Activity Report 2013

Institut de Nanociència i Nanotecnologia de la Universitat de Barcelona

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Graphic design and layout: Cristina Muñoz Idoate | **www.idoate.com**

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Presentation and Objectives

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 of 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 immunology, 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.

Moreover, 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.

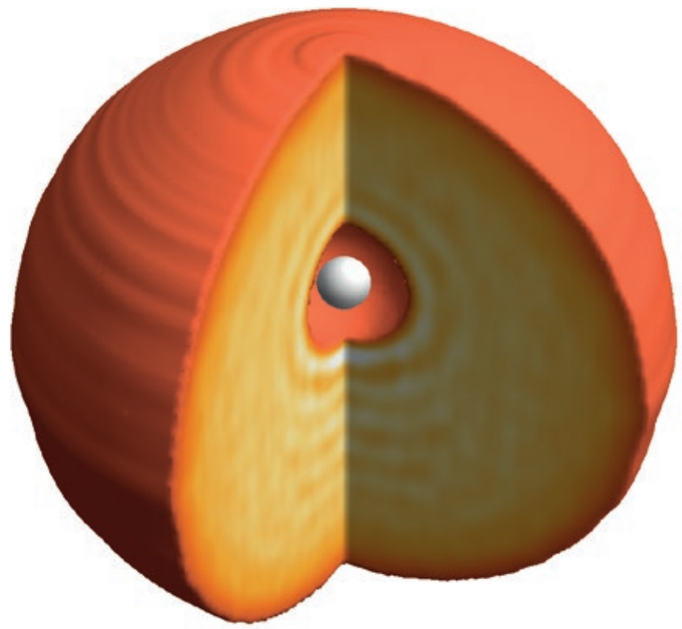
1 Scientific Activity

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 sorted in two different areas:

1. Bose-Einstein condensates.
We have investigated the long range effects of the dipolar interaction by studying the propagation of excitations between non-overlapping dipolar Bose-Einstein condensates.

2. Quantum liquids.
Within a real time dependent density functional formalism we have explained the Landau critical velocity, experimental observed, in the desorption of excited Ag atom coated by an helium droplet. We had calculated the absorption spectra 6p --> 6s of Ba+. Also we have calculated the sinking process of the same ion in an helium droplet, during this process we have observed the format.



^4He droplet doped with a sodium atom. The sodium atom is simulated with a test particles approximation (blue ones).

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

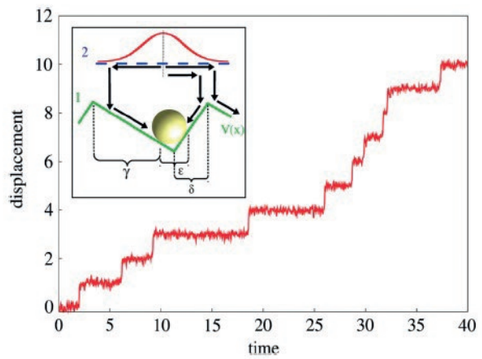
1. An analysis of the magnetisation dynamics of nanoparticles at very short time scales has been performed. This analysis has led to predicting a new regime by which magnetisation performs a nutational motion which could be observed experimentally.

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.

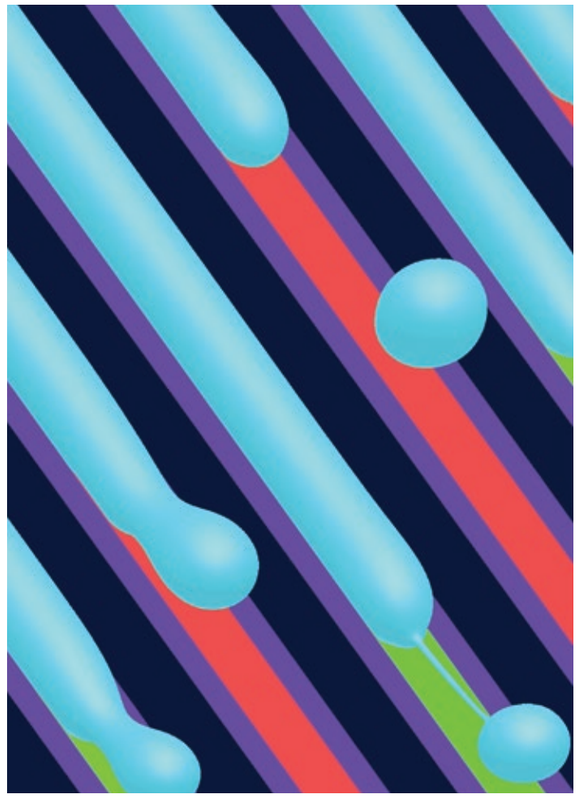


Typical trajectory generated by a two-state ratchet description of a molecular motor. The inset displays the different steps that characterize the molecular motor and identify the region around the minimum of the bounding potential (green curve) where the motor makes the transition to the less bound 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)

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.

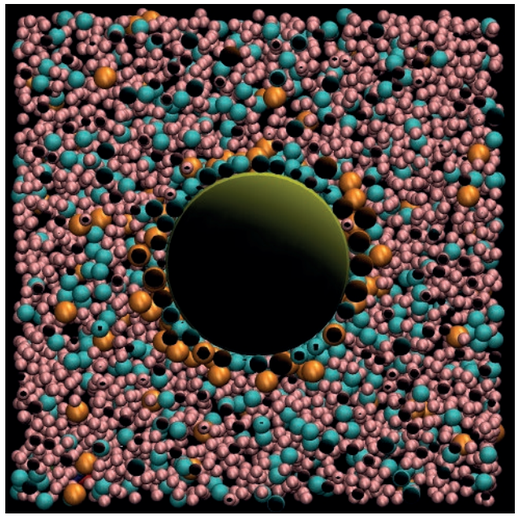
7. A new mode of collective ratcheting in Brownian particles has been identified. This new kind of rectification emerges due to the interplay between variable constrictions and the intrinsic motion that keeps a Brownian particle out of equilibrium. Cooperative rectification can be relevant for driven 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.



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))

Also within the Nanosystems Statistical Physics Group, the **Complex Matter Unit** has studied, by means of computer simulations and Statistical Physics, bio-nano systems is solution. 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.

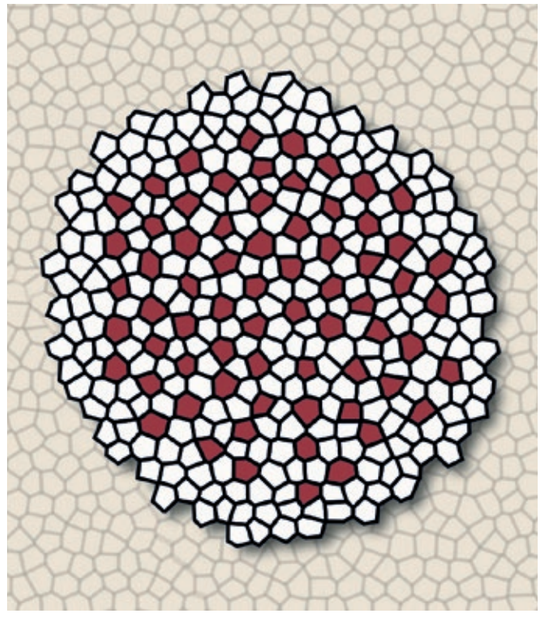


Competitive adsorption of 3 blood plasma proteins, Albumin (pink), Immunoglobulin-G (cian) and Fibrinogen (orange), to a 200 nm hydrophobic Nanoparticle.

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.

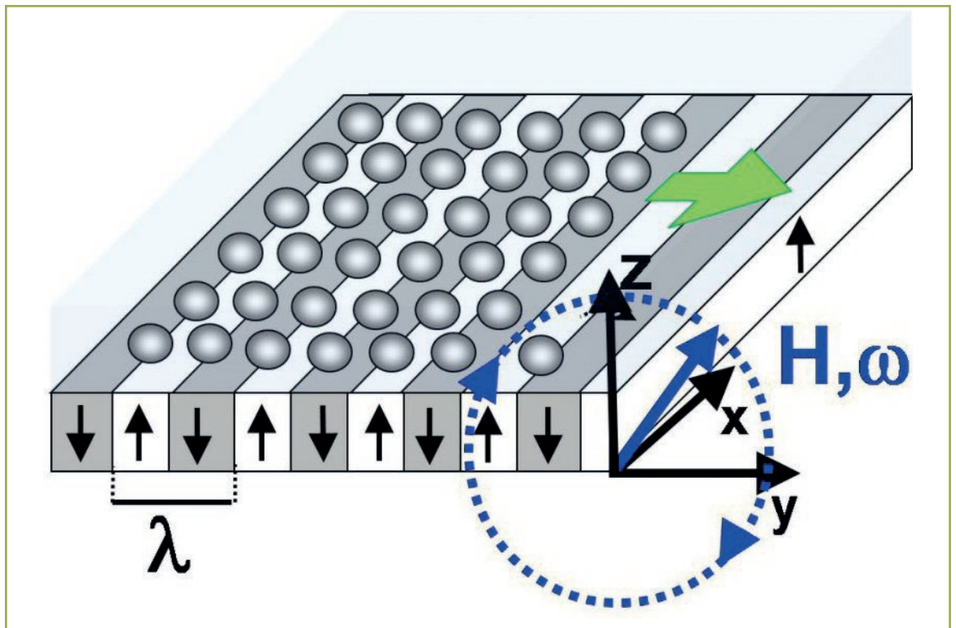


Artistic representation of a tissue where cells compete for differentiating into neurons (white and red cells) invading a non-differentiated tissue where cells are not competing yet for differentiation (light brown cells). Red cells represent differentiated neurons that inhibit its first neighbors to adopt the same fate, white cells represent cells that are willing to differentiate into the neural fate. (Reproduced with permission of Pau Formosa-Jordan).

Regarding the topic of molecular motors we have studied the physical properties of molecular turbines which interchange chemical and mechanical energies by the transmembrane flux of particles. We have found that there is a regime of parameter where the machine cannot operate at all.

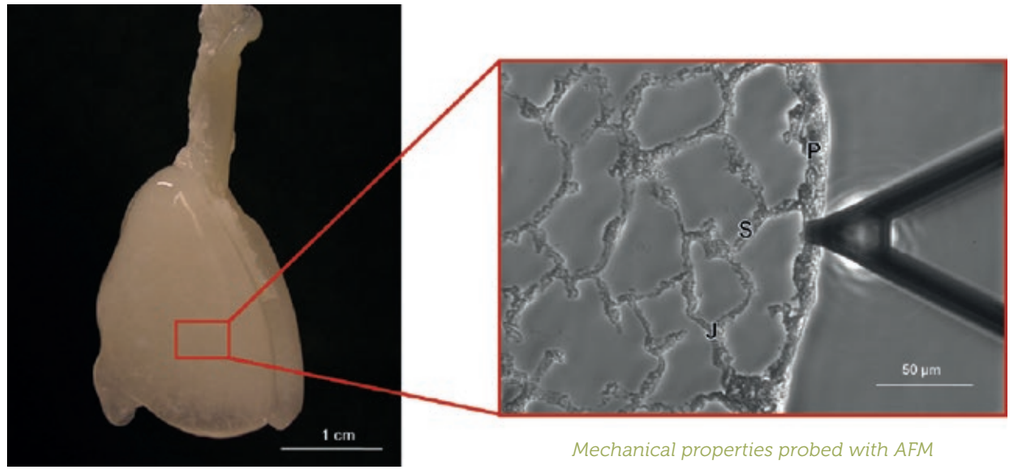
With regard to Brownian motion, it has been shown, by means of extensive simulations, that some anomalies exist concerning both transport and diffusion within Brownian non-interacting particle systems when in movement on surfaces which present a certain degree of disorder. In that sense, four different anomalous regimes have been observed: supertransport subtransport, subdiffusion and superdiffusion when particles follow an infradamped regime, with friction as the relevant parameter.

The **Magnetic Soft Matter Group** has focused on studying the dynamics of interacting paramagnetic colloids transported via a magnetic ratchet effect above a modulated periodic potential. Upon increasing the modulation frequency, it was found that the particles undergo a series of dynamic transitions, from a continuous smectic flow to a disorder flow, and later enter into a two phase flow regime, ending in a complete pinned state. In the disordered phase, the system organizes into density waves due to traffic jams, as in granular systems, while the two-phase flow regime shows strong similarities with plastic flow in vortex matter. Finally, it was demonstrated that induced attractive interactions between the moving colloids lead to enhancement of the particle current due to formation of condensed chains travelling along the modulated landscape.



"Schematic showing paramagnetic colloids above a ferrite garnet film with spatial periodicity 2.6 micron and subjected to an external magnetic field H." Published in Phys. rev. Lett. 109, 198304 (2012)

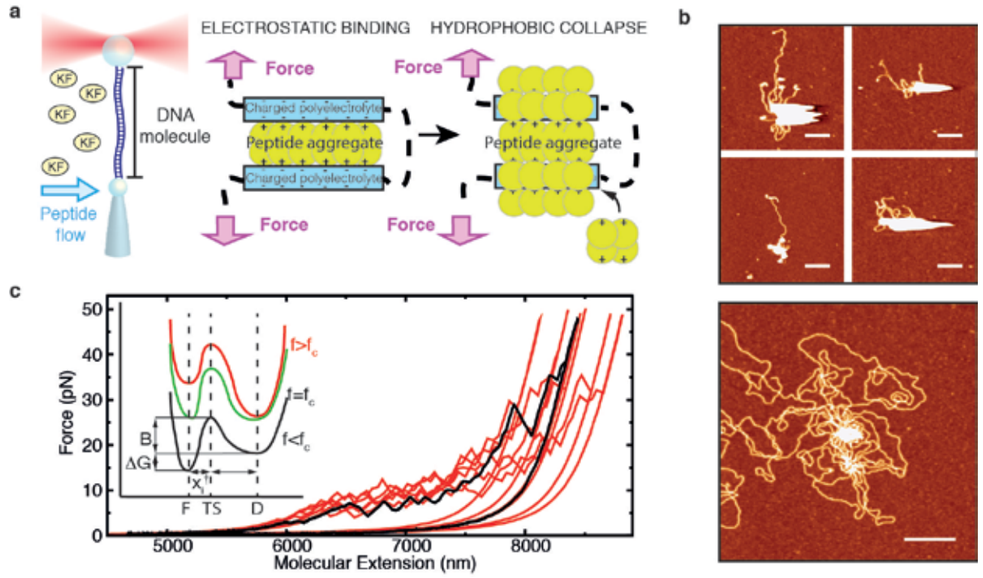
Mechanical properties of cells play a critical role in many essential biological functions including migration, contraction, differentiation and gene expression. Moreover, cells sense and actively respond to adhesive forces and deformations exerted by the adjacent cells and the extracellular matrix (ECM). The **Biophysics and Bioengineering Unit** applies nanotechnologies to probe the mechanical properties of molecules, cells and ECM at the nanoscale. We developed a new technique to probe nanomechanical properties of the extracellular matrix at different regions of the lung parenchyma. Our data revealed marked regional heterogeneity of the lung scaffold with ECM stiffness ranging from ~ 15 kPa in the alveolar septa to ~ 45 kPa in the pleura. We used magnetic tweezers and advanced optical microscopy to reveal a basic molecular structure that cells use to generate forces that probe substrate rigidity. To study cell and tissue dynamics we develop new technologies to measure cellular velocities and physical forces at the cell-cell and cell-matrix interface. Using these techniques we unveiled a new mechanism of cellular guidance by intercellular physical forces.



Decellularized lung scaffold

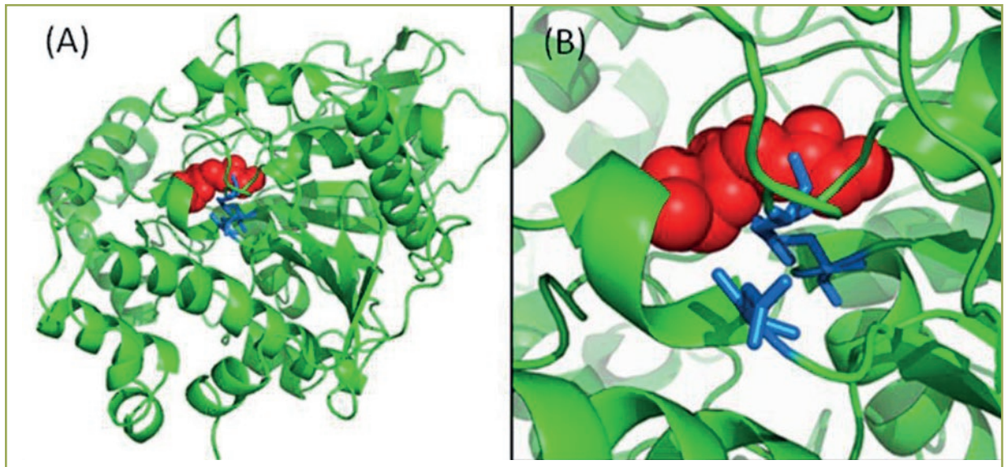
Mechanical properties probed with AFM

During this year, the **Small Biosystems Lab Group** has focused on several projects related to nanotechnologies. Among them, a research in which we have investigated the interaction between an hydrophobic anticancer agent with a high tendency to aggregate (Kahalalide F) and DNA has been recently finished. Understanding the mechanisms by which self-aggregating peptides and proteins bind polyelectrolytes is relevant due to the increasing evidence of its relation to neurodegenerative diseases (e.g. Alzheimer and Parkinson diseases). In particular, recent studies have shown that amyloid peptides with positive charges (e.g., Aβ40, α-synuclein) have a strong binding affinity to negatively charged polymers (e.g., nucleic acids, polysaccharides). However, to date most studies of aggregation kinetics have been performed using ensemble techniques where the individual behavior of molecules cannot be distinguished. Our recently published research (ACS Nano, 2013, 7 (6), pp 5102–5113) is the first attempt to extract quantitative information about the binding affinity and kinetic steps involved in the interaction between a nucleic acid (DNA) and an anticancer self-aggregating peptide (Kahalalide F) at the single molecule level. Using optical tweezers and AFM imaging (Figure 1) we have been able to dissect the kinetic steps involved in the interaction process, finding that there is an initial electrostatic binding of the peptide that is followed by an hydrophobic collapse of the assembled structure. From the modelling of our results we have obtained relevant parameters of the interaction (binding affinities, kinetic barriers), and hypothesize that the described affinity of KF to polyanions might be related to its cytotoxic activity. We think that these results should be of interest to the nanotechnology community as a new methodology to characterize biochemical processes in which structured or amorphous aggregates are formed.



a. *Experimental set-up showing the two kinetic steps of KF-DNA aggregation (electrostatic binding and hydrophobic collapse)* ***b.*** *AFM images of KF-DNA complexes showing DNA compaction and aggregation (scale bar is 200 nm).* ***c.*** *Experimental force-extension curve of a KF-DNA complex (black) and a set of six simulations with the determined thermodynamic parameters for the interaction(red).*

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.

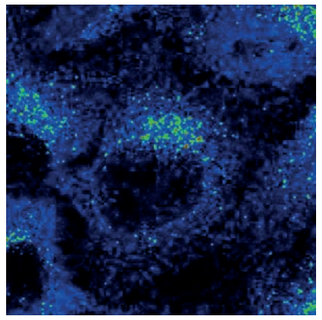


(A) *3D structural model obtained for Bacillus sp. BP-7 esterase EstBP7 using the known crystal structure of Bacillus subtilis esterase PnbA (pdb 1c7j).* ***(B)*** *Detail of the amino acids constituting the oxyanion hole (spheres) and those of the conserved catalytic triad (rods).*

Along the past two years, the work of the **Intracellular Compartments and Membrane Trafficking Lab** has demostrated that PAP2b (also known as LPP3) is the family member of phosphatidic acid phosphatases (PAPs) involved in membrane trafficking events attributed to diacylglycerol in the early secretory pathway. At the same time, we have definitively solved the presence of b-spectrin III in the Golgi and its contribution to the maintenance of the Golgi architecture and transport carrier formation. One major finding is the essential contribution of PI4P (and not PIP2 as expected by in vitro studies) to the in vivo recruitment of this cytoskeleton component to Golgi membranes. Finally, in the membrane trafficking research line we have also published by invitation a recent 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.

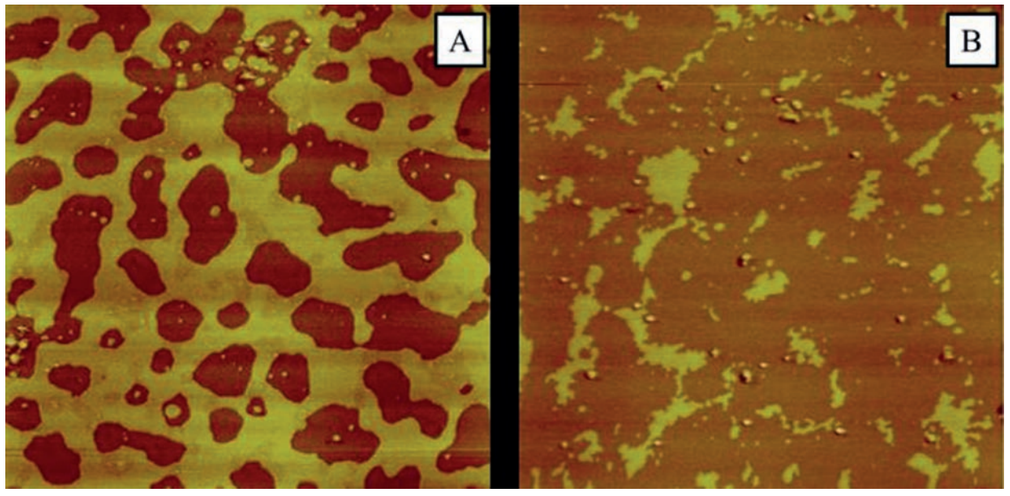
In collaboration with Ernest Giralt (IRB, Bareclona) we have definitively established a model of blood brain barrier (BBB) in vitro, which has been successfully used to assay functionalized gold nanoparticles. Also in collaboration with Isabel Fabregat (IDIBELL, Barcelona), we have contributed to characterize the role of CXCR4 in hepatocarcinoma cell lines.

Our current goals are focused in the pathophysiology of vascular cells in Marfan syndrome, a disorder that severely perturbs the extracellular matrix and TGF-b signaling. We are examining among other things the assembly of ECM lattice when cells are subjected to mechanical forces and signaling responses that it brings.



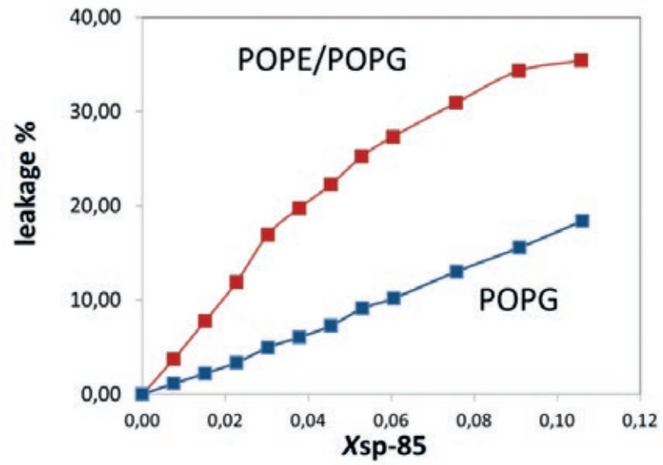
Subcellular localization of LPP3 in the Golgi apparatus and vesicular carriers in HeLa cells examined under the confocal microscope. Picture taken by Enric Gutiérrez-Martínez

Along 2012-13 the **Peptides and Proteins: Physicochemical Studies Group** has continued 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. In this period, its research has been focused specifically on three overlapped sequences of GBV-C E1 protein and one of the GBV-C E2 protein (fig. 1) to deepen on their capacity to inhibit in vitro the HIV-1 peptide.



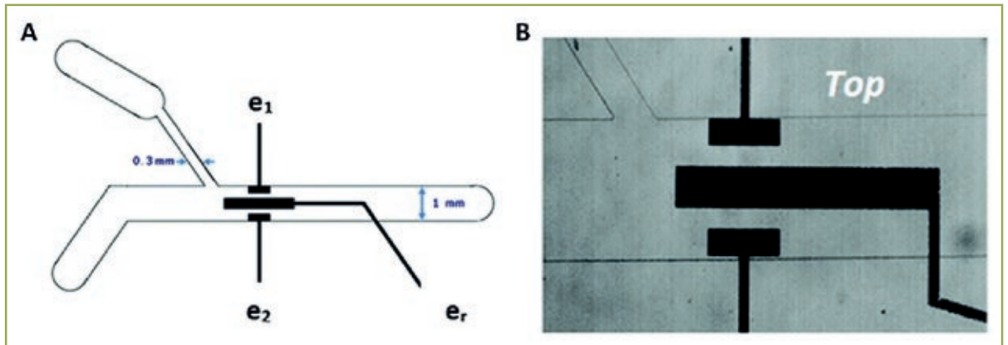
Supported Lipid Bilayer (SLB) of DMPC: DMPS (2:1, mol/mol) before (A, C) and after 30 min incubation of HIV-1 FP peptide at 5 μM (B) or incubation of P45 (GBV-C E2 peptide) together with HIV-1 FP 5 μM (D). Scale bar is 20 nm.

The research on polycationic peptides has focused on the membrane activity of new synthetic lipopeptides with broad spectrum of activity against clinically relevant bacteria, by using POPG and POPE:POPG monolayers and liposomes as model of Gram positive and Gram negative bacteria. Results show that insertion and membrane destabilization requires the presence of negative charge, but zwitterionic POPE further enhances peptide activity.



Leakage of aqueous contents from vesicles determined by a fluorescence-based assay. Sp-85 is a synthetic analog of lipopeptide polymyxin B.

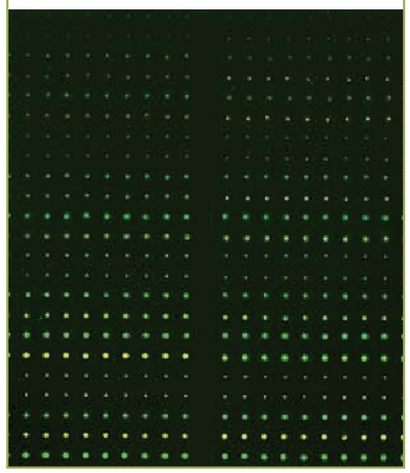
The **Nanobioengineering Group** is a truly multidisciplinary team composed by researchers coming from very diverse backgrounds (chemistry, physics, material science, electronic engineering, pharmacy and molecular biology) and working together in applying nanotechnology to the development of new biomedical 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 .



*Schematics **(A)** and microscopic image **(B)** of a microfluidic device with 3 integrated biosensors.*

The projects carried out by the group are focused on clinical and industrial problems and are related to four convergent research lines:

Representative fluorescence scanner images of an a-PMMA protein microarray.



1. Biosensors and Lab-on-a-chip for clinical diagnosis and food safety applications
- DNA sensors for cancer biomarker detection
- Antibody-based sensors for pathogenic microorganisms' detection
- Olfactory receptor-based sensors for odorant and volatile compounds detection
- Polymer nanowires-based biosensors
- 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 biomedical studies and 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 ocular and cardiac tissue regenerative therapies based on stem cells
- 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
- Engineering microfluidic platforms for neurobiological studies.

The **Supramolecular Systems in Nanomedicine** is a multidisciplinar group that uses the supramolecular chemistry as a tool to develop novel nanomaterials with interest in nanomedicine, such as sensing and theranostics tools, through a bottom-up strategy:

1. Macrocyclic and open-chain cationic compounds are synthesized and used to form vesicles, nanoparticles and gels, and which properties can be tuned when the counter-ion is changed. These systems can be used as vehicles for sustained drug delivery *(Figure 1)*.

2. Nanoparticles of different materials such as gold, iron oxide or silicon oxide are synthesized, characterized and functionalized with specific organic compounds that interact with cells, sensing

important parameters or helping in therapy. For example: gold nanoparticles functionalized with porphyrins can be useful for photodynamic skin therapy.

3. Microtools are functionalized to work as sensors and tagging agents for cells. For example, polysilicon barcodes have been functionalized with WGA, a protein capable of recognizing lectins in the cell membrane of embryos. This makes possible effective cell tagging in assisted reproduction, only needing an optical microscope *(Figure 2)*.

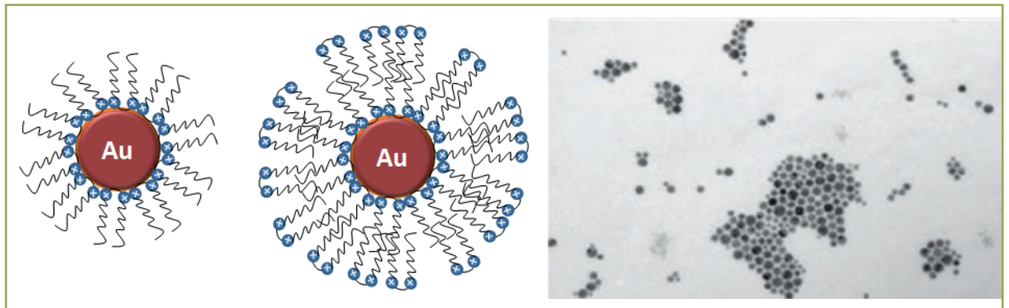


Figure 1. *Bis-imidazolium amphiphiles coated gold nanoparticles for anion recognition and transport. Langmuir, 2012, 28, 2368-2381*

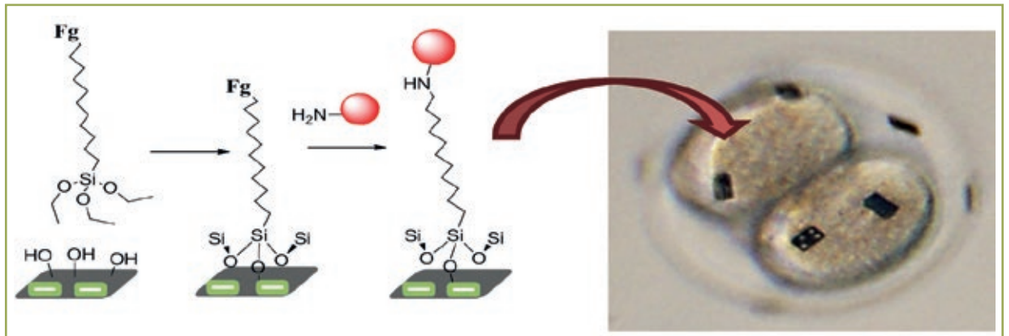
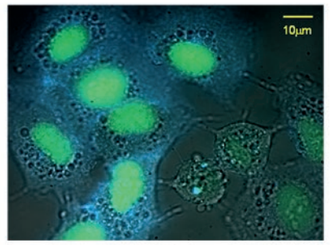


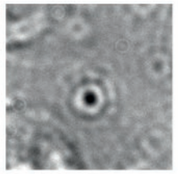
Figure 2*. Lectin biofunctionalization in encoded polysilicon materials and their adhesion to the zona pellucida of mice embryos. Bioconjugate Chemistry, 2012, 23, 2392-2402*

The goal of the **Optical Trapping Lab Group (BiOPT)** is to develop new optical tools allowing *in vivo* studies of molecular processes inside living cells. In particular, the group is interested in the activity of molecular motors, which so far have been widely studied *in vitro*. Experiments *in vivo*, however, are scarce due to the difficulty of measuring forces inside the cytoplasm of the cell.

The group hopes to contribute to bridging the gap by working in three directions: real-time manipulation of samples with holographic optical tweezers, development of compatible force measurement methods valid inside living cells, and high-speed tracking with nanometre accuracy for the detection of molecular motor steps.

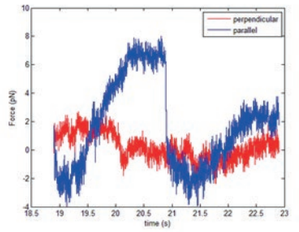


(a)

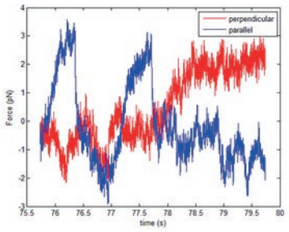


(b)

(a) General view of several A549 cells. (b) Motile optically dense vesicles (possibly lipid droplets) were easily observed and trapped in the cytoplasm of these cells.



(c)



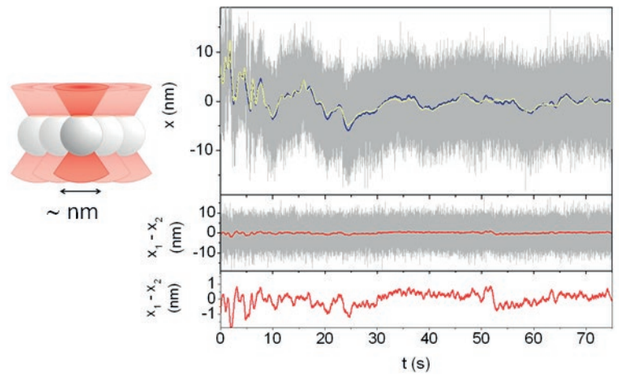
(d)

*Examples of stall force measurements in **(c)** the outward direction ("kinesins") and in **(d)** the inward direction ("dyneins").*

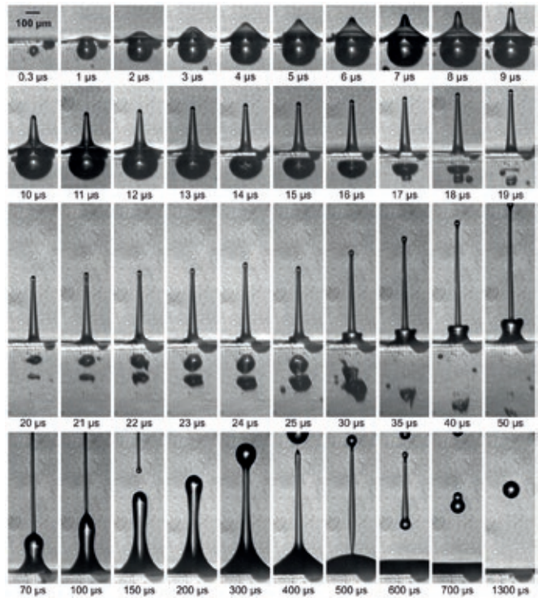
The spin-off *Impetux Optics SL* was created in mid-2012 to commercialize an apparatus to measure optical forces based on light momentum changes which, unlike other existing methods, is not constrained to certain shapes of the trapped particles or properties of the surrounding medium.
With this new technique, forces of hundreds of kinesin and myosin stall events inside A549 lung epithelial cells could successfully be detected and measured. Interestingly, the results differ from *in vitro* behaviour, as recently assessed by other groups.

The group has also developed a multiple-trap holographic system which makes dynamic, interactive optical manipulation of samples compatible with accurate force measurement and, additionally, provides nanometer long-term stability.

In collaboration with experts in Cell Biology, the group has studied how densely packed, artificially-induced organelles derived from the endoplasmic reticulum easily allow exerting large forces inside cells, compared with other probes such as native organelles or internalized synthetic beads.



Stability of the holographic "dumbbell": when generating two traps holographically, the drift of the system is common and is therefore essentially cancelled when computing the distance between two trapped beads (red: relative position; blue and yellow: individual positions). Sub-nanometer long-term stability is achieved with this system.



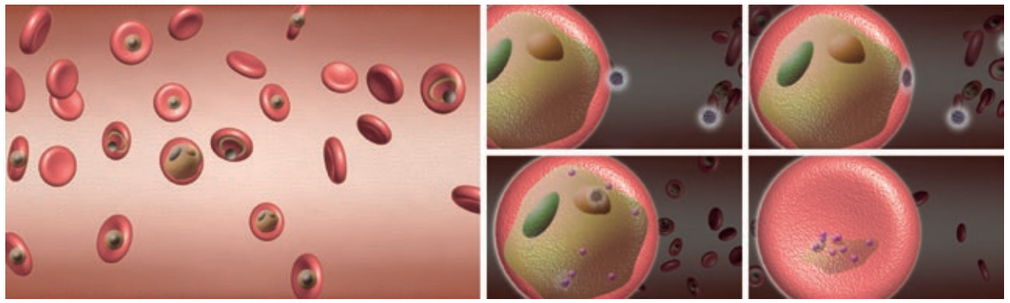
Jetting dynamics corresponding to liquid ejection during the laser microprinting of inks. The laser beam, which impinges from the top, is focused at a depth of 80 µm inside the liquid. Each frame displays the delay time after laser pulse impingement, and the acquisition time is 20 ns.

The research activity of the **Laser Processing Group** is focused on the study and development of laser microfabrication techniques. Along the 2012-13 period this research has been developed in the frame of three particular fields: laser scribing of transparent materials, laser microprinting of conductive lines, and the analysis of the laser microprinting through time-resolved microscopy.

Laser scribing: We have optimized the method developed during the last year to scribe lines of up to 2 mm length with submicrometric width.

Laser microprinting: We have investigated the performances of the technique for printing lines of conductive Ag inks with high-resolution for organic electronics applications. Several process parameters, like drop overlap or laser fluence have been analyzed systematically.

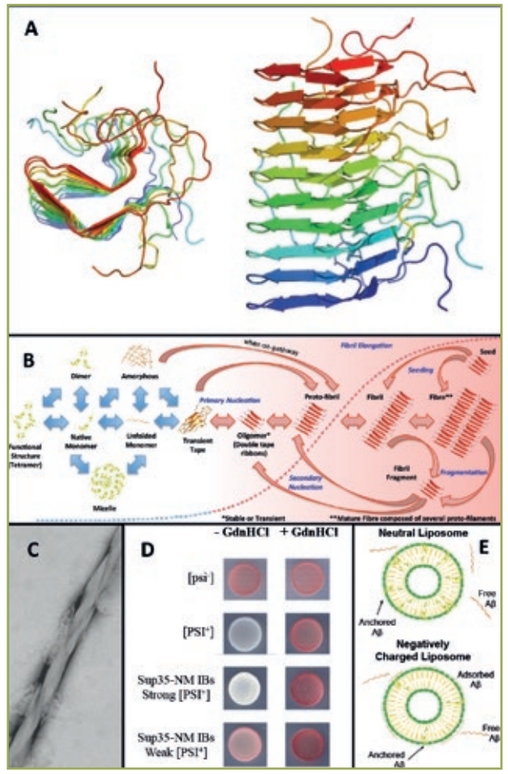
Time-resolved microscopy: The mechanism responsible for the microfluidics jetting dynamics characteristic of liquid ejection during laser microprinting has been unveiled.



*When added to Plasmodium-infected blood (left panel), drug-conjugated polymers (small panels, clockwise from upper left) **(i)** bind and **(ii)** enter parasitized erythrocytes, **(iii)** releasing drug that **(iv)** eliminates the pathogen.*

The current activity of the **Nanomalaria Group** is focused on the development of nanosystems addressed to establish new diagnostic, prophylactic, and therapeutic tools against infectious diseases of poverty, including strategies based on single-molecule force spectroscopy for the identification of new antimalarial and antibiotic agents and the design of nanovectors suitable for drug release against malaria and leishmaniasis. This includes the study of metabolic pathways present in the parasite causing malaria but absent in humans, with the aim of identifying specific enzymes as therapeutic targets, and the development of new targeting molecules based on DNA aptamers and glycosaminoglycans of marine origin. An objective of the group is the commitment to applying nanomedicine to diseases prevalent in developing regions.

The adhesion of heparin to Plasmodium-infected red blood cells (pRBCs) has been probed by single-molecule force spectroscopy, as a pioneering approach to quantitatively evaluating heparin-pRBC interactions at the individual molecule level.

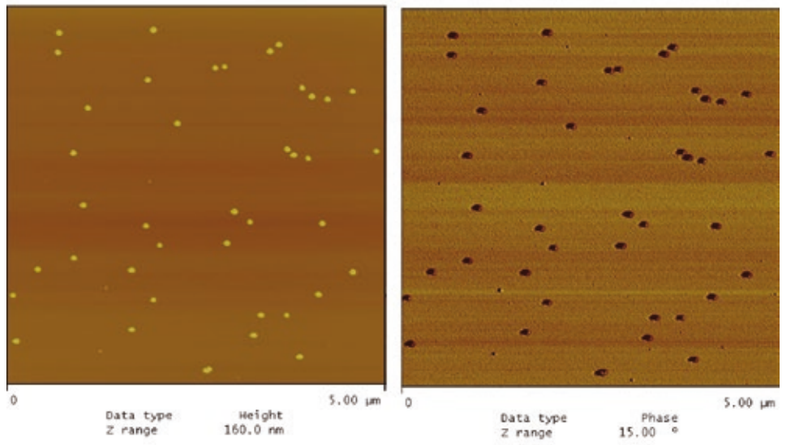


The **Conformational Diseases Group** has focused on the problems that may occur in the protein fold and which may result in misfolded species that can disturb the essential cellular processes. Protein misfolding entailing polypeptide aggregation into amyloid structures has been associated with dozens 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.

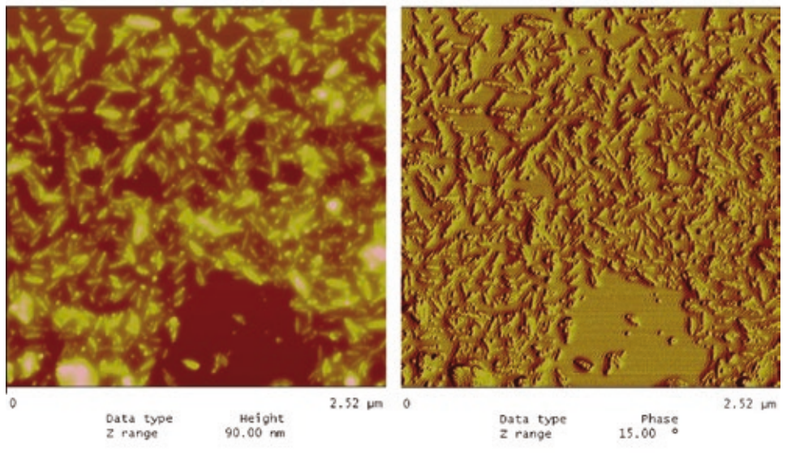
***a.** High resolution structure of HET-s prion forming domain in its fibrillar and infective conformation. **b.** Scheme of the amyloid aggregation process. **c.** Transmission electronic microscopy image of PrP prion protein. **d.** Sup35 prion protein infectivity. **e.** Membrane interaction of amyloid beta peptide.*

1.3. NANOPHARMACOTHERAPY

The **Drug Development within Nanostructured Systems** has been working with biocompatible polymeric meso/macroporous materials and nanoparticles, using highly-concentrated emulsions and nano-emulsions as templates. These nanosystems can be used as implants for controlled drug release. The group is currently exploring the development and characterization of crosslinked self-assembled nanostructures for the treatment of arthritic diseases and hepatic pathologies. The research group has also been working in the analysis of the mechanisms involved in the freeze-drying process of polymeric nanostructured systems, determining the collapse temperature by thermal analysis and freeze-drying microscopy. The incorporation of nanostructured lipid carriers to semisolid formulations for improve topical adhesion has also been studied.



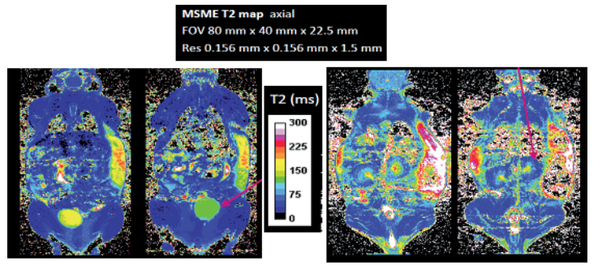
Atomic Force Microscopy images of polyurethane nanoparticles prepared in O/W nano-emulsions.



Atomic Force Microscopy images of streptavidine crystallization.

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. 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.

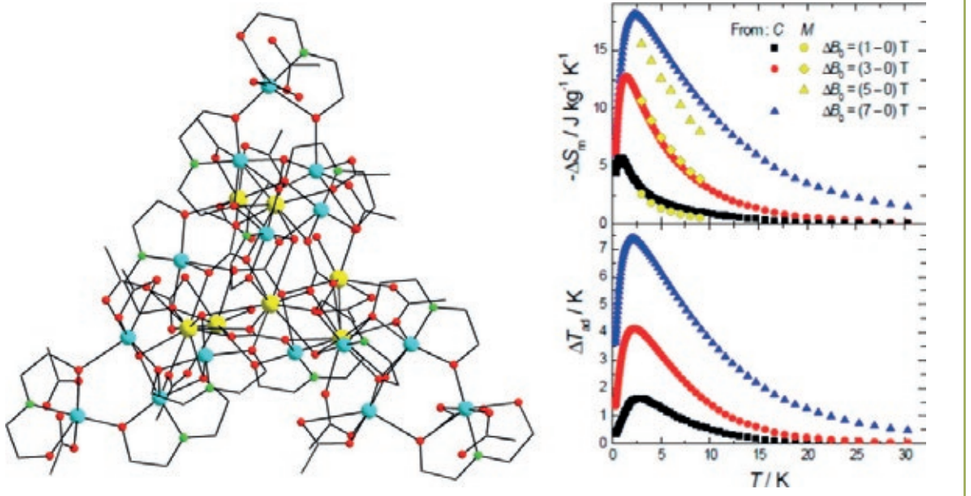
The work of the **Colloids Group** is mainly centered in preparing luminescent/magnetic liposomes for theranostic applications. As a function of the kind of encapsulated material, these magnetoliposomes can be used for therapeutic or diagnosis applications. In the first case, liposomes can encapsulate a drug and the particle can be directed to the interest site either by means of a ligand located into the external bilayer or focusing it under the action of a magnetic field. Moreover, if the size of the magnetic particle is the suitable, such particles can provoke the increase of temperature in neighboring tissues (thermal hyperthermia). As a diagnosis system, the particles can be used in Magnetic Resonance Imaging. On the other hand, if the bilayer contains a fluorescent probe, the interaction of the particles can be followed by fluorescent microscopy or flux cytometry. The Group is collaborating with members of the Departments of Physiology and Pharmacy and Pharmaceutical Technology of the Faculty of Pharmacy.



MRI images taken before (left) and after 20 min (right) of an intravenous injection of magnetoliposomes in mice. The magnetoliposomes are formed by a ferrofluid stabilized with polyethylene glycol. There is a drop of T2 value due to the metabolism and removal of the particles in liver, spleen, urinary bladder and kidneys.

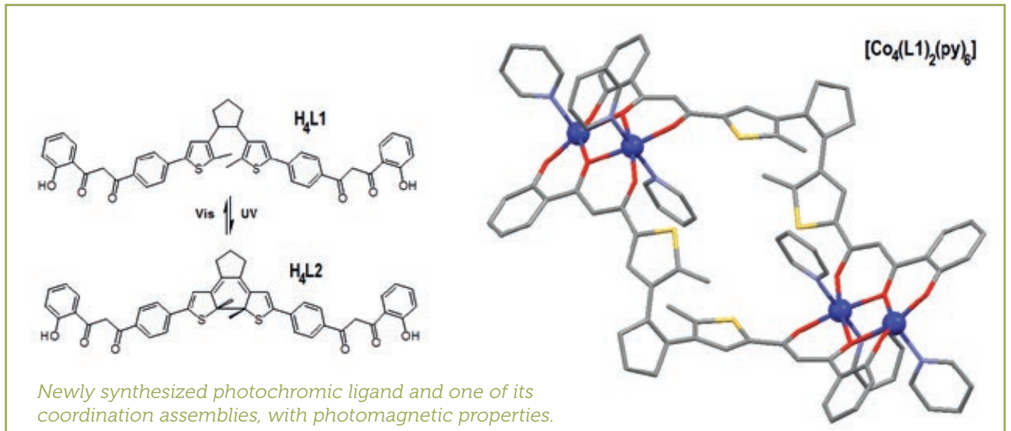
1.4. NANOMAGNETISM, NANOELECTRONICS AND NANOPHOTONICS

The main target of the **Molecular Magnetism Group** has been the design of discrete systems with high nuclearity or 1D compounds with single-molecule/chain magnet response (SMM/SCM) focusing on anisotropic cations as the NiII, MnIII, IV and lanthanides, with the aim to obtaining high nuclearity systems (nanomolecules) with a ground state of maximum spin multiplicity and high anisotropy. The bridging ligands which offered best results have been phosphonate and the polytopic pyridyl-oximates or pyridyl-alcoxo ligands, often combined with azido bridges. High spin and low anisotropic systems (as the plotted {Cu15Gd7} system), are also of our interest as magnetic refrigerants.

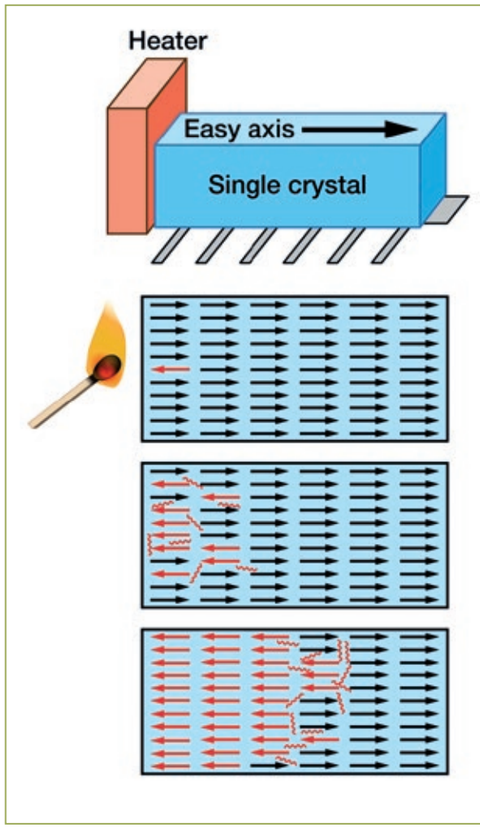


T dependencies of the magnetic entropy change as obtained from the heat capacity (C) and magnetization (M) data (top) and the adiabatic temperature change obtained from C data (bottom). Inorg. Chem. 52, 10235-10237, 2013.

The **Magnetism and Functional Molecules Group (GMMF)** has during the period 2012-2013 received funding from the European Union (ERC Starting Grant) and the Spanish Ministry (Plan Nacional). Some of the most relevant highlights for 2012-2013 are i) Advances on the study of cooperativity within Spin Crossover compounds (See Angew. Chem. Int. Ed. 2012, 51, 2142-2145; Chem., Eur. J. 2012, 18, 11703 – 11715; Inorg. Chem. 2013, 52, 7203–7209), ii) The preparation of design coordination clusters for Quatum computing (eg, Chem. Commun. 2012, 48, 14131415; Chem. Soc. Rev. 2012, 41, 537546, cover; Chem., Eur. J. 2013, 19, 5881–5891), iii) The preparation of multifunctional coordination complexes and nanostructuration (Chem. Eur. J. 2013, 19, 9064 – 9071; Chem. Eur. J. 2012, 18, 11545 – 11549), 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.

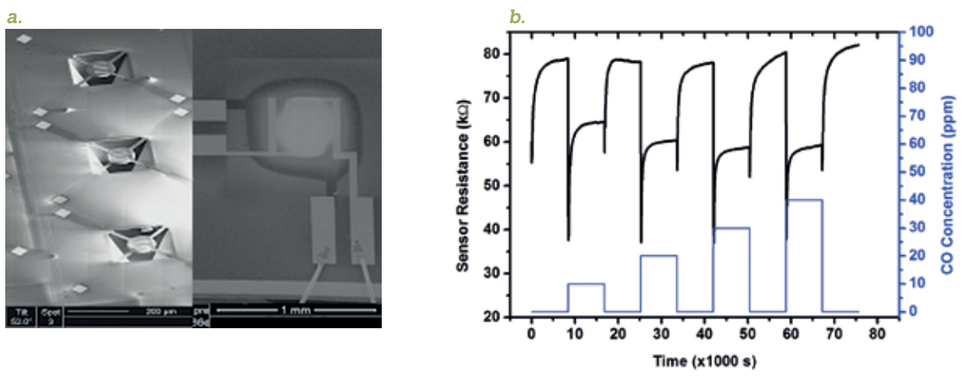


During the last year the **Grup de Magnetisme** has worked on the process of magnetic deflagration in different magnetic materials and has focused on associated phenomena. The work has lead to the conclusion that magnetic deflagration processes might be present in several magnetic systems during magnetic relaxation and its study might bring new insights to the understanding of spin dynamics [Phys. Rev. Lett. 110, 207203 (2013)]. The group has also proved recently that two-state systems may exhibit mechanical forces of pure quantum origin that have not counterpart in classical physics. These forces, for example, must exist in molecular magnets due to quantum tunnelling between classical degenerate magnetic states. The dynamics and excitation modes of the vortex state have been investigated considering an elastic vortex core line [arXiv:1308.4909 (cond-mat.mes-hall), submitted].

Top image: schematic of the setup developed for the detection of magnetic avalanches: a heater triggers the avalanche in a single Mn12-acetate crystal, and magnetic sensors monitor the propagation of the spin reversal front across the sample. Other images: schematic of the propagation of an avalanche in Mn12-acetate. [Phys. Rev. Lett. 110, 207203 (2013)]

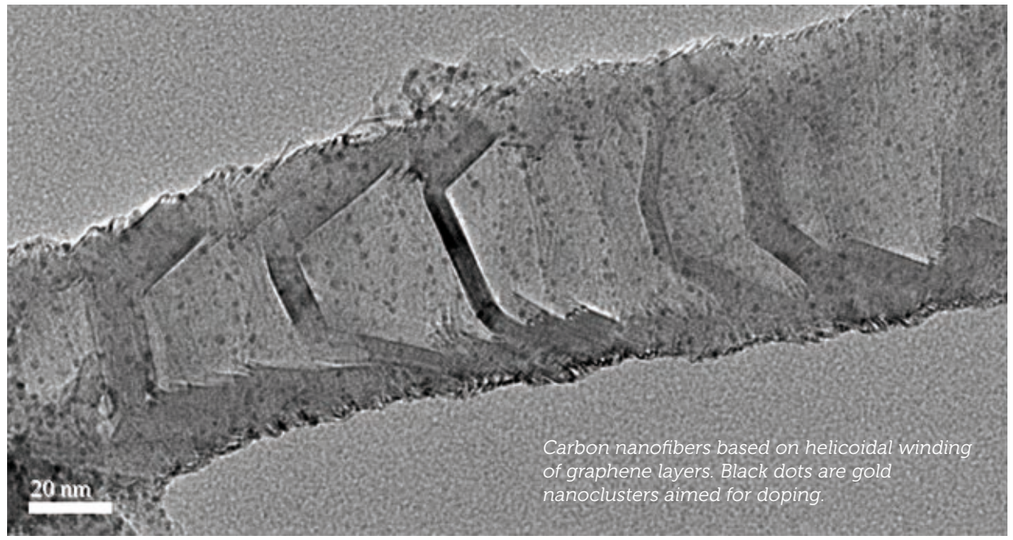
Research carried out by the **MIcro-nanoengineering and Nanoscopies for photonic and electronic Devices Group (MIND)** has been developed in different and complementary fields.

The **Nano and Microtechnologies Unit** is actively working in the developement of new and improved fabrication strategies of sensing electronic micro- and nanodevices, with a special focus on chemical sensors. In this frame, a main activity is the design and fabrication of innovative low power gas sensors based on individual nanowires (NWs), which can be operated with extremely reduced power supply and, thus, compatible with energy harvesting techniques. Additionally integration of nanowire-based gas sensing devices into micromembranes fabricated using microsystem technology in combination with in-situ growth of the nanowires is gaining interest due to the possibilities that this technology opens to integrate other materials with silicon technology.



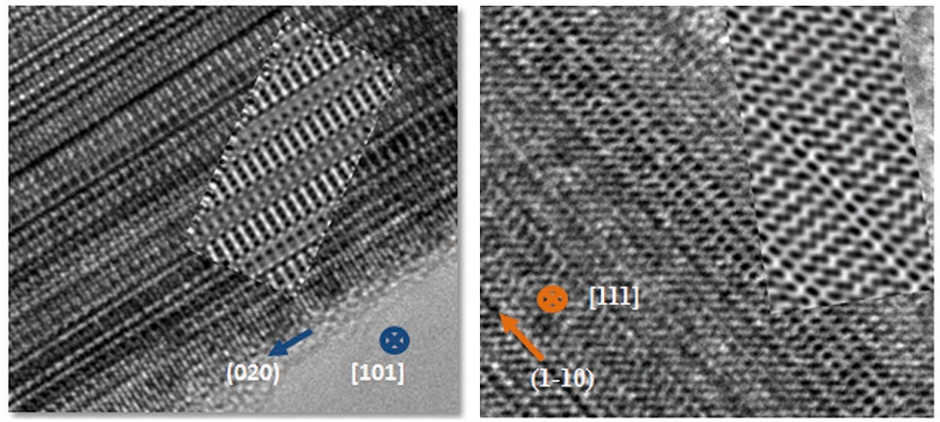
a. *Micromembranes on top of which Ge (on the left) and SnO2 NWs (on the right) have been grown by the VLS method. The central light part is the region with high crystalline quality NWs.* ***b.*** *Resistance variation of the device of the right part of figura a) in the presence of different concentrations of CO in synthetic air. Journal: Chemical Communications, Volume: 48 (4734 – 4736) Year: 2012*

As a part of the same group, the **Applied Nanoelectronics Unit** has focused its research on sensors, printed electronics and simulation. The development of sensors has continued, based on previous knowledge on monolithic ceramic technology for rigid devices in the framework of project Nanomat. Besides, flexible devices were developed for project Infinitex. Both approximations take advantage of the reactivity of certain nanostructures, like metal oxide nanofibers or carbon nanofibers -see figure-, as sensing materials. For the development of these sensors at the nanoscale, advanced inkjet printing technology was set-up. Such a development and deep knowledge on printed electronics allowed the unit to propose the use of inkjet for passive applications in different fiels (projects Thermprint and Trilobits) and for active applications. In fact new printed transistors based on graphene are expected in the next year. Finally, the unit has continued his strategy on simulation by the development of an advanced tool for first-principle compute of the transport of quantum dots.



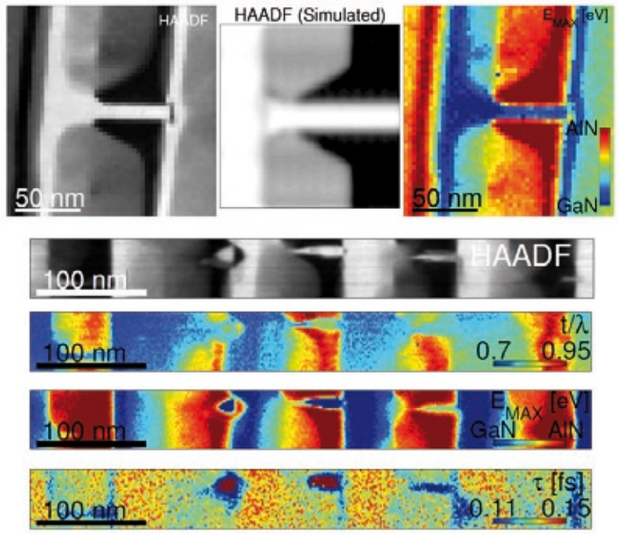
Carbon nanofibers based on helicoidal winding of graphene layers. Black dots are gold nanoclusters aimed for doping.

Also within the MIND group, the **LENS (Laboratory of Electron Nanoscopy)** team has been actively working in several lines. From the point of view of instrumentation development, the main focus has been the combination of advanced operational modes in Transmission Electron Microscopy. Starting with an innovative approach using electron Tomography and Electron beam precession in imaging mode, the combination Electron Energy Loss Spectroscopy with Electron Tomography and Electron Beam Precession (this latest mode giving rise to an international patent application 12160112.4-221) has extended the research field to advanced modes in analytical electron microscopy.

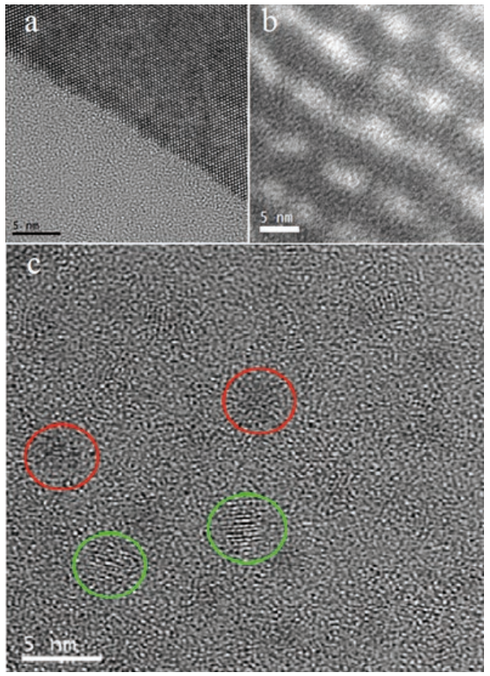


Experimental and simulated high resolution TEM images of Nb2O5 nanowires used as humidity sensors.

Mathematical protocols have also been developed to extract quantitative information from low loss EEL regime to retrieve significant properties of materials as chemical composition and dielectric function through plasmon analysis.



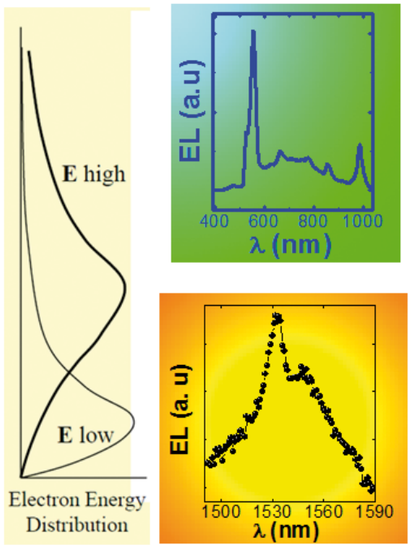
Chemical segrations in III-V nitrides heterostructures for optoelectronics, identified by plasmon analysis and image simulation: E_{max} is plasmon energy position, t/λ is foil thickness to mean free path ratio, and τ is the life time of the damped plasmon in the different materials.



From the point of view of materials science and technology, LENS has been collaborating in national and international contexts in structural and chemical sub-nanometer / atomic resolution characterization of materials and devices in the field of: **i)** tandem solar cells based in Si nanocrystals; **ii)** proton conducting materials for solid oxide fuel cells; **iii)** complex oxides core-shell magnetic nanoparticles for biomedical applications; **iv)** biferroic materials for spintronic applications; **v)** semiconducting nanowires for chemical sensors and **vi)** III-V nitrides for opto-electronic devices.

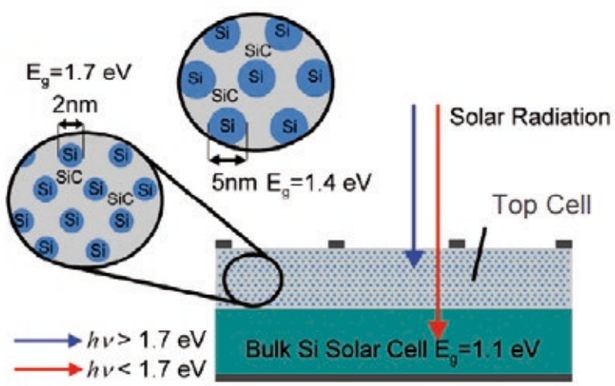
Si-nanocrystals for advanced tandem solar cells.

The **Electrophotonics Unit** of MIND is working on the IP EU project HELIOS: Photonics and Electronics Functional Integration on CMOS. Particularly, the unit has shown during this year a new type of integrated light emitters which can emit with high efficiency in the infrared and visible (see pictures). By a careful design and fabrication process, the integrated nanoLEDs have been coupled to a slot waveguide and to the exterior through a grating. Thus, the unit has been able to show that light in a Photonic Integrated Circuit (PIC) can be generated, distributed and coupled. The light is in the visible and infrared in devices with only few tens of nm. Er ions are coupled to Silicon nanocrystals in the active layers and are excited by the impact of hot electrons. A photon is emitted when they de-excite. So, these devices are of impact excitation type with a high V threshold.



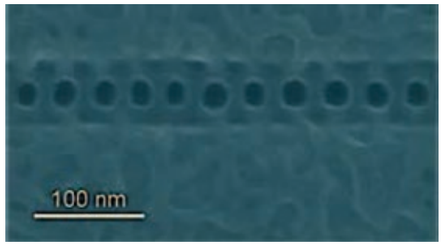
Electroluminescence spectra in the visible and infrared range.

Moreover, and in collaboration with other members of the MIND group, the Electrophotonics Unit has continued this year their successful work in the STREP EU Project NASCENT: Nanostructured Tandem Solar Cells. The objective is to fabricate a double solar cell in which the upper part is made up of thin nanocrystalline layers of Si and/or SiC. The size of the nanocrystals is controlled to the atomic scale and thus due to quantum confinement effects, the band gap absorption of the upper cell can be taylored following the needs. We have estimated that a band gap of 1.7 eV maximizes efficiency of the overall cell for a Si bulk solar cell down.

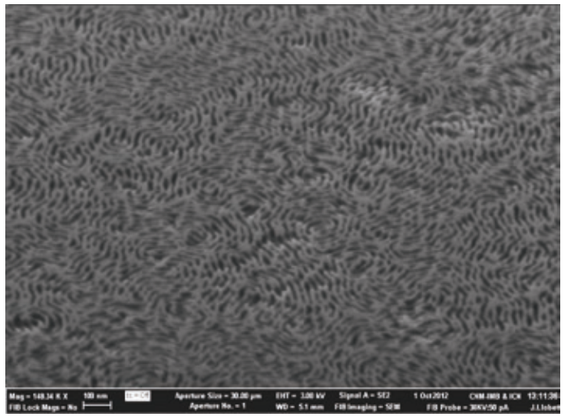


Section of a tandem soar cell with Si-nanocrystals.

Within the frame of the Nanoblock project, other researchers from the MIND group have explored the fabrication of higly ordered nanostructures for electronic and photonic nanodevices has been further developed using block-copolymer nanotechnology. By means of electron beam deposition, ion beam synthesis or reactive ion etching, the formation of organized nanoparticles and nanowires has been attained onto selected regions of submicrometric size, where the active area of the devices will be defined.



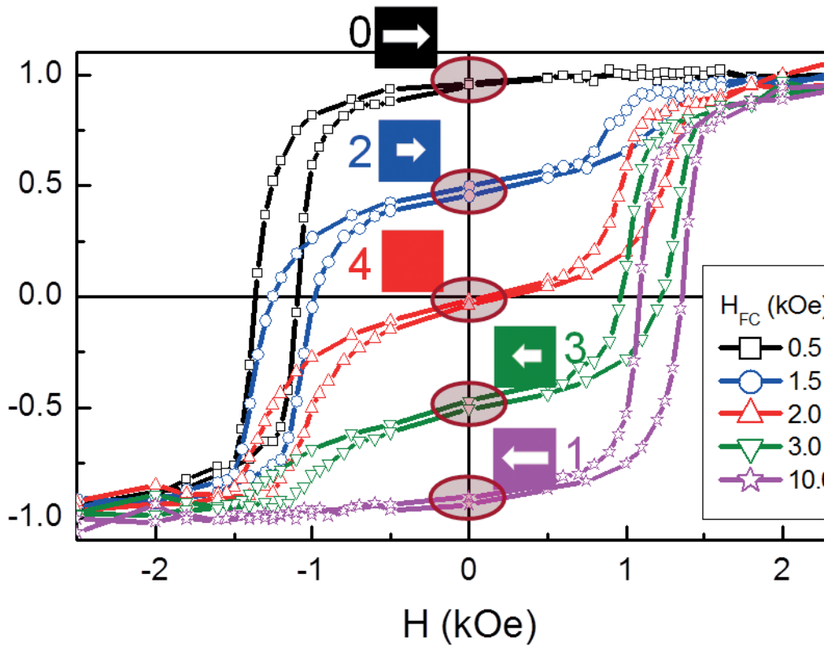
Silicon nanoparticles row deposited onto a nanotrench defined by means of graphoepitaxy.



Laminar silicon wires defined by reactive ion etching of 20 nm silicon layer patterned by means of a block-polymer etching mask.

The **Organic Materials Group** has been focusing on the study of a new family of organic molecules unprecedented in the literature, since they have magnetic properties despite the absence of both radical structures and metal atoms. It is remarkable that these systems maintain their magnetic order, at least, between 4 K, and room temperature. Sixteen new molecules were synthesized, designed with the aim of improving the properties of the first molecules discovered by the group. Of these materials, we studied their birradical character and magnetic behaviour, and we conducted a thorough computational study of its structure. As a result, the group has proposed a general structure for the design of birradical molecules with magnetic properties. The group is also preparing polymeric and dendrimer-structured derivatives of these molecules.

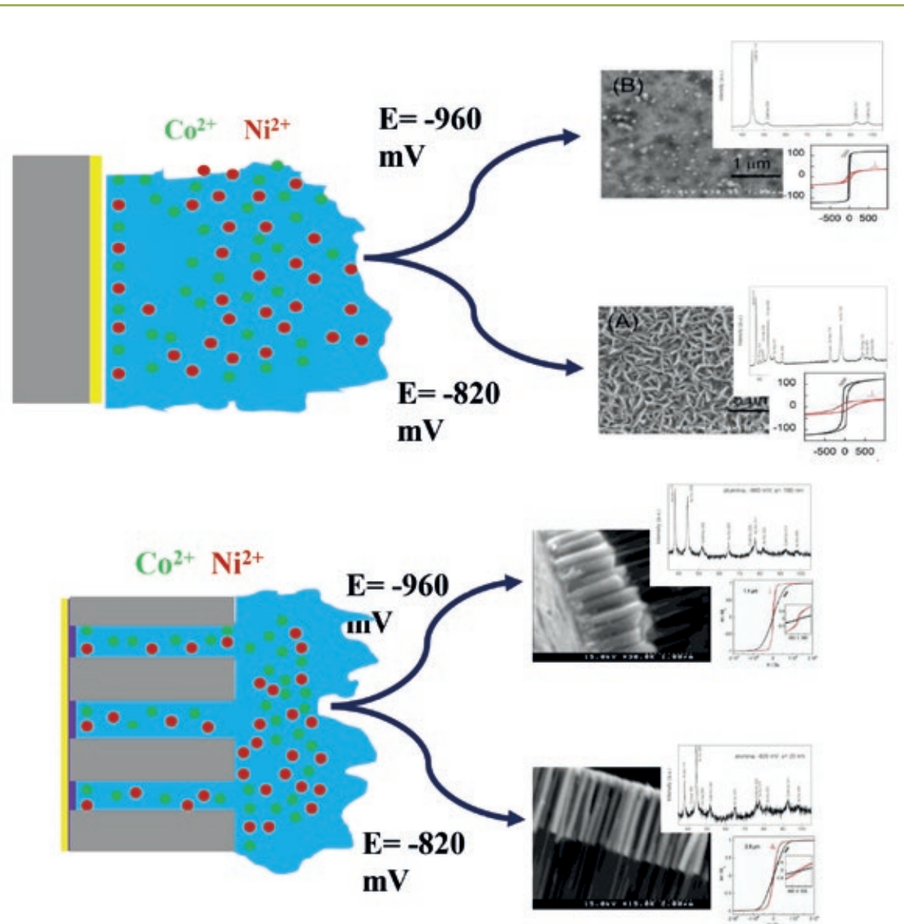
The **Magnetic Nanomaterials Group** has studied during the past months Magnetic Nanostructures for Multidigit Storage and Non-Binary logics. The ever-increasing demand of storage capacity in electronic devices, as hard drives and non-volatile solid state memories, has pushed the bit feature size to critical limits that compromise the miniaturization of binary unit cells of electronic products. In order to overcome these restrictions and increase the storage capacity, more capable mechanisms holding information in multistate digital elements (multidigits) have been considered. Achieving multidigit storage is still a great challenge and different multistate switching techniques are currently been explored for the next-generation of high density storage media. We have described a novel approach to define multistate switching memory units based on magnetic nanostructures exhibiting the so-called exchange bias phenomenon. Writing and reading conditions were studied in patterned antiferromagnetic/ferromagnetic thin films. We have established the necessary and sufficient requirements for this multidigit memory concept that opens up new possibilities for the exploration and design of suitable room temperature spintronic devices and for multistate logics, beyond conventional binary logics.



Setting multiple remanence states. Hysteresis loops for FeF2 (70 nm)/Ni (20nm)/Al (4 nm) at five different cooling fields. Remanence states define five digits corresponding to the sketched magnitude and direction of magnetization. Accepted in APL.

1.5. NANOSTRUCTURED MATERIALS

The Thin-film and **Nanostructures Electrodeposition Group** is working in the last times in the development, 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 nanowires and nanotubes of cobalt and platinum alloys, with controllable magnetic properties and potential application in fuel cells. Also, we are working in the use of ionic liquids of new generation for electrodepositing determined alloys and adsorbed monolayers for the definition of new shaped structures or intercalation between magnetic thin films.

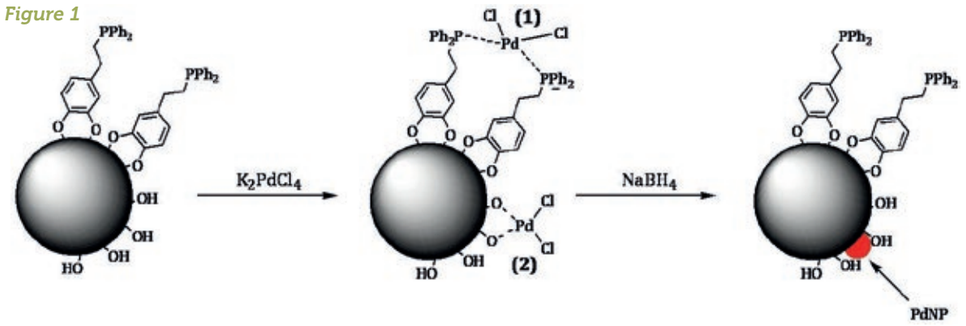


Growth of films and nanowires of CoNi by electrochemical methods. Control of crystalline structure and composition as a function of the applied potential J. Vilana, E. Gómez, E. Vallés, J. Electroanal. Chem. 703 (2013) 88-96

The activity of the **Homogeneous Catalysis Group** in the area of nanoscience is focused on the development of new systems based on nanoparticles (NPs) of two types: metallic nanoparticles whose surface has been functionalised with ligands and Fe_3O_4 nanoparticles containing several metals such as Pd, Rh or Au deposited on their surface.

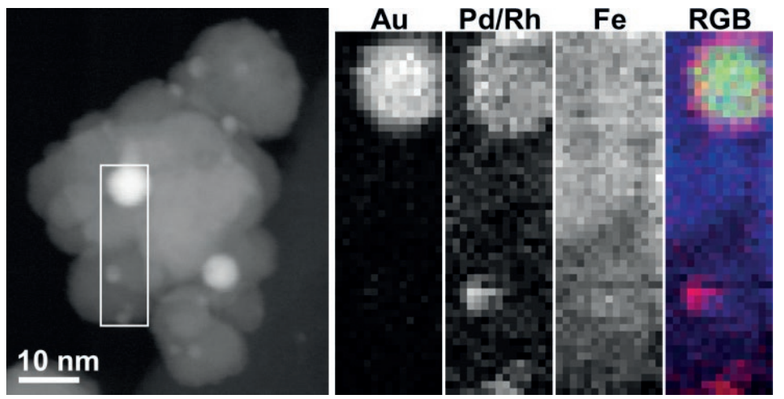
The aim is the exploration of the potential of these NPs as reusable catalysts to be used in sequential reactions like Suzuki C-C cross-coupling reactions or hydrogenation. An example of the synthetic methodology used to prepare such systems is depicted in the Figure 1.

Figure 1



The formation of Fe_3O_4dopPPh$_2$Pd is accomplished in two steps, namely the coordination of K_2PdCl_4 to phosphine ligands or hydroxyl groups on the surface followed by the reduction of palladium with $NaBH_4$ to form the PdNPs. In this way is possible to load the Fe_3O_4 particle with different metals as shown in Figure 2. Chem. Eur. J., 2013, 19, 11963 – 11974.

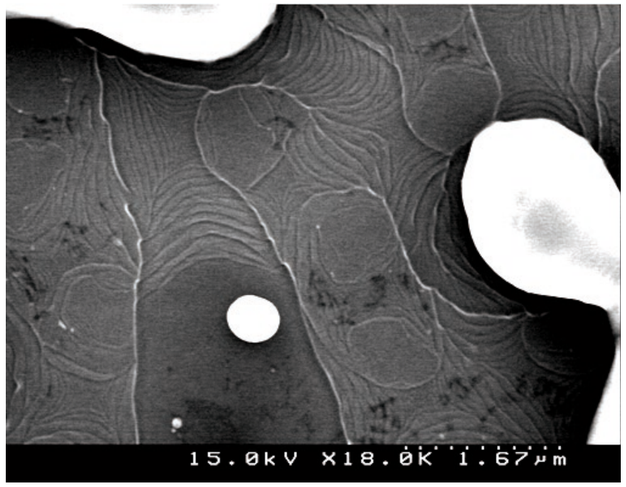
Figure 2



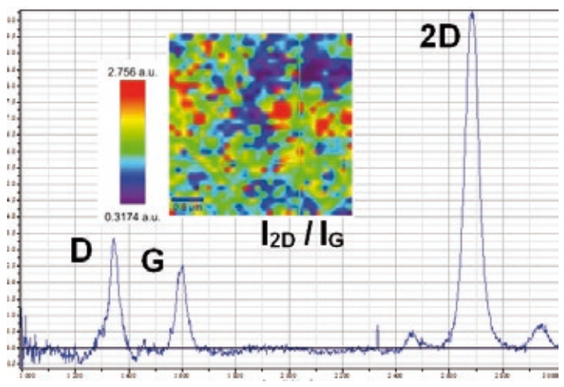
HAADF-STEM image of Fe_3O_4dopPPh$_2$@Pd/Au/Rh and elemental maps calculated from the EDX image obtained from the area outlined with a white rectangle. The RGB map is generated using red for Pd/Rh, green for Au, and blue for Fe. Chem. Eur. J., 2013, 19, 11963 – 11974.

The **Physics and Engineering of Nanostructured and Amorphous Materials Group (FEMAN)** has obtained evidences of graphene of very few layers at relatively large area, deposited by a new modified CVD method (project BIOGRAPH). The results of development of new materials have been reported in two doctoral thesis entitled: "Production and characterisation of Fe@Cnanoparticles obtained by arc-discharge plasma" by Noemí Aguiló-Aguayo and "Producción de nanopartículas de si monodispersas obtenidas mediante plasma modulado" by María José Inestrosa Izurieta, both resulting from the projects NANOBIOMED and NANOTRAPPING respectively.

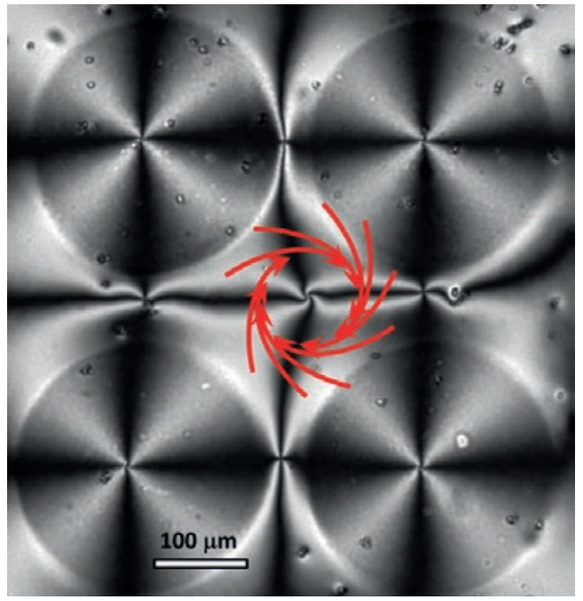
Further studies have been done on the possible applications of carbon nanotubes in the energy field (supercapacitors) and in the field of environment concerning the extremely high-surface nanostructured materials aimed at trapping specific pollutants.



Polycrystalline domains of few layer graphene deposited on a Cu/c-Si substrate produced by a modified CVD process at 900ºC.



MicroRaman shift spectrum corresponding to a monolayer graphene deposited on Cu/c-Si. The colored map corresponds to the I_{2D}/I_G distribution ratio in a region of 10 μm_2.



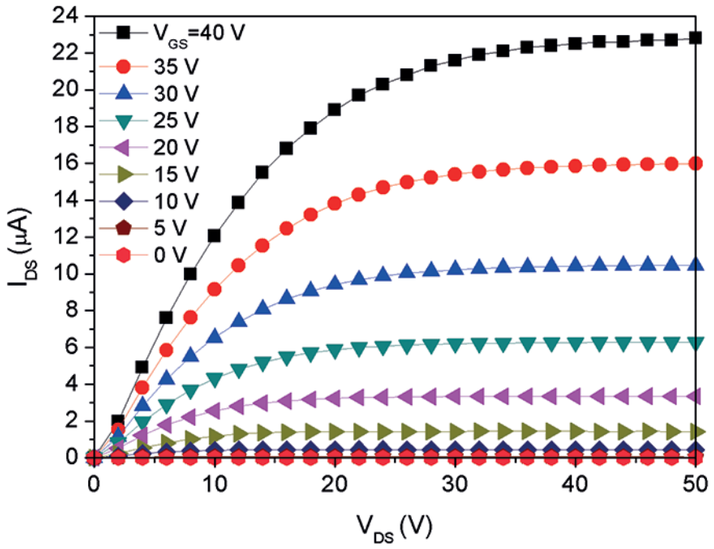
Polarizing microscopy image showing a liquid crystal cells patterned by means of a photosensitive surface. A low-frequency alternating field drives the dynamic self-assembly of anisometric colloidal particles around the central node through the non-linear electrophoretic effect.

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 monomolecular films of biomolecules. Within the context of the latter type of systems, we have demonstrated the coupling of chiral influences of chemical and physical origin in the determination of the chirality in self-assembled supramolecular aggregates, both when the chemical dopant is embedded in the surfactant monolayer and when it is dissolved in the supporting subphase. We have continued with the study of surfactant monolayer flow in constrained geometries, demonstrating the spontaneous development of structured backflow patterns in the aqueous subphase induced by surface tension gradients.

A significant part of our work has been devoted in studying 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 drive ensembles of microparticles by using non-linear electrophoresis mediated by a liquid crystal medium as driving force, and electric field or light-induced control of the local mesogen orientational field as the inclusion steering control.

1.6. NANOENERGY: PRODUCTION, STORAGE AND ENVIRONMENT

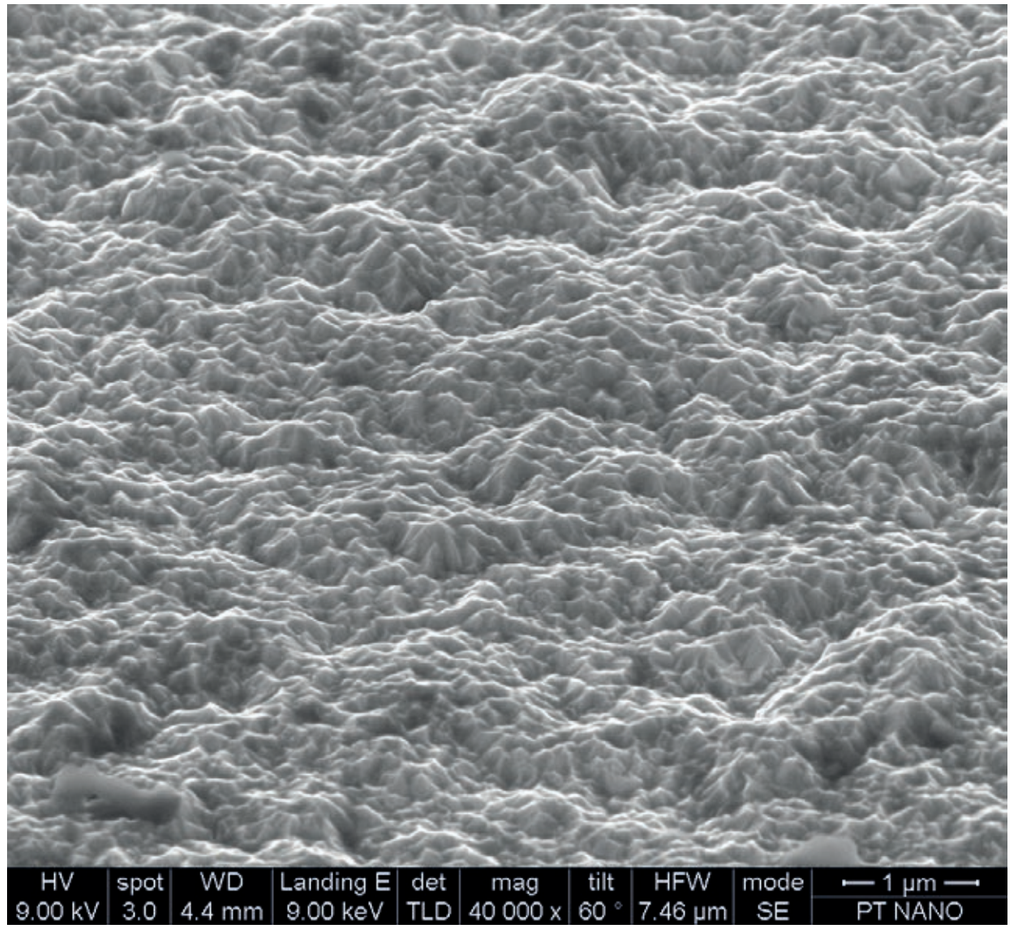
The **Electronic Materials and Energy Group (M-2E)** has made progress in the manufacturing of transparent and flexible TFTs by inkjet, by using metal oxides as semiconductor electrodes. Several tin-oxide-based compositions with various additives were tested, verifying polarity, quality and continuity of the layers, transparency, morphology, compatibility with previously developed materials and their electrical characteristics. The group is currently studying an optimal method to develop an entirely transparent and flexible electronics.



Ouput characteristics of transparent Ga-In:SnO2 thin-film transistor (TFT) made by sol-gel and inkjet processing.

The **Catalytic Materials Group (MATCAT)** is currently working on the development and design of new materials with catalytic properties for use in processes of reformation of bioalcohols which may be applied to an alternative production of hydrogen and to the chemical recycling of CO_2, by means of their conversion into higher alcohols. The materials are fabricated following different methods, and their structural and physico-chemical characteristics are related to their catalytic behaviour in the aforementioned processes, among others.

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.

General Activity Report

- During the 2012-2013 academic year, 13 new students have enrolled (first year). The total number of students enrolled in the programme at present is 68. The PhD program in Nanoscience began during the 2007-2008 academic year and from then until October 2013, a number of 4 doctoral theses have been defended. The theses defended between November 1st 2012 and October 31st 2013 are the following:

  - **Producción de nanopartículas de Si monodispersas obtenidas mediante plasma modulado**
    Author: María José Inestrosa Izurieta. Supervisor: Enric Bertran Serra.

  - **Production and Characterisation of Carbon-encapsulated Iron Nanoparticles by Arc-discharge Plasma**
    Author: Noemí Aguiló Aguayo. Supervisor: Enric Bertran Serra.

  - **Nanoscale Structural and Mechanical Properties of Lipid Bilayers in Air Environment.**
    Author: Aurora Dols Pérez. Supervisor: Gabriel Gomila Lluch.

  - **Self-assembled Monolayers and Patterned surfaces derived from them as templates for the Growth of Chiral Crystals.**
    Author: Ángela Bejarano Villafuerte. Supervisor: David A. Amabilino.

- As far as doctoral studies are concerned, it is worth to highlight the fact that the coordinator of the the PhD program in Nanoscience, Prof. Albert Cirera, has impulsed the creation of an Industrial PhD program in **Materials, Nanotechnology and Industrial Processes**. This program has been launched in association with five other Catalan universities (UAB, UPC, URV, UdG, UVic), and several research centres (ICMAB, CSIC, IREC, CIN2, IN²UB), and is the result of an initiative of the Generalitat of Catalonia. Industrial PhD programs enable students/researchers to develop their training in collaboration with a university, but working 50% of the time at the industry. PhD program in **Materials, Nanotechnology and Industrial Processes** was presented at Hotel Alimara on June 19th 2013.
  For further details on both these Programs, please visit the site:
  http://www.ub.edu/in2ub/doctorat_nanociencia

- Falling into the academic year 2012-2013, the IN²UB celebrated the fifth edition of its scientific meeting on November 15th 2012. 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 25 posters presented by young researchers and to attend ten lectures offered by a plenary speaker (Ilya Reviakine, CIC BiomaGUNE, San Sebastián) and members of both the IN²UB and the CCiTUB (Centres Científics i Tecnològics de la Universitat de Barcelona)

- 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. On the other hand, the SECPHO fourth yearly meeting is expected to take place by the end of 2013.
  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. After the official presentation in July 2012 of the ICM 2015 organising committee amongst attendants at the Busan XIXth ICM edition, the local and the steering committees have met in Barcelona (May 16th and June 25th, respectively), in order to further define important tasks and benchmarks. For further details about the ICM2015, please check **http://www.icm2015.org/index.html**

- In addition, the IN²UB has cofunded and given support to the following conferences and workshops:
  - The MAGNIFYCO European Project Final International WORKSHOP (February 19th-22nd 2013). The final workshop of this project, focused on the assembly and fabrication of a new generation of multifunctional nanostructures aimed at the achievement of combined hyperthermia and controlled drug release, specifically targeted to cancer cells, was held at the premises of the University of Barcelona and welcomed about 160 researchers from different international research centers and universities. During the workshops, attendants could listen to 38 oral presetations. Moreover, 32 scientific posters were presented. The fact that the MAGNIFYCO final workshop was held at the University of Barcelona gave a number of researchers working in this field and others related, as well as the students enroled both in the Master in Nanociences and Nanotechnology and the Nanoscience PhD program of this university the opportunity to attend the talks. For further details about the MAGNIFYCO European Project, please check **http://www.magnifyco.eu**

  - The 15th International Conference on Transport in Interacting Disordered Systems (TIDS15). The TIDS Conference has as a main scope systems lacking translational symmetry. In such systems, interactions are often important, and dramatic differences in the behavior of crystalline solids and the “disordered” systems can occur. Some examples of the latter are amorphous materials, polymer aggregates, materials whose properties are governed by impurities, and biological systems. Specific topics of this edition have been hopping transport, electron glasses and relation to other glassy systems, Anderson localization and many-body localization, quantum glasses, metal-insulator and superconductor-insulator transitions, transport in nanoparticle assemblies, disorder and interaction in cold atoms, topological insulators, and transport in biological systems.

Attendance was of about 70 delegates; more than 40 talks were offered and about 20 posters presented. The conference was sponsored by the European Physical Society, as well as by the University of Barcelona and the IN²UB, and resulted in a fruitful exchange of ideas between theorists and experimentalists in these areas. For further information about this successful event, please check **http://www.ub.edu/tids15**

  - The 1st International Symposium on Functional Metal Complexes that Bind to Biomolecules (second Whole Action Meeting of the COST Action CM1105) was held on September 9-10th in Barcelona. Amongst the five different working groups taking part in this cooperative initiative, about 75 talks were offered, along with some round tables and a poster session where 42 posters were presented. For further details about this event, please check **http://www.cm1105.eu/index.php?title=WHAMs**

- During the academic year 2012-2013, several research groups of the IN²UB have generously organized seminars and talks of general interest to the IN²UB community:

  - **How Mechanical Forces are Generated by Actin Polimerization?**, by Jean Baudry (**Laboratoire de colloïdes et matériaux divisés, ESPCI ParisTech, France**). January 25th, 2013.

  - **The fd virus and its mutants as model system of colloidal rod with tunable features: structure and dynamics of its self-organization into liquid-crystalline phases**, by Eric Grelet (**Centre de Recherche Paul-Pascal, CNRS - Université de Bordeaux, Pessac, France**). February 15th, 2013.

  - **Multiprobe Characterization of Coexisting Superconducting and Magnetic Order in Ba (FE, Ni) 2As2**, by Yasutomo Uemura (**Columbia University**). July, 10th, 2013.

  - **Topological Objects in Magnets and Superconductors**, by Eugene Chudnovsky (**Columbia University, New York**), July 11th, 2013.

  - **Random Fields in Magnets and Superconductors**, by Eugene Chudnovsky (**Columbia University, New York**), July 15th, 2013.

  - **Generating Terahertz Electromagnetic Wave Based on Supercondictitvity**, by Xiao Hu (International Center for Materials Nanoarchitectonics (**WPI-MANA; National Institute for Materials Science, Tsukuba, Japan**), September 13th, 2013.

  - **Magneto-optical Analysis of Magnetic Microstructures**, by Rudolf Schäfer (**Leibniz Institute for Solid State and Materials Research (IFW) Dresden, Germany**; IEEE Distinguished Lecturer 2013), September 18th, 2013.

- It is also worth mentioning that the IN²UB has cofunded the expenses derived from installation and maintenance of the lithography and nanofabrication system **FEI Strata Dual Beam FIB**, an equipment which was formerly part of the PCB Nanotechnology Platform and that is now located at the Clean Room of the Faculty of Physics, under the administrative management of CCiTUB. By September 2013, the IN²UB has already contributed to this cofunding action with € 15,000.00, and it is expected to contribute with a further amount of € 3,000.00 before the end of the current year. This equipment allows to operate several advanced nanolithography modes, and is one of the best available systems for the production of TEM-suitable slabs. The equipment is of great interest to a large number of IN²UB reseachers, and its transfer to its new location will make it more accessible to all researchers at the University of Barcelona.

appendix 1 List of Projects Funded

appendix

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

Principal Investigator: MANUEL BARRANCO GOMEZ (Estructura i Constituents de la Matèria) **Title:** **Física Nuclear Teòrica i de Moltes Partícules en Interacció.** **Reference:** 2009SGR1289 **Institution:** Universitat de Barcelona

Principal Investigator: RICARDO MAYOL SANCHEZ (Estructura i Constituents de la Matèria) **Title:** **Research topics in the structure and dynamics of atomic, nuclear and electronic systems** **Reference:** FIS2011-28617-C02-01 **Institution:** Universitat de Barcelona

Principal Investigator: JOSÉ IGNACIO LATORRE SENTIS (Estructura i Constituents de la Matèria) **Title:** **Información Cuántica: entrelazamiento, redes de tensores y gases fríos** **Reference:** FIS2010-16185 **Institution:** Universitat de Barcelona

Principal Investigator: ANTONI PLANES VILA (Estructura i Constituents de la Matèria) **Title:** **Materials: Transicions de Fase Estructurals i Magnètiques** **Reference:** 2009SGR893 **Institution:** Universitat de Barcelona

Principal Investigator: EDUARD VIVES SANTA-EULALIA (Estructura i Constituents de la Matèria) **Title:** **Relación entre propiedades ferroicas en materiales con características multifuncionales** **Reference:** MAT2010-15114 **Institution:** Universitat de Barcelona

Principal Investigator: LLUIS MAÑOSA CARRERA (Estructura i Constituents de la Matèria) **Title:** **Materiales Calóricos Gigantes para aprovechamiento de energía y refrigeración sostenible** **Reference:** PRI-PIBIN-2011-0780 **Institution:** Universitat de Barcelona

Principal Investigator: JOSE MIGUEL RUBI CAPACETI (Física Fonamental) **Title:** Física Estadística **Reference:** 2009SGR634 **Institution:** Universitat de Barcelona

Principal Investigator: JOSE MIGUEL RUBI CAPACETI (Física Fonamental) **Title:** **Formación, transporte y energética en sistemas multidisciplinares en la mesoescala** **Reference:** FIS2011-22603 **Institution:** Universitat de Barcelona

Principal Investigator: IGNACIO PAGONABARRAGA MORA (Física Fonamental) **Title:** **Pulsatile Viscus and Viscoelastic Micrfluidics (MICROPULSATILE)** **Reference:** PIEF-GA-2011-301214 **Institution:** Universitat de Barcelona

Principal Investigator: IGNACIO PAGONABARRAGA MORA (Física Fonamental) **Title:** **Physics of Complex Colloids: Equilibrium and Driven (COMPLOIDS)** **Reference:** 234810 **Institution:** Universitat de Barcelona

Principal Investigator: M. DEL CARMEN MIGUEL LOPEZ (Física Fonamental) **Title:** **Robustez, adaptabilidad y fallos en materiales complejos y redes socio-tecnológicas** **Reference:** FIS2010-21781-C02-02 **Institution:** Universitat de Barcelona

Principal Investigator: GIANCARLO FRANZESE (Física Fonamental) **Title:** **Dinámica y Termodinàmica del Agua Nano-Confinada e Interfacial** **Reference:** FIS2009-10210 **Institution:** Universitat de Barcelona

Principal Investigator: GIANCARLO FRANZESE (Física Fonamental) **Title:** **Interacciones entre sistemas nanoscópicos y macromoléculas biológicas en presencia de agua** **Reference:** FIS2012-31025 **Institution:** Universitat de Barcelona

Principal Investigator: GIANCARLO FRANZESE (Física Fonamental) **Title:** **Modelling basis and kinetics of nanoparticle interaction with membranes, uptake into cells, and sub-cellular and inter-compartmental transport (NanoTrans**Kinetics). **Reference:** NMP4-SL-2011-266737 **Institution:** Universitat de Barcelona

Principal Investigator: JORDI ORTIN RULL (Estructura i Constituents de la Matèria) **Title:** FÍSICA NO LINEAL **Reference:** 2009SGR14 **Institution:** Universitat de Barcelona

Principal Investigator: JOSE MARIA SANCHO HERRERO (Estructura i Constituents de la Matèria) **Title:** Dinámica no lineal y estocástica en sistemas físicos y biofísicos **Reference:** FIS2009-

NANOBIOTECHNOLOGY

13360-C03-01 **Institution:** Universitat de Barcelona

Principal Investigator: JAUME CASADEMUNT VIADER (Estructura i Constituents de la Matèria) **Title:** **Auto-organización en materiales blandos y materia viva: II) Fluidos complejos, Células y Tejidos** **Reference:** FIS2010-21924-C02-02 **Institution:** Universitat de Barcelona

Principal Investigator: AURORA HERNANDEZ MACHADO (Estructura i Constituents de la Matèria) **Title:** **Dinámica interfacial en fluidos y sistemas biofísicos: Teoría y experimentos** **Reference:** FIS2009-12964-C05-02 **Institution:** Universitat de Barcelona

Principal Investigator: FCO.I.JAVIER PASTOR BLASCO (Microbiologia) **Title:** **Grup de Biodegradació de Xenobiòtics i Productes Naturals: aspects bàsics i aplicacions a tecnologies netes** **Reference:** 2009SGR819 **Institution:** Universitat de Barcelona

Principal Investigator: FCO.I.JAVIER PASTOR BLASCO (Microbiologia) **Title:** **Enzimas para la valorización y mejora biotecnológica de las fibras de celulosa** **Reference:** CTQ2010-20238-C03-02 **Institution:** Universitat de Barcelona

Principal Investigator: M. PILAR DIAZ LUCEA (Microbiologia) **Title:** **Tecnologías enzimáticas pra la producción de biomateriales de nueva generación: Biocatálisis mediada por lipasas** **Reference:** CTQ2010-21183-C02-02 **Institution:** Universitat de Barcelona

Principal Investigator: RAMON FARRE VENTURA (Ciències Fisiològiques I) **Title:** **Efecto de los estímulos mecánicos en la diferenciación de células madre hacia el fenotipo epitelial alveolar** **Reference:** SAF2008-02991 **Institution:** Universitat de Barcelona

Principal Investigator: DANIEL NAVAJAS NAVARRO (Ciències Fisiològiques I) **Title:** **Alteración de la nanomecánica de los neutrófilos en la lesión pulmonar inducida por el ventilador** **Reference:** PI081908 **Institution:** Universitat de Barcelona

Principal Investigator: DANIEL NAVAJAS NAVARRO (Ciències Fisiològiques I) **Title:** **Señalización mecánica en la diferenciación de células madre en el pulmón. Modelo pulmón-en-un-chip** **Reference:** PI11/00089 **Institution:** IBEC

Principal Investigator: RAMON FARRE VENTURA (Ciències Fisiològiques I) **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:** Universitat de Barcelona

Principal Investigator: DANIEL NAVAJAS NAVARRO (Ciències Fisiològiques I) **Title:** **Mechanical pathways in cells: from molecular mechanisms to cell function (MecPath)** **Reference:** PCIG10-GA-2011-303848 **Institution:** Universitat de Barcelona

Principal Investigator: GUSTAVO EGEA GURI (Biologia Cel.lular i Anatomia Patològica) **Title:** **Tràfic intracel·lular i dinàmica del citoesquelet** **Reference:** 2009SGR1070 **Institution:** Universitat de Barcelona

Principal Investigator: GUSTAVO EGEA GURI (Biologia Cel·lular,Immunologia i Neurociències) **Title:** **El citoesqueleto de actina y la homeostasis del diacilglicerol en la organización del aparato de Golgi** **Reference:** BFU2009-07186 **Institution:** Universitat de Barcelona

Principal Investigator: GUSTAVO EGEA GURI (Biologia Cel·lular, Immunologia i Neurociències) **Title:** **Membrane trafficking of TGF-b receptors in Marfan cell lines: a new strategy to handle the TGF-b-induced signaling** **Reference:** PJ009801 **Institution:** Universitat de Barcelona

Principal Investigator: FELIX RITORT FARRAN (Física Fonamental) **Title:** **Física de biomoléculas i sistemes petits (Small Biosystems Lab)** **Reference:** 2009SGR271 **Institution:** Universitat de Barcelona

Principal Investigator: FELIX RITORT FARRAN (Física Fonamental) **Title:** **High-resolution tweezers for DNA replication and sequence identification (MagRepS)** **EU Reference:** 267862 **Institution:** Universitat de Barcelona

Principal Investigator: FELIX RITORT FARRAN (Física Fonamental) **Title:** **Cinética de unzipping en móleculas individuales de ácidos nucleicos y la actividad enzimática de motores moleculares que se desplazan sobre ellos** **Reference:** FIS2010-19342 **Institution:** Universitat de Barcelona

Principal Investigator: FRANCISCO VILADOMAT MEYA (Productes Naturals, Biologia Vegetal i Edafologia) **Title:** **Grup de Productes Naturals** **Reference:** 2009SGR1060 **Institution:** Universitat de Barcelona

Principal Investigator: ANTONIO FERNANDEZ TIBURCIO (Productes Naturals, Biologia Vegetal i Edafologia) **Title:** **Amino oxidasas y expresión génica** **Reference:** BIO2008-05493-C02-01 **Institution:** Universitat de Barcelona

Principal Investigator: ANTONIO FERNANDEZ TIBURCIO (Productes Naturals, Biologia Vegetal i Edafologia) **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:** Universitat de Barcelona

Principal Investigator: M. ASUNCION ALSINA ESTELLER (Fisicoquímica) **Title:** **Pèptids i proteïnes: Estudis Fisicoquímics** **Reference:** 2009SGR560 **Institution:** Universitat de Barcelona

Principal Investigator: FRANCESC RABANAL ANGLADA (Química Orgànica) **Title:** **Diseño, desarrollo sintético, estudio biofísico y evaluación biológica de lipopéptidos cíclicos como nuevos agentes antimicrobianos y anticancerígenos** **Reference:** CTQ2008-06200/BQU **Institution:** Universitat de Barcelona

Principal Investigator: M. ASUNCION ALSINA ESTELLER (Fisicoquímica) **Title:** **Estudio del mecanismo de acción del GBV-C/HGV en sistemas lipídicos y su posible implicación en el proceso de inhibición del HIV** **Reference:** CTQ2009-13969-C02-02 **Institution:** Universitat de Barcelona

Principal Investigator: ISABEL HARO VILLAR **Title:** **Diseño de nanosistemas peptídicos de liberación controlada para la administración ocular de fármacos** **Reference:** CSIC-CITMA **Institution:** CSIC

Principal Investigator: M. ERMITAS ALCALDE PAIS (Farmacologia i Química Terapèutica) **Title:** **Grup de Desenvolupament de Sistemes Policíclics Nitrogenats d'interés Biològic (DSPNIB)** **Reference:** 2009SGR562 **Institution:** Universitat de Barcelona

Principal Investigator: M. LUISA PEREZ GARCIA (Farmacologia i Química Terapèutica) **Title:** **Bio-functionalization of Micronanotools to study, tag and actuate inside living cells** **Reference:** TEC2008-06883-C03-02 **Institution:** Universitat de Barcelona

Principal Investigator: M. LUISA PEREZ GARCIA (Farmacologia i Química Terapèutica) **Title:** **Funcionalización de micronanoherramientas para ciencias de la vida** **Reference:** TEC2011-29140-C03-02 **Institution:** Universitat de Barcelona

Principal Investigator: M.IMMACULADA DINARES MILA (Farmacologia i Química Terapèutica) **Title:** **Química de Sistemas Moleculares Basados en Sales de Imidazolio** **Reference:** CTQ2010-15251 **Institution:** Universitat de Barcelona

Principal Investigator: DAVID B. AMABILINO **Title:** **Quiralitat en superfícies i màquines moleculars** (CSIC) **Reference:** 2009SGR158 **Institution:** CSIC

Principal Investigator: M. LUISA PEREZ GARCIA (Farmacologia i Química Terapèutica) **Title:** **Funcionalización de micronanoherramientas para ciencias de la vida** **Reference:**TEC2011-29140-C03-02 **Institution:** UB

Principal Investigator: JOSE LUIS MORENZA GIL (Física Aplicada i Òptica) **Title:** **Capes Fines i Enginyeria de Superficies** **Reference:**2009SGR1538 **Institution:** Universitat de Barcelona

Principal Investigator: PEDRO SERRA COROMINA (Física Aplicada i Òptica) **Title:** **Desarrollo de una nueva técnica de impresión directa con**

láser para la realización de micromotivos de biomoléculas **Reference:**MAT2010-15905 **Institution:** Universitat de Barcelona

Principal Investigator: PEDRO SERRA COROMINA (Física Aplicada i Òptica) **Title:** Laser printing of organic/inorganic material for the fabrication of electronic devices (E-LIFT) **EU Reference:** 247868 **Institution:** Universitat de Barcelona

Principal Investigator: JORDI BORRELL HERNANDEZ (Fisicoquímica) **Title:** Nanoestructura de Biomembranes (NANOBIOMEMB) **Reference:** 2009SGR1179 **Institution:** Universitat de Barcelona

Principal Investigator: Investigador principal: JORDI HERNANDEZ BORRELL (Fisicoquímica) **Title:** Investigación de la nanoestructura de la región periférica de un modelo de proteína integral de membrana **Reference:** CTQ2008-03922/BQU **Institution:** Universitat de Barcelona

Principal Investigator: JOSEP SAMITIER MARTI (Electrònica) **Title:** Bioelectrònica i nanobioenginyeria: SIC-BIO **Reference:** 2009SGR505 **Institution:** IBEC - Institut de Bioenginyeria de Catalunya

Principal Investigator: JOSEP SAMITIER MARTI (Electrònica) **Title:** Terapias regenerativas con células madre para el fallo cardiaco **Reference:** PLE2009/0147 Institució: IBEC - Institut de Bioenginyeria de Catalunya

Principal Investigator: JOSEP SAMITIER MARTI (Electrònica) **Title:** LABINACHIP: Nuevos métodos para la fabricación de dispositivos microfluídicos **Reference:** IDC-20101178 Institució: IBEC - Institut de Bioenginyeria de Catalunya

Principal Investigator: JOSE M. LOPEZ VILLEGAS (Electrònica) **Title:** Creixement 2011 del CEMIC-Dep. d'Electrònica-UB (centre tecnio) **Reference:** TECCIT11-1-0023 **Institution:** Universitat de Barcelona

Principal Investigator: JOSEP SAMITIER MARTI (Electrònica) **Title:** Universal Diagnostic Platforms Based On Oligonucleotide Codified Nanoparticles and DNA Microarray Sensor Devices **Reference:** DPI2011-29216-C02-01 **Institution:** IBEC

Principal Investigator: JOSEP SAMITIER MARTI (Electrònica) **Title:** Plataforma Nanomedicina_2011 **Reference:** INF-2011-0047-300000 **Institution:** IBEC

Principal Investigator: JOSEP SAMITIER MARTI (Electrònica) **Title:** An integrated platform enabling Theranostic applications at the Point of Primary Care (TheraEDGE) **EU Reference:** 216027 **Institution:** Universitat de Barcelona

Principal Investigator: JOSEP SAMITIER MARTI (Electrònica) **Title:** Array of Robots Augmenting the KiNematics of Endoluminal Surgery (ARAKNES) **EU Reference:** 224565 **Institution:** Universitat de Barcelona

Principal Investigator: JOSEP SAMITIER MARTI (Electrònica) **Title:** Bioelectronic Olfactory Neuron Device (BOND) **EU Reference:** 228685 **Institution:** Universitat de Barcelona

Principal Investigator: XAVIER FERNÁNDEZ BUSQUETS **Title:** Exploration of new efficient targeting molecules for nanovector-mediated antimalarial drug delivery **Reference:** MINECO BIO2011-25039 **Institution:** IBEC

NANOPHARMACOTHERAPY

Principal Investigator: MARIA JOSE GARCIA CELMA (Farmàcia i Tecnologia Farmacèutica) **Title:** Tecnologías de autoagregación de moléculas anfifílicas para aplicaciones terapéuticas **Reference:** CTQ2011-29336-C03-03 **Institution:** Universitat de Barcelona

Principal Investigator: MARIA LUISA GARCIA LOPEZ (Fisicoquímica) **Title:** Analysis of the stress mechanisms during sterilization and stabilisation by lyophilisation of nanostructured biomaterials and the effects on their biopharmaceutical profiles **Reference:** MAT2011-26994 **Institution:** Universitat de Barcelona

Principal Investigator: MARIA LUISA GARCIA LOPEZ (Fisicoquímica) **Title:** Análisis del proceso de liofilización y esterilización de sistemas nanoestructurados y su efecto en el comportamiento biofarmacéutico y en el perfil toxicológico **Reference:** MAT2010-19877 **Institution:** Universitat de Barcelona

Principal Investigator: ELIANA SOUTO **Title:** NanoLaseRelief: Integrating nanotechnologies for pain relief in laser therapy of vascular lesions **Reference:** PTDC/SAU-FAR/113100/2009 **Institution:** External

Principal Investigator: ISABEL HARO VILLAR **Title:** Diseño de nanosistemas peptídicos de liberación controlada para la administración ocular de fármacos **Reference:** CSIC-CITMA **Institution:** External

Principal Investigator: MARIA JOSE GARCIA CELMA (Farmàcia i Tecnologia Farmacèutica) **Title:** Obtención y caracterización de estructuras meso/macroporosas a partir de emulsiones altamente concentradas: aplicación en Biomedicina como implantes y sistemas de liberación controlada de fármacos **Reference:** CTQ2008-06892-C03-02/PPQ **Institution:** Universitat de Barcelona

Principal Investigator: ROSA MARIA LAMUELA RAVENTOS (Nutrició i Bromatologia) **Title:** Evaluación del efecto antihipertensivo y antiinflamatorio de los polifenoles, carotenos y vitamina C deltomate, según la ración dietética ingerida **Reference:** AGL2010-22319-C03-01 **Institution:** UB

Principal Investigator: JOAN ESTELRICH LATRAS (Fisicoquímica) **Title:** Nanopartículas magnéticas blandas con aplicaciones biomédicas **Reference:** MAT2009-13155-C04-03 **Institution:** Universitat de Barcelona

NANOMAGNETISM, NANOELECTRONICS AND NANOPHOTONICS

Principal Investigator: RAMON VICENTE CASTILLO (Química Inorgànica) **Title:** Interaccions magnètiques i magnetisme molecular **Reference:** 2009SGR1454 **Institution:** Universitat de Barcelona

Principal Investigator: ALBERTO ESCUER FITE (Química Inorgànica) **Title:** Magnetismo molecular:sistemas magnéticos ordenados (SCM, SMM) y modelos bioinorgànicos derivados de elementos de transición d y f **Reference:** CTQ2009-07264 **Institution:** Universitat de Barcelona

Principal Investigator: GUILLEM AROMI BEDMAR (Química Inorgànica) **Title:** Diseño, Síntesis y Estudio Físico-Químico de Materiales Funcionales de Base Molecular **Reference:** CTQ2009-06959 **Institution:** Universitat de Barcelona

Principal Investigator: GUILLEM AROMI BEDMAR (Química Inorgànica) **Title:** Design and Preparation of Functional Molecules for Quantum Computing and Information Processing (FuncMolQIP) **EU Reference:** 258060 **Institution:** Universitat de Barcelona

Principal Investigator: MANUEL VARELA FERNANDEZ (Física Aplicada i Òptica) **Title: Oxidos Multifuncionales para la Manipulación de Spin y Comunicaciones Agiles Reference:** MAT2008-06761-C03-03/ NAN **Institution:** Universitat de Barcelona

Principal Investigator: MANUEL VARELA FERNANDEZ (Física Aplicada i Òptica) **Title: Materiales avanzados y nanotecnologías para dispositivos y sistemas eléctricos, eléctricos, electrónicos y magnetoelectrónicos innovadores' Reference:** CSD2007-00041 **Institution:** Universitat de Barcelona

Principal Investigator: MANUEL VARELA FERNANDEZ (Física Aplicada i Òptica) **Title: Óxidos y estructuras híbridas de respuesta multifuncional Reference:** MAT2011-29269-C03-03 **Institution:** Universitat de Barcelona

Principal Investigator: JAVIER TEJADA PALACIOS (Física Fonamental) **Title: Grup de Magnetisme Reference:** 2009SGR1249 **Institution:** Universitat de Barcelona

Principal Investigator: JAVIER TEJADA PALACIOS (Física Fonamental) **Title: Experimentos a bajas temperaturas con ondas acústicas superficiales, microondas y campos magnéticos giratorios, en sistemas magnéticos y superconductores Reference:** MAT2008-04535/ MAT **Institution:** Universitat de Barcelona

Principal Investigator: JOAN MANEL HERNANDEZ FERRAS (Física Fonamental) **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:** Universitat de Barcelona

Principal Investigator: JAVIER TEJADA PALACIOS (Física Fonamental) **Title: Spint torque oscillators with applications in non digital computing science and communications (SpinTorqOsc) EU Reference:** 253214 **Institution:** Universitat de Barcelona

Principal Investigator: MA. DOLORES VELASCO CASTRILLO (Química Orgànica) **Title: Preparación y estudio de materiales orgánicos multifuncionales. Desarrollo de dispositivos optoelectrónicos y aplicaciones magnéticas Reference:** CTQ2009-13797 **Institution:** Universitat de Barcelona

Principal Investigator: ALBERT CORNET CALVERAS (Electrònica) **Title: Micro-nanotecnologies i nanoscòpies per dispositius electrònics i fotònics (MIND) Reference:** 2009SGR35 **Institution:** Universitat de Barcelona

Principal Investigator: JUAN DANIEL PRADES GARCIA (Electrònica) **Title: Sistemas de detección y cuantificación de biomarcadores de la Enfermedad de Alzheimer (KIT-ALZHEIMER) Reference:** IPT-2011-1055-900000 **Institution:** Universitat de Barcelona

Principal Investigator: ALBERT CIRERA HERNANDEZ (Electrònica) **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:** Universitat de Barcelona

Principal Investigator: ALBERT CIRERA HERNANDEZ (Electrònica) **Title: Materiales Híbridos y recubrimientos basados en nanopartículas (NANOMAT). Actividad 2 Reference:** NANOMAT **Institution:** Universitat de Barcelona

Principal Investigator: ALBERT CIRERA HERNANDEZ (Electrònica) **Title: Nanosensores integrados sobre microtecnología cerámica monolítica Reference:** TRA2009-0078 **Institution:** Universitat de Barcelona

Principal Investigator: ALBERT CIRERA HERNANDEZ (Electrònica) **Title: Investigación de estructuras textiles con capacidad sensórica y que actúen como sistemas activos (Actuadores). CENIT INFINITEX Reference:** INFINITEX **Institution:** FBG

Principal Investigator: ALBERTO ROMANO RODRIGUEZ (Electrònica) **Title: Sistema modular basado en micro- y nanotecnologías avanzadas para aplicaciones de seguridad y calidad ambiental Reference:** TEC2010-21357-C05- **Institution:** Universitat de Barcelona

Principal Investigator: BLAS GARRIDO FERNANDEZ (Electrònica) **Title: Interconexión óptica modulable a GHz y Láser a microdisco basados en tecnología CMOS Reference:** TEC2009-08359 **Institution:** Universitat de Barcelona

Principal Investigator: BLAS GARRIDO FERNANDEZ (Electrònica) **Title: Silicon Nanodots for Solar Cell Tandem (NASCENT) EU Reference:** NMP4-SL-2010-245977 **Institution:** Universitat de Barcelona

Principal Investigator: BLAS GARRIDO FERNANDEZ (Electrònica) **Title: PHotonics ELectronics functional Integration on CMOS (HELIOS) EU Reference:** 224312 **Institution:** Universitat de Barcelona

Principal Investigator: PAOLO PELLEGRINO (Electrònica) **Title: NANOdevice fabrication using BLOCK -copolymer based technology Reference:** EUI2008-03806 **Institution:** Universitat de Barcelona

Principal Investigator: PEIRO MARTINEZ (Electrònica) **Title: IMAGINE....Ciencia de Materiales a Resolución Sub-Angstrom Reference:** CSD2009-00013 **Institution:** Universitat de Barcelona

Principal Investigator: FRANCISCA PEIRO MARTINEZ (Electrònica) **Title: Soluciones en Microscopía Electrónica aplicada a Materiales Nanoestructurados Reference:** MAT2010-16407 **Institution:** Universitat de Barcelona

Principal Investigator: AMILCAR RAMON LABARTA RODRIGUEZ (Física Fonamental) **Title: Grup de Nanomaterials Magnètics Reference:** 2009SGR876 **Institution:** Universitat de Barcelona

Principal Investigator: XAVIER BATLLE GELABERT (Física Fonamental) **Title: Magnetismo y transporte de carga dependiente de espín en materiales nanoestructurados ordenados/desordenados metálicos/aislantes Reference:** MAT2009-08667 **Institution:** Universitat de Barcelona

NANOSTRUCTURED MATERIALS

Principal Investigator: CARLOS MARIA MULLER JEVENOIS (Química Física) **Title: ELECTRODEP Reference:** 2009SGR949 **Institution:** Universitat de Barcelona

Principal Investigator: ELISA VALLES GIMENEZ (Química Física) **Title: Métodos electroquímicos para la preparación de materiales base CoPt con propiedades magnéticas y mecánicas modulables Reference:** CTQ2010-20726 **Institution:** Universitat de Barcelona

Principal Investigator: JAIME RAMON GRANELL SANVICENTE (Química Inorgànica) **Title: Grup de Química Organometal·lica Reference:** 2009SGR1164 **Institution:** Universitat de Barcelona

Principal Investigator: GUILLERMO MULLER JEVENOIS (Química Inorgànica) **Title: Diseño de nuevos ligandos quirales P-dadores: química de la coordinación, nanopartículas metálicas y aplicaciones en procesos enantioselectivos Reference:** CTQ2010-15292 **Institution:** Universitat de Barcelona

Principal Investigator: ENRIC BERTRAN SERRA (Física Aplicada i Òptica) **Title: Física i Enginyeria de Materials Amorfs i Nanoestructures (FEMAN) Reference:** 2009SGR185 **Institution:** Universitat de Barcelona

Principal Investigator: ENRIC BERTRAN SERRA (Física Aplicada i Òptica) **Title: Sistemas Multifuncionales de Absorción de Contaminantes Emergentes Basados en Nanotubos de Carbono Reference:** CTQ2009-14671-C02-01 **Institution:** Universitat de Barcelona

Principal Investigator: JOSE LUIS ANDUJAR BELLA (Física Aplicada i Òptica) **Title:** **Crecimiento de capas ultradelgadas de grafeno sobre substrato metálico para aplicaciones biomédicas** **Reference:** MAT2010-20468 **Institution:** Universitat de Barcelona

Principal Investigator: JOSE MARIA GUTIERREZ GONZALEZ (Enginyeria Química) **Title:** **Tecnologías de Autoagregación de Compuestos Anfifílicos para Aplicaciones en Alimentos Funcionales y Cosmética** **Reference:** CTQ2011-29336-C03-02 **Institution:** Universitat de Barcelona

Principal Investigator: JOSE LUIS MORENZA GIL (Física Aplicada i Òptica) **Title:** **Capes Fines i Enginyeria de Superficies** **Reference:** 2009SGR1538 **Institution:** Universitat de Barcelona

Principal Investigator: JOAN ESTEVE PUJOL (Física Aplicada i Òptica) **Title:** **Funcionalización superficial de materiales para aplicaciones de alto valor añadido (FUNCOAT)** **Reference:** CSD2008-00023 **Institution:** Universitat de Barcelona

Principal Investigator: ARTURO LOUSA RODRIGUEZ (Física Aplicada i Òptica) **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:** Universitat de Barcelona

Principal Investigator: FRANCESC SAGUES MESTRE (Química Física) **Title:** **SOC&SAM (Self-Organized Complexity and Self-Assembling Materials)** **Reference:** 2009SGR1055 **Institution:** Universitat de Barcelona

Principal Investigator: FRANCESC SAGUES MESTRE (Química Física) **Title:** **Auto-organización en materiales blandos y materia viva:I) Monocapas de surfactantes. Cristales Líquidos y Coloides** **Reference:** FIS2010-21924-C02-01 **Institution:** Universitat de Barcelona

NANOENERGY: PRODUCTION, STORAGE AND ENVIRONMENT

Principal Investigator: MERCE SEGARRA RUBI (Ciència dels Materials i Enginyeria Metal·lúrgica) **Title:** **Grup de disseny i optimització de processos i materials** **Reference:** 2009SGR645 **Institution:** Universitat de Barcelona

Principal Investigator: MERCE SEGARRA RUBI (Ciència dels Materials i Enginyeria Metal·lúrgica) **Title:** **Diseño y obtención de pilas de combustible de óxido sólido de temperatura intermedia. Nuevos componentes y configuraciones** **Reference:** MAT2008-06785-C02-01/MAT **Institution:** Universitat de Barcelona

Principal Investigator: MERCE SEGARRA RUBI (Ciència dels Materials i Enginyeria Metal·lúrgica) **Title:** **Celdas reversibles de óxido sólido de temperatura intermedia** **Reference:** MAT2011-23623 **Institution:** Universitat de Barcelona

Principal Investigator: MERCE SEGARRA RUBI (Ciència dels Materials i Enginyeria Metal·lúrgica) **Title:** **Incentivació de la transferència tecnològica del centre DIOPMA (itt-diopma)** **Reference:** TECCIT11-1-0022 **Institution:** Universitat de Barcelona

Principal Investigator: JOAN RAMON MORANTE LLEONART (Electrònica) **Title:** **Materials electrònics i energia (M-2E)** **Reference:** 2009SGR440 **Institution:** IREC - Institut de Recerca en Energia de Catalunya

Principal Investigator: JOAN RAMON MORANTE LLEONART (Electrònica) **Title:** **REDES 2025** **Reference:** PSE-120000-2009-5 **Institution:** IREC - Institut de Recerca en Energia de Catalunya

Principal Investigator: JOAN RAMON MORANTE LLEONART (Electrònica) **Title:** **Nuevas utilizaciones industriales sostenibles del CO_2** **Reference:** CEN-2008 - 1027 **Institution:** IREC-Institut de Recerca en Energia de Catalunya

Principal Investigator: JOAN RAMON MORANTE LLEONART (Electrònica) **Title:** **Development of more efficient catalysts for the design of sustainable shemical processes and celan energy production** **Reference:** CSD2009-00050 **Institution:** IREC-Institut de Recerca en Energia de Catalunya

Principal Investigator: JOAN RAMON MORANTE LLEONART (Electrònica) **Title:** **Multifunctional materials in 3D nano architectures for energy conversion and storage** **Reference:** MAT2010-21510 **Institution:** IREC- Institut de Recerca en Energia de Catalunya

Principal Investigator: JOAN RAMON MORANTE LLEONART (Electrònica) **Title:** **S3** **EU Reference:** FP7-NMP-2009-47768 **Institution:** IREC-Institut de Recerca en Energia de Catalunya

Principal Investigator: JOAN BERTOMEU BALAGUERO (Física Aplicada i Òptica) **Title:** **Grup d'Energia Solar** **Reference:** 2009SGR1532 **Institution:** Universitat de Barcelona

Principal Investigator: JOAN BERTOMEU BALAGUERO (Física Aplicada i Òptica) **Title:** **Diseño e industrialización de módulos fotovoltaicos en Silicio de capa fina (Microsilo8)** **Reference:** PSS-120000-2008-2-3-4-5-6 **Institution:** Universitat de Barcelona

Principal Investigator: JOAN BERTOMEU BALAGUERO (Física Aplicada i Òptica) **Title:** **Avances en Materiales e Interfaces para Células solares de silicio en lámina delgada** **Reference:** ENE2010-21384-C04-03 **Institution:** Universitat de Barcelona

Principal Investigator: JOAN BERTOMEU BALAGUERO (Física Aplicada i Òptica) **Title:** **Inndisol - Innovación en dispositivos fotovoltaicos e integración arquitectónica solar** **Reference:** IPT-420000-2010-6 **Institution:** Universitat de Barcelona

Principal Investigator: JOAN BERTOMEU BALAGUERO (Física Aplicada i Òptica) **Title:** **High Efficient Very Large Area Thin Film Silicon Photovoltaic Modules (HELATHIS)** **Reference:** 241378 **Institution:** Universitat de Barcelona

Principal Investigator: NARCISO HOMS MARTI (Química Inorgànica) **Title:** **Materials Inorgànics Avançats i catàlisi** **Reference:** 2009SGR674 **Institution:** Universitat de Barcelona

Principal Investigator: NARCISO HOMS MARTI (Química Inorgànica) **Title:** **Diseño de catalizadores multicomponentes para la producción de hidrógeno de alta pureza por reformado oxidante de bioalcoholes** **Reference:** MAT2008-02561/MAT **Institution:** Universitat de Barcelona

Principal Investigator: NARCISO HOMS MARTI (Química Inorgànica) **Title:** **Soluciones a la Producción de Hidrógeno Energético y Reconversión asociada CENIT SPHERA** **Reference:** SPHERA **Institution:** Universitat de Barcelona

appendix 2 List of Publications

appendix

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

- **Simultaneous detection of acoustic emission and barkhausen noise during the martensitic transition of a ni-mn-ga magnetic shape-memory alloy** **By:** Baro, Jordi; Dixon, Steve; Edwards, Rachel S.; *et al.* PHYSICAL REVIEW B **Volume:** 88 **Issue:** 17 **Article Number:** 174108 **Published:** NOV 20 2013

- **Large temperature span and giant refrigerant capacity in elastocaloric Cu-Zn-Al shape memory alloys** **By:** Manosa, Lluis; Jarque-Farnos, Segio; Vives, Eduard; *et al.* APPLIED PHYSICS LETTERS **Volume:** 103 **Issue:** 21 **Article Number:** 211904 **Published:** NOV 18 2013

- **The structure of mixed He-3-He-4 droplets doped with OCS: A density functional approach** **By:** Leal, Antonio; Mateo, David; Pi, Marti; *et al.* JOURNAL OF CHEMICAL PHYSICS **Volume:** 139 **Issue:** 17 **Article Number:** 174308 **Published:** NOV 7 2013

- **Critical Landau Velocity in Helium Nanodroplets** **By:** Brauer, Nils B.; Smolarek, Szymon; Loginov, Evgeniy; *et al.* PHYSICAL REVIEW LETTERS **Volume:** 111 **Issue:** 15 **Article Number:** 153002 **Published:** OCT 8 2013

- **Finite-size scaling investigation of the liquid-liquid critical point in ST2 water and its stability with respect to crystallization** **By:** Kesselring, T. A.; Lascaris, E.; Franzese, G.; *et al.* JOURNAL OF CHEMICAL PHYSICS **Volume:** 138 **Issue:** 24 **Article Number:** 244506 **Published:** JUN 28 2013

- **Large reversible entropy change at the inverse magnetocaloric effect in Ni-Co-Mn-Ga-In magnetic shape memory alloys** **By:** Emre, Baris; Yuece, Sueheyla; Stern-Taulats, Enric; *et al.* JOURNAL OF APPLIED PHYSICS **Volume:** 113 **Issue:** 21 **Article Number:** 213905 **Published:** JUN 7 2013

- **Electron Photo-ejection from Bubble States in Liquid He-4** **By:** Barragan, J.; Mateo, D.; Pi, M.; *et al.* JOURNAL OF LOW TEMPERATURE PHYSICS **Volume:** 171 **Issue:** 3-4 **Pages:** 171-177 **Published:** MAY 2013

- **Giant Electrocaloric Strength in Single-Crystal BaTiO3** **By:** Moya, Xavier; Stern-Taulats, Enric; Crossley, Sam; *et al.* ADVANCED MATERIALS **Volume:** 25 **Issue:** 9 **Pages:** 1360-1365 **Published:** MAR 6 2013

- **Inertial coupling for point particle fluctuating hydrodynamics** **By:** Balboa Usabiaga, F.; Pagonabarraga, I.; Delgado-Buscalioni, R. JOURNAL OF COMPUTATIONAL PHYSICS **Volume:** 235 **Pages:** 701-722 **Published:** FEB 15 2013

- **Elastocaloric and magnetocaloric effects in Ni-Mn-Sn(Cu) shape-memory alloy** **By:** Castillo-Villa, Pedro O.; Manosa, Lluis; Planes, Antoni; *et al.* JOURNAL OF APPLIED PHYSICS **Volume:** 113 **Issue:** 5 **Article Number:** 053506**Published:** FEB 7 2013

- **A density functional study of the structure of small OCS@He-3(N) clusters** **By:** Mateo, David; Pi, Marti; Navarro, Jesus; *et al.* JOURNAL OF CHEMICAL PHYSICS **Volume:** 138 **Issue:** 4 **Article Number:** 044321 **Published:** JAN 28 2013

- **Influence of the feeding mechanism on deposits of square particles** **By:** Acevedo, M.; Hidalgo, R. C.; Zuriguel, I.; *et al.* PHYSICAL REVIEW E **Volume:** 87 **Issue:** 1 **Article Number:** 012202 **Published:** JAN 10 2013

- **Probing the interface of doped isotopically mixed helium droplets by the directional anisotropy of interatomic Coulombic decay** **By:** Kryzhevoi, Nikolai V.; Mateo, David; Pi, Marti; *et al.* PHYSICAL CHEMISTRY CHEMICAL PHYSICS **Volume:** 15 **Issue:** 41 **Pages:** 18167-18173 **Published:** 2013

- **Translational dynamics of photoexcited atoms in He-4 nanodroplets: the case of silver** **By:** Mateo, David; Hernando, Alberto; Barranco, Manuel; *et al.* PHYSICAL CHEMISTRY CHEMICAL HYSICS **Volume:** 15 **Issue:** 42 **Pages:** 18388-18400 **Published:** 2013

- **Understanding and modulating the competitive surface-adsorption of proteins through coarse-grained molecular dynamics simulations** **By:** Vilaseca, Pol; Dawson, Kenneth A.; Franzese, Giancarlo SOFT MATTER **Volume:** 9 **Issue:** 29 **Pages:** 6978-6985 **Published:** 2013

- **Advanced materials for solid-state refrigeration** **By:** Manosa, Lluis; Planes, Antoni; Acet, Mehmet JOURNAL OF MATERIALS CHEMISTRY A **Volume:** 1 **Issue:** 16 **Pages:** 4925-4936 **Published:** 2013

NANOBIOTECHNOLOGY

- **Theoretical study of a molecular turbine** **By:** Perez-Carrasco, R.; Sancho, J. M. PHYSICAL REVIEW E **Volume:** 88 **Issue:** 4 **Article Number:** 042705 **Published:** OCT 21 2013
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- **Unconventional dynamic hysteresis in a periodic assembly of paramagnetic colloids** **By:** Tierno, Pietro; Johansen, Tom H.; Sancho, J. M. PHYSICAL REVIEW E **Volume:** 87 **Issue:** 6 **Article Number:** 062301 **Published:** JUN 3 2013

- **Speeding chemical reactions by focusing** **By:** Lacasta, A. M.; Ramirez-Piscina, L.; Sancho, J. M.; *et al.* JOURNAL OF CHEMICAL PHYSICS **Volume:** 138 **Issue:** 14 **Article Number:** 144502 **Published:** APR 14 2013

- **Modeling the mechanochemistry of the phi 29 DNA translocation motor** **By:** Perez-Carrasco, R.; Fiasconaro, A.; Falo, F.; *et al.* PHYSICAL REVIEW E **Volume:** 87 **Issue:** 3 **Article Number:** 032721 **Published:** MAR 28 2013

- **Emergent bimodal firing patterns implement different encoding strategies during gamma-band oscillations** **By:** Sancristobal, B.; Vicente, R.; Sancho, J. M.; *et al.* FRONTIERS IN COMPUTATIONAL NEUROSCIENCE **Volume:** 7 **Article Number:** UNSP 18 **Published:** MAR 26 2013

- **Noise focusing and the emergence of coherent activity in neuronal cultures** **By:** Orlandi, Javier G.; Soriano, Jordi; Alvarez-Lacalle, Enrique; *et al.* NATURE PHYSICS **Volume:** 9 **Issue:** 9 **Pages:** 582-590 **Published:** SEP 2013

- **Cooperative Force Generation of KIF1A Brownian Motors** **By:** Oriola, David; Casademunt, Jaume PHYSICAL REVIEW LETTERS **Volume:** 111 **Issue:** 4 **Article Number:** 048103 **Published:** JUL 26 2013

- **Spontaneous Motility of Actin Lamellar Fragments** **By:** Blanch-Mercader, C.; Casademunt, J. PHYSICAL REVIEW LETTERS **Volume:** 110 **Issue:** 7 **Article Number:** 078102 **Published:** FEB 15 2013

- **Special Rhodococcus sp CR-53 esterase Est4 contains a GGG(A)X-oxyanion hole conferring activity for the kinetic resolution of tertiary alcohols** **By:** Bassegoda, Arnau; Fillat, Amanda; Javier Pastor, F. I.; *et al.* APPLIED MICROBIOLOGY AND BIOTECHNOLOGY **Volume:** 97 **Issue:** 19 **Pages:** 8559-8568 **Published:**OCT 2013

- **Acidic lipase Lip I.3 from a Pseudomonas fluorescens-like strain displays unusual properties and shows activity on secondary alcohols** **By:** Panizza, P.; Syfantou, N.; Pastor, F. I. J.; et ál. SOURCE: JOURNAL OF APPLIED MICROBIOLOGY**Volume:** 114 **Issue:** 3 **Pages:** 722-732 **published:** MAR 2013

- **Exploring a new, soluble lipase for FAMEs production in water-containing systems using crude soybean oil as a feedstock** **By:** Cesarini, Silvia; Diaz, Pilar; Nielsen, Per Munk PROCESS BIOCHEMISTRY **Volume:** 48 **Issue:** 3 **Pages:** 484-487 **Published:** MAR 2013

- **Functional characterization of ExFadLO, an outer membrane protein required for exporting oxygenated long-chain fatty acids in Pseudomonas aeruginosa** **By:** Martinez, Eriel; Estupinan, Monica; Javier Pastor, F. I.; et ál. BIOCHIMIE **Volume:** 95 **Issue:** 2 **Pages:** 290-298 **Published:** FEB 2013

- **Local micromechanical properties of decellularized lung scaffolds measured with atomic force microscopy** **By:** Luque, T.; Melo, E.; Garreta, E.; *et al.* ACTA BIOMATERIALIA **Volume:** 9 **Issue:** 6 **Pages:** 6852-6859 **Published:** JUN 2013

- **Bond Elasticity Controls Molecular Recognition Specificity in Antibody-Antigen Binding** **By:** Alemany, Anna; Sanvicens, Nuria; de Lorenzo, Sara; *et al.* NANO LETTERS **Volume:** 13 **Issue:** 11 **Pages:** 5197-5202 **Published:** NOV 2013

- **RecG and UvsW catalyse robust DNA rewinding critical for stalled DNA replication fork rescue** **By:** Manosas, Maria; Perumal, Senthil K.; Bianco, Piero; *et al.* NATURE COMMUNICATIONS **Volume:** 4 **Article Number:** 2368 **Published:** SEP 2013

- **Electrostatic Binding and Hydrophobic Collapse of Peptide-Nucleic Acid Aggregates Quantified Using Force Spectroscopy** **By:** Camunas-Soler, Joan; Frutos, Silvia; Bizarro, Cristiano V.; *et al.* ACS NANO **Volume:** 7 **Issue:** 6 **Pages:** 5102-5113 **Published:** JUN 2013

- **Counter-propagating dual-trap optical tweezers based on linear momentum conservation** **By:** Ribezzi-Crivellari, M.; Huguet, J. M.; Ritort, F. REVIEW OF SCIENTIFIC INSTRUMENTS **Volume:** 84 **Issue:** 4 **Article Number:** 043104 **Published:** APR 2013

- **Fluctuation Relation for Weakly Ergodic Aging Systems** **By:** Crisanti, A.; Picco, M.; Ritort, F. PHYSICAL REVIEW LETTERS **Volume:** 110 **Issue:** 8 **Article Number:** 080601 **Published:** FEB 20 2013

- **Overactivation of the TGF-beta Pathway Confers a Mesenchymal-Like Phenotype and CXCR4-Dependent Migratory Properties to Liver Tumor Cells** **By:** Bertran, Esther; Crosas-Molist, Eva; Sancho, Patricia; *et al.* HEPATOLOGY **Volume:** 58 **Issue:** 6 **Pages:** 2032-2044 **Published:** DEC 2013

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- **Combined (S)TEM-FIB Insight into the Influence of the Preparation Method on the Final Surface Structure of a Co3O4/La-Modified-CeO2 Washcoated Monolithic Catalyst** **By:** Hernandez-Garrido, Juan C.; Gomez, Diana M.; Gaona, Diana; *et al.* JOURNAL OF PHYSICAL

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- **Insight into the Compositional and Structural Nano Features of AlN/GaN DBRs by EELS-HAADF** **By:** Eljarrat, Alberto; Lopez-Conesa, Lluis; Magen, Cesar; *et al.* MICROSCOPY AND MICROANALYSIS **Volume:** 19 **Issue:** 3 **Pages:** 698-705 **Published:** JUN 2013

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- **Template growth of vertically aligned carbon nanotubes using self-assembled monolayers of SiO2 particles by Langmuir-Blodgett technique** **By:** Cabrera, Edgar J.; Amade, Roger; Jaller, Lina; *et al.* JOURNAL OF NANOPARTICLE RESEARCH **Volume:** 16 **Issue:** 1 **Published:** DEC 27 2013

- **Nitrogen plasma functionalization of carbon nanotubes for supercapacitor applications** **By:** Hussain, Shahzad; Amade, Roger; Jover, Eric; *et al.* JOURNAL OF MATERIALS SCIENCE **Volume:** 48 **Issue:** 21 **Pages:** 7620-7628 **Published:** NOV 2013

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- **Improving the binding capacity of Ni2+ decorated porous magnetic silica spheres for histidine-rich protein separation** **By:** Benelmekki, M.; Caparros, C.; Xuriguera, E.; *et al.* COLLOIDS AND SURFACES B-BIOINTERFACES **Volume:** 101 **Pages:** 370-375 **Published:** JAN 1 2013

- **Chemical to electrical transduction mechanisms from single metal oxide nanowire measurements: response time constant analysis** **By:** Morante, J. R. NANOTECHNOLOGY **Volume:** 24 **Issue:** 44 Special **Issue:** SI **Article Number:** 444004 **Published:** NOV 8 2013

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- **Heterostructured p-CuO (nanoparticle)/n-SnO2 (nanowire) devices for selective H2S detection** **By:** Shao, F.; Hoffmann, M. W. G.; Prades, J. D.; *et al.* SENSORS AND ACTUATORS B-CHEMICAL **Volume:** 181 **Pages:** 130-135 **Published:** MAY 2013

- **Solution-growth and optoelectronic properties of ZnO:Cl@ZnS core-shell nanowires with tunable shell thickness** **By:** Fan, Jiandong; Fabrega, Cristian; Zamani, Reza; *et al.* JOURNAL OF ALLOYS AND COMPOUNDS **Volume:** 555 **Pages:** 213-218 **Published:** APR 5 2013

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- **Interaction Mechanisms of Ammonia and Tin Oxide: A Combined Analysis Using Single Nanowire Devices and DFT Calculations** **By:** Shao, Feng; Hoffmann, Martin W. G.; Daniel Prades, Joan; *et al.* JOURNAL OF PHYSICAL CHEMISTRY C **Volume:** 117 **Issue:** 7 **Pages:** 3520-3526 **Published:** FEB 21 2013

- **Embedding catalytic nanoparticles inside mesoporous structures with controlled porosity: Au@TiO2** **By:** Nafria, Raquel; Ramirez de la Piscina, Pilar; Homs, Narcis; *et al.* JOURNAL OF MATERIALS CHEMISTRY A **Volume:** 1 **Issue:** 45 **Pages:** 14170-14176 **Published:** 2013

- **One-dimensional CuO-SnO2 p-n heterojunctions for enhanced detection of H2S** **By:** Giebelhaus, Irina; Varechkina, Elena; Fischer, Thomas; *et al.* JOURNAL OF MATERIALS CHEMISTRY A **Volume:** 1 **Issue:** 37 **Pages:** 11261-11268 **Published:** 2013

- **Highly electrocatalytic flexible nanofiber for improved vanadium-based redox flow battery cathode electrodes** **By:** Flox, Cristina; Fabrega, Cristian; Andreu, Teresa; *et al.* RSC ADVANCES **Volume:** 3 **Issue:** 30 **Pages:** 12056-12059 **Published:** 2013

- **Oxide-oxide nanojunctions in coaxial SnO2/TiO2, SnO2/V2O3 and SnO2/(Ti0.5V0.5)(2)O-3 nanowire heterostructures** **By:** Zamani, Reza; Fiz, Raquel; Pan, Jun; *et al.* CRYSTENGCOMM **Volume:** 15 **Issue:** 22 **Pages:** 4532-4539 **Published:** 2013

- **Colloidal synthesis and thermoelectric properties of Cu2SnSe3 nanocrystals** **By:** Ibanez, Maria; Cadavid, Doris; Anselmi-Tamburini, Umberto; *et al.* JOURNAL OF MATERIALS CHEMISTRY A **Volume:** 1 **Issue:** 4 **Pages:** 1421-1426 **Published:** 2013

- **Influence of the Annealing Atmosphere on the Performance of ZnO Nanowire Dye-Sensitized Solar Cells** **By:** Fan, Jiandong; Hao, Yan; Munuera, Carmen; *et al.* JOURNAL OF PHYSICAL CHEMISTRY C **Volume:** 117 **Issue:** 32 **Pages:** 16349-16356 **Published:** AUG 15 2013

- **Theoretical and experimental study of the interaction of CO on TiC surfaces: Regular versus low coordinated sites** **By:** Mant, Barry P.; Giacomo Asara, Gian; Anderson, James A.; *et al.* SURFACE SCIENCE **Volume:** 613 **Pages:** 63-73 **Published:** JUL 2013

- **VO2+ Reaction with Hydrotalcite and Hydrotalcite-Derived Oxide: The Effect of the Vanadium Loading on the Structure of Catalyst Precursors and on the Vanadium Species** **By:** de Castro, Fernando Rabello; Lam, Yiu Lau; Herbst, Marcelo Hawrylak; *et al.* EUROPEAN JOURNAL OF INORGANIC CHEMISTRY **Issue:** 2 **Pages:** 241-247 **Published:** JAN 2013

- **Hydrogen production from oxidative steam reforming of bio-butanol over ColIr-based catalysts: Effect of the support** **By:** Cai, Weijie; Ramirez de la Piscina, Pilar; Gabrowska, Klaudia; *et al.* BIORESOURCE TECHNOLOGY **Volume:** 128 **Pages:** 467-471 **Published:** JAN 2013

appendix 3

List of Patents

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Id. GREC: 000130
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: 12/04/2013

Id. GREC: 000131
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: 22/04/2013

Id. GREC: 000142
Authors: Alejandro Morata García; Iñigo Garbayo Senosiain; Alberto Tarancón Rubio; Maria de les Neus Sabaté Vizcarra; Luis Fonseca Chácharo; Marc Salleras Freixes; Juan Ramón Morante Lleonart
Title: Sensor electroquímico de estado sólido
Date of application: 05/12/2013

Id. GREC: 000234
Authors: Alcalde, E.; Almansa, C.; Díaz, J.L.; Mesquida, N.; Paloma, L.
Title: Indene derivatives, their preparation and use as medicaments
Date of application: 03/07/2013

Id. GREC: 000236
Authors: Alcalde, E.; Díaz, J.L.; Mesquida, N.; Paloma, L.
Title: Imidazo[2,1-b]thiazole derivatives, their preparation and use as medicaments
Date of application: 04/07/2013

appendix 4 List of Members

LIST OF MEMBERS

ALBALAT PIÑOL, ROSA
ALCALDE PAIS, M. ERMITAS
ALMENDROS LÓPEZ, ISAAC
ALSINA ESTELLER, M.ASUNCION
ANDREU BATALLE, JORDI
ANDUJAR BELLA, JOSE LUIS
ARIMON BEDOS, MURIEL
AROMI BEDMAR, GUILLEM
ARRO PLANS, MONTSERRAT
ASENSI LOPEZ, JOSE MIGUEL
BARBERAN FALCON, NURIA
BARRANCO GOMEZ, MANUEL
BASTIDA ARMENGOL, JAIME
BATLLE GELABERT, XAVIER
BERTOMEU BALAGUERO, JOAN
BERTRAN SERRA, ENRIC
BORRELL HERNANDEZ, JORDI
BUSQUETS VIÑAS, M.ANTONIA
CABALLERO BRIONES, FELIPE
CAJAL VISA, YOLANDA C.
CALPENA CAMPMANY, ANA CRISTINA
CALVO BARRIO, LORENZO
CANILLAS BIOSCA, ADOLFO
CASADEMUNT VIADER, JAUME
CASTAN VIDAL, MARIA TERESA
CIRERA HERNANDEZ, ALBERT
CLARET BONET, JOSEP
CORBELLA CORDOMI, MONTSERRAT
CORNET CALVERAS, ALBERT
CORVERA POIRÉ, EUGENIA
D'ENTERRIA ADAN, DAVID
DIAZ GASA, M. DEL CARMEN
DIAZ LUCEA, M. PILAR
DIEZ PEREZ, ISMAEL
DINARES MILA, M.IMMACULADA
DOMENECH CABRERA, OSCAR
EGEA GRAS, M. ANTONIA
EGEA GURI, GUSTAVO
EL FALLAH , MOHAMED SALAH
ESCRIBANO FERRER, ELVIRA
ESCUER FITE, ALBERTO
ESPINA GARCIA, MARTA
ESTELRICH LATRAS, JOAN
ESTEVE PUJOL, JOAN
ESTRADE ALBIOL, SONIA
FARRE VENTURA, RAMON
FARRERA PIÑOL, JOAN ANTONI
FERNANDEZ BUSQUETS, XAVIER
FERNANDEZ PRADAS, JUAN MARCOS
FERNANDEZ TIBURCIO, ANTONIO
FERRATER MARTORELL, CESAR
FIGUEROLA SILVESTRE, ALBERT
FONDEVILLA SALA, NURIA
FRAILE RODRIGUEZ, ARANTXA
FRANZESE , GIANCARLO
GALLARDO ROMAN, OSCAR
GALLARDO SAURET, MONTSERRAT
GAMISANS LINARES, FIDENCIA

GARCIA CAPDEVILA, JAVIER
GARCIA CELMA, MARIA JOSE
GARCIA CESPEDES, JORDI
GARCIA DEL MURO SOLANS, MONTSERRAT
GARCIA LOPEZ, MARIA LUISA
GARCIA SANTIAGO, ANTONI
GARCIA-CUENCA VARONA, Mª VICTORIA
GARCÍA GÜELL, ALEIX
GARRIDO FERNANDEZ, BLAS
GIRONA BRUMOS, MA. VICTORIA
GOMEZ SIMON, MONTSERRAT
GOMEZ VALENTIN, ELVIRA
GOMILA LLUCH, GABRIEL
GORDO VILLOSLADA, SUSANA
GUILLEUMAS MORELL, MONTSERRAT
GUTIERREZ GONZALEZ, JOSE MARIA
GÜELL VILA, FRANC
HERNANDEZ FERRAS, JOAN MANEL
HERNANDEZ MACHADO, AURORA
HERNANDEZ MARQUEZ, SERGIO
HERNANDEZ RAMIREZ, FRANCISCO DE P.
HERRERA COROMINAS, JULIA
HOMS MARTI, NARCISO
IBAÑES MIGUEZ, MARTA
IGLESIAS CLOTAS, OSCAR
IGNES MULLOL, JORDI
IMPERIAL RODENAS, SANTIAGO
IZQUIERDO ROCA, VICTOR
KOVYLINA, MIROSLAVNA
LABARTA RODRIGUEZ, AMILCAR RAMON
LATORRE TOBIA, SONIA
LAUROBA VILADROSA, JACINTO
LOPEZ CALAHORRA, FRANCISCO
LOUSA RODRIGUEZ, ARTURO
MAESTRO GARRIGA, ALICIA
MAYOL SANCHEZ, RICARDO
MAÑOSA CARRERA, LLUIS
MAÑOSAS CASTEJON, MARIA
MARTIN BADOSA, ESTELA
MESQUIDA ESTEVEZ, M. DE LES NEUS
MIGUEL LOPEZ, M. DEL CARMEN
MONFORT PEREARNAU, MONTSERRAT
MONTERO BARRIENTOS, M. TERESA
MONTES USATEGUI, MARIO
MORALES COMAS, MIGUEL
MORANTE LLEONART, JOAN RAMON
MORENZA GIL, JOSE LUIS
MORRAL RUIZ, GENOVEVA
MULLER JEVENOIS, GUILLERMO
MUÑOZ ALARCON, M. TERESA
MUÑOZ JUNCOSA, M. MONTSERRAT
NAVAJAS NAVARRO, DANIEL
OLIVA GIMENO, JOSE IGNACIO
OLIVA HERRERA, MIREIA
ONCINS MARCO, GERARD
ORTIN RULL, JORDI
PAGONABARRAGA MORA, IGNACIO
PALASSINI, MATTEO

PASCUAL MIRALLES, ESTHER
PASTOR BLASCO, FCO.I.JAVIER
PEIRO MARTINEZ, FRANCISCA
PELLEGRINO, PAOLO
PEREZ GARCIA, M. LUISA
PEREZ RODRIGUEZ, ALEJANDRO
PI PERICAY, MARTI
PICART FAIGET, PEDRO
PLANES VILA, ANTONI
POLO TRASANCOS, M. DEL CARMEN
PORRAS RODRIGUEZ, M. MONTSERRAT
PORTAL, SABINE
PRADES GARCIA, JUAN DANIEL
PRAT AIXELA, JOSEFA
PUJOL CUBELLS, MONTSERRAT
QUERALT REGUE, JOSE
RAMIREZ DE LA PISCINA MILLAN, M.PILAR
REGUERA LOPEZ, DAVID
RIBAS ARIÑO, JORDI
RIBAS GISPERT, JUAN
RITORT FARRAN, FELIX
ROCA-CUSACHS SOULERE, PERE
RODRIGUEZ LAZARO, MIGUEL
ROMANO RODRIGUEZ, ALBERTO
ROTGER ESTAPE, MARIA DEL MAR
RUBI CAPACETI, JOSE MIGUEL
SABATE LAGUNAS, RAIMON
SAGUES MESTRE, FRANCESC
SALES CABRE, JOAQUIM
SALVADO LLADOS, M. ANGELES
SALVANY BALADA, MERITXELL
SAMITIER MARTI, JOSEP
SANCHO HERRERO, JOSE MARIA
SANZ CARRASCO, FAUSTO
SARDIN CHARLES, JORGE
SEGARRA RUBI, MERCE
SELVA SANCHEZ, JAVIER
SERRA COROMINA, PEDRO
SERRE, CHRISTOPHE
TEJADA PALACIOS, JAVIER
TIERNO, PIETRO
TORRAS CLAVERIA, LAURA
VALLES GIMENEZ, ELISA
VALLS PLANELLS, JOSEP ORIOL
VARELA FERNANDEZ, MANUEL
VELASCO CASTRILLO, M. DOLORES
VICENTE CASTILLO, RAMON
VILA ARBONES, ANA MARIA
VILADOMAT MEYA, FRANCISCO
VIVES SANTA-EULALIA, EDUARD
WERONSKI , KONRAD JANUSZ
XURIGUERA MARTIN, M. ELENA

appendix 5

List of Trainees & Postdocs

LIST OF TRAINEES AND POSTDOCS

ABREGO ESCOBAR, GUADALUPE

AGUILA AVILES, DAVID

ALARCON, FRANCISCO

ALEMANY ARIAS, ANNA

ALVARADO BONILLA, HELEN LISETTE

ARTEAGA BARRIEL, ORIOL

BAKKALI, HICHAM

BEDNARCZUK, LUKASZ

BERENCEN RAMIREZ, YONDER A.

BONILLA VALLADARES, PABLO

BORILOVIC, IVANA

BUSTOS SALGADO, PAOLA

CABALLERO LORENZO, ALVARO

CABALLERO LUCAS, FRANCESC

CAMUÑAS SOLER, JOAN

CARRERAS SEGUÍ, PAZ

CRAIG, GAVIN

ELJARRAT ASCUNCE, ALBERTO

FERNÁNDEZ MARTÍNEZ, ANTONIO

HERNANDEZ NAVARRO, SERGI

IBAÑEZ JIMENEZ, ANNA

ILLERA ROBLES, SERGIO

LATELLA, IVAN

LIMON MAGAÑA, DAVID

LLUSCA JANE, MARTA

LOPEZ CONESA, LUIS

LORENZO ROS, SARA

LÓPEZ VIDRIER, JULIÀ

MALLANDRICH MIRET, MIREIA

MARTI PRIETO, MARIA

MONEREO CUSCO, ORIOL

MONTANYA TANYA, NURIA

MORALES SUAREZ, SILVIO RENE

MORRONE, LUIGI

MOYA ALVAREZ, CARLOS

NUNES RODRIGUES, ANA MAFALDA

PENON ESTEVA, JOSEP ORIOL

PULIDO COMPANYS, ALBA

RAMÍREZ RAMÍREZ, JOAN MANEL

REBLED CORSELLAS, JOSE MANUEL

REY SERRA, BLANCA

RODRIGUEZ ABRIL, SONIA

ROIG ROIG, FERRAN

RUIZ CARIDAD, ALICIA

SAMA MONSONIS, JORDI

SUAREZ GERMA, MARIA CARME

VELASCO AMIGÓ, VERÓNICA

VESCIO, GIOVANNI

Activity Report 2013

Institut de Nanociència i Nanotecnologia de la Universitat de Barcelona

INSTITUT DE NANOCIÈNCIA I NANOTECNOLOGIA

Martí i Franquès 1, 3rd floor, 08028 Barcelona

B:KC Barcelona Knowledge Campus

Universitat de Barcelona