINA, PEDRO Title: Impresión con láser de tintas de nanofibras metálicas para su aplicación a dispositivos electrónicos Reference: 001775 Institution: Universitat de Barcelona

Principal Investigator: TIERNO, PIETRO Title: Transport and collective dynamics of colloidal particles in a magnetic ratchet potential Reference: 57049473 Institution: Deutscher Akademischer Austauch Dienst (DAAD) (Servicio Alemán de Intercambio Académico)

Principal Investigator: TIERNO, PIETRO Title: Dynamics and assemblies of colloidal particles under Magnetic and Optical forces (DynaMO) Reference: 335040 Institution: Unió Europea

Principal Investigator: TIERNO, PIETRO Title: Dynamics of colloidal particles under Magnetic and Optical Forces (ERC Starting grant) Reference: FIS2011-15948-E Institution: Ministerio de Ciencia e Innovación

Principal Investigator: VINARDELL MARTINEZ-HIDALGO, MA. PILAR Title: Subvenció per a la contractació d'investigadors dins del Programa Ramon y Cajal. Inclou 15.000,00 euros de finançament addicional a la primera anualitat. Reference: RYC-2009-04683 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: VINARDELL MARTINEZ-HIDALGO, MA. PILAR Title: Adaptación de modelos in vitro para evaluar la seguridad de partículas coloidales de escala micro y nanométrica Reference: MAT2012-38047-C02-01 Institution: Ministerio de Economia y Competitividad

3. NANOPHARMACOTHERAPY

Principal Investigator: BUSQUETS VIÑAS, M.ANTONIA Title: Nanopartículas magnéticas para aplicaciones teranósticas: magnetoliposomas Reference: MAT2012-36270-C04-03 Institution: Ministerio de Economia y Competitividad

Principal Investigator: ESTELRICH LATRAS, JOAN Title: Subvenció per a la contractació d'investigadors dins del Programa Ramon y Cajal. Reference: RYC-2011-07987 Institution: Ministerio de Ciencia e Innovació

Principal Investigator: GARCIA LOPEZ, MARIA LUISA Title: ANALYSIS OF THE STRESS MECHANISMS DURING STERILIZATION AND STABILIZATION BY LYOPHILISATION OF NANOSTRUCTURED BIOMATERIALS AND THE EFFECTS ON THEIR BIOPHARMACEUTICAL PROFILES Reference: MAT2011-26994 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: GARCIA LOPEZ, MARIA LUISA Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Segona convocatòria 2014. Reference: 008854 Institution: Universitat de Barcelona

Principal Investigator: GARCIA CELMA, MARIA JOSE Title: Grup de Tensiactius Reference: 2014SGR1655 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: GARCIA CELMA, MARIA JOSE Title: TECNOLOGÍAS DE AUTOAGREGACIÓN DE MOLÉCULAS ANFIFÍLICAS PARA APLICACIONES TERAPÉUTICAS Reference: CTQ2011-29336-C03-03 Institution: Ministerio de Ciencia e Innovación

4. NANOMAGNETISM, NANOELECTRONICS AND NANOPHOTONICS

Principal Investigator: AROMI BEDMAR, GUILLEM Title: Grup de Magnetisme i Molécules Funcionals (GMMF) Reference: 2014SGR129 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: AROMI BEDMAR, GUILLEM Title: Design and Preparation of Functional Molecules for Quantum Computing and Information Processing (FuncMolQIP) Reference: 258060 Institution: Unió Europea

Principal Investigator: AROMI BEDMAR, GUILLEM Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2008. Reference: 006677 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: AROMI BEDMAR, GUILLEM Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2013. Reference: 008567 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: AROMI BEDMAR, GUILLEM Title: Subvenció per a la contractació d'investigadors dins del Programa Ramon y Cajal. Inclou 15.000,00 euros de finançament addicional a la primera anualitat. Reference: RYC-2010-05821 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: AROMI BEDMAR, GUILLEM Title: Subvenció per a la contractació d'investigadors dins del Programa Juan de la Cierva. Reference: JCI-2011-10893 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: AROMI BEDMAR, GUILLEM Title: Moléculas, polímeros y nanoestructuras funcionales basadas en la química de coordinación: Diseño, preparación y estudio Reference: CTQ2012-32247 Institution: Ministerio de Economia y Competitividad

Principal Investigator: BATLLE GELABERT, XAVIER Title: Coupling effects in magnetic patterned nanostructures (COEF-magNANO) Reference: PIRSES-GA-2012-318901 Institution: Unió Europea

Principal Investigator: BATLLE GELABERT, XAVIER Title: Nanoestructuras magnéticas multifuncionales: efectos de superficie, interfase y proximidad Reference: MAT2012-33037 Institution: Ministerio de Economia y Competitividad

Principal Investigator: CALVO BARRIO, LORENZO Title: Tecnologías fotovoltaicas sostenibles de bajo coste y alta eficiencia para nuevos módulos solares basados en elementos abundantes en la corteza terrestre Reference: ENE2013-49136-C4-4-R Institution: Ministerio de Economia y Competitividad

Principal Investigator: CIRERA HERNANDEZ, ALBERT Title: Ajuts destinats a finançar les despeses de disseny i elaboració de propostes de programes de doctorat (2013) Ref. 2012PRODI00002 Reference: 2012PRODI00002 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: CIRERA HERNANDEZ, ALBERT Title: Caracterización de materiales y estudios de sinterización alternativos (FRACTAL) (CIEN) Reference: 012563 Institution: Centro para el Desarrollo Tecnológico Industrial (CDTI)

Principal Investigator: CIRERA HERNANDEZ, ALBERT Title: Ajuts destinats a finançar les despeses de disseny i elaboració de propostes de programes de doctorat (2013) Ref. 2012PRODI00002 Reference: 2012PRODI00002 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: CIRERA HERNANDEZ, ALBERT Title: Caracterización de materiales y estudios de sinterización alternativos (FRACTAL) (CIEN) Reference: 012563 Institution: Centro para el Desarrollo Tecnológico Industrial (CDTI)

Principal Investigator: CIRERA HERNANDEZ, ALBERT Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2010. Reference: 007284 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: CIRERA HERNANDEZ, ALBERT Title: Desarrollo de una tecnología de esterilización ambiental en continuo para la eliminación de toxinas químicas y biológicas en interiores de aviones y espacios cerrados Reference: IPT-2012-1277-300000 Institution: Ministerio de Economia y Competitividad

Principal Investigator: CIRERA HERNANDEZ, ALBERT Title: Desarrollo de supercapacidades, en la que se desarrollaran nuevos sustratos flexibles basados en la impresión de tintas mediante tecnologías de Inkjet y mediante la tecnología tape casting (eCUB) (NUCLIS) Reference: 012562 Institution: Agència de Suport a l'Empresa Catalana (ACC1Ó)

Principal Investigator: CIRERA HERNANDEZ, ALBERT Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Segona convocatòria 2014. Reference: 008848 Institution: Universitat de Barcelona

Principal Investigator: CORNET CALVERAS, ALBERT Title: Micronanotecnologies i nanoscòpies per dispositius electrònics i fotònics (MIND) Reference: 2014SGR672 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: CORNET CALVERAS, ALBERT Title: Micronanotecnologies i nanoscòpies per dispositius electrònics i fotònics (MIND) Reference: 2014SGR672 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: DIEZ PEREZ, ISMAEL Title: Developing single-molecule switches for applications in nanoscale organic devices (Single-Molec-Switch) Reference: PIIF-GA-2012-328893 Institution: Unió Europea

Principal Investigator: DIEZ PEREZ, ISMAEL Title: Estudio de propiedades electromecánicas en contactos eléctricos con una sola proteína Reference: CTQ2012-36090 Institution: Ministerio de Economia y Competitividad 328893 Institution: Unió Europea

Principal Investigator: ESCUER FITE, ALBERTO Title: Estrategias de síntesis, propiedades y aplicaciones de moléculas magnéticas funcionales, nanoestructuras magnéticas y materiales de base molecular Reference: CTQ2012-30662 Institution: Ministerio de Economia y Competitividad

Principal Investigator: ESCUER FITE, ALBERTO Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2009. Reference: 006947 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: FRAILE RODRIGUEZ, MARIA ARANZAZU Title: Ajut per a l'accés a la infraestructura beamline BESSY II del Helmholtz Zentrum Berlin Reference: 14201194_ST Institution: Helmholtz Zentrum Berlin (HZB)

Principal Investigator: FRAILE RODRIGUEZ, MARIA ARANZAZU Title: Ajut per a l'accés a la infraestructura beamline (PEEM3) of the Advanced Light Source (ALS) del Lawrence Berkeley National Lab Reference: ALS-06575 Institution: Lawrence Berkeley Laboratory

Principal Investigator: GARRIDO FERNANDEZ, BLAS Title: Iluminación de estado sólido innovadora e inteligente e interconexiones ópticas a 1.5 micras con fotónica de silicio basada en tecnología CMOS Reference: TEC2012-38540-C02-01 Institution: Ministerio de Economia y Competitividad

Principal Investigator: GARRIDO FERNANDEZ, BLAS Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Reference: 008632 Institution: Universitat de Barcelona

Principal Investigator: HERNANDEZ FERRAS, JOAN MANEL Title: Fenómenos a escala nanométrica en materiales magnéticos y superconductores a bajas temperaturas, bajo la acción de microondas de alta frecuencia y campos magnéticos rotatorios Reference: MAT2011-23698 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: PEIRO MARTINEZ, FRANCISCA Title: IMAGINE....Ciencia de Materiales a Resolución Sub-Angstrom. Reference: CSD2009-00013 Institution: Ministerio de Educación y Ciencia

Principal Investigator: PEIRO MARTINEZ, FRANCISCA Title: Microscopia Electrónica de Transmisión: modos avanzados y tratamiento de datos para elucidar propiedades de los materiales Reference: MAT2013-41506-P Institution: Ministerio de Economia y Competitividad

Principal Investigator: PRADES GARCIA, JUAN DANIEL Title: Nanodevice Engineering for a Better Chemical Gas Sensing Technology (BetterSense) Reference: 336917 Institution: Unió Europea

Principal Investigator: PRADES GARCIA, JUAN DANIEL Title: Sistemas de detección y cuantificación de biomarcadores de la Enfermedad de Alzheimer (KIT-ALZHEIMER) Reference: IPT-2011-1055-900000 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: PRADES GARCIA, JUAN DANIEL Title: Ajuts en el marc del Programa de Retenció del Talent 2013 Reference: 008364 Institution: Universitat de Barcelona

Principal Investigator: PRADES GARCIA, JUAN DANIEL Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Segona convocatòria 2014. Reference: 008861 Institution: Universitat de Barcelona

Principal Investigator: ROMANO RODRIGUEZ, ALBERT Title: Innovación tecnológica en micro y nanosensores para monitorización de calidad de aire y control medioambiental Reference: TEC2013-48147-C6-1-R Institution: Ministerio de Economia y Competitividad

Principal Investigator: ROMANO RODRIGUEZ, ALBERT Title: Innovación tecnológica en micro y nanosensores para monitorización de calidad de aire y control medioambiental Reference: 001769 Institution: Universitat de Barcelona

Principal Investigator: ROMANO RODRIGUEZ, ALBERT Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Reference: 008665 Institution: Universitat de Barcelona

Principal Investigator: ROMANO RODRIGUEZ, ALBERT Title: On-chip Electrical Flow Cytometry for Cancer Cell Detection Cell-Check (TECSPR14-1-0024) Reference: 012501 Institution: Agència de Suport a l'Empresa Catalana (ACC1Ó)

Principal Investigator: TEJADA PALACIOS, JAVIER Title: Grup de Magnetisme Reference: 2014SGR500 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: TEJADA PALACIOS, JAVIER Title: Ajut postdoctoral dins del Programa Beatriu de Pinós (BP), Modalitat B. 2013 Reference: 2013BP-B 00163 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: TEJADA PALACIOS, JAVIER Title: Spint torque oscillators with applications in non digital computing science and communications (SpinTorqOsc) Reference: 253214 Institution: Unió Europea

Principal Investigator: TEJADA PALACIOS, JAVIER Title: Ajut per incentivar i consolidar la recerca d'excel·lència ja existent a les universitats públiques de Catalunya. Programa ICREA Academia 2008. Reference: 006685 Institution: Fundació Institució Catalana de Recerca i Estudis Avançats (ICREA)

Principal Investigator: TEJADA PALACIOS, JAVIER Title: Detección de defectos estructurales por deterioro de stents coronarios implantados en arterias mediante técnicas no invasivas de microondas Reference: TEC2013-49465-EXP Institution: Ministerio de Economia y Competitividad

Principal Investigator: VARELA FERNANDEZ, MANUEL Title: Oxidos y estructuras híbridas de respuesta multifuncional Reference: MAT2011-29269-C03-03 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: VELASCO CASTRILLO, MA. DOLORES Title: Estudio de moléculas orgánicas semiconductoras con propiedades ópticas, electrónicas, magneticas y su aplicación en materiales liquido-cristalinos mecano-luminiscentes Reference: CTQ2012-36074 Institution: Ministerio de Economia y Competitividad

5. NANOSTRUCTURED MATERIALS

Principal Investigator: CANILLAS BIOSCA, ADOLFO Title: Projecte a realitzar: 'Polarimetric characterization of natural and artificial bianisotropic media' Reference: 2011BP_B00059 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: CANILLAS BIOSCA, ADOLFO Title: Polarimetric characterization of natural and artificial chiral anisotropic media (NANOCHIRALITY) Reference: PIIF-GA-2012-330513 Institution: Unió Europea

Principal Investigator: ESTEVE PUJOL, JOAN Title: Doctorats industrials 2013. Empresa: Zanini Auto Grup S.A. Reference: 2013DI070 Institution: Agència de Gestió d'Ajuts Universitaris i de Recerca. Generalitat de Catalunya. AGAUR

Principal Investigator: FARRERA PIÑOL, JOAN ANTONI Title: Recerca sobre l'aprenentatge de la química en alumnes dels Graus de Química, Enginyeria Química i Enginyeria de Materials: tipologia d'alumne, hàbits d'estudi i competències durant el 1r i 3r semestres. Exploració i repercussions per a la d Reference: REDICE14-1393 Institution: Institut de Ciències de l'Educació (ICE) - Universitat de Barcelona (UB)

Principal Investigator: GUTIERREZ GONZALEZ, JOSE MARIA Title: Tecnologías de Autoagregación de Compuestos Anfifílicos para Aplicaciones en Alimentos Funcionales y Cosmética Reference: CTQ2011-29336-C03-02 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: SAGUES MESTRE, FRANCESC Title: Subvenció per a la contractació d'investigadors dins del Programa Ramon y Cajal. Inclou 15.000,00 euros de finançament addicional a la primera anualitat. Reference: RYC-2008-02745 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: SAGUES MESTRE, FRANCESC Title: Materia blanda forzada, activa y viva Reference: 001772 Institution: Universitat de Barcelona

Principal Investigator: VILA ARBONES, ANA MARIA Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Reference: 008679 Institution: Universitat de Barcelona

6. NANOENERGY: PRODUCTION, STORAGE AND ENVIRONMENT

Principal Investigator: ASENSI LOPEZ, JOSE MIGUEL Title: Reliable assessment of degradation in new thin-film photovoltaic technologies (DEGRADATION) Reference: 0311/BIE/12 Institution: Unió Europea

Principal Investigator: BERTOMEU BALAGUERO, JOAN Title: CÉLULAS SOLARES DE SILICIO DE ALTA EFICIENCIA Y BAJO COSTE FABRICADAS A BAJA TEMPERATURA Reference: ENE2013-48629-C4-2-R Institution: Ministerio de Economia y Competitividad

Principal Investigator: BERTOMEU BALAGUERO, JOAN Title: CÉLULAS SOLARES DE SILICIO DE ALTA EFICIENCIA Y BAJO COSTE FABRICADAS A BAJA TEMPERATURA Reference: 001739 Institution: Universitat de Barcelona

Principal Investigator: GÜELL VILA, FRANC Title: Ultrafast and correlated carrier energetic and dynamics in highly excited nanomaterials (UCORN) Reference: MBI001954 Institution: Unió Europea

Principal Investigator: GÜELL VILA, FRANC Title: Femtosecond field-induced bandgap modification in dielectric materials (FIBMOD) Reference: MBI002096 Institution: Unió Europea

Principal Investigator: GÜELL VILA, FRANC Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Reference: 008636 Institution: Universitat de Barcelona

Principal Investigator: SEGARRA RUBI, MERCE Title: CELDAS REVERSIBLES DE ÓXIDO SÓLIDO DE TEMPERATURA INTERMEDIA Reference: MAT2011-23623 Institution: Ministerio de Ciencia e Innovación

Principal Investigator: SEGARRA RUBI, MERCE Title: Contractació d'un tècnic de suport a la recerca de la UB del Grup 3. Referència del grup de recerca consolidat 2009SGR645 Reference: 008414 Institution: Universitat de Barcelona

Principal Investigator: SEGARRA RUBI, MERCE Title: Ajuts per impulsar la participació en projectes internacionals de recerca (2014) en el marc del programa HORIZON 2020. Segona convocatòria 2014. Reference: 008863 Institution: Universitat de Barcelona

Principal Investigator: SEGARRA RUBI, MERCE Title: Centre de Disseny i Optimització de Materials Reference: DIOPMA Institution: Agència de Suport a l'Empresa Catalana (ACC1Ó)

Appendix 3

List of patents

Find below a list of patents applied by IN²UB researchers during 2014:

Authors: Pierre-Philippe Grand; Jesús Salvador Jaime Ferrer; Verónica Bermúdez Benito; Edgardo Saucedo Silva; Víctor Izquierdo Roca; Andrew M. Fairbrother; Diouldé M. Sylla; Alejandro Pérez Rodríguez
Title: Method and system for real time in-situ monitoring of a solution during a solution based process
Date of application: 2014

Authors: Jaume Esteve Tintó; Jose Antonio Plaza Plaza; Marta Duch Llobera; Núria Torras Andrés; Mª Lluïsa Pérez García; Juan Pablo Agusil Antonoff
Title: Método de obtención de un array de microparticulas planares con multiplexado molecular superficial, array obtenido y su uso
Date of application: 2014

Authors: Enric Bertran Serra; Roger Amade Rovira
Title: Superficie con propiedades de reducción de la luz difusa por condensación de agua y procedimiento de obtención de ésta
Date of application: 2014

Authors: Francesc Rabanal Anglada; Yolanda Cajal Visa; Ariadna Grau Campistany; Jordi Vila Estapé; Xavier Vila Farré
Title: Compuestos peptídicos útiles como agentes antibióticos
Date of application: 2014

Authors: Enric Bertran Serra; Víctor Manuel Freire Soler; Adrià Ramírez Sánchez; Esther Pascual Miralles; José Luis Andújar Bella
Title: Procedimiento para la producción controlada de grafeno a muy baja presión y dispositivo para llevar a cabo el procedimiento
Date of application: 2014

GENERAL ACTIVITY REPORT

During the 2013-2014 academic year, 25 new students have enrolled (first year). The total number of students enrolled in the programme at present is 75. The PhD programmme in Nanoscience began during the 2007-2008 academic year and from that first year, about 40 doctoral theses have been defended. The theses defended between January and December 2014 are the following:

- **"Atomistic study of structural and electronic transport properties of silicon quantum dots for optoelectronic applications".** Author: Núria García Castelló. Supervisor: Joan Daniel Prades and Albert Cirera.

- **"Ordered mesoporous metal oxides for solid oxide fuel cells and gas sensors".** Author: Laura Almar Liante. Supervisors: Albert Tarancón and Teresa Andreu.

- **"Nanomagnetism and high frequency experiments. Basic science and technological applications".** Author: Víctor López Domínguez. Supervisor: Javier Tejada.

- **"Estudi de materials magnètics amb microones".** Author: Antonio Fernández Martínez. Supervisor: Joan Manel Hernández Ferràs.

- **"Sistemas nanoestructurados y propiedades de transporte en capas delgadas de manganita".** Author: Luis Peña Guédez. Supervisor: Benjamín Martínez Perea and Lluís Balcells Argemí.

- **"Development of a multi-electrode impedimetric biosensor: detection of pathogenic bacteria and mycotoxins".** Author: Marilia Barreiros Santos. Supervisors: Josep Samitier Martí and Vaso Teixeira.

- **"Fabrication and characterization of macroscopic graphene layers on metallic substrates". Author: Víctor Manuel Freire Soler. Supervisors: Carlos Corbella and Enric Bertran.**

- **"Electric polarization properties of single bacteria measured with electrostatic force microscopy".** Author: Daniel Esteban Ferrer. Supervisors: Gabriel Gomila and Antonio Juárez.

- **"Carbon Nanotubes Deposited by Hot Wire Plasma CVD and Water Assisted CVD for Energetic and Environmental Applications".** Author: Shahzad Hussain. Supervisors: Enric Bertran and Roger Amade.

- **"Elements de captació i emmagatzematge d'energies residuals del medi".** Author: Llorenç Servera Serapio. Supervisor: Joan Ramon Morante

- **"Studies and integration of Silicon-based light emitting systems".** Author: Alfredo A. González Fernández. Supervisors: Carlos Domínguez and Mariano Aceves.

- **"Development and Characterization of Liposomal formulations to enhance Transdermal drug delivery".** Author: Bhargava Ram Nimmaraju. Supervisors: Hernández-Borrell J., Vázquez-González, M.L, Doménech Ò, Montero, M.T and Calpena A.C.

For further details on both the **Nanosciences** Programme and the Industrial PhD programme in **Materials, Nanotechnology and Industrial Processes**, please visit the site http://www.ub.edu/in2ub/doctorat_nanociencia

Falling into the academic year 2013-2014, the IN²UB celebrated the sixth edition of its scientific meeting on June 5th 2014. The meeting was held at the premises of the University of Barcelona (Aula Enric Casassas), and was attended by both members of the IN²UB and young researchers working with the groups composing the institute. The conference attendees had the chance to see over 40 posters presented by young researchers and to attend eleven lectures, among which those offered by offered by the plenary speakers Timo Betz (Institut Curie) and Alexander S Mikhailov (Fritz-Haber Institut). The scientific committee of the 2014 edition of this meeting was composed of Gustavo Egea, Jordi Ignés and José María Sancho. The meeting was attended by over 100 IN²UB members and young researhers.

Since July 2009, the IN²UB is part of the scientific cluster SECPhO (Southern European Cluster of Photonics and Optics). The IN²UB collaborates with the costs and activities of the cluster through an annual fee and, when needed, funds attendance to specialized conferences by the cluster members belonging to the IN²UB. In March 2014, the IN²UB financed the attendance of some of its researchers to the Healthcare and Photonics event organized by this scientific cluster at the Parc Audiovisual de Catalunya. In relation to SECPHO, it is also worth mentioning that the IN²UB FEMAN Group has been successfully working on a project aimed at developing a new type of microscope –the Müller Matrix microscope–, which will soon improve the performance of the current polarized-light microscopes and allows to measure the Müller matrix of any sample with micrometric resolution. For further details about the SECPHO Cluster, please check http://www.secpho.net/secpho/index.jsp

After approval by the IUPAP in January 2010 of the city to host the XXth edition of the ICM 2015, the IN²UB has continued working towards the organisation of this event. Currently, 80% of the bulk of the research carried out in magnetism is closely related to nanotechnologies, and the IN²UB members therefore believe that holding this conference in our city will be extremely positive for the scientific community doing research in this field in our country. Now there is less than a year left before the ICM 2015 takes place and the chair and the conference committees are working on the final preparations. For further details about the ICM2015, please check http://www.icm2015.org/index.html

In addition, the IN²UB has cofunded and given support, among others, to the following conferences and workshops:

- **Fira del Coneixement de Berga** (April 2014)
- **New Horizons in Statistical Physics and its Applications** (June, 2014) – http://www.ffn.ub.edu/sitges/
- Encuentros de la Red Española de Sistemas Fuera del Equilibrio (June 2014)
- EMRS FALL Meeting 2014: **Symposium B: Organized nanostructures and nano-objects: fabrication, characterization and applications** (September 15-19, 2014) – http://www.emrs-strasbourg.com/index.php?option=com_content&task=view&Itemid=137&id=753
- Worskshop on Excitations in Nanomagnetism Barcelona, December 4th-5th 2014 Website: https://sites.google.com/site/excitationsbcn2014/home

During the academic year 2014, several research groups of the IN²UB have generously organized seminars and talks of general interest to the IN²UB community:

- *Non-equilibrium Thermodynamics in Systems of Active Particles*, by Demian Levis (Université de Montpellier). April, 2014
- *Magnetic Materials in Medicine: Applications in Diagnosis, Management and Treatment of Disease*, by Tim St Pierre (School of Physics, The University of Western Australia). May, 2014
- *Magnetic Force Microscopy: True Infirmation or Artifacts?*, by Oscar Iglesias (Instituto de Ciencia de Materiales de Madrid). July, 2014
- *Crucial Experiments at the Dawn of Modern Physics: the Story beyond Einstein*, by Sergio Ciliberto (ENS, Lyon), October, 2014
- *On the Heat Flux and Entropy produced by Thermal Fluctuations*, by Sergio Ciliberto (ENS, Lyon), October, 2014
- *Magnetic Bioprobes: Synthesis, Functionalisation and Applications*, by Lyudmila Bronstein (Indiana University), October, 2014
- *Topological Effects in Nanoscale Magnetism*, by Hans-Banjamin Braun (School of Physics, University College Dublin), December, 2014

OUR RESEARCHERS

1. MODELLING AND SIMULATION OF SYSTEMS. PROPERTIES OF MATTER IN THE NANOSCALE

Theoretical physics of Nanoscopic Systems
(Dep. Structure and Constituents of Matter, Fac. Physics)
Martí Pi Pericay (Full Professor)
Manuel Barranco Gómez (Full Professor)
Montserrat Guilleumas Morell (Professor)
Ricardo Mayol Sánchez (Professor)

Materials: Phase transitions
(Dep. Structure and Constituents of Matter, Fac. Physics)
Antoni Planes Vila (Full Professor)
Lluís Mañosa Carrera (Full Professor)
Teresa Castán Vidal (Full Professor)
Eduard Vives Santa-Eulàlia (Professor)

Nanosystems Statistical Physics
(Dep. Fundamental Physics, Fac. Physics)
Miguel Rubí Capaceti (Full Professor)
Ignacio Pagonabarraga Mora (Full Professor)
Mª del Carmen Miguel López (Tenured Assistant Professor)
David Reguera López (Tenured Assistant Professor)

Nanosystems Statistical Physics-Complex Matter Group
(Dep. Fundamental Physics, Fac. Physics)
Giancarlo Franzese (Professor)
Oriol Vilanova Gabarrón (PhD Student)

2. NANOBIOTECHNOLOGY

Non-linear Physics in Nanobiophysics
(Dep. Structure and Constituents of Matter, Fac. Physics)
Jose M. Sancho Herrero (Full Professor)
Jordi Ortin Rull (Full Professor)
Aurora Hernandez Machado (Full Professor)
Jaume Casademunt Viader (Professor)
Marta Ibañes Míguez (Tenured Assistant Professor)
Eugenia Corvera Poire (Collaborator)

Non-linear Physics in Nanobiophysics-Magnetic Soft Matter Group
(Structure and Constituents of Matter, Fac. Physics)
Pietro Tierno (RyC and ERC starting grant)
Antonio Ortiz-Ambriz (Postdoc)
Fernando Martinez-Pedrero (Postdoc)

Microbian Enzymes for Industrial Applications Group
(Dep. Microbiology, Fac. Biology)
Pilar Díaz Lucea (Professor)
Francisco I. Javier Pastor Blanco (Professor)
Josefina Martínez Martínez (Professor)
Susana Valenzuela Mayorga (Postdoc)

Nanomalaria Group
Xavier Fernández Busquets (Senior Researcher. *IBEC-CRESIB*)
Santiago Imperial Ródenas (Professor. *Dep. Biochemistry and Molecular Biology. Fac. Biology)*

Biophysics and Bioengineering Unit
(Dep. Physiological Sciences I, Fac. Medicine)
Daniel Navajas Navarro (Full Professor)
Ramon Farré Ventura (Full Professor)
Pere Roca Cusachs (Tenure-Track Lecturer)

Intracellular Compartments and Membrane Trafficking
(Dep. Cell Biology, Immunology and Neurosciences, Fac. Medicine)
Gustavo Egea Guri (Full Professor)

Biomolecule and small-system physics: Small Biosystems Lab
(Dep. Fundamental Physics, Fac. Physics)
Fèlix Ritort Farran (Professor)
Matteo Palassini (Tenured Assistant Professor)

BiOPT: Optical Trapping Lab - Biophotonics Group
(Dep. Applied Physics and Optics, Fac. Physics)
Mario Montes Usategui (Professor)
Estela Martín Badosa (Tenured Assistant Professor)
Josep Mas Soler (PhD Student)
Frederic Català Castro (PhD Student)
Arnau Farré Flaquer (Collaborator)
Ferran Marsà Samper (Collaborator)

Surfactants and Cell Membrane Interactions Group
(Dep. Physiology, Fac. Pharmacy)
Mª Pilar Vinardell Martínez-Hidalgo (Full Professor)
Montserrrat Mitjans Arnal (Tenured Assistant Professor)
Mª del Carmen Moran Bádenas (Tenured Assistant Professor)
Héctor Llanas Marco (PhD Student)

Genomics, Proteomics and Plant Metabolomics
(Dep. Natural Products, Plant Biology and Soil Science, Fac. Pharmacy)
(Dep. Biochemistry and Molecular Biology, Fac. Pharmacy)
Antonio Fernàndez Tiburcio (Full Professor)
Jaume Bastida Armengol (Professor)
Francesc Viladomat Meya (Professor)
Montserrat Arrò Plans (Tenured Assistant Professor)
Laura Torras Claveria (Adjunct Lecturer)

Peptides and Proteins: Physicochemical Studies
(Dep. Physicochemistry, Fac. Pharmacy)
M. Asunción Alsina Esteller (Full Professor)
Victòria Girona Brumós (Full Professor)
Josefina Prat Aixelà (Professor)
Montserrat Pujol Cubells (Professor)
Yolanda Cajal Visa (Professor)
Montserrat Muñoz Juncosa (Tenured Assistant Professor)

Bioelectronics Unit and Nanobioeneering Lab
(Dep. Electronics, Fac. Physics)
Josep Samitier Martí (Full Professor)

Supramolecular Systems in Nanobiomedicine
(Dep. Pharmacology and Therapeutic Chemistry, Fac. Pharmacy)
M. Ermitas Alcalde Pais (Full Professor)
M. Lluïsa Pérez Garcia (Professor)
Immaculada Dinarès Milà (Professor)
Neus Mesquida Estévez (Tenured Assistant Professor)
David Limon Magaña (PhD Student)

Laser Processing and Biomedical Applications
(Dep. Applied Physics and Optics, Fac. Physics)
José Luís Morenza Gil (Full Professor)
Juan Marcos Fernández Pradas (Professor)
Pere Serra Coromina (Tenured Assistant Professor)
Adrian Patrascioiu (PhD Student)
Camilo Florian Baron (PhD Student)
Francesc Caballero Lucas (PhD Student)

Nanostructure of Biomembranes Group
(Dep. Physicochemistry, Fac. Pharmacy)
Jordi Borrell Hernández (Professor)
María Teresa Montero Barrientos (Professor)
Òscar Domènech Cabrera (Tenure-Track Lecturer)
Martha L. Vázquez González (PhD Student)
Bhargava Ram Nimmaraju (Student)

Conformational Diseases Group
(Dep. Physicochemistry, Fac. Pharmacy)
Raimon Sabaté Lagunas (Postdoc: RyC)
Alba Espargaró Colomé (Postdoc: JdC)

3. NANOPHARMACOTHERAPY

Drug Development in Nanostructured Systems
(Dep. Physicochemistry, Fac. Pharmacy)
(Dep. Pharmacy and Pharmaceutical Technology, Fac. Pharmacy)
M. Luïsa García López (Professor)
M. Antonia Egea Gras (Professor)
Marta Espina García (Professor)
M. José García Celma (Professor)
M. Àngels Salvadó Lladó (Professor)
Genoveva Morral Ruiz (Tenured Assistant Professor)
Fidencia Gamisans Linares (Adjunct Lecturer)
Rosa M. Aparicio Pelegrín (Adjunct Lecturer)
Estefanía Vega Freire (Collaborator)
Mireia Mallandrich Miret (PhD Student)

Drug Design and Response-evaluation within Pharmaceutical Nanostructured and self-ordered Systems Group
(Dep. Pharmacy and Pharmaceutical Technology, Fac. Pharmacy)
Elvira Escribano Ferrer (Professor)
Josep Queralt Regué (Professor)
Jacinto Lauroba Viladrosa (Professor)
Xavier Garcia Sala (Researcher UB)

Colloids
(Dep. Physicochemistry, Fac. Pharmacy)
Joan Estelrich Latràs (Full Professor)
M. Antonia Busquets Viñas (Professor)
Montserrat Gallardo Sauret (Professor)

Other IN²UB researchers who carry out research within the nanopharmacotherapy area in *Dep. Pharmacy and Pharmaceutical Technology, Fac. Pharmacy* are:
Ana Calpena Campmany (Professor)
J. Ignasi Oliva Gimeno (Professor)
Julia Herrera Corominas (Professor)
Mireia Oliva (Collaborator)

4. NANOMAGNETISM, NANOELECTRONICS AND NANOPHOTONICS

Magnetic Interactions and Molecular Magnetism
(Dep. Inorganic Chemistry, Fac. Chemistry)
Ramón Vicente Castillo (Full Professor)
Montserrat Corbella Cordomí (Professor)
Carmen Díaz Gasa (Professor)
Albert Escuer Fité (Full Professor)
Montserrat Monfort Perarnau (Professor)
Mohamed Salah El Fallah (Tenured Assistant Professor)
Eva Carolina Sañudo (Postdoc: RyC)
Albert Figuerola Silvestre (Postdoc: RyC)

Magnetism and Funtional Molecules Group (GMMF)
(Dep. Inorganic Chemistry, Fac. Chemistry)
Guillem Aromí Bedmar (Tenured Assistant Professor)
Verónica Velasco Amigó (Adjunt Lecture)

Thin Layer Stuctures for Spintronics
(Dep. Applied Physics and Optics, Fac. Physics)
Manuel Varela Fernández (Full Professor)
M. Victoria García-Cuenca Varona (Professor)
César Ferrater Martorell (Professor)
Mª Carmen Polo Trasancos (Professor)

Magnetism
(Dep. Fundamental Physics, Fac. Physics)
Javier Tejada Palacios (Full Professor)
Antoni García Santiago (Tenured Assistant Professor)
Joan Manuel Hernández Ferràs (Tenured Assistant Professor)
Ferran Macià Bros (Postdoc: BdP)

Micro-nanotecnologies and nanoscopies for electronics and photonic devices (MIND)
(Dep. Electronics. Fac. Physics)
Albert Cornet Calveras (Full Professor)
Blas Garrido Fernández (Full Professor)
Albert Romano Rodríguez (Professor)
Francisca Peiró Martínez (Professor)
Paolo Pellegrino (Tenured Assistant Professor)
Albert Cirera Hernández (Tenured Assistant Professor)
Juan Daniel Prades Garcia (Tenured Assistant Professor and ERC Starting grant)
Sergio Hernández Márquez (Tenured Assistant Professor)
Sònia Estradé Albiol (Tenure-Track Lecturer)
Lorenzo Calvo Barrio (Adjunct Lecturer)
Josep Manel Rebled Corselles (PhD Student)
Luís López Conesa (PhD Student)
Alberto Eljarrat Ascunce (PhD Student)
Sergio Illera Robles (PhD Student)
Oriol Monereo Cusco (PhD Student)
Giovanni Vescio (PhD Student)
Julià López Vidrier (PhD Student)
Joan Manel Ramirez Ramirez (PhD Student)
Jordí Samà Monsonís (PhD Student)

Organic Materials Unit
(Dep. Organic Chemistry, Fac. Chemisty)
Francisco López Calahorra (Full Professor)
Dolors Velasco Castrillo (Professor)

Magnetic Nanomaterials Group
(Dep. Fundamental Physics, Fac. Physics)
Amílcar Labarta Rodríguez (Full Professor)
Xavier Batlle Gelabert (Full Professor)
Óscar Iglesias Clotas (Tenured Assistant Professor)
Montserrat García del Muro (Tenured Assistant Professor)
Maria Aranzazu Fraile Rodriguez (Postdoc: RyC)

5. NANOSTRUCTURED MATERIALS

Thin-film and Nanostructure electrodeposition group
(Dep. Physical Chemistry. Fac. Chemistry)
Elisa Vallés Giménez (Professor)
Elvira Gómez Valentín (Professor)
Albert Serrà Ramos (PhD Student)
Joan Vilana Balastegui (PhD Student)

Homogeneous Catalysis
(Dep. Physical Chemistry. Fac. Chemistry)
Guillermo Müller Jevenois (Full Professor)
Montserrat Gómez Simón (Collaborator - UPS Toulose)

Phyisics and Engineering of amorphous materials and Nanostructures. FEMAN
(Dep. Applied Physics and Optics, Fac. Physics)
Enric Bertran Serra (Full Professor)
José Luis Andújar Bella (Professor)
Adolf Canillas Biosca (Professor)
Esther Pascual Miralles (Professor)
Roger Amade Rovira (Tenured Assistant Professor)
Joan Antó Roca (Collaborator)
Oriol Arteaga Barriel (Postdocs)
Shahzad Hussain (Postdocs)
Victor Manuel Freire Soler (Postdocs)
Mohammad Reza Sanaee (PhD Student)
Edgar Julian Cabrera Magaña (PhD Student)
Stefanos Chaitoglou (PhD Student)
Arevik Musheghyan Avetisyan (PhD Student)
Fernando Pantoja Suarez (PhD Student)

Engineering of colloidal systems
(Dep. Chemical Engineering. Fac. Chemsitry)
José María Gutiérrez González (Professor)
Mª del Carmen González Azón (Professor)
Alicia Maestro Garriga (Tenured Assistant Professor)

Surface Engineering. Thin-layer Lab
(Dep. Applied Physics and Optics, Fac. Physics)
Joan Esteve Pujol (Full Professor)
Arturo Lousa Rodríguez (Professor)

Self-organized complexity and self-assembling materials
(Dep. Physical Chemistry. Fac. Chemistry)
Francesc Sagués Mestre (Full Professor)
Rosa Albalat Piñol (Professor)
Josep Claret Bonet (Professor)
Joan Antoni Farrera Piñol (Professor)
Jordi Ignés Mullol (Professor)
Pau Guillamat (PhD Student)

Instrumentation Systems and Communications (SIC)
(Dep. Electronics. Fac. Physics)
Anna Vilà Arbonés (Professor)
Christofe Serre (Tenured Assistant Professor)

6. NANOENERGY: PRODUCTION, STORAGE AND ENVIRONMENT

Design and improvement of Processes and Materials (DIOPMA)
(Dep. Materials Science and Metallurgical Engineering, Fac. Chemistry)
Mercè Segarra Rubí (Professor)
Elena Xuriguera Martín (Adjunct Lecturer)
Miguel Morales Comas (Collaborator)

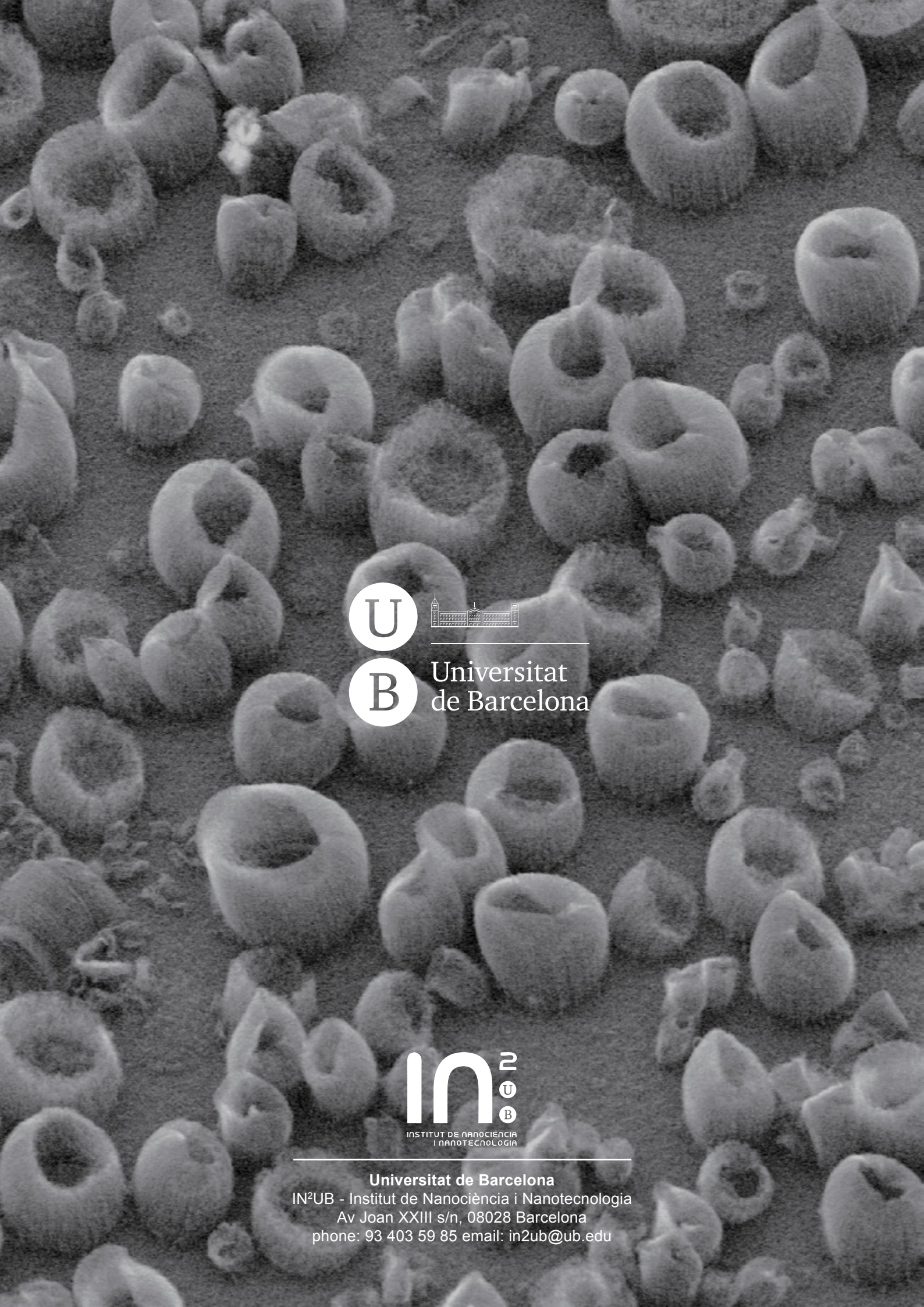
M2E-Nanoenergy and Electronic Materials
(Dep. Electronics. Fac. Physics)
Joan Ramon Morante Lleonart (Full Professor)
Alejandro Pérez Rodríguez (Full Professor)
Franc Güell Vilà (Professor)

Solar and Photovoltaic Energy Group
(Dep. Applied Physics and Optics, Fac. Physics)
Jordi Andreu Batallé (Professor)
Joan Bertomeu Balagueró (Professor)
José Miguel Asensi López (Tenured Assistant Professor)
Jordi Escarré Palou (Tenured Assistant Professor)
Fredy Enrique Rojas Tarazona (Collaborator)

Catalysis and Advanced Materials (MATCAT)
(Dep. Inorganic Chemistry, Fac. Chemistry)
Narcís Homs Martí (Full Professor)
Pilar Ramírez de la Piscina (Full Professor)
Joaquim Sales Cabré (Full Professor)
Alberto Cordoba Sola (PhD Student)
Sonia Rodriguez Abril (PhD Student)
Lukasz Bednarczuk (PhD Student)
Xianyun Liu (PhD Student)

RyC: Ramon y Cajal program
BdP: Beatriu de Pinós program
JdC: Juan de la Cierva program

INSTITUT DE NANOCIÈNCIA I NANOTECNOLOGIA



Universitat de Barcelona

INSTITUT DE NANOCIÈNCIA I NANOTECNOLOGIA

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