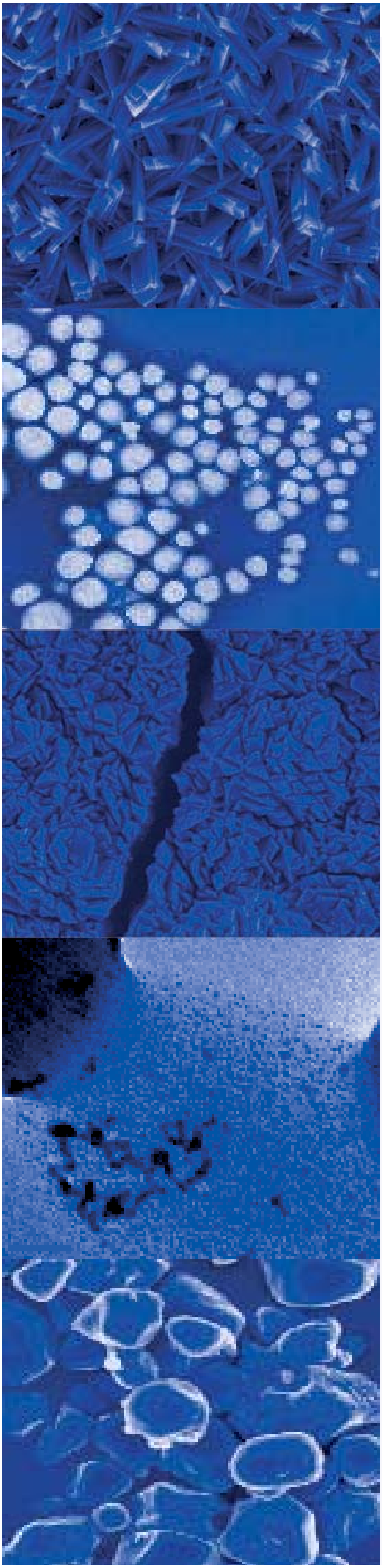

NANOSPAIN 2009

Zaragoza (Spain) March 9-12, 2009

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NanoSciences GRAND SUD - OUEST

UNIVERSITAS PUBLICA NAVARRENSIS

Edited by

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During the last two decades, a revolutionary scientific new age, based on the capacity to observe, characterize, manipulate and organize matter in the nanometric scale, is appearing. In this scale, physics, chemistry, materials science, computational theory, and engineering converge towards the same theoretical principles and experimental findings that are basically governed by the laws of the Quantum Mechanics. Nanotechnology involves these interdisciplinary knowledge areas and methodologies in order to study, manufacture and characterize functional structures with dimensions of tens of nanometers.

Since 2008, Spain, Portugal and France (through their respective networks NanoSpain, PortugalNano and C'Nano GSO) decided to join efforts in order that NanoSpain events facilitate the dissemination of knowledge and promote interdisciplinary discussions not only in Spain but among the different groups from Southern Europe.

In 2009, this event will therefore be organised again in collaboration with 3 networks:

- **NanoSpain** (Spain): 266 Spanish groups with around 2000 researchers in total - one of the widest Spanish scientific networks
- **Portugalnano** (Portugal): 188 Portuguese groups
- **C'Nano Grand Sud Ouest** (France): 50 labs and more than 500 researchers

Other objectives will also be to enhance industrial participation and permit considering the situation of Nanoscience and Nanotechnology in the south of Europe.

In order to organise the various sessions and to select contributions, the meeting will be structured in the following thematic lines, but interactions among them will be promoted:

1. NanoBiotechnology/Nanomedicine
2. NanoMaterials
3. NanoElectronics/Molecular Electronics
4. NanoChemistry
5. Nanomagnetism
6. NanoPhotonics/NanoOptics
7. Nanotubes
8. NEMS/MEMS
9. Scanning Probe Microscopies (SPM)
10. Infrastructure & Scientific Policy
11. Simulation at the nanoscale

Thematic parallel sessions will also be organised to enhance information flow between participants and in particular:

-Exchange information of current work in specific research areas
-Solve particular technological problems
-Look for areas of common ground between different technologies
-Provide contributions to specific reports

The following Thematic Sessions will be organised:

1. NanoBiotechnology (Coordinators: Josep Samitier, Jesus M. De la Fuente & Elena Martínez)
2. NanoFabrication (Coordinators: Francesc Pérez-Murano & Fernando Briones)
3. Industrial (Coordinators: José Luís Viviente & Emilio Prieto)
4. NanoChemistry (Coordinators: Jaume Veciana & Nora Ventosa)
5. NanoOptics & NanoPhotonics (Coordinators: Juan José Sáenz & Antonio García Martín)

Finally, thanks must be directed to the staff of all organising institutions whose hard work has helped the smooth organisation and planning of this conference.

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The **CIBER BBN** is one of the new CIBER consortiums existing in Spain that was created under the leadership of Instituto de Salud Carlos III (ISCIII) to encourage the following objectives:

- To increase research capabilities by sharing resources and promoting synergies.
- To enhance a greater and better use of advanced technologies in the National Health System.
- To improve the technological level of the national industry in this field.
- To favour the emergence of specialists with a high level of training in health technologies.
- To increase the presence of Spain in decision-making forums and international research networks in this field.

The scientific areas comprised within the CIBER-BBN are: Bioengineering and biomedical imaging, Biomaterials and tissue engineering and Nanomedicine, and the Center's research is focused on the development of prevention, diagnostic, and follow-up systems, and on technologies related to specific therapies such as Regenerative Medicine and Nanotherapies.

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Nanomedicina & Biotecnología

Andalusian Initiative for Advanced Therapies:

Advanced therapies are gaining momentum in Andalusia, one of the world's pioneer regions to enact specific regulations enabling human embryonic stem cell research (2003), preimplantation genetic diagnosis (2005) and the therapeutical application of cellular reprogramming techniques (2007). Recently a set of top-class infrastructures -including research centres, stem cell bank and GMP-compliant clean rooms network- was also established. On the talent side, international recruitment and training initiatives were deployed for researchers and technicians. Finally, specific calls for research projects have been launched and funded sustainedly, as well as independent clinical trials on cell therapy and regenerative medicine.

Cell Therapy & Regenerative Medicine, Clinical Genetics & Genomic Medicine and Nanomedicine programmes support the regional strategy to foster translational research (*from-bench-to-bed*), through the **Andalusian Initiative for Advanced Therapies**, which is the core of the **Strategic Plan for Health Research, Development and Innovation 2006-2010** of the Regional Ministry of Health. The Initiative's structure and key action lines are based on the fundamentals of the R&D and innovation process, that is to say, knowledge **generation**, knowledge **diffusion** and technology transfer, and knowledge **traslation** into clinical applications. To enforce this value-creating chain, more and stronger links amongst academia, research organisations, healthcare providers and biotech SMEs have been established. Each of the above strategic research programs have a specific thematic research centre. And BIONAND creates a multidisciplinary research environment that provides expertise and fosters collaborations for the design, development, and use of nanosystems for therapeutic and diagnostic purposes. BIONAND steers the convergence of recent advances in nanotechnology with modern biology and medicine: the new research domain of nanobiotechnology.

Our Strategic Goals

* Design, develop, and evaluate nanostructures for the delivery of therapeutic and diagnostic agents
* Facilitate the translation of promising delivery systems to clinical research
* Foster new and ongoing collaborative projects
* Recruit experts in nanomedicine research and enhance infrastructure
* Provide training in the emerging multidisciplinary field of nanomedicine

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Universidad de Valladolid

The University of Valladolid, whose history can be traced back to the 13th century, has been the inspirational foundation for numerous other prestigious universities in Spain. It has at all times upheld its firm commitment to teaching and research and, while forging links with Europe and the Americas, has remained deeply committed to its home region of Castilla y León as well to the economic and social development of the society of which it forms part and ultimately aims to serve through its activities.

Through these pages we wish to provide visitors with useful information reflecting the long history of innovation and fruitful labour undertaken by all those who make up our university –teaching staff, service and administration personnel and students- and the responsibility we have to remain duty-bound to the society we serve by putting all of our scientific potential at its disposal.

Our four campuses –Valladolid, Palencia, Segovia and Soria-, offering over 100 degree courses, the numerous postgraduate and PhD courses, our renowned international relations, distinguished research centres, wide range of cultural and sports activities together with a rich architectural and archival heritage, provide a unique academic environment in line with the oldest universities in Europe whose history, through excellence and the ability to innovate, we form part of.

Research activity

Universities have the responsibility to be at the leading edge of research activity and at the forefront in the creation of the intellectual wealth that is to contribute to the social well being of mankind. Aware of these changes, the University of Valladolid is involved in significant research work in the fields of the humanities, social sciences, experimental sciences, architecture and engineering as well as biomedical sciences. To this end, it has a staff of research teaching personnel of whom 63% are doctors, with over 500 scholarship fellows and research contracts.

Researchers at the University of Valladolid carry out their activity in different research units: 59 departments, seven university institutes (LOU), nine university institutes of its own and six technology centres part-owned by the university. To perform their research work, state-of-the-art technology and equipment is available, as well as libraries with over 800 000 monographs and more than 16 000 current journals.

The University of Valladolid manages around 740 research projects financed through competitive public R+D+I calls (European, national or regional), and approximately 500 contracts and agreements aimed at the transfer of knowledge and technology, amounting to an average value of over fifteen million Euros per annum. Moreover, its researchers take part in almost 200 further projects and contracts managed by other institutions. As a result of this research work, the University of Valladolid holds 57 patents and annually publishes around 800 articles in journals listed in the Science Citation Index SCI, around 250 books, and is present at many national and international congresses with over 1 900 papers and communications. Furthermore, an average of 140 doctoral theses are read at the university every year.

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Nanoaracat is a collaboration agreement framework among the Spanish Communities Aragon and Catalonia, to encourage a series of joint actions in I+D+i in the area of the Nanoscience and the Nanotechnology. Since 2006 this initiative promotes the research collaboration and the technology transfer among 13 research centres and 5 universities from both communities participating in the project.
Find in our Web page www.nanoaracat.com more information about the members.

Current projects and activities:

- Organization of Nanoscience scientific conferences and technology transfer sessions with the academic and industrial sectors. (see events on the Webpage)
    - AINIII (3rd Nanotechnology Applications for Industry). 29th May. Barcelona.
- Promotion of scientific interchanges to provide facilities and equipment of other centers, including the payment for the journey and the accommodation.
- Financing training courses for researchers and technicians in Catalonia and Aragon.
- Financing visits to set new projects.
- Financing scientific exchanges among these communities.

Researchers in Nanoscience and Nanotechnology areas from Catalonia and Aragon can request budget for those activities applying at: www.nanoaracat.com/solicitudes.html
The applications will be revised by the scientific commission, which will decide the appropriateness of the request, as we as the amount of the financing of the action in about 10 days.

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Atomic Force F&E GmbH was founded in 1998 as a distribution, service and application support organisation for advanced metrological instrumentation for the European research community. The companies well-established pre-sales technical consulting and after sales technical support ensure productive work and support rapid return of investment into research equipment of its clients.
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Four physicists and one electrical engineer work in the headquarter and the regional office near Munich, supported by a full time secretary and two part time internals.
Since its foundation, Atomic Force F&E GmbH has experienced rapid growth of sales and customer base and supported this growth by increasing staff and office space.

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- Veeco Instruments (SPM, Optical and Mechanical Profilers)
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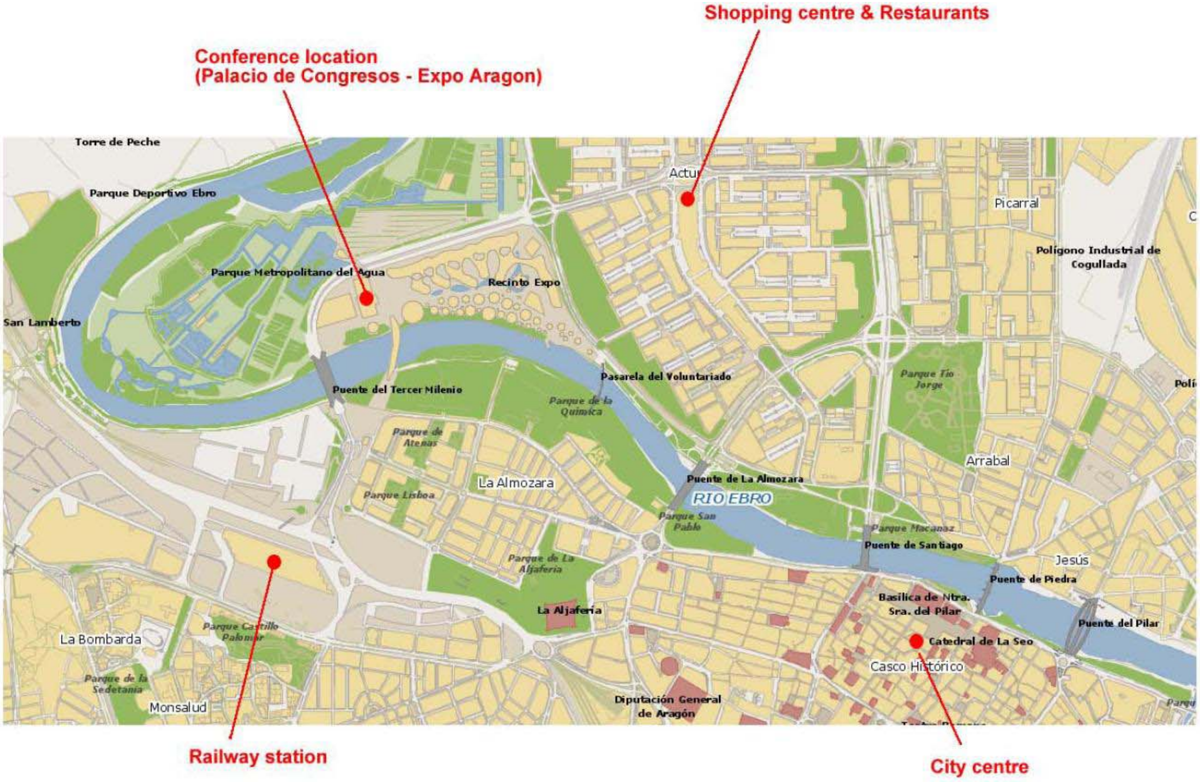
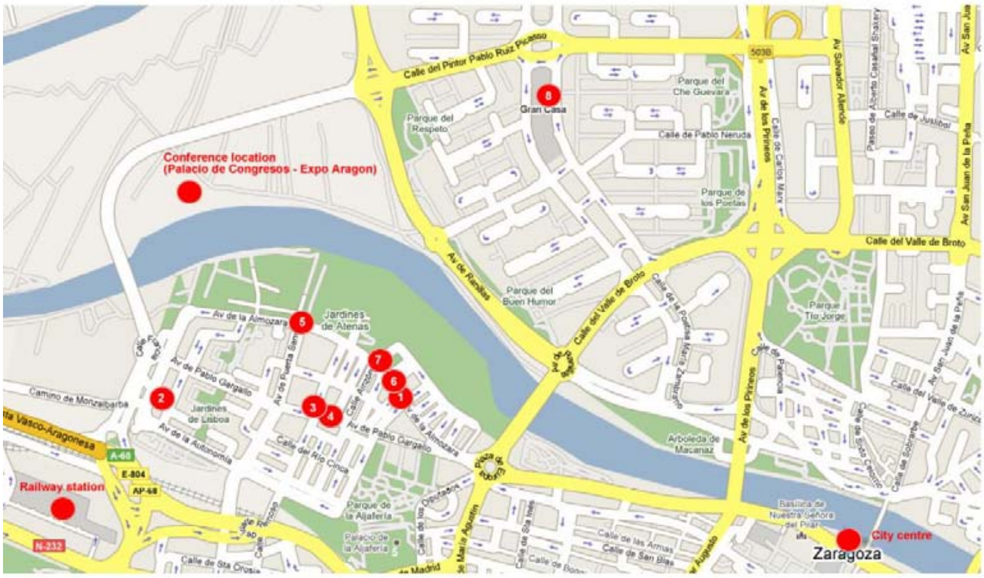
web: www.lot-oriel.com

Maps





Restaurants

1. Casa Antón
Avenida Almozara 39

2.Hotel Tryp
Avenida Francia s/n

Bars

3. La Antigua Carbonera
Avenida Pablo Gallardo 84

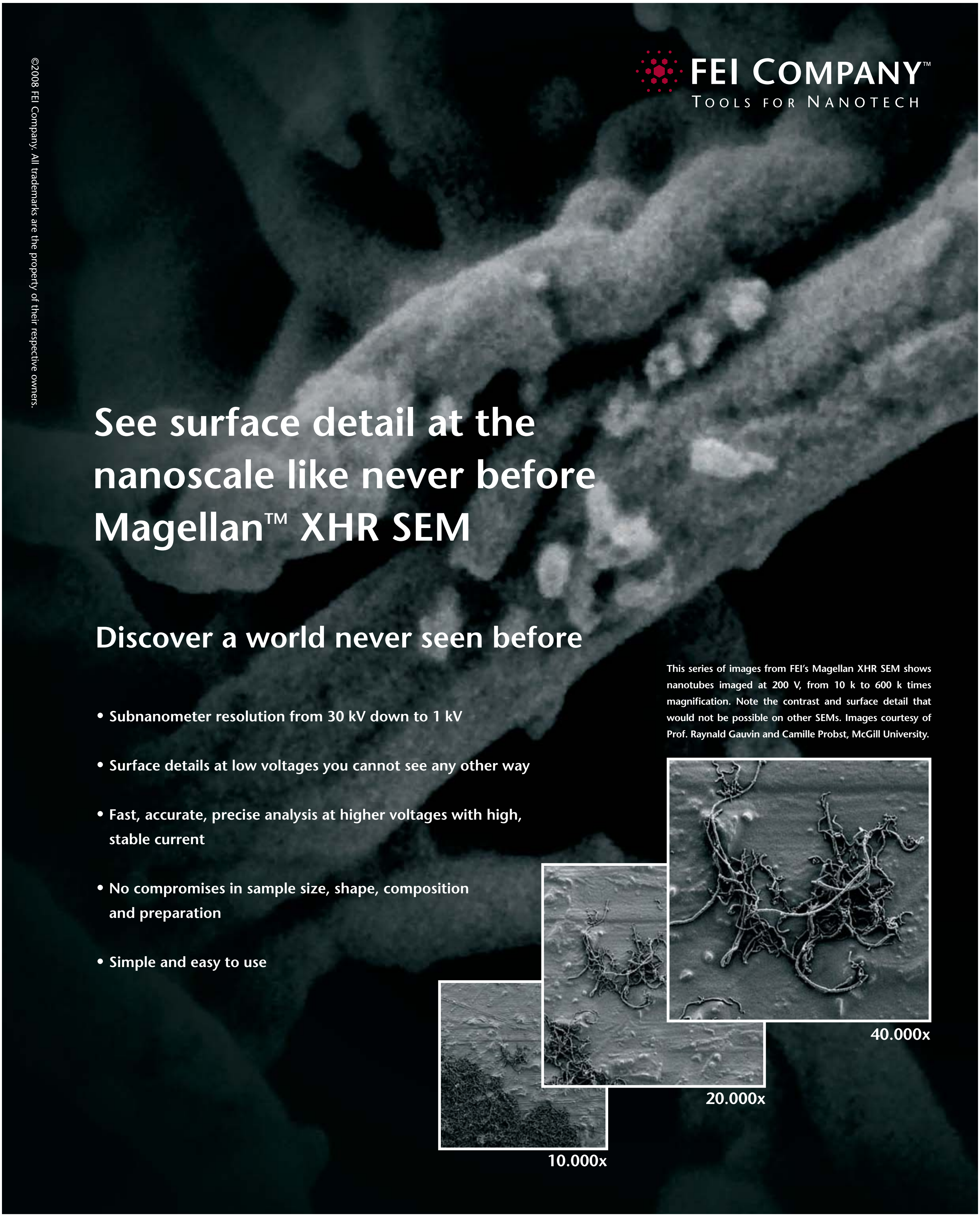
4. Cervino
Calle Ainzon 18

5. Tiki Taka
Avenida Almozara esquina Av Puerta Sancho

6.Cervecería Monalisa
Avenida Almozara 38

7. Café Saudade
Avenida Almozara 42

8. Shopping centre & Restaurants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NANOSPAIN2009

SCIENTIFIC PROGRAMME

SCIENTIFIC PROGRAMME

Monday March 09, 2009

08h00-09h00	**Registration and welcome**	
(Session: Nanobiotechnology / Nanomedicine) - Chairman: Jesús M. de la Fuente (Spain)		
09h00-09h40	**Albert van den Berg** (University of Twente, The Netherlands)	**I**
(page 21)	*"Lab-on-a-Chip: from micro/nanofluidic research-platform to biomedical applications"*	
09h40-10h00	**Pilar Rivera Gil** (Philipps Universität Marburg, Germany)	**O**
(page 97)	*"Biodegradable polyelectrolyte capsules for medical applications"*	
10h00-10h20	**Elena Martinez** (Institute for Bioengineering of Catalonia, Spain)	**O**
(page 75)	*"Designing micro and nanopatterned surfaces for cell studies and biosensor applications"*	
10h20-10h40	**Javier Tamayo** (IMM-CSIC, Spain)	**O**
(page 105)	*"Nanomechanical Devices: Label- free Ultrasensitive Biosensors"*	
10h40-11h30	**Coffee Break – Poster Session & Instrument Exhibition**	
(Session: Nanotubes) - Chairman: Wolfgang Maser (Spain)		
11h30-12h10	**Maurizio Prato** (University of Trieste, Italy)	**I**
(page 19)	*"Funtionalization of Carbon Nanotubes for Applications in Materials and Nanomedicine"*	
12h10-12h30	**Marino Arroyo** (Universitat Politècnica de Catalunya, Spain)	**O**
(page 27)	*"Multiwalled carbon nanotubes: the thicker, the softer"*	
12h30-12h50	**Nicolas Camara** (IMB-CNM, CSIC, Spain)	**O**
(page 39)	*"Very large monolayer graphene ribbons grown on SiC"*	
12h50-13h10	**Bogdana Borca** (Universidad Autónoma de Madrid, Spain)	**O**
(page 37)	*"Electronic corrugation of rippled graphene epitaxially grown on Ru(0001)"*	
13h10-13h30	**Poster Flash Contributions**	
13h30-15h30	**Lunch**	
(Session: Nanophotonics & Nanooptics) - Chairman: Juan Jose Saenz (Spain)		
15h30-16h10	**Xavier Marie** (INSA-CNRS-LPCNO, France)	**I**
(page 15)	*"Optical and Electrical Spin Injection in Semiconductor Quantum Dots"*	
16h10-16h30	**Luis Froufe** (ICMM-CSIC, Spain)	**O**
(page 55)	*"Reduced density of states governs light scattering in photonic crystals"*	
16h30-16h50	**Lluis F. Marsal** (University Rovira i Virgili, Spain)	**O**
(page 71)	*"Synthesis and Characterization of Light-Emitting Polymer Microfibers using Porous Silicon"*	
16h50-17h10	**Jose Gonzalo** (CSIC -Institute of Optics, Spain)	**O**
(page 57)	*"From Nanolentils to Nanocolumns: Tailoring the shape of metal nanoparticles by pulsed laser deposition"*	
17h10-17h30	**Ricardo Sapienza** (ICMM-CSIC, Spain)	**O**
(page 101)	*"Self-assembled self-tuned random lasers"*	
17h30-18h00	**Poster Flash Contributions**	
18h00-20h00	**Coffee Break – Poster Session & Instrument Exhibition**	
21h00	**Welcome Reception**	

SCIENTIFIC PROGRAMME

Tuesday March 10, 2009

(Session: Nanomaterials) - Chairman: Xavier Marie (France)		
09h00-09h40	**Etienne Duguet** (University of Sciences and Technology of Bordeaux, France)	**I**
(page 11)	*"From shape-controlled nanoparticles to "colloidal molecules""*	
09h40-10h00	**Rubén Alvarez-Rodriguez** (Bioforge - University of Valladolid, Spain)	**O**
(page 25)	*"Gold Nanoparticles and Recombinant Elastin-like Polymers: Synthesis of Smart Hybrids"*	
10h00-10h20	**Zorica Konstantinovic** (ICMAB-CSIC, Spain)	**O**
(page 65)	*"Self-organized growth in Manganite Thin Films"*	
10h20-10h40	**Eva Natividad** (Instituto de Ciencia de Materiales de Aragón (ICMA), Spain)	**O**
(page 81)	*"Adiabatic versus non-adiabatic determination of specific absorption rate of ferrofluids"*	
10h40-11h00	**Daniel Ruiz-Molina** (Centro de Investigación en Nanociencia y Nanotecnología, Spain)	**O**
(page 99)	*"pH-Responsive molecular fluorescent arrays fabricated by direct-write parallel Dip-Pen and other micro-/nanolithographic techniques"*	
11h00-11h30	**Coffee Break – Poster Session & Instrument Exhibition**	
(Session: Infrastructure & Scientific Policy) - Chairman: Xavier Bouju (France)		
11h30-11h45	**Ricardo Ibarra** (Instituto de Nanotecnología de Aragon, Spain)	**O**
(page 63)	*"Institute of Nanoscience of Aragon (INA)"*	
11h45-12h00	**Jordi Pascual** (Institut Catalá de Nanotecnología, Spain)	**O**
(page 85)	*"The Catalan Institute of Nanotechnology (ICN) and the Research Centre on Nanoscience and Nanotechnology CIN2(ICN-CSIC)"*	
12h00-12h10	**Jose Luis Serrano** (INA-NanoAracat, Spain)	**O**
(page 103)	*"Nanoaracat"*	
12h10-12h20	**Marta Otero Leal** (Laboratorio Oficial de Metroloxía de Galicia, Spain)	**O**
(page 83)	*"Nanogal: Galician Technological Platform on Nanotechnology"*	
12h20-12h35	**Natividad Cuende** (Iniciativa Andaluza en Terapias Avanzadas, Spain)	**O**
(page 45)	*"Andalusian initiative for advanced therapies"*	
12h35-12h45	**Igor Campillo** (NanoBasque, Spain)	**O**
(page 41)	*"The nanoBasque Strategy"*	
12h45-13h00	**Txema Pitarke** (CIC nanoGUNE, Spain)	**O**
(page 91)	*"CIC nanoGUNE Consolider: the big challenge of the small"*	
13h00-15h00	**Lunch**	
15h00-17h15	Thematic Parallel Sessions	
	Nanobiotechnology – Chairmen: Josep Samitier, Jesús M. De la Fuente & Elena Martínez	
	Nanofabrication – Chairmen: Francesc Perez Murano & Fernando Briones	
	Industrial – Chairmen: José-Luís Viviente & Emilio Prieto	
	Nanochemistry – Chairmen: Jaume Veciana & Nora Ventosa	
	NanoPhotonics & NanoOptics – Chairmen: Juan José Sáenz & Antonio García Martín	
17h15-18h00	**Coffee Break – Poster Session & Instrument Exhibition**	
(Session: Theory) - Chairman: Antonio García-Martín (Spain)		
18h00-18h20	**Xavier Cartoixa** (Universitat Autònoma de Barcelona, Spain)	**O**
(page 43)	*"Theory of defect formation energies in one-dimensional systems: dopant activation in Si nanowires"*	
18h20-18h40	**Rubén Pérez** (Universidad Autónoma de Madrid, Spain)	**O**
(page 89)	*"Imaging, manipulation and chemical identification of individual atoms with dynamic force microscopy: a theoretical perspective."*	
18h40-19h20	**Alexandre Bouzdin** (Université Bordeaux 1, France)	**I**
(page 7)	*"Superconductor-ferromagnet nanostructures"*	
21h30	**Conference Dinner**	

Programme – NanoBiotechnology Thematic Session – Tuesday March 10, 2009		
15h00-15h30	**Jose Manuel Guisan** (ICP-CSIC, Spain)	**K**
(page 129)	*"Immobilization of high amounts of correctly orientated antibodies on fully inert surfaces: use of hydrophilic supports containing glyoxyl groups"*	
15h30-15h45	**Vera Trabadelo** (Tekniker/Dpto. Micro y Nanotecnologías, Spain)	**O**
(page 161)	*"Protein patterning by thermal nanoimprint lithography and NH3-plasma functionalization of polystyrene"*	
15h45-16h00	**Maruxa Estevez** (Institute for Bioengineering of Catalonia, Spain)	**O**
(page 119)	*"Topographic features at the micrometer scale induce changes in cell cytoskeleton and Golgi complex morphologies"*	
16h00-16h15	**Sara Puertas** (Instituto de Nanociencia de Aragón, Spain)	**O**
(page 143)	*"Functionalization of Magnetic Nanoparticles with Antibodies: Does the Antibody Orientation Matter?"*	
16h15-16h30	**Maria Moros** (Instituto de Nanociencia de Aragon, Spain)	**O**
(page 139)	*"Protein-carbohydrate interaction studies by means of superparamagnetic nanoparticles clustering"*	
16h30-16h45	**Slavko Kralj** (Jozef Stefan Institute, Slovenia)	**O**
(page 133)	*"Preparation of fluorescent, functionalized, silica-coated magnetic nanoparticles marked with monoclonal antibodies"*	
16h45-17h15	**Discussion & Conclusion**	

Programme – NanoFabrication Thematic Session – Tuesday March 10, 2009		
15h00-15h30	**José María de Teresa** (ICMA (CSIC-UNIZAR), Spain)	**K**
(page 117)	*"Electrical transport properties of metallic nanowires and nanoconstrictions created with FIB/SEM dual beam"*	
15h30-16h00	**Andreas Berger** (Asociación CIC nanoGUNE, Spain)	**K**
(page 113)	*"Controlling Magnetic Hysteresis by Nano-Scale Materials Design"*	
16h00-16h15	**Ignacio Garcia** (CIDETEC/NEW MATERIALS, Spain)	**O**
(page 125)	*"Double Shell FeNi Nanoparticles"*	
16h15-16h30	**Nuno Sousa** (Universidade do Porto, Portugal)	**O**
(page 157)	*"Theoretical study of magnetodynamics in BCC iron nanoparticles"*	
16h30-16h45	**Ivan Fernandez** (IMM-CSIC, Spain)	**O**
(page 121)	*"Magnetostrictive drive of AFM cantilevers for liquid operation"*	
16h45-17h00	**Oliver Wilhelmi** (FEI Company, Netherlands)	**O**
(page 169)	*"Advances in Focused Ion Beam Nanoprototyping"*	
17h00-17h15	**Discussion & Conclusion**	

Programme – Industrial Thematic Session – Tuesday March 10, 2009		
15h00-15h30	**Jordi Reverter** (ICN-UAB, Spain)	**K**
(page 149)	*“Technology transfer in nanotechnology: from the research to the market”*	
15h30-15h45	**Nora Ventosa** (ICMAB-CSIC, Spain)	**O**
(page 165)	*"Uniform shape and size drug particles prepared by a new Pressure Induced Water Anti-Solvent Precipitation (PIWASP) methodology"*	
15h45-16h15	**Victor Puntes** (ICN-UAB, Spain)	**K**
(page 145)	"*Nanotechnology: from nanotoxicology to nanomedicine"*	
16h15-16h45	**Ruth Jimenez** (Higienista Industrial, Spain)	**K**
(page 131)	*"Safe production and use of nanomaterials: Health and Safety management"*	
16h45-17h00	**Francisco Balas** (CIBER-BBN - Instituto de Nanociencia de Aragón, Spain)	**O**
(page 111)	*"Nanosost: Towards a Sustainable, Responsible and Safe Nanotechnology"*	
17h00-17h15	**Discussion & Conclusion**	

Programme – NanoChemistry Thematic Session – Tuesday March 10, 2009		
15h00-15h30	**Jose Angel Martin Gago** (ICMM-CSIC, Spain)	**K**
(page 135)	*"Fullerenes formation from aromatic precursors by a surface catalysed cyclodehydrogenation process"*	
15h30-15h45	**Miguel Valcárcel Cases** (University of Córdoba, Spain)	**O**
(page 163)	*"Ag-coated CdSe/ZnS quantum dots: optical properties and analytical potential"*	
15h45-16h00	**José Carlos Conesa** (Instituto de Catálisis y petroleoquímica, CSIC, Spain)	**O**
(page 115)	*"DFT modeling of CuO catalyst nanoparticles"*	
16h00-16h15	**Alfonso Fernández-González** (Universidad de Oviedo, Spain)	**O**
(page 123)	*"Formation of ternary nano-complex gold nanoparticles-copper ions-histamine"*	
16h15-16h30	**José Manuel Pingarrón** (University Complutense of Madrid, Spain)	**O**
(page 141)	*"Gold nanoparticles - structured electrochemical biosensors for applications in the food industry"*	
16h30-16h45	**Bartolomé Simonet** (University of Córdoba, Spain)	**O**
(page 155)	*"Analytical potential of the carbon nanoparticles-ionic liquid combination"*	
16h45-17h00	**Damien Voiry** (CRPP, Centre de Recherche Paul Pascal, France)	**O**
(page 167)	*“Control of covalent functionalization of SWCNT through reduction”*	
17h00-17h15	**Discussion & Conclusion**	

Programme – NanoPhotonics & NanoOptics Thematic Session – Tuesday March 10, 2009		
15h00-15h30	**Luís Martín Moreno** (Universidad de Zaragoza, Spain)	**K**
(page 137)	*"Guiding plasmons with subwavelength lateral confinement in the optical and THz regimes"*	
15h30-16h00	**Romain Quidant** (ICFO, Spain)	**K**
(page 147)	*"Shaping the optical and thermal properties of plasmonics nanostructures for biological applications"*	
16h00-16h15	**Juan Bautista González-Díaz** (IMM-CNM-CSIC, Spain)	**O**
(page 127)	*"Magneto-Optical activity emerging from Plasmonic Gold Nanodisks"*	
16h15-16h30	**Rogelio Rodríguez-Oliveros** (Instituto Estructura de la Materia-CSIC, Spain)	**O**
(page 151)	*"Surface Plasmon Resonances of Metal Nanoparticle Dimers through the Hybridization Model and Generalization to Nanoparticle chains"*	
16h30-16h45	**Martin Schnell** (Asociación CIC nanoGUNE, Spain)	**O**
(page 153)	*"Control of local near fields in optical antennas by load engineering: bridging the gap"*	
16h45-17h00	**Johannes Stiegler** (Asociación CIC nanoGUNE, Spain)	**O**
(page 159)	*"Nanoscale infrared near-field mapping of free-carrier concentration in single semiconductor nanowires"*	
17h00-17h15	**Discussion & Conclusion**	

SCIENTIFIC PROGRAMME		
Wednesday March 11, 2009		
(Session: Nanomagnetism) - Chairman: Andreas Berger (Spain)		
09h00-09h40	**Marco Affronte** (CNR-INFM National Research Center, Italy)	**I**
(page 5)	*"Molecular nanoMagnets for information technologies: challenges, achievents and perspectives"*	
09h40-10h00	**Juan de la Figuera** (Instituto de Quimica-Fisica Rocasolano CSIC, Spain)	**O**
(page 47)	*"Why does a thick film de-wet?"*	
10h00-10h20	**Paolo Vavassori** (Asociación CIC nanoGUNE, Spain)	**O**
(page 107)	*"Magnetostatic dipolar domain wall pinning in chains of Permalloy triangular rings micromagnets"*	
10h20-10h40	**Fernando Bartolomé** (ICMA-CSIC - Universidad de Zaragoza, Spain)	**O**
(page 31)	*"Magnetization of Pt13 clusters supported in a NaY zeolite: a XAS and XMCD study."*	
10h40-11h40	**Poster Session / Coffee Break & Instrument Exhibition**	
(Session: Nanomagnetism) - Chairman: Paolo Vavassori (Spain)		
11h40-12h20	**Russell Cowburn** (Imperial College London, UK)	**I**
(page 9)	*"Domain walls in nanowires"*	
12h20-12h40	**Adriana Figueroa** (Instituto de Ciencia de Materiales de Aragón, Spain)	**O**
(page 53)	*"Magnetic properties of Co nanoparticles capped with a W thin film"*	
12h40-13h00	**Lluis Balcells** (ICMAB-CSIC, Spain)	**O**
(page 29)	*"Dipolar Driven Spontaneous self assembly of Superparamagnetic Co Nanoparticles into micrometric Rice-Grain like structures"*	
13h00-15h00	**Lunch**	
(Session: C´NANO GSO) - Chairman: Jean-Pierre Aimé (France)		
15h00-15h20	**Hélène Feracci** (Université Bordeaux &, CNRS UPR 8641, France)	**O**
(page 51)	*"Single Molecule studies to decipher Cadherin-mediated Cell Adhesion"*	
15h20-15h40	**Yannick Guari** (Institut Charles Gerhardt Montpellier, France)	**O**
(page 59)	*"RuO2@SiO2 nanomaterials as catalytic filters for gas sensors"*	
15h40-16h00	**Pierre-Jean Debouttière** (Laboratoire de Chimie de Coordination(LCC), France)	**O**
(page 49)	*"Organometallic synthesis of water-soluble Pt and Ru nanoparticles"*	
16h00-16h20	**Florent Houdellier** (CEMES-CNRS, France)	**O**
(page 61)	*"Strain determination by dark-field electron holography"*	
16h20-16h40	**Sylvie Lacombe** (IPREM CNRS UMR 5254 Université de Pau, France)	**O**
(page 67)	*"Nanofunctional Mesoporous Films with Photo-oxidative Properties"*	
16h40-19h00	**Coffee Break – Poster Session & Instrument Exhibition**	
20h00	**Visit of the "Palacio de la Aljafería de Zaragoza"**	

SCIENTIFIC PROGRAMME

Thursday March 12, 2009

	(Session: Nanobiotechnology / Nanomedicine) - Chairman: Josep Samitier (Spain)	
09h00-09h40	**Wolfgang Parak** (University Marburg, Germany)	**I**
(page 17)	*"Biological Applications of Colloidal Nanoparticles"*	
09h40-10h00	**Ralf Richter** (CIC biomaGUNE, Biosurfaces Unit, Spain)	**O**
(page 95)	*"Getting a grip on strongly hydrated biomolecular films – the example of the pericellular coat"*	
10h00-10h20	**Imma Ratera** (ICMAB-CSIC, Spain)	**O**
(page 93)	*"Surface modification with engineered bacterial biocompatible nanomaterials for cell proliferation"*	
10h20-10h40	**Carlos Martinez-Boubeta** (ICMAB-CSIC, Spain)	**O**
(page 77)	*"Self-assembled Multifunctional Fe/MgO Nanospheres for Magnetic Resonance Imaging and Hyperthermia"*	
10h40-11h10	**Coffee Break – Poster Session & Instrument Exhibition**	
	(Session: Nanochemistry) - Chairman: Jaume Veciana (Spain)	
11h10-11h50	**Jurriaan Huskens** (University of Twente, The Netherlands)	**I**
(page 13)	*"Supramolecular Nanomaterials"*	
11h50-12h10	**Mª Soledad Martin** (IMM-CSIC, Spain)	**O**
(page 73)	*"Electrochemical potential and electrolyte effect on the conductance of Au nanocontacts"*	
12h10-12h30	**Juan Bartolomé** (Instituto de Ciencia de Materiales de Aragón, Spain)	**O**
(page 31)	*"Large orbital moment in alfa-Fe phthalocyanine thin films: an XMCD study"*	
12h30-12h50	**Mónica Luna** (IMM-CSIC, Spain)	**O**
(page 69)	*"Carbohydrate-carbohydrate interaction prominence in 3D supramolecular self-assembly"*	
12h50-13h10	**Sergio Moya** (CIC biomaGUNE, Spain)	**O**
(page 79)	*"Polyelectrolytes as building blocks in nanotechnology"*	
13h10-13h30	**Isabel Pastoriza-Santos** (Universidade de Vigo, Spain)	**O**
(page 87)	*"Encapsulation Gold Nanoparticles in Thermoresponsive Microgels. Molecular traps for SERS"*	
13h30-13h50	**Alexander Bittner** (Asociación CIC nanoGUNE, Spain)	**O**
(page 35)	*"Nanofabrication with Peptide and Protein tubes"*	
13h50-14h00	**Concluding Remarks / NanoSpain2010 announcement**	

Poster Flash Contributions – Monday March 09, 2009			
13h10-13h15	**Carlos Cuestas** (Insituto de Nanociencia de Aragon, Spain)	**NanoBiotechnology**	*"Bio-surface engineering for cell adhesion studies"*
13h15-13h20	**Gonçalo Doria** (CIGMH/DCV & REQUIMTE/DQ - FCT/UNL, Portugal)	**NanoBiotechnology**	*"Au-nanoprobe optimization for SNP detection at room temperature by non-cross-linking aggregation"*
13h20-13h25	**Célia Sousa** (IFIMUP and IN- Institute of Nanoscience and Nanotechnology, Portugal)	**NanoBiotechnology**	*"Ordered Assembly of Oxide Nanotubes in Porous Alumina Membranes for Biomedical Applications"*
13h25-13h30	**María Rosa López Ramírez** (Universidad de Málaga, Spain)	**NanoChemistry**	*"Nanostructured metallic substrates for micro-SERS biological applications"*
17h30-17h35	**José Miguel González Domínguez** (ICB-CSIC, Spain)	**Nanomaterials**	*"Advanced trifunctional epoxy – swnts composite materials. preparation and characterization"*
17h35-17h40	**Tirma Herranz Cruz** (Instituto de Quimica Fisica Rocasolano-CSIC, Spain)	**Nanomaterials**	*"In-situ spectroscopy of monodispersed cobalt nanoparticles during reduction and carbon monoxide hydrogenation"*
17h40-17h45	**Plamen Kirilov** (Université Paul Sabatier, France)	**Nanomaterials**	*"Colloidal nanoparticles of gelled oil – elaboration process and characterization"*
17h45-17h50	**Víctor Sebastian Cabeza** (Universidad de Zaragoza, Spain)	**Nanomaterials**	*"Zeolite films as catalytic coating on micro-reactors for SELOX reaction"*
17h50-17h55	**Ewelina Andrzejewska** (Fundacion IMDEA-Nanociencia, Spain)	**NanoElectronics**	*"Characterization of organic/organic/substrate interfaces of thin p-n heterostructures"*
17h55-18h00	**Virginia Estévez Nuño** (Instituto Ciencias de Materiales de Madrid, Spain)	**NanoElectronics**	*"Spin accumulation, current oscillations and negative differential in transport through nanoparticle arrays"*

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"Gold Nanoparticles and Recombinant Elastin-like Polymers: Synthesis of Smart Hybrids"		
Marino Arroyo (Universitat Politècnica de Catalunya, Spain)	**ORAL**	**p.27**
"Multiwalled carbon nanotubes: the thicker, the softer"		
Francisco Balas (CIBER-BBN - Instituto de Nanociencia de Aragón, Spain) – Industrial	**ORAL Parallel Session**	**p.111**
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"Large orbital moment in alfa-Fe phthalocyanine thin films: an XMCD study"		
Fernando Bartolomé (ICMA, CSIC - Universidad de Zaragoza, Spain)	**ORAL**	**p.33**
"Magnetization of Pt13 clusters supported in a NaY zeolite: a XAS and XMCD study."		
Andreas Berger (CIC nanoGUNE, Spainl) – Nanofabrication	**ORAL Parallel Session**	**p.113**
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Alexander Bittner (Asociacion CIC nanoGUNE, Spain)	**ORAL**	**p.35**
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Bogdana Borca (Universidad Autónoma de Madrid, Spain)	**ORAL**	**p.37**
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Alexandre Bouzdin (University Bordeaux 1, France)	**INVITED**	**p.7**
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Nicolas Camara (IMB-CNM, CSIC, Spain)	**ORAL**	**p.39**
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Igor Campillo (NanoBasque, Spain)	**ORAL**	**p.41**
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Xavier Cartoixa (Universitat Autònoma de Barcelona, Spain)	**ORAL**	**p.43**
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Jose Carlos Conesa (Instituto de Catálisis y petroleoquímica, CSIC, Spain) – NanoChemistry	**ORAL Parallel Session**	**p.115**
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Russell Cowburn (Imperial College London, UK)	**INVITED**	**p.9**
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Natividad Cuende (Iniciativa Andaluza en Terapias Avanzadas, Spain)	**ORAL**	**p.45**
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Juan de la Figuera (Instituto de Quimica-Fisica Rocasolano CSIC, Spain)	**ORAL**	**p.47**
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Pierre-Jean Debouttière (Laboratoire de Chimie de Coordination(LCC), France)	**ORAL**	**p.49**
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Jose Maria De Teresa (ICMA (CSIC-UNIZAR), Spain) – Nanofabrication	**ORAL** **Parallel Session**	**p.117**
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Etienne Duguet (University of Sciences and Technology of Bordeaux, France)	**INVITED**	**p.11**
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Maruxa Estevez (Institute for Bioengineering of Catalonia, Spain) – NanoBiotechnology	**ORAL** **Parallel Session**	**p.119**
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Helene Feracci (Université Bordeaux &, CNRS UPR 8641, France)	**ORAL**	**p.51**
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Ivan Fernandez (IMM-CSIC, Spain) – Nanofabrication	**ORAL** **Parallel Session**	**p.121**
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Alfonso Fernández-González (Universidad de Oviedo, Spain) – NanoChemistry	**ORAL** **Parallel Session**	**p.123**
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Adriana Figueroa (Instituto de Ciencia de Materiales de Aragón, Spain)	**ORAL**	**p.53**
“Magnetic properties of Co nanoparticles capped with a W thin film”		
Luis Froufe (ICMM-CSIC, Spain)	**ORAL**	**p.55**
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Ignacio Garcia (CIDETEC/NEW MATERIALS, Spain) – Nanofabrication	**ORAL** **Parallel Session**	**p.125**
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Juan Bautista González-Díaz (Instituto de Microelectrónica de Madrid IMM-CSIC, Spain) – Nanophotonics	**ORAL** **Parallel Session**	**p.127**
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Jose Gonzalo (CSIC/ Institute of Optics, Spain)	**ORAL**	**p.57**
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Yannick Guari (Institut Charles Gerhardt Montpellier, France)	**ORAL**	**p.59**
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Florent Houdellier (CEMES-CNRS, France)	**ORAL**	**p.61**
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Jurriaan Huskens (University of Twente, The Netherlands)	**INVITED**	**p.13**
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Ricardo Ibarra (Instituto de Nanotecnologia de Aragon, Spain)	**ORAL**	**p.63**
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Ruth Jimenez (Higienista Industrial, Spain) – Industrial	**ORAL** **Parallel Session**	**p.131**
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Zorica Konstantinovic (ICMAB-CSIC, Spain)	**ORAL**	**p.65**
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Slavko Kralj (Jozef Stefan Institute, Slovenia) – NanoBiotechnology	**ORAL** **Parallel Session**	**p.133**
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Sylvie Lacombe (IPREM CNRS UMR 5254 Université de Pau, France)	**ORAL**	**p.67**
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Mónica Luna (IMM-CSIC, Spain)	**ORAL**	**p.69**
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Xavier Marie (INSA-CNRS-LPCNO, France)	**INVITED**	**p.15**
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Lluis F. Marsal (University Rovira i Virgili, Spain)	**ORAL**	**p.71**
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Maria Soledad Martin (Instituto de Microelectrónica de Madrid, IMM-CNM-CSIC, Spain)	**ORAL**	**p.73**
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Luis Martin Moreno (Universidad de Zaragoza, Spain) – NanoPhotonics	**ORAL** **Parallel Session**	**p.137**
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Elena Martinez (Institute for Bioengineering of Catalonia, Spain)	**ORAL**	**p.75**
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Carlos Martinez-Boubeta (ICMAB-CSIC, Spain)	**ORAL**	**p.77**
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Maria Moros (Instituto de Nanociencia de Aragon, Spain) – NanoBiotechnology	**ORAL Parallel Session**	**p.139**
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Sergio Moya (CIC biomaGUNE, Spain)	**ORAL**	**p.79**
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Eva Natividad (Instituto de Ciencia de Materiales de Aragón (ICMA), Spain)	**ORAL**	**p.81**
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Marta Otero Leal (Laboratorio Oficial de Metroloxía de Galicia, Spain)	**ORAL**	**p.83**
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Wolfgang Parak (University Marburg, Germany)	**INVITED**	**p.17**
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Jordi Pascual (Institut Catalá de Nanotecnología, Spain)	**ORAL**	**p.85**
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Rubén Pérez (Universidad Autónoma de Madrid, Spain)	**ORAL**	**p.89**
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Txema Pitarke (CIC nanoGUNE, Spain)	**ORAL**	**p.91**
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José Manuel Pingarrón (University Complutense of Madrid, Spain) – NanoChemistry	**ORAL Parallel Session**	**p.141**
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Maurizio Prato (University of Trieste, Italy)	**INVITED**	**p.19**
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Sara Puertas (Instituto de Nanociencia de Aragón, Spain) – NanoBiotechnology	**ORAL Parallel Session**	**p.143**
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Victor Puntes (Institut Català de Nanotecnologia, Spain) – Industrial	**ORAL** **Parallel Session**	**p.145**
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Imma Ratera (ICMAB-CSIC, Spain)	**ORAL**	**p.93**
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Jordi Reverter (ICN-UAB, Spain) – Industrial	**ORAL** **Parallel Session**	**p.149**
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Ralf Richter (CIC biomaGUNE, Biosurfaces Unit, Spain)	**ORAL**	**p.95**
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Pilar Rivera Gil (Philipps Universität Marburg, Germany)	**ORAL**	**p.97**
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Martin Schnell (Asociación CIC nanoGUNE, Spain) – Nanophotonics	**ORAL** **Parallel Session**	**p.153**
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Nuno Sousa (Universidade do Porto, Portugal) – Nanofabrication	**ORAL** **Parallel Session**	**p.157**
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Johannes Stiegler (CIC nanoGUNE Consolider, Spain) – Nanophotonics	**ORAL** **Parallel Session**	**p.159**
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Javier Tamayo (Instituto de Microelectrónica de Madrid/Bionanomechanics Lab, Spain)	**ORAL**	**p.105**
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Vera Trabadelo (Tekniker/Dpto. Micro y Nanotecnologías, Spain) – NanoBiotechnology	**ORAL Parallel Session**	**p.161**
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Albert van den Berg (University of Twente, The Netherlands)	**INVITED**	**p.21**
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Paolo Vavassori (CIC nanoGUNE Consolider, Spain)	**ORAL**	**p.107**
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Nora Ventosa (ICMAB-CSIC, Spain) – Industrial	**ORAL Parallel Session**	**p.165**
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ABSTRACTS

INVITED CONTRIBUTIONS

4

MOLECULAR NANOMAGNETS FOR INFORMATION TECHNOLOGIES: CHALLENGES, ACHIEVENTS AND PERSPECTIVES.

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In ten years the size of a magnetic register (bit) and that of a processor will attain ≤10nm, thus comparable to that of nanoparticles and molecules. At this length scale, quantum effects become relevant and bottom-up approaches for the production of nano-devices become competitive with respect to top-down fabrication processes. Nanomagnets will play a role for the storage and processing of information in the next future. So it is straightforward to wonder to which extent, *molecular nanomagnets* will contribute to this game. I'll briefly review basic requirements for the information technologies and some of the recent achievements in the field as well as some ideas that can be further pursued[i].

The main part of my talk will be devoted to the use of molecular spin clusters for quantum computation. Molecular magnets are indeed quantum objects, with well-defined spin states at low temperature[ii]. The challenge is to obtain scalable quantum hardware with long coherence time. I'll consider the paradigmatic case of molecular antiferromagnetic (AF) spin systems to show that they can effectively encode quantum bits. The case of AF spin triangles already contains the main features of quantum hardware. A more sophisticate case is that of AF rings in which an extra spin was introduced to have a S=1/2 as ground state[iii] and use excited states as a resource for implementing two-qubit gates[iv]. The mechanism of decoherence can be studied in details by considering hyperfine interactions with finite number of nuclear spins[v]. Molecular nanoMagnets can be functionalized to be grafted on surface[vi]. Positioning and visualizing molecular nanomagnets is another issue and I'll briefly mention our efforts and achievement in this direction[vii]. Molecular building blocks can also be linked each other by forming supramolecular complexes[viii,ix] with tuneable entanglement of spin states. This provides a unique opportunity to observe conditional quantum dynamics of spins in molecular systems and eventually to exchange information between magnetic molecules. Finally, I'll briefly mention our efforts in the development of graphene-based devices for molecular spintronics.

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G. A. Timco, S. Carretta, F. Troiani, F. Tuna, R. J. Pritchard, E. J. L. McInnes, A. Ghirri, A. Candini, P. Santini, G. Amoretti, M. Affronte and Richard E. P. Winpenny. *Nature Nanotechnology (2009 Feb.) DOI:10.1038/NNANO.2008.404*

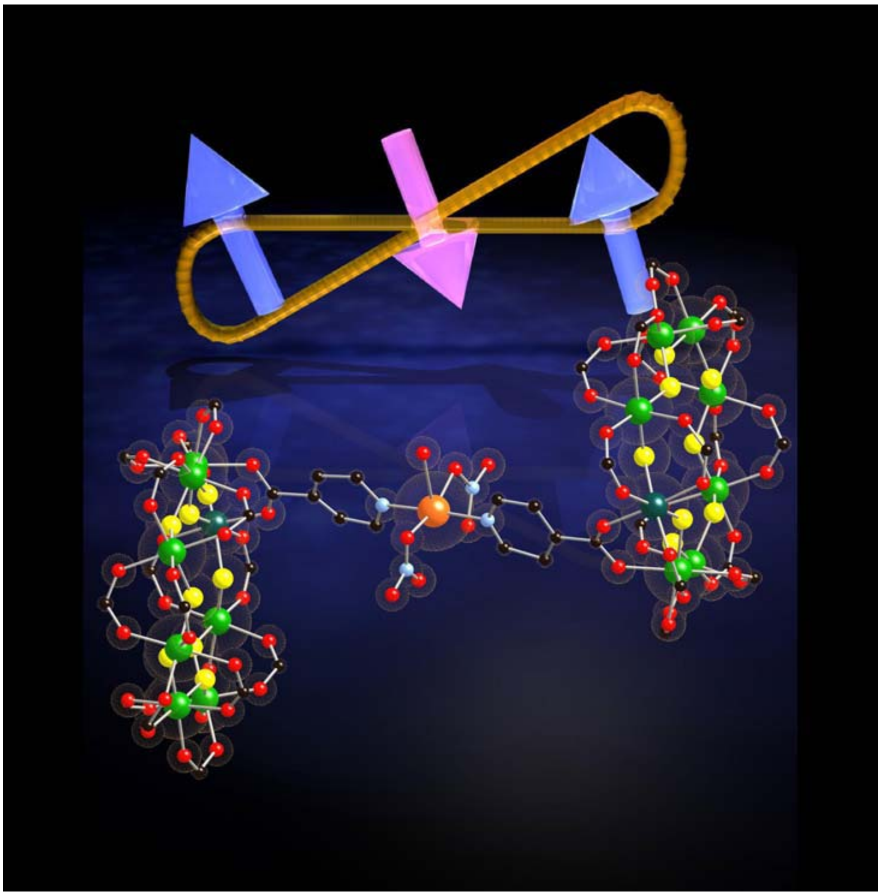

Figure: Entanglement of spins in supramolecular architectures. Ref.9

SUPERCONDUCTOR-FERROMAGNET NANOSTRUCTURES

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A strong exchange field acting on the Cooper pairs in the ferromagnetic (F) metal leads to the damping oscillatory behaviour of the superconducting order parameter inside the F layer. In consequence in the superconductor-ferromagnet (S-F) multilayers the critical temperature and Josephson current depend in an oscillatory manner on the exchange field and thickness of ferromagnetic metal [1].

These oscillations are related with the transition into the state where the phase of superconducting order parameter is opposite in S-F-S Josephson junction. Such π-junction incorporated in a superconducting circuit may generate a spontaneous current. Moreover, Josephson junction where the weak link is formed by a noncentrosymmetric ferromagnet has very interesting properties. The ground state of this junction is characterized by the finite phase difference φ_0, which is proportional to the strength of the spin-orbit interaction and the exchange field in the normal metal [2]. Such φ_0- junction gives a direct coupling between the superconducting current and the magnetic moment. The superconducting current could flip the magnetic moment and inversely the ac Josephson effect may generates a magnetic precession providing then a feedback to the current [3]. The superconductor-ferromagnet nanostructures open very interesting perspectives for the superconducting spintronics.

In addition the interplay between superconductivity and magnetism in (F/S/F) spin-valve sandwiches provides an interesting switching effect. When the superconductor layer thickness is smaller or of the order of the superconducting coherence length, its critical temperature is controlled by the proximity effect due to the strong exchange field in F region. Therefore the critical temperature and other superconducting characteristics strongly depend on the mutual orientation of the magnetization in F layers. This means that a weak magnetic field would trigger a very strong variation of the resistivity.

Domain structure in ferromagnet may provoke in S-F bilayer the appearance of the superconductivity localized near the domain wall. Inversely, under certain conditions, the superconductivity could trigger the transition into a short period domain state in the F layer.

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DOMAIN WALLS IN NANOWIRES

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Nanometre scale planar magnetic nanowires can exhibit a special magnetic property known as domain wall (DW) conduit behaviour in which DWs can be transmitted along the nanowire by the application of weak magnetic fields or electrical currents. Topographical changes such as corners, junctions, constrictions and protrusions in otherwise straight magnetic nanowires allow control of the DWs within these conduits as they create changes in the energy landscape which modify their local propagation field. This opens up the possibility of integrated circuits containing complex networks of nanowires in which information is carried, stored and processed by DWs flowing along nanowire conduits. In this talk I describe the main features of how artificial structures such as constrictions, side arms and crossed wires modify the energy landscape of a moving DW and explain the key role that the chirality of the transverse component of the DW plays in understanding how DWs interact with artificial structures. I explain the concept of a chirality coherence length and how that coherence length can be extended by artificial structuring. Finally, I present a high efficiency domain wall gate in which a DW can be blocked or transmitted according to the magnetic state of a third magnetic input.

FROM SHAPE-CONTROLLED NANOPARTICLES TO "COLLOIDAL MOLECULES"

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Hybrid organic-inorganic nanoparticles with well-controlled morphology are currently of great interest for numerous applications. Synthetic routes leading to robust aggregates made of nanoparticles of different chemical natures which are associated in a controlled manner (*i.e.* number of nanoparticles and geometrical arrangement) are especially investigated.

Our strategy is based on a seeded emulsion polymerization process leading to biphasic particles, which are composed of spherical silica spheres surrounded by a varying number of polystyrene (PS) nodules [1]. The hydrophilic surface of the silica seed particles (50-400 nm) needs to be previously functionalized by silane chemistry. Emulsion polymerization of styrene is carried out in presence of these particles. In such conditions, the nucleation/growth of the PS nodules is highly favoured at the silica surface, leading to multipod-like morphologies (bipods, tetrapods, hexapods, octopods, etc.) (Figure 1). While varying different experimental parameters, it was demonstrated that the key parameters to control the pod number and arrangement are (i) the ratio between the number of silica seeds and the number of growing PS nodules, (ii) the size of silica seeds and (iii) the silane grafting density [2].

In particular, we demonstrated that the number of PS latex per silica seed can be calculated from the size of the silica seed by solving an equation which results from the minimization of a two-term-energy. The first one is an attraction towards the centre and the contribution of the second one produces two-body particle repulsions, which can balance the attractive central force [2].

Original cryo-TEM images were recorded and 3D-reconstructions allowed measuring the contact angle between the PS nodules and the surface of silica seeds [3].

Lastly, original planar biphasic colloids may be also obtained by shaping these multipod-like particles on planar substrates by taking advantage of the softness of the PS nodules, leading to triangles, squares, pentagons, hexagons, octagons, etc (Figure 2).

A key feature of our approach is that our synthetic process is reproducible, fast and may yield grams of biphasic submicronic particles (up to 90% purity).

Therefore, it opens the way to the fabrication of large amounts of “colloidal molecules” and smart devices by self-assembly.

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Figure 1:

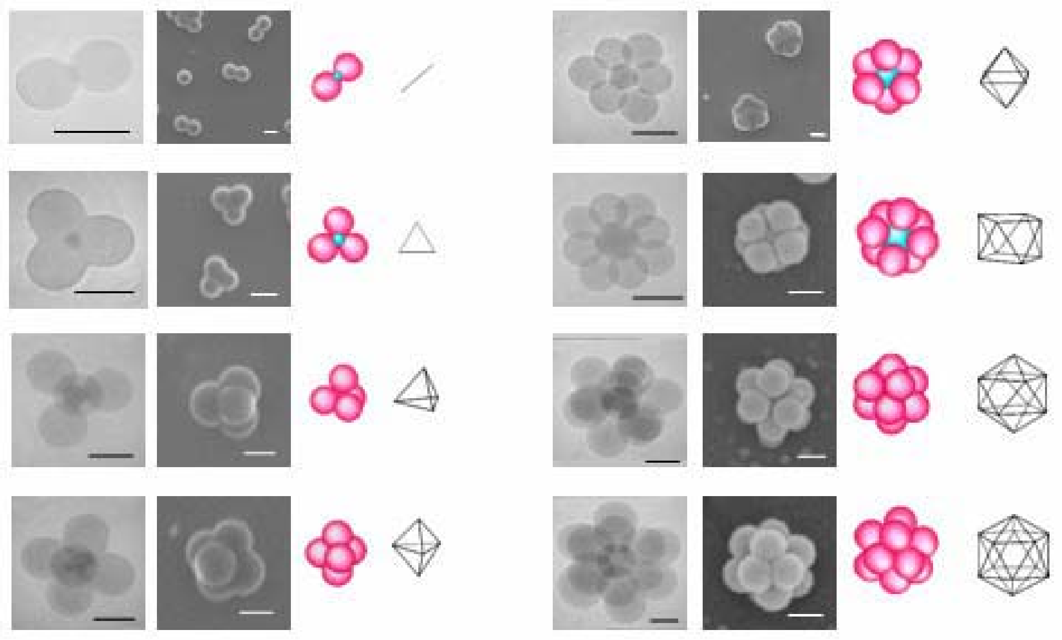
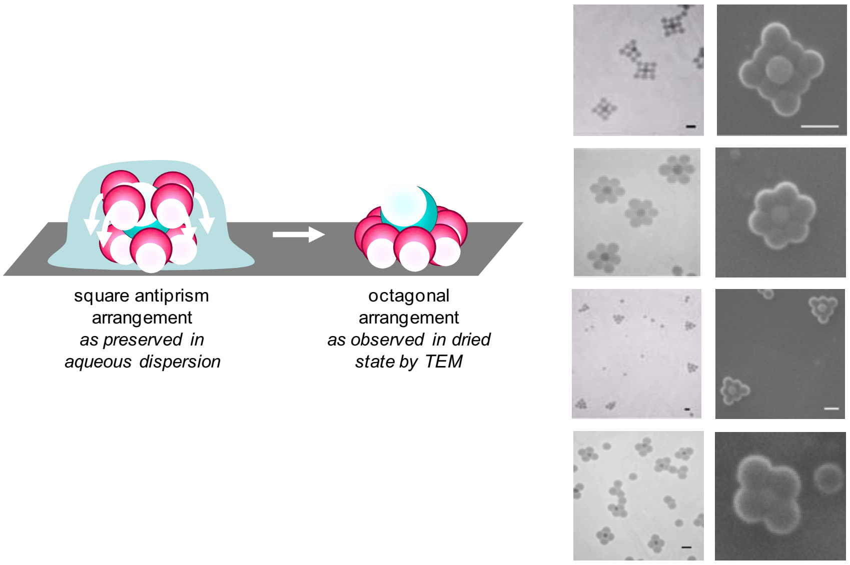


Figure 2:



SUPRAMOLECULAR NANOMATERIALS

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Nanotechnology deals with enabling technologies for the fabrication and study of materials (atoms, molecules, particles, etc.) on the nanoscale. In order to study nanoobjects, the preparation of nanoobjects is not enough: careful study of their individual properties usually requires anchoring to a substrate, and preferably to targeted or prepatterned areas of a substrate.

Nanofabrication is the subdiscipline that deals with the development of general fabrication methodologies for the preparation of nanoobjects as well as of patterned substrates and of assembly methods for the anchoring of the objects to the patterned areas. In general, nanofabrication methods fall into two classes, which are called top-down and bottom-up. The integration of top-down and bottom-up nanofabrication schemes is considered a key issue for the advance of nanotechnology.

In this paper, we will show elaborate examples of such an integration approach. We chose to use nanoimprint lithography (NIL) as the top-down technique [1], because it is a technique that allows sub-10 nm resolution in pattern replication. This was combined with the assembly of mesoscale (100-500 nm) polymer particles in order to create ordered particle assemblies. These were inverted by infiltration using layer-by-layer (LBL) assembly [2] of small gold nanoparticles and dendrimers using supramolecular interactions. The full integration of these methods, using this double templating strategy of NIL patterning and particle assembly, followed by removal of both templates, leads to the fabrication of free-standing 3D supramolecular nanoparticle objects of complex shapes [3]. For the LBL assembly, we have used a supramolecular approach [4], based on host-functionalized substrates (“molecular printboards” [5]) and nanoparticles [6] in combination with guest-functionalized dendrimers [7]. The whole procedure is shown to result in a multistep, high-fidelity process yielding 3D supramolecular nanoparticle objects. It will be shown that these maintain supramolecular recognition properties.

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OPTICAL AND ELECTRICAL SPIN INJECTION IN SEMICONDUCTOR QUANTUM DOTS

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Numerous proposals for future spintronic and quantum information devices are based on manipulating or storing information in the form of electronic or nuclear spin polarization in semiconductor quantum dots (QD). This approach is very attractive since a long coherence time is expected, as a result of the inhibition of the classical spin relaxation mechanisms: the discrete energy levels in semiconductor quantum dots and the corresponding lack of energy dispersion lead to a slowdown of the spin relaxation processes compared to bulk or two-dimensional structures [1,2].

We have studied the spin dynamics of electrons, holes, neutral and charged excitons in undoped and doped QD by time-resolved photoluminescence. We will give a review of recent experimental results on optical spin injection in InAs/GaAs [1-9], GaAs/AlGaAs [10] and GaN/AlN [11] quantum dots.

An electron spin confined to a quantum dot is not subject to the classical spin relaxation mechanisms known for free carriers but it strongly interacts with the nuclear spin system via the hyperfine interaction. By analysing the polarization state of photons absorbed or emitted by the dot, we show how optical pumping of electron spins in individual self assembled InAs QDs leads to a strong nuclear polarisation that can be measured via a drastic change in the Zeeman splitting (the Overhauser shift) in magneto-photoluminescence experiments [7-9].

We will show that the nuclear magnetic field, in the order of a few Teslas, created through optical pumping is bistable [8-10] and can be controlled through a slight variation of an experimental parameter such as the excitation laser polarization or external magnetic field.

Finally we will present results on the electrical spin injection in Spin-LED quantum dots Device [12,13].

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BIOLOGICAL APPLICATIONS OF COLLOIDAL NANOPARTICLES

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Two ideas for applications in which colloidal nanoparticles are used to interface cells are discussed. For this the report will be structured in three parts. In the first part the colloidal nanoparticles and in particular their surface chemistry will be discussed. In the second part a nanoparticles based FRET system for the detection of intracellular ions will be reported. In the third part an alternative system for the detection of intracellular ions based on polymer capsules / nanoparticles based will be described

With a very general procedure inorganic hydrophobic nanoparticles of different materials can be transferred into aqueous solution by coating them with an amphiphilic polymer that is based on a poly(maleic anhydride) backbone modified with alkylamine sidechains. Functional groups with an amino anchor can be directly introduced in the polymer by reacting them to anhydride groups of the backbone. This offers a very general route to water-soluble nanoparticles of high colloidal stability, with good size distribution, and with a variety of functional groups that are directly embedded in the polymer shell without the need of post-bioconjugation.

A FRET-pair based on colloidal quantum-dot donors and multiple organic fluorophores as acceptors is reported. In contrast to similar systems which are used as biosensors and detect specific changes of the donor/acceptor-distance under the influence of analyte binding, our nanoparticle design seeks to optimize sensors that detect spectral changes of the acceptor at fixed donor/acceptor distance. This approach allows for relatively small acceptor-donor distances, and thus for high energy transfer efficiencies, while simultaneously permitting high colloidal stability. The photophysics of the system is characterized and compared to similar systems which have been reported in literature.

Polyelectrolyte microcapsules have been loaded with a pH sensitive, high molecular weight SNARF-1-dextran conjugate. SNARF-1 exhibits a significant pH-dependent emission shift from green to red fluorescence under acidic and basic conditions, respectively. The spectral properties of the dye were found to be largely retained after the encapsulation. Upon ingestion of SNARF-1-filled capsules by breast cancer cells or fibroblasts, the pH change of the local capsule environment during transition from the alkaline cell medium to the acidic endosomal/lysosomal compartments could be observed. By incorporating magnetic and fluorescent colloidal nanoparticles into the capsule-shell a novel type of multiplexed sensor system was developed.

FUNCTIONALIZATION OF CARBON NANOTUBES FOR MATERIALS AND NANOMEDICAL APPLICATIONS

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Carbon nanotubes (CNT) have generated great expectations due to their electronic and mechanical properties. However, high molecular weights and strong hydrophobic forces keep CNT together in bundles, making their manipulation, characterization and analytical investigation very difficult. The organic functionalization offers the great advantage of producing soluble and easy-to-handle CNT. As a consequence, compatibility of CNT with other materials, such as polymers, is expected to improve. In addition, once properly functionalized, CNT become soluble in many solvents, so that their solution properties can be studied. Many functionalized carbon nanotubes may find useful applications in the field of materials science and technology, including photovoltaics. Also in medicinal chemistry carbon nanotubes are set to play an important role. Their use as drug delivery scaffolds and substrates for vaccines has already been demonstrated. CNT functionalized with bioactive moieties are particularly suited for targeted drug delivery. In fact, not only they become less toxic but also exhibit a high propensity to cross cell membranes. To this aim, several strategies have been devised to solubilize nanotubes. Among these, the most successful are: 1) the covalent functionalization of sp^2 carbons at the sidewalls with organic pendant groups and 2) the non-covalent functionalization through supramolecular interactions (e.g., π-π stacking interactions), which allows the formation of stable suspensions.

Within this contribution, we will review our most recent achievements in the field of synthesis of functionalized carbon nanotubes and their applications in materials science and medicinal chemistry. Not only can CNT function as useful components in polymer composites and photovoltaic devices, but they are excellent carriers for drug delivery and ideal substrates for neuronal growth.

LAB-ON-A-CHIP: FROM MICRO/NANOFLUIDIC RESEARCH-PLATFORM TO BIOMEDICAL APPLICATIONS

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Over the past 15 years, the concept of Lab on a Chip (LOC) has been developed to a great level of maturity. These microfluidics systems are nowadays employed both for research purposes as for a variety of applications in physics, analytical chemistry and biomedical applications. The first example is the use of a nanofluidic channel to separate DNA. It is found that the movement of DNA fragments is 20 nm high nanoslits in a strong electrical field is not continuous, but in a so-called “stop-and-go” manner. DNA fragments are in the stop-phase for up to 90% of the time, and in the go-phase for only 10% of the time.

Moreover, even in the go-phase, the calculated electrophoretic mobility is 10-100 times smaller than that of DNA in microchannels. We suggest two possible explanations for this effect, di-electrophoretic trapping (DEP) or mechanical trapping, both induced by surface roughness effects [1]. (see fig 1). In a second example, the development of a chip for monitoring lithium medication levels in manic-depressive patients.

This chip consists of a separation microchannel with integrated conductivity detection electrodes [2]. (see fig 2). Moving towards cell-manipulation and analysis, the fabrication of a million-well petri-dish will be presented, for very high throughput cell-experiments [3]. More focused on the single cell-level, we developed a chip for electroporation and gene transfection of single cells. First, we show that single cells can efficiently be electroporated as indicated by the translocation of dye’s into the cell. Then, it is found that using a microfluidic chip we can electroporate and transfect C2C12 cells and human mesenchymal stem cells with high yield (>75%). It is found that GFP-ERK1 constructs transfected in HMSC’s translocate form cytosol to nucleus upon stimulus with growth factor bFGF [4]. In a final example, the use of a simple microfluidics chip for evaluation of the efficiency of cancer-drugs is shown. It is found that the efficiency of drugs can be measured by determining the cell-covered surface after drug treatment. Application of different drugs lead to either apoptosis or necrosis of cancerous cells [5]. From these experiments future possibilities for a “Lab-in-a-Cell” will be discussed.

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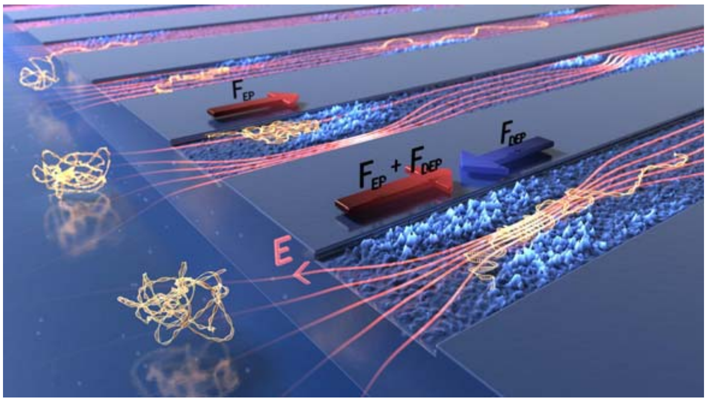

Fig. 1 Trapping of DNA in a nanofluidic channel

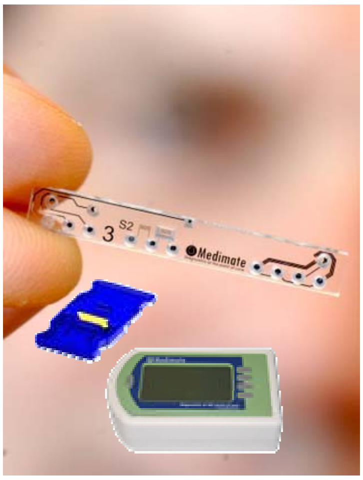

Fig. 2 Lithium chip for blood analysis

ORAL CONTRIBUTIONS

GOLD NANOPARTICLES AND RECOMBINANT ELASTIN-LIKE POLYMERS: SYNTHESIS OF SMART HYBRIDS

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Abstract

Recently, control over surface interactions of gold clusters and biomolecules is being pursued for potential use in biomedical and biosensing applications [1]. Furthermore, one and two dimensional assemblies of gold clusters allow for the creation of nanoconducting networks, direct visualization of biomolecules or control of plasmonic coupling [2]. Within the third dimension in space, gold clusters embedded in polymeric micelles and vesicles have been proposed as catalysts and drug delivery vehicules [3]. On the other hand, our research group has a vast experience in the production of smart materials based on recombinant elastin-like polymers (ELPs) [4]. Recombinant ELPs exhibit conformational changes in their structure in response to external stimuli by a LCST-like (low critical solubilization temperature) mechanism. Furthermore, interesting self assembled architectures such as nanopores, micelles and vesicles are exhibited by these biocompatible proteinaceous polymers.

To this extent, it appeared attractive to us to explore the synthesis of ELP´s tailored with gold clusters and investigate the potential applications of these hybrid systems. In this sense, a two fold aim was pursued. Firstly, the synthesis of gold nanoparticles mediated by ELP´s allowed for the investigation of the surfactant properties exhibited by these biopolymers and their subsequent role in controlling nanoparticle growth and aggregation during nanoparticle formation. And secondly, it is possible to investigate the covalent tailoring of gold clusters with ELP´s that exhibit sulfhydril functions for the development of functional materials that exhibit features of their mother components.

Here, we report on our research efforts on the synthesis of thermal and pH responsive gold clusters embedded in a recombinant matrix that exhibit reversible pH and temperature aggregation. In addition, the formation of defined and organized nano and micro structures in a biopolymer mediated assembly of gold clusters has been achieved. Astoundingly, the architectures observed by transmission electron microscopy (TEM) include the formation of gold beaded nanochains and gold clusters transported within polymer vesicles (**Fig. 1, 2**)
Furthermore, spectroscopic measurements have been carried out to investigate the structure-properties relationship of the hybrids synthesized. Noteworthy is that gold-ELP´s conjugates exhibit thermo and pH sensitive optical properties (**Fig. 3**) suitable for optical sensors and biological applications.

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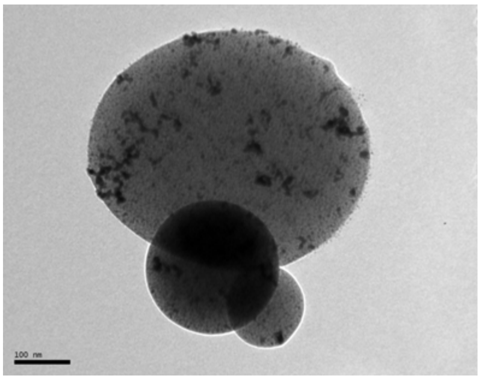

Figure 1: TEM micrograph of recombinant polymer vesicles exhibited by gold-ELP hybrid.

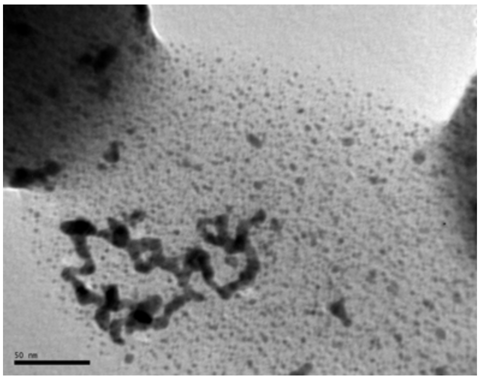

Figure 2: TEM micrograph of gold beaded nanochains contained within polymer vesicles of gold-ELP hybrid.

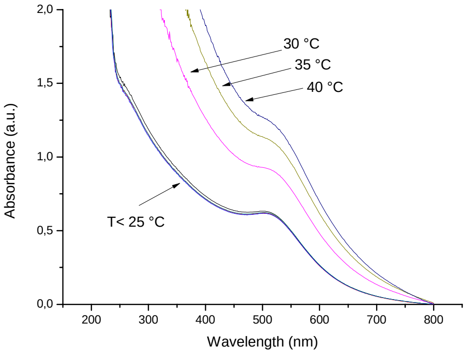

Figure 3: Light absorption exhibited by a gold-ELP hybrid as function of temperature.

MULTIWALLED CARBON NANOTUBES: THE THICKER, THE SOFTER

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Size matters for the mechanics of multiwalled carbon nanotubes (MWCNTs). It has been known for some time that MWCNTs often wrinkle under deformation exhibiting the so-called rippling deformation pattern, which makes MWCNTs much softer. Through large-scale multiscale simulations [1-3] we have characterized with a power law the softer wrinkled response, and showed that the transition strain between the super-stiff behaviour attributed to MWCNTs and this softer regime scales as the inverse of the tube diameter [4]. Thus, the tera Pascal Young's modulus can be fully exploited in devices and materials with for moderately sized MWCNTs or tubes subject to moderate deformations. Similarly, in interpreting experiments or designing devices, the classical Euler-Bernouilli beam theory can only be applied to such tubes.

The elasticity of thick MWCNTs is nonlinear. These tubes typically display mixtures of wrinkled and unwrinkled sections, and often exhibit hysteretic mechanical behaviour. This makes thick MWCNTs attractive components for energy dissipation. We propose to model thick multiwalled carbon nanotubes as beams with non-convex curvature energy [5]. Such models develop stressed phase mixtures composed of smoothly bent sections and rippled sections. This model is motivated by experimental observations and large-scale atomistic-based simulations. The model is analyzed, validated against large-scale simulations, and exercised in examples of interest. It is shown that modelling MWCNTs as linear elastic beams can result in poor approximations that overestimate the elastic restoring force considerably, particularly for thick tubes. In contrast, the proposed model produces very accurate predictions both of the restoring force and of the phase pattern.

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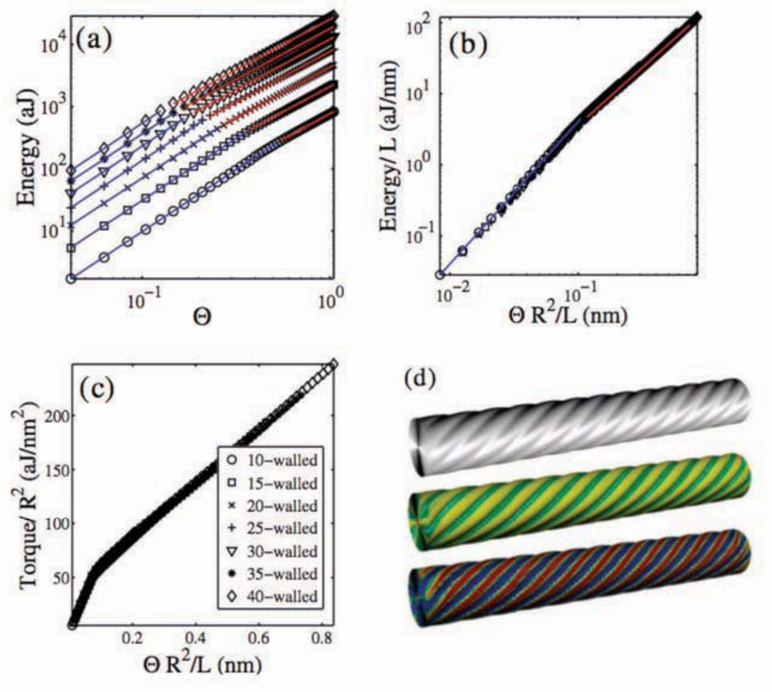

Figure 1: Twisted MWCNTs. (a) Strain energy vs twisting angle log-log plots for various MWCNTs and (b) data collapse upon appropriate rescaling. The power-law fits with exponents 2 (blue) and 1.63 (red) are shown for illustration. (c) Rescaled torque vs twisting angle relation highlighting the unified law. (d) 35-walled CNT in torsion, deformed shape (top), Gaussian curvature map (middle, green is zero, red is positive, blue is negative), and energy density map (bottom, red is high, blue is low).

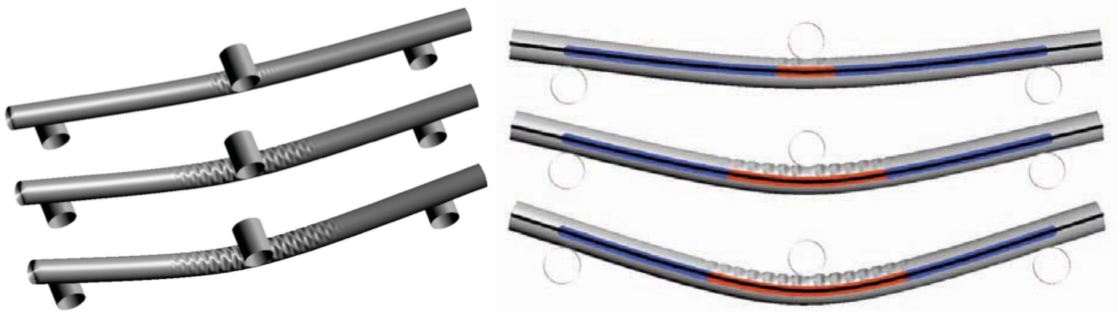

Figure 2: View of the 3D deformation of a 20-walled CNT 280 nm long subjected to a vertical displacement of 28 nm, from the onset of rippling to the last computed configuration (left). Comparison between the deformations and rippling patterns provided by the full 3D model and the mesoscopic beam model (right).

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DIPOLAR DRIVEN SPONTANEOUS SELF ASSEMBLY OF SUPERPARAMAGNETIC Co NANOPARTICLES INTO MICROMETRIC RICE-GRAIN LIKE STRUCTURES

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Abstract. Superparamagnetic single crystal single domain Cobalt nanoparticles of 6 nm in diameter evaporated onto Highly Pyrolytic Oriented Graphite spontaneously self assemble into super structures with an elongated shape. These structures have been studied by optical and scanning electron microscopies, atomic and magnetic force microscopy, electron dispersive x-ray analysis and SQUID Magnetometry. We propose that the weak dipolar interactions between superparamagnetic dipoles of the cobalt nanoparticles are the responsible for the formation of this structures when the dipolar magnetic interactions are strong enough to influence the general process of self assembly dominated by Van der Waals forces between nanoparticles and between nanoparticles and substrate, and the evaporation dynamics of the experiment.

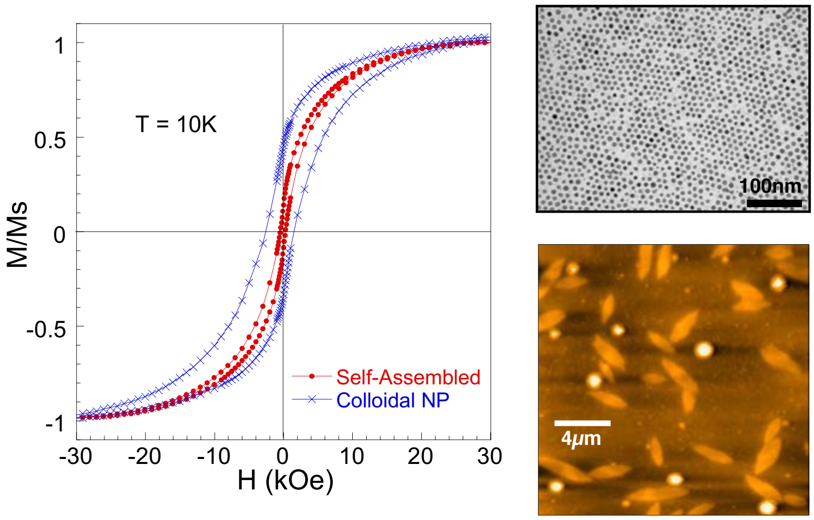

Figure. Left: Hysteresis loop for colloidal and self-assembled Co NP at low temperature. Right up: TEM images of Co nanoparticles. Right down: AFM image of self-assemble structures integrated by cobalt NP.

LARGE ORBITAL MOMENT IN A-FE PHTHALOCYANINE THIN FILMS: AN XMCD STUDY

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The metal phthalocyanines (MPc) form a family of compounds with a very wide range of commercial applications such as catalysts or dyes, and more recently in thin film technology [1]. In MPc the M atom has square-planar coordination with four pyrrolic N atoms (Fig. 1). In previous work it was shown that the α-FePc phase is ferromagnetic below 10 K, differently to the β-FePc which remains paramagnetic at all temperatures [2].

These molecules may be deposited on a substrate forming a well defined film, by means of Organic Molecular Beam Epitaxy. In case of depositing on sapphire the MPc molecules stack in a herringbone structure forming long needles parallel to the substrate Fig. 2a. In contrast, when deposited on Au substrate the molecule plane is parallel to the substrate Fig. 2b. From Mössbauer experiments it was found to have the record highest hyperfine field ever measured on an Fe(II) (B_{hf} = 66.2 T). It was conjectured that could be related to the electronic configuration $d_{xy2}(d_{xz},d_{yz})3d_{z2}$, which has an orbitally degenerate ground state, and as a consequence, an expectation value of $\langle L_z \rangle$ =1 [3].

An X-ray Magnetic Circular Dichroism (XMCD) spectroscopic study has been performed on α-FePc thin films, deposited on sapphire and Au substrates. From the angular dependence of the The XMCD spectra at the Fe L_3 and L_2 edges were measured as a function of incident angle, θ..(Fig. 3a, and b) From the sum rule analysis the values for the $m_L(\theta)$ and $m_{S,eff}(\theta)$ moments were obtained (Fig. 4), concluding that the Fe magnetic anisotropy is nearly planar, in good agreement with previous SQUID magnetization data. From the analysis of the data in Fig. 4 with the relation $m_{L,Seff} = m^{z}_{L,Seff}\cos^2\theta + m^{xy}_{L,Seff}\sin^2\theta$, the orbital moment m_L=1 μ_B is obtained, therefore, the conjecture is proven to be correct. The $m_{S,eff}$ moment is analyzed with the expression $m_{s,eff}(\theta) = m_s[1+(7/2)(Q^*_{zz}\cos^2\theta + Q^*_{xx}\sin^2\theta)]$, which yields the values for the istropic spin compònent m_S=1.2 μ_B, a strong dipolar component with components Q_{zz} = 0.15 and $Q_{xx} = Q_{yy}$ = - 0.07, which comply with the rule that $Q_{xx}+Q_{yy}+Q_{zz}=0$.

The main conclusion of this work is that this compound has the highest orbital moment known for an Fe(II) atom, namely, m_L=1 μ_B. Such a large value of m_L is originated by the orbital degeneracy of the d_{xz}, d_{yz} level occupied just by three electrons, thus proving the conjecture proposed from previous Mössbauer spectroscopy .

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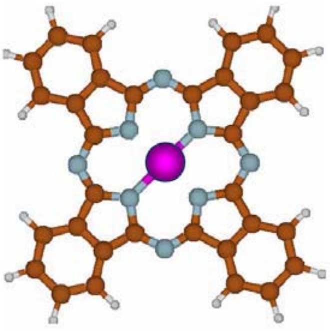
Figures:



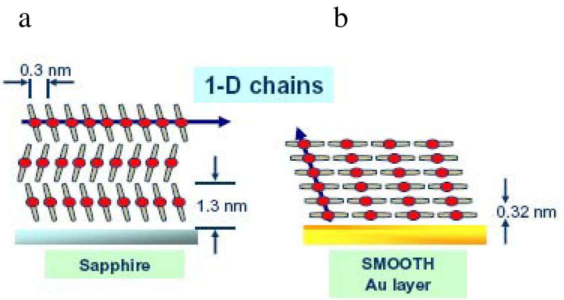


Fig 1. Fe Phthalocyanine molecule. The central Fe(II) has square-planar coordination with four pyrrolic N atoms.

Fig 2. a) FePc molecules deposited on sapphire: molecules stack in a herringbone structure forming long needles parallel to the substrate. b) Deposited on Au: the molecules self-order parallel to the substrate.

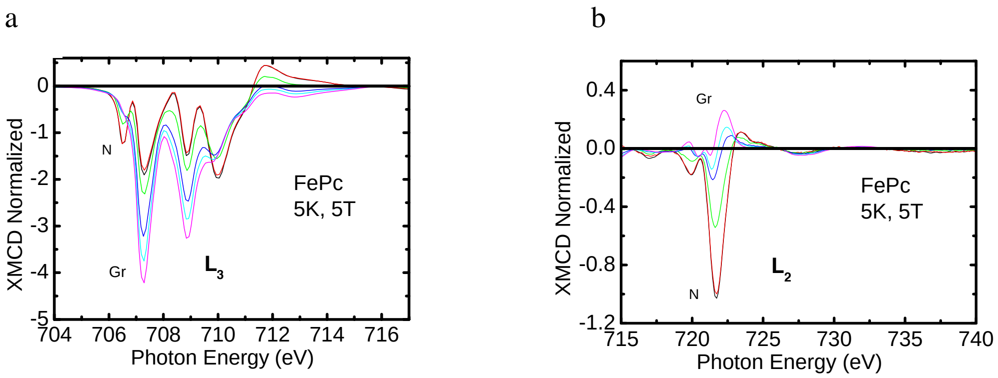


Fig 3. Angular dependence of the XMCD spectra: a) at the Fe L_3 edge, b) at the L_2 edge. (Gr: Grazing angle; N: Normal incidence)

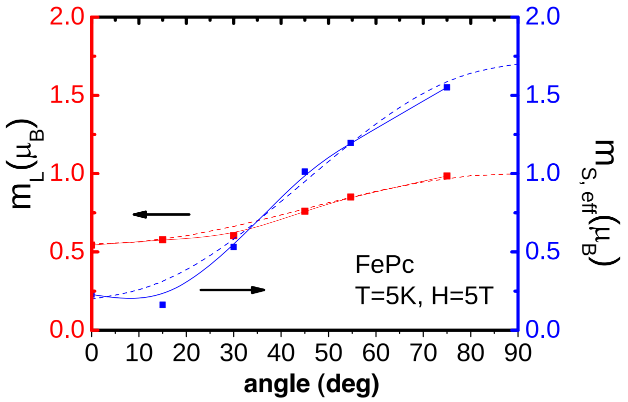


Fig 4. Angular dependence of the orbital moment m_L and effective spin moment $m_{S,eff}$ derived with the sum rules from the data in Fig. 3. The angle of incidence is given in degrees.

MAGNETIZATION OF Pt13 CLUSTERS SUPPORTED IN A NaY ZEOLITE: A XAS AND XMCD STUDY.

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Zeolites are frequently used as support of Pt species in catalysis. Pt in I and III valence states, and forming dimers are known to yield to paramagnetic signals in EPR [1]. Recently, small Pt clusters supported in NaY zeolites, containing 13 atoms have been reported [2,3]. These Pt particles are prepared in two chemical states: Pt_{13} particles covered by H adsorbed atoms in one case, and Pt_{13} particles in the bare neutral cluster case [2]. They are dispersed in a zeolite matrix, with a maximum Pt charging of 6% in weight. The cluster may sit on a puckered 6-ring window (SII site of the faujasite structure) (Fig. 1), in which three oxygen atoms point towards the cluster and three away from it.

X-ray Absorption (XAS) and Magnetic Circular Dichroism (XMCD) spectra have been recorded at the $L_{2,3}$ edges of Pt of Pt_{13} and hydrogenated $Pt_{13}H_m$ clusters dispersed in NaY zeolite. From the XAS measurements the number of holes nh in the 5d band of these systems is found. From the difference of the $L_{2,3}$ edge spectra the Pt-H antibonding state, created by the hydrogenation embedded in the Pt d-band, is characterized by a shape resonance with energy $E_{res} = 2.3$ eV. The average orbital and spin moments m_L and m_S for Pt atom have been determined from the XMCD measurements (Fig. 2). The total magnetic moment field dependence XMCD(H) was determined and scaled to the absolute value of the average moment per Pt atom. The fit of XMCD(H) to a Langevin function yields a magnetic moment per cluster of $\mu = 3.7\ \mu_B$ (Fig. 3). It is shown that non-magnetic clusters coexist with those giving a non-zero magnetic signal. The amount of Pt constituting the magnetic Pt_{13} clusters is 15-20% of the total Pt. The XMCD data are compared with SQUID magnetization measurements. The moment found is consistent with density of state (DOS) calculations which predict a stable state for Pt_{13} clusters with J = 3 - 4 angular momentum.

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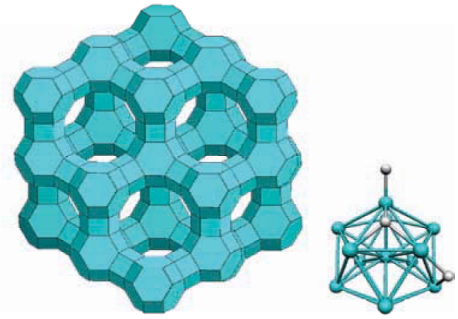

Fig. 1. Left: NaY zeolite. Right: $Pt_{13}H_1^{+1}$ cluster [1]

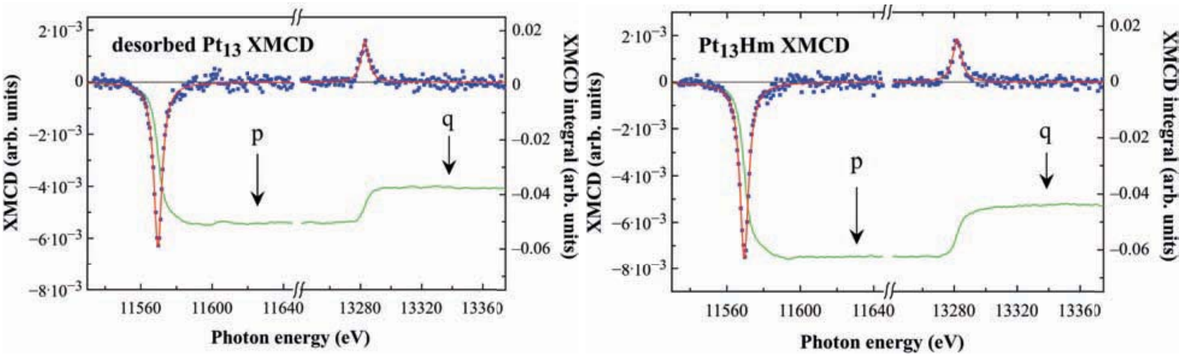

Fig. 2. Normalized XMCD spectra at the $L_{2,3}$ Pt edges. (top) spectra of Pt_{13}, (lower panel) $Pt_{13}H_m$. (dots) experimental points. (red line) fit to Lorenzian functions as guide to the eye. (green) Area integral. The arrows indicate the higher limit of the *p* and *q* integrals.

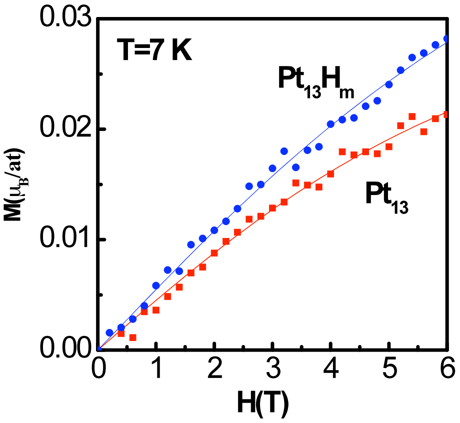

Fig. 3. XMCD *M(H)* data of Pt_{13}(■), and $Pt_{13}H_m$(●).Fits of the to a Langevin function (-).

NANOFABRICATION WITH PEPTIDE AND PROTEIN TUBES

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Tubular structures can be obtained in various elegant ways. Electrospinning is the electrostatic formation of thin fibers from viscous polymer solutions. Employing self-assembling monomers such as phospholipids and proteins is a novel route, which we extended to short peptides. [1] Aromatic residues in the peptides cause pi-stacking of the molecules, and together with the electrostatic interactions (peptides are zwitterions) fiber and tube formation is induced. On the macroscale, electrospun tubes usually coil up in an irregular mesh-like structure (Fig 1). We show that a collector with sharp edges can lead to alignment and suspended structures (Fig 2). Based on the chemical variability of peptide tubes, we plan to develop a new setup for experiments on nanofluidics.

Nature, too, has developed some very efficient tube formation strategies. One of the uses of protein tubes is to protect and transport RNA, which in turn codes for the same protein: The resulting structure is a virus. One of the simplest, and certainly the best characterised, is the Tobacco mosaic virus, which is pathogenic only for a number of plants. The helically arranged coat proteins and the RNA form a 300 nm long tube with an inner channel of only 4 nm diameter. The structure can be arranged on solid surfaces, [2] and metallized in aqueous suspension, [3] giving access to wires of only 3 nm diameter (Fig 3). [4] Preliminary results on Molecular Dynamics clarify how water is arranged in and on the virus, [5] which is of utmost importance for wet chemical nanofabrication.

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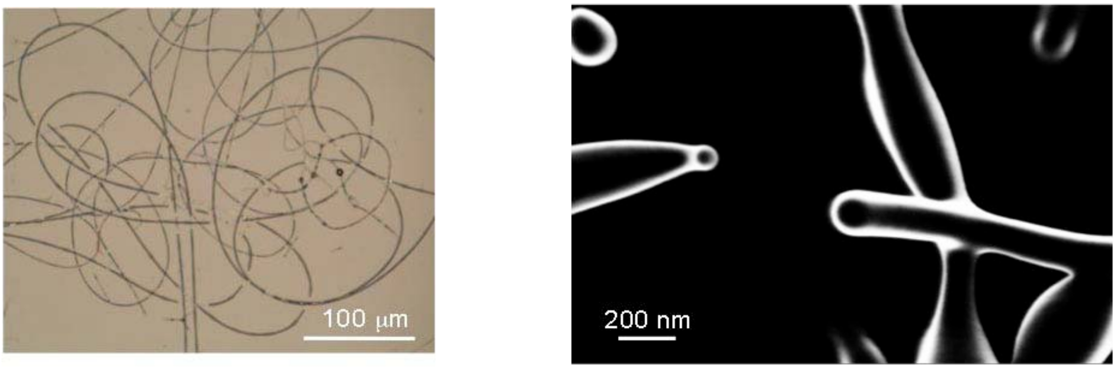

Fig 1: Electrospun di-phenylalanine tubes, optical and electron microscopy.

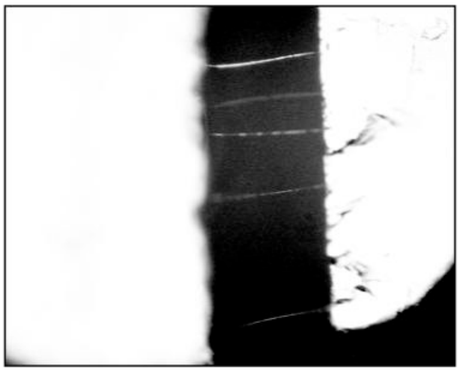

Fig 2: Di-phenylalanine tubes bridging a gap of ca. 0.1 mm.

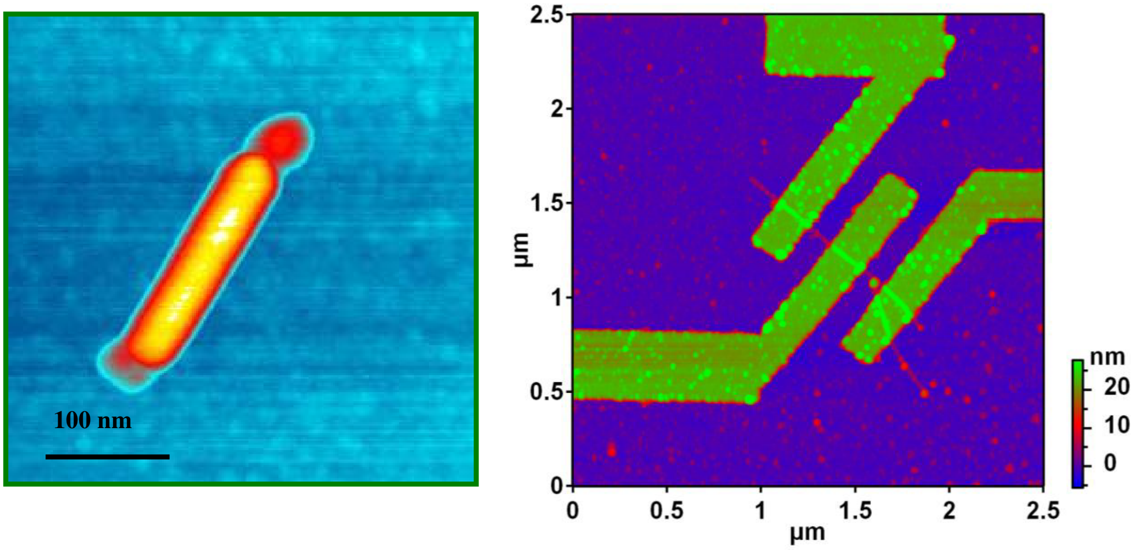

Fig 3: Gold-virus-gold dumbbell structure and contacted 3 nm nickel wire (AFM).

ELECTRONIC CORRUGATION OF RIPPLED GRAPHENE EPITAXIALLY GROWN ON Ru(0001)

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Theoretical predictions [1] and recent experiments [2-4] present graphene, one atom thick carbon layer, as a very interesting material for its extraordinary electronic properties and its application potential [1-7]. Although it has a zero band gap and a vanishing density of states at the Fermi energy, graphene exhibits metallic behaviour due to the topological singularities at the K points in the Brillouin zone. The conduction and the valence bands touch in conical, Dirac, point and the dispersion relation is linear within ±1 eV of the Fermi energy. In a freestanding graphene layer the Fermi energy coincides with the conical points [7-9]. For epitaxial graphene grown on SiC, the substrate-graphene stacking breaks the symmetry within the graphene unit cell opening a gap in the π-band at the Dirac point [10-12], there is also a small doping of the graphene layer. When graphene is grown on metallic surfaces [13], the metal substrates cause the Fermi level to move away from the conical points in graphene, resulting in doping with either electrons or holes [14]. The sign and amount of doping is due to the difference of work function between the metal and the carbon layer and from the chemical bonding between the metal and carbon atoms.

We present an Scanning Tunneling Microscopy/Spectroscopy STM/STS investigation of corrugation of epitaxial graphene monolayer grown on Ru(0001) under Ultra High Vacuum (UHV). The bonding with the substrate occurs through the hybridization of C π-states with Ru *d* states. Photoelectron spectroscopy shows that the layer bonding is not carbidic and the energy shift of the C 1*s* core level indicates that the graphene is doped with electrons by the substrate [15]. Graphene and Ru(0001) have different lattice parameters that induce in the graphene overlayer a Moiré pattern in a hexagonal arrangement of protrusions with a period around 2.7-3.0nm. The registry and therefore the hybridization between the carbon atoms and the ruthenium ones changes inside the unit cell introducing spatial charge redistribution in the graphene with electron pockets in the upper part of the Moiré structure. This modulation in the electronic structure has been measured with spatially resolved dI/dV maps [16].

The influence of the modulated electronic structure in the STM images is quite strong. In the upper panel of figure 1, we show 2 STM images measured exactly in the same position but changing the bias voltage applied between tip and sample. As can be seen in the profile the corrugation of the graphene structure changes a factor of two, from a bias voltage of -1V to +1V. In the lower panel we show a compilation of data measured with different tips and different samples. The apparent corrugation of the Moiré superstructure is essentially constant in the interval from -3V to -1V and changes from 0.1±0.03nm at -1V to 0.02±0.03nm at +2V. When the bias voltage applied is higher then +2V the contrast of the Moiré inverse; as can be observed also in a succession of images taken in the same position, at bias voltages $V_b \geq +2V$ (Figure 1d). The bias voltage were the contrast is inverted depends on the distance between tip and sample, a clear indication that different electronic state are involved in the formation of the STM images.

This proves that the electronic effects in this system are stronger than the actual geometric corrugation of the graphene layer. In fact all the scanning tunnelling data can be explained with a very simple tight-binding model using a flat graphene layer and applying an external potential with the periodicity of the Moiré [16].

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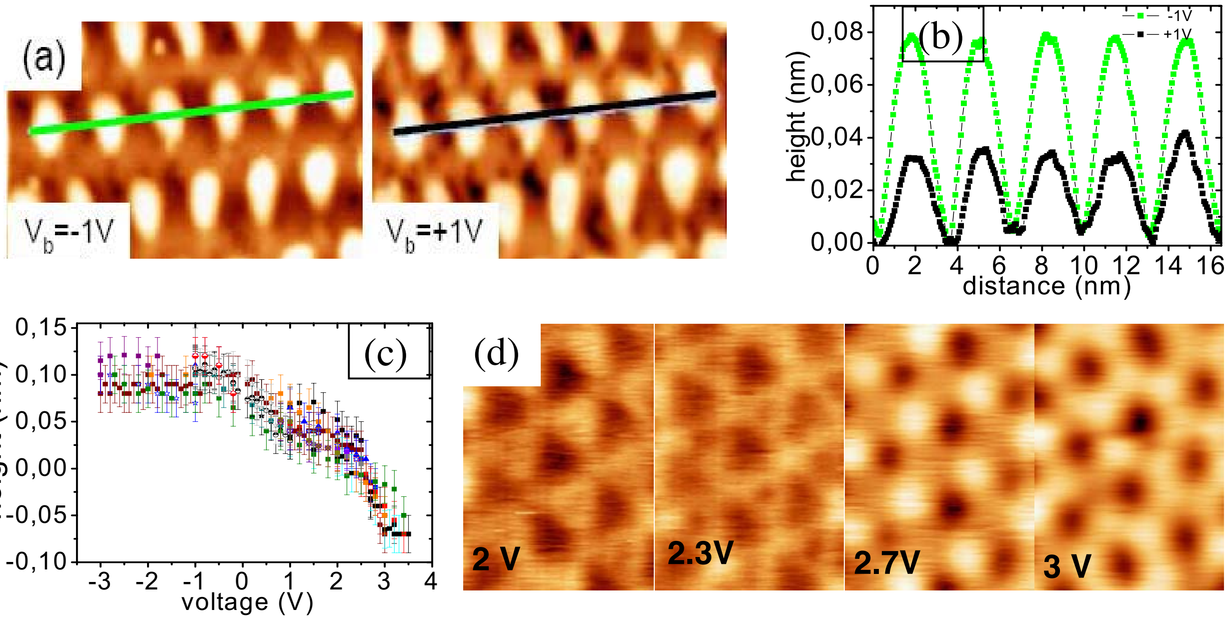
Figure1: a) 18nmx8nm STM images measured with V_b=-1V (left) and V_b=+1V (right) in the same area. b) Line profiles measured on the images shown on (a). c) Summary of the change in the corrugation of the Moiré pattern with the bias voltage, measured for different tips and samples. d) Succession of images (9nmx12.5nm) measured in the same area with different bias voltages, showing the change of contrast from +2V to +3V. The tunneling current of the presented images is constant I=0.1nA.



VERY LARGE MONOLAYER GRAPHENE RIBBONS GROWN ON SiC

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Graphene has emerged recently as a new material with outstanding electronic properties. This includes mass-less Dirac fermions, ballistic transport properties at room temperature and good compatibility with the silicon planar technology. Graphene-based devices are then promising candidates to complement silicon in the future generations of high frequency microelectronic devices. Different techniques have been developed over the past 4 years to fabricate mono or bi-layers of graphene. They range from exfoliated graphite, either mechanically,[1] or in a liquid-phase solution,[2] to chemical vapor deposition on a metal surface,[3,4] and more recently, to substrate-free synthesis when passing ethanol into an argon plasma.[5] The method investigated in this work consists in a controlled sublimation of few atomic layers of Si from a mono crystalline SiC substrate.[6] Such epitaxial growth (EG) of graphene seems to be the most suitable option for industrial applications,[7] but for easy control, it necessitates large and homogeneous sheets of monolayer or few layers of graphene (FLG) covering either a full-wafer surface or a specific area of an AlN pre-patterned SiC substrate.[8]

Unfortunately, whatever the SiC polytype under investigation (4H, 6H or, even, 3C), or the sublimation conditions pressure varying from UHV (Ultra-High Vacuum) below 10^{-9} Torr to more standard SV (Secondary Vacuum) conditions in the range 10^{-8} to 10^{-6} Torr, it is still challenging to grow FLG with homogeneous domain sizes larger than few hundred nanometers.[9,10,11] However, sublimation from the C-face leads to wider domains and higher mobility than the Si-face,[10] but still, it is very challenging to process any set of homogeneous devices on the same wafer. A noticeable exception is the recent result by Emtsev et al.[12] that showed that performing graphitization on a 6H-SiC substrate under Argon at 900 mbar could lead to large, regular, graphene monolayers and bilayers, but unfortunately on the Si-face where the grown FLG mobility is lower. The purpose of this work is to show that there is an alternative way in which very large monolayer graphene ribbons can be grown on the C-face of a graphite-capped SiC sample using only a commercial radio frequency (RF) heated furnace under SV conditions, as normally used for SiC post-implantation annealing.

In such a way, increasing the temperature up to 1700°C, we found out that the intrinsic spontaneous growth is blocked while the nucleation procedure that originates from isolated surface defects is still activated, since less demanding in energy.[13] The increase of the Si partial pressure near the surface forced the graphene growth to expand more in 2 dimensions. It starts from the defect point and follows the natural SiC step structures that are ordered in long terraces. This results in the long graphene islands shown by Optical Microscopy in dark field mode Figure 1. They have the shape of ribbons, about 30 to 300 μm long depending on the processing time, surrounded by the SiC surface not yet converted in graphene.

Raman spectroscopy method was used to control the homogeneity of the ribbon. The spectra were collected at room temperature, in the confocal configuration using the 514 nm line of an Ar^+-ion laser as excitation wavelength. We obtained homogeneous Raman spectrum with a typical signature after subtraction of the bare SiC signal shown on Figure 2. The observed Raman signature of the ribbon is very close to the ones found in the literature for graphene monolayer exfoliated on top of SiO_2/Si.[14,15,16,17,18,19,20]

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Figures:

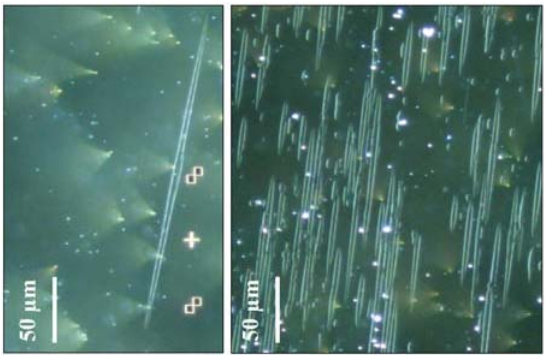

Figure 1. Wide range Optical Microscopy view of samples covered by very long graphene ribbons from 30 to 300 μm long and 5 μm large depending on the sublimation time. Higher density of ribbons is encountered where higher density of defects on the surface of the SiC substrate.

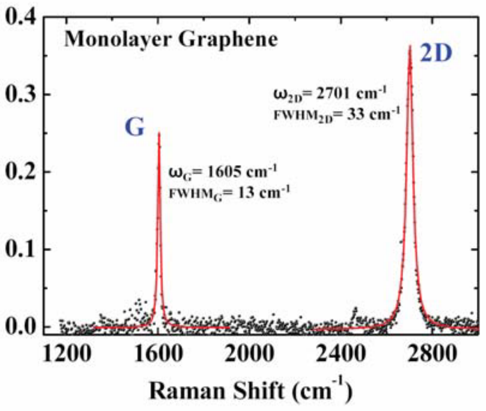

Figure 2. Typical Raman spectrum of a monolayer graphene ribbon.

THE NANOBASQUE STRATEGY

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On December 3 2008, the Department of Industry, Trade and Tourism of the Basque Government launched the nanoBasque Strategy in the framework of the Basque Science, Technology and Innovation Plan 2010. The nanoBasque Strategy is an initiative designed to develop a new economy sector enabled by nanotechnology. It sees nanoscience and micro and nanotechnologies as instruments that can stimulate the transformation and diversification of the Basque business environment. The nanoBasque Strategy is an open and integrating approach made up of vectors an initiatives that covers three main areas of action, namely: company, knowledge an Society. It sets itself the purpose of creating a new model of relations in which both national and international companies, scientific, technological, political and social agents are involved. The expected result is an efficient and integrating ecosystem of innovation that is clearly aimed at the market, based on the cooperation between all parties, where knowledge is both input and result, talent the most precious asset of all, and with the involvement of the entire Basque society. The nanoBasque Strategy strives to boost Basque companies and research agents' presence on international nanotechnology initiatives and markets. The assessment of the nanoBasque Strategy's degree of progress will be set by a means of a combination of metrics in terms of productivity, capacity to diversify the industry fabric, competitiveness and the openness of the Basque nanotechnology ecosystem. Five hundred and fifty million euros are expected to be mobilized in the 2009-2015 period, with a proportion of public funding of 52% on the total funding.

The launch of the nanoBasque Strategy has been accompanied by the creation of a dynamic support agency, the nanoBasque Agency, with the mission of coordinating and managing the development of the Strategy.

Theory of defect formation energies in one-dimensional systems: dopant activation in Si nanowires

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The formation energy of a defect [1] is a quantity of paramount technological importance; it determines the structural configuration and the charge state that a given set of impurities will favor, and it is used in the computation of impurity equilibrium concentrations, solubilities, diffusivities, dopant compensation mechanisms, etc. In addition, the calculation of the formation energy is required whenever a comparison between configurations with different number of atoms/chemical species is wanted.

In bulk host materials the study of the energetics of the formation of defects is a very well-developed topic, [2–4] and formation energies are calculated according to the well-established expression due to Zhang and Northrup [1], where they are formulated in terms of the chemical potentials of the constituent species and the total energy of the system with the impurities. On the other hand, for one-dimensional (1D) semiconductor systems the nonequivalence of the different constituent atoms in, say, a silicon nanowire (SiNW), in addition to the possible presence of surface passivation and the proper treatment of the defect charge state, render the straightforward application of the Zhang-Northrup formalism troublesome. In particular, the choice of the chemical potential of the atomic species involved is ill-defined, preventing calculations of the formation energy of self-interstitials, vacancies or substitutionals for semiconductor nanowires. Additionally, the most stable configuration of a defect in a semiconductor may have a charge state different from zero, depending on the doping condition of the material. In a periodic boundary condition (PBC) formalism, a finite net charge in the simulation cell would give rise to a divergent Coulomb energy because of the monopole-monopole interaction with its periodic images. While the correct procedure for the removal of this contribution to the total energy is still a matter of debate, recent reports [5] indicate that the uniform background charge [6, 7] and the local-moment counter charge [8] yield similar results for bulk materials. However, a treatment for charged defects in one-dimensional systems is lacking so far.

We will present a recently proposed [9] framework for the calculation of formation energies of neutral and charged point defects in 1D systems. The difficulties mentioned above are overcome thanks to the use of a construction involving as many unit cells as necessary to form a new "layer" of NW (Fig. 1), and a derivation of the Madelung correction for systems with a dielectric *tensor* as opposed to a dielectric constant.

As a case study of technological significance, we have investigated the energetics of dopant incorporation into SiNWs, focusing on the case of Al, which can also be found as a contaminant from Al-catalyzed growth process [10]. Specifically, we deal with substitutional and interstitial defects at different radial positions in $\langle 110\rangle$ and $\langle 111\rangle$ SiNWs of 1.0 (Fig. 2) and 1.5 nm diameter, finding that, as in bulk, substitutionals are preferred over interstitials. However, although Al continues to behave as an acceptor in the SiNWs (ie. there is a 0/- transition as the Fermi level is increased), the activation energy is strongly increased due to the quantum confinement effect. Also, we predict a solubility of Al in the studied NWs at least an order of magnitude larger than in bulk. We stress that these calculations are made possible only thanks to the use of the dielectric tensor-enabled Madelung correction that we have derived, which provides a strong convergence with respect to the unit cell lateral size (Fig. 3), with previous calculations [11] not performing the necessary correction.

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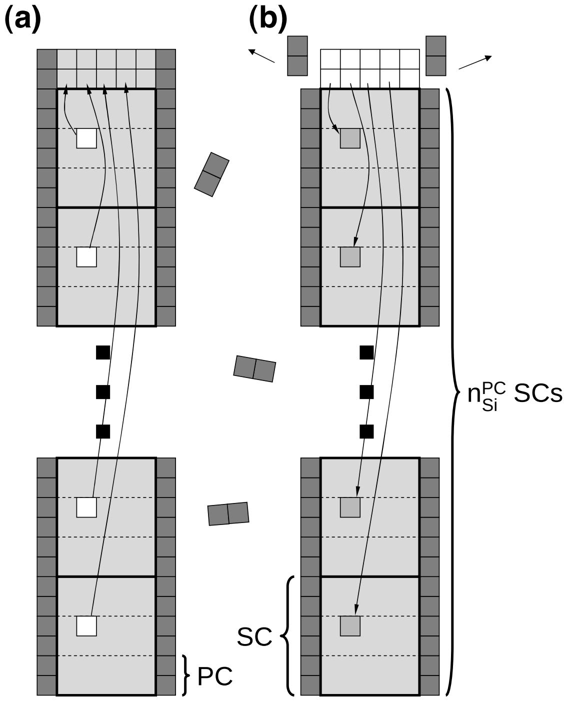

FIG. 1: Construction for dealing with defects in 1D semiconductor structures. (a) Vacancies and substitutionals: we create as many defects as necessary for adding an extra primitive cell to the wire. (b) Self-interstitials: we create as many defects as necessary for removing a primitive cell from the wire.

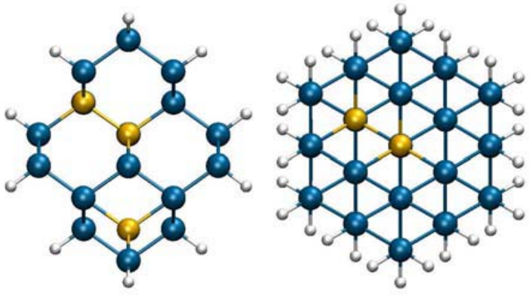

FIG. 2: 1.0 nm ⟨110⟩ and ⟨111⟩ nanowires with several Al positions marked.

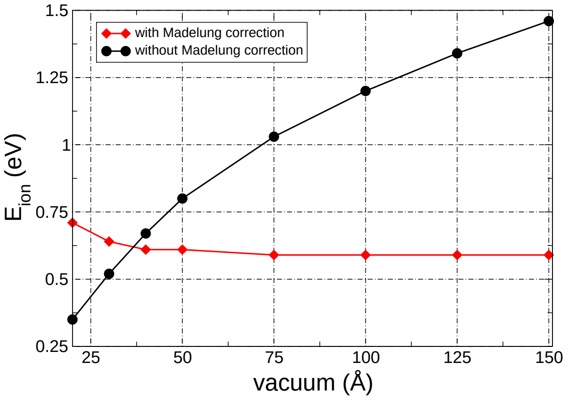

FIG. 3: Activation energy of an Al donor in a 1.0nm ⟨110⟩ SiNW host as a function of the lateral separation between the nanowire instances, with and without the dielectric tensor-enabled Madelung correction.

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Around the year 2003, Andalusia, placed the first stone of a future project in research and advanced therapies. It started by passing a pioneer law that regulates the research with human preembryos no viable from in vitro fertilization in the region. This small step, for some, had a major significance for the region and Spain. Andalusia became one of the few leading region in this research field. However the plan was not centered in cell therapies but was designed with a broader spectrum. Andalusia decided to create and organize a program in advanced therapies that drive the region in the research areas towards the future.

To do so, the Andalusian Government created three research programs; Cell Therapy and Regenerative Medicine, Clinical Genetics & Genomic Medicine and Nanomedicine. Each of the programs is based and supported in a recently created centre; CABIMER (Cell therapy and regenerative medicine-Seville), GENYO (Genomics and Oncological Research-Granada) and BIONAND (Nanomedicine & Biotechnology-Malaga). Furthermore the Andalusian Government envisages the future as a mixture of collaboration among these three areas.

Moreover several biomedical research institutes are being born linked to the relevant University Hospitals, favoring the combination of basic and clinical research as well as the transfer of the research results to the everyday clinical practice within the health system. We already have two research institutes linked to university hospital centers –the Institute of Biomedicine of Seville (IBIS) and the Maimonides Institute for Biomedical Research in Cordoba (IMIBIC). And two more research Institutes are planned to be built for the next years.

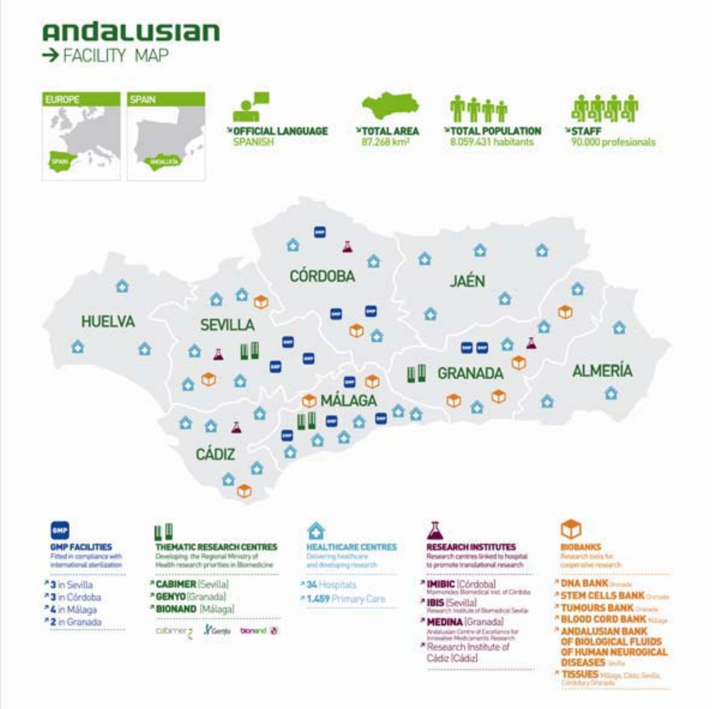
The coordination and promotion of the future collaborative research among the all main centres and peripheral laboratories working in those topics required a major structure that hosts all the tools for the engine of future innovation. That structure in Andalusia was created and named the Andalusian Initiative for Advanced Therapies. The Initiative's structure and key action lines are based on the fundamentals of the R&D and innovation process, that is to say, knowledge generation, knowledge diffusion and technology transfer, and knowledge translation into clinical applications. To enforce this value-creating chain, more and stronger links amongst academia, research organisations, healthcare providers and biotech SMEs have been established.

The Initiative is not only a management structure but is also focused in the translation of knowledge between the basic and clinical research. To promote both ends of that chain, the initiative has generated a network of Biobanks that are primordial for basic research and has built a network of GMP facilities that are required for the transfer from basic science to applied clinical trials.

At the moment this effort has already granted our first results. The initiative counts with a full in running centre, CABIMER; five networks of Biobanks (cord blood, DNA, embryonic stem cells, tumours and tissues), one accredited GMP (seven more in process), five cell therapy clinical trials and the full backup of the whole Andalusian Health system.

In the other hand for the near future the initiative is managing the opening of GENYO and BIONAND; a new network of Biobanks, the validation of the rest of the GMP facilities and the authorisation of another three clinical trials.

The best description of the generated research infrastructures until the moment is drawn in the following diagram:



The Initiative is not only generating new structures is also generating supportive economical aid by having competitive grants available for new and established research groups working in Advanced Therapies.

In relation with the human resources area, the Initiative has also designed recruitment, training and return programs; reaching important agreements with international competitive centers and structures as is the case of the NIH and Michigan State University. The initiative is still working to broaden the agreements with other international structures. Finally the Initiative is giving a full training course directed to all the positions needed within the advanced therapies projects.

In the nanomedice area specifically, the Initiative has created BIONAND. BIONAND is a centred based in Malaga promoted by the Ministry of Health, the Ministry of Innovation, Science and Industry and the University of Malaga that will host around 150 scientists in a newly built centre of 6,500 m^2. The promoters are investing more than 12 millions € in the building and the needed infrastructure. The centre will host multidisciplinary professionals (clinicians, molecular biologist, chemist, pharmacist, bioinformatics, physicists and bioengineers) working in the following research lines:

- Diagnostic Devices: will be focused on the identification of new diagnostic nanodevices using molecular and cellular tools.

- Targeted Drug Delivery: This area will be focus on new processes of reaching the targeted organ or tissue for a selective delivery.

- Tissue Engineering and Regenerative Medicine: For cell therapies to be effective, they need the adequate vehicles or scaffolds. This area will be focus in the more engineering aspect of the advanced therapies.

As a step forward for nanomedicine in Andalusia, this meeting will be held in Malaga the following year.

WHY DOES A THICK FILM DE-WET?

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Growing a flat, uniform film of a material that has a substantial lattice mismatch with a given substrate remains a complicated problem. To start with, many film/substrate systems are unstable if the film uniformly covers the substrate – the film will tend to break apart into discrete, 3D islands. The energetic driving force for forming 3D islands typically arises because the surface energy of the substrate is less than the sum of the film/substrate interface energy and the film's surface energy. Even in systems that will eventually de-wet and form 3D islands, low-temperature deposition can yield relatively flat films. This approach for producing uniform films, which many technologies depend upon, works if the kinetic processes that de-wet the film are practically slow. Since the atomic processes that convert a flat film into 3D islands are poorly known, predicting the time needed for film de-wetting is currently not possible. Well-defined 3D structures, such as dots and wires, on surfaces also have great technological potential. Hence, research has been devoted to determining whether de-wetting is a viable route to synthesizing self-organized nanostructures[1-4]. To understand the competition between smoothing and film de-wetting, we perform real-time observations by low energy electron microscopy (LEEM).

Here we reveal a process by which a continuous film simultaneously thins to expose the wetting layer in local regions and thickens in adjacent regions, eventually forming 3D islands. We study the system of single-crystal Cr films on a W(110) substrate [5], a system free of threading dislocations. Cr films grown near room temperature are rough. When annealed, the films first smooth and can uniformly cover the substrate. With further annealing, the films de-wet. Because of this system's large anisotropy, the trenches that expose the stable wetting layer only form along one crystallographic direction, the W [001] direction. The Cr islands formed by de-wetting are arrays of 3D, unidirectional stripes. Fe also forms stripes when de-wetting W(110) [6,7]. This directionality allows the nucleation of individual trenches to be observed with sufficient temporal and spatial resolution to see the motion of individual atomic film steps.

The 3D islands shape of unidirectional stripes greatly simplifies observing the de-wetting mechanism. Our microscopic observations reveal that de-wetting starts at points of the surface with a high density of atomic steps. We observe that a section of an atomic film step advances (downhill) relative to the substrate steps, making this local region thicker, and, therefore, more stable than surrounding regions. This thicker region then draws material from adjacent areas where steps retract (uphill). These instabilities grow and eventually form trenches that reach down to the wetting layer. With time, the Cr stripes between the trenches become continuously narrower and thicker. Eventually, the Cr film is converted into reasonably well-organized patterns of Cr stripes as the trenches that expose the wetting layer lengthen along the W[001] direction (see Figure).

The thick Cr films are largely not strained by the substrate as detected by low energy electron diffraction (LEED). Instead, we propose that surface stress provides the driving force for the observed morphological instability. Atomistic simulation and analytic elastic models show that surface stress can cause the dependence of film energy on thickness required for simultaneous thinning and thickening. We observe that de-wetting is also initiated at bunches of substrate steps in two other systems, Ag/W(110) and Ag/Ru(0001). Thus, we expect that the observed de-wetting mechanism of cooperative motion of film steps relative to substrate steps is general.

This research was supported by the Office of Basic Energy Sciences, Division of Materials Sciences, U.S. Department of Energy under Contract No. DE-AC04-94AL85000, by the Spanish Ministry of Science and Technology through Project No. MAT2006-13149-C02-02 and by the Comunidad Autónoma de Madrid and the CSIC through Project No. CCG07-CSIC/MAT-2030.

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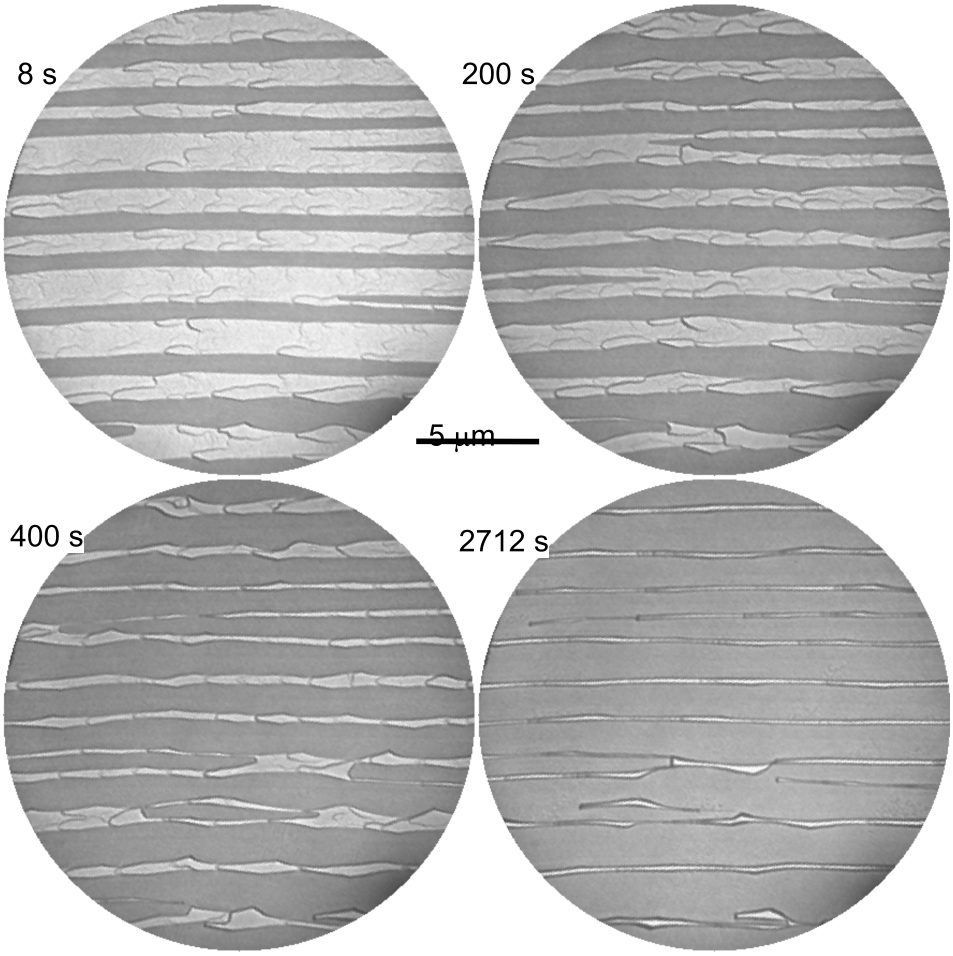
Figures:

Figure 1. Successive low energy electron images acquired while annealing a Cr/W film at 620ºC.



ORGANOMETALLIC SYNTHESIS OF WATER-SOLUBLE Pt AND Ru NANOPARTICLES

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In the last few decades, the synthesis and catalytic application of nano-scaled particles prepared from Group VIII elements have been widely explored and have achieved promising results.[1] The use of these nanoparticles (NPs) as catalysts provide new opportunities since NPs offer an efficient combination of conventionally used homogenous and heterogeneous catalyst advantages.[2] Classical homogeneous catalysts raise extraction and recycling difficulties when dealing with metal complexes and/or ligands, whereas heterogeneous catalysts generally require more drastic experimental conditions, such as high temperatures and high pressures, to be effective. The separation of expensive transition metal catalysts from substrate(s) and product(s) mandatory for industrial applications of homogeneous catalysis has led to the development of several concepts for low-cost catalyst recovery. These include the use of multiphase reaction systems like liquid/liquid biphasic systems, where the two solvents have a low miscibility. Most often the catalyst is soluble in water while the substrate(s)/product(s) are soluble only in the organic phase, hence providing a feasible separation process. Therefore, the use of water-soluble NPs catalysts instead of conventional catalytic systems is a breakthrough owing to their improved handling and considering environmental and economic aspects.[3]

In our team, the research activity has been focused for years on the preparation of well defined metallic NPs stabilized by various ligands for application in the field of catalysis and others. The synthesis methodology consists in an organometallic approach.[4] Stable transition-metal NPs with average sizes of less than 5 nm and narrow size distributions can be conveniently prepared from organometallic precursors that are decomposed in mild conditions under reactive gas (H_2, CO…). Recent studies on the use of phosphorous containing ligands to stabilize NPs[5] have led us to test 1,3,5-triaza-7-phosphaadamantane as NPs stabilizer which is well known for the formation of water-soluble complexes.[6] Special attention has been devoted to Ru and Pt NPs synthesis for their interest in catalysis and in NMR investigations to understand NPs surface reactivity. Thus, the synthesis and the characterization (TEM, WAXS, NMR…) of water soluble Pt and Ru NPs from organometallic complexes will be described. To our knowledge, this is an innovative way to obtain aqueous colloidal solutions. These NPs are of interest for application in catalysis like arene hydrogenation.[7]

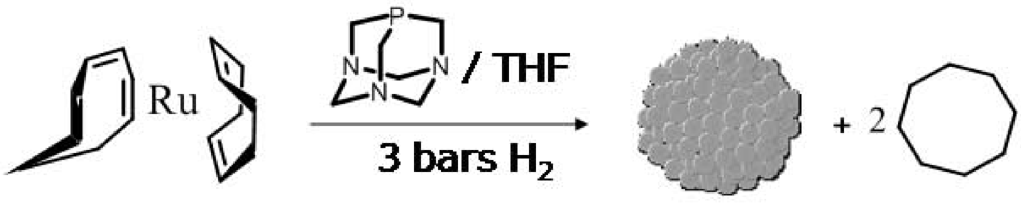

Figure 1: synthesis of Ru NPs by decomposition of Ru(COD)(COT) under H_2

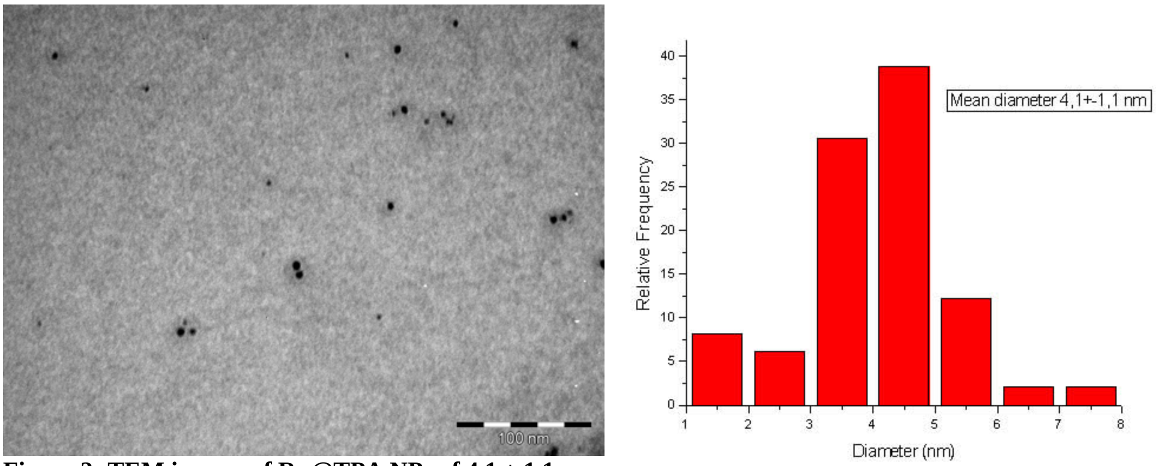

Figure 2: TEM images of Ru@TPA NPs of 4.1 ± 1.1 nm

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SINGLE MOLECULE STUDIES TO DECIPHER CADHERIN-MEDIATED CELL ADHESION

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Cell-cell junctions provide tissue integrity and promote cell polarity. Classical cadherins are adhesive receptors involved in controlling the specificity, organization and dynamics of Ca^{2+}-dependent cell-cell adhesion, which is crucial for the development and maintenance of tissue architecture and function. Alteration in the expression and functions of cadherins often correlate with the progression to tumor malignancy. Cadherins on neighbouring cells interact through their extracellular subdomain repeats (EC1 to EC5). Their adhesive engagement initiates intracellular signals ranging from cytoskeletal organization to cell polarity, proliferation, or apoptosis that are communicated through their conserved cadherin tail domain. The role of adhesion forces in the signaling process is yet to be understood due to the difficulty in the interpretation of biological responses involving multimolecular organizations.

Our aim is to better understand how cadherins regulate cell contacts stability, and how dynamics and mechanical stress regulate intracellular signaling pathways. Since the EC domain is crucial for their adhesive function, we recombinantly expressed EC domains of different type I and type II classical cadherins. Aggregation assays indicate that these fragments retain biological activity when chemically immobilized on glass beads (Perret et al., 2002). Individual cadherin trans interaction was then analyzed using biophysical approaches such as Laminar Flow Chamber (Perret et al. 2002), Biomembrane Force Probe (Perret et al. 2004) and AFM (du Roure et al., 2006). These studies revealed multiple dissociation events, which could provide distinct properties needed for transient-specific recognition as well as stable tissue formation. Comparison, at the single molecule level, of the kinetics parameters between different cadherins homophilic interactions should help understanding differences in their biological roles. In order to understand how a cell deciphers the information given by adhesive contacts, cadherin-decorated petri dishes are also used. These molecular studies provide a better understanding of the molecular processes used by cadherins for maintenance of cohesion and plasticity of cell-cell adhesion.

This work was supported by grants from the Association pour la Recherche sur le Cancer, Fondation pour la Recherche Médicale, Ligue Contre le Cancer Dordogne , and the Région Aquitaine.

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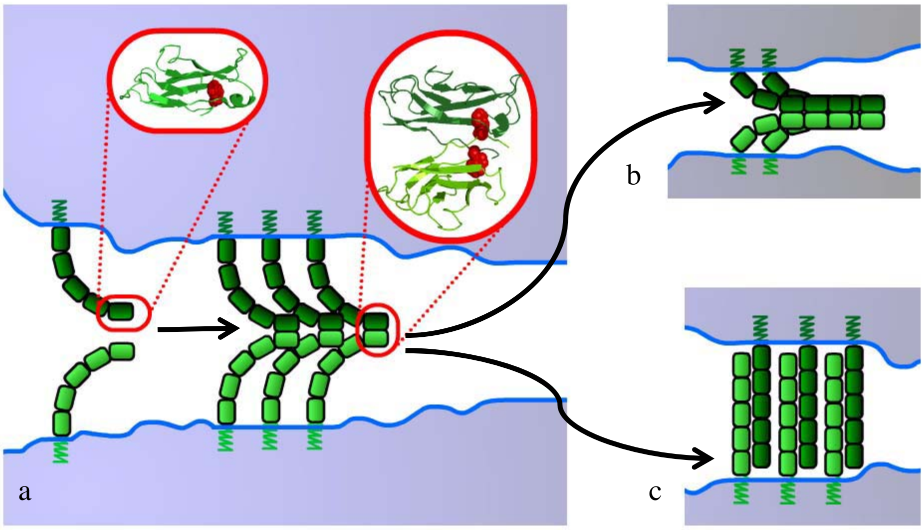

(a) Schematic drawing of different adhesive surfaces between cadherin molecules leading to adhesive contacts (insert: Trp2 intramolecularly docked, to beta-strand exchange as observed in C/EC15 crystals. (b-c) Deeper interactions have been characterized by BFP between E/EC15 Perret et al., 2004) and C/EC15 by SFA, but never directly visualized.

MAGNETIC PROPERTIES OF Co NANOPARTICLES CAPPED WITH A W THIN FILM

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Co nanoparticles are formed by sputtering of Co on amorphous alumina substrate. A subsequent capping of the particles with a metal film creates a matrix which surrounds the particles. The Co mean diameter prior to capping depends on the nominal thickness t_{Co} of the deposited Co. When capping with a noble metal film of nominal width t_M, like Cu, Ag or Au, i.e. with the nd band nearly fully occupied, the particles behave as superparamagnet with an anisotropy constant that depends on the metal used [1]. The average diameter of the nanoparticle modifies strongly the magnetic behavior, because of the relative increase of the number of atoms at the surface with respect to the core, while the width of the noble metal capping plays no role.

In this work the capping metal is W, which has less than half filled $5d^4$ band, which gives rise to completely different trends in the dependence of their magnetic properties with the configuration of the multilayers. We present results on samples with t_{Co}=0.4, 0.7 and 1 nm, with a capping film of t_W= 0.6, 1.5 and 4.5 nm, and the number of layers ranging between N=20 and 25 (Fig. 1 and 2). Magnetization and susceptibility measurements and XMCD spectroscopy experiments were performed to study their magnetic properties. All the measured samples showed superparamagnetic behavior above a blocking temperature T_B which increases with t_{Co}, just as with the noble metal capping. However, in stark contrast with them, the saturation magnetization per atom decreases strongly with decreasing t_{Co}, and it also decreases with increasing width of the capping W below T_B. These results are consistent with the formation of a magnetic dead shell around the Co core of the nanocluster, of CoW alloys (Fig. 3). The amount of W and the effective surface of the particle surface modulate the thickness of the dead shell, thereby, modifying the mean Co moment and particle anisotropy.

XMCD measurements performed at the W $L_{2,3}$ edges (Fig. 4) reveal a polarization of $\sim 10^{-2}\mu_B$ at W moments antiparallel coupled to Co moments. Application of sum's rules to XMCD data allows us to identify a parallel arrangement of the W orbital and spin moments which implies a Hund's third rule violation as it has been previously observed in Fe/W multilayers [2].

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Figures:

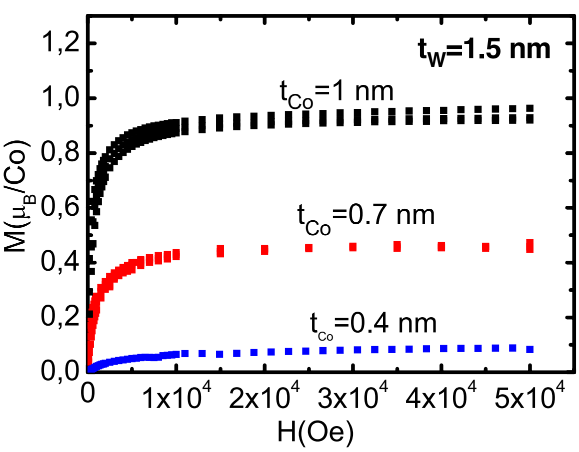

Fig 1. Magnetization curves for samples with t_{Co}=0.4, 0.7 and 1.0 nm, and a capping film of t_W=1.5nm, showing how the saturation magnetization per atom decreases with decreasing t_{Co}.

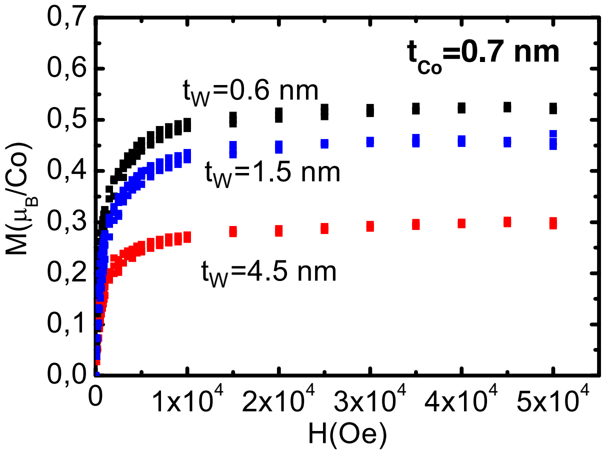

Fig 2. Magnetization curves for samples with t_{Co}=0.7 nm, and different W capping width, t_W= 0.6, 1.5 and 4.5 nm, showing how the saturation magnetization per atom decreases with increasing width of the capping W below T_B.

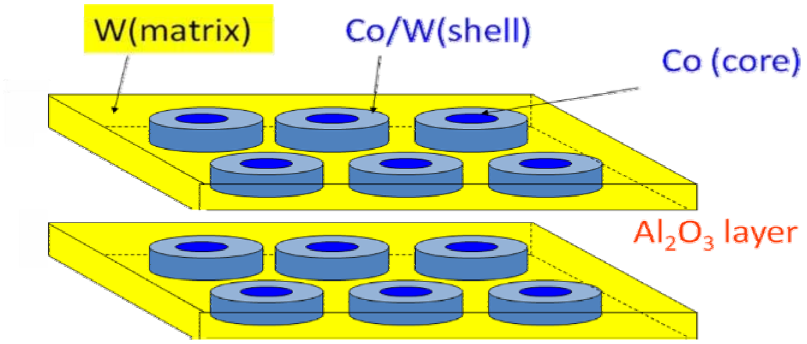

Fig 3. Diagram of the possible formation of a magnetic dead shell (of Co_3W alloy) around the Co core.

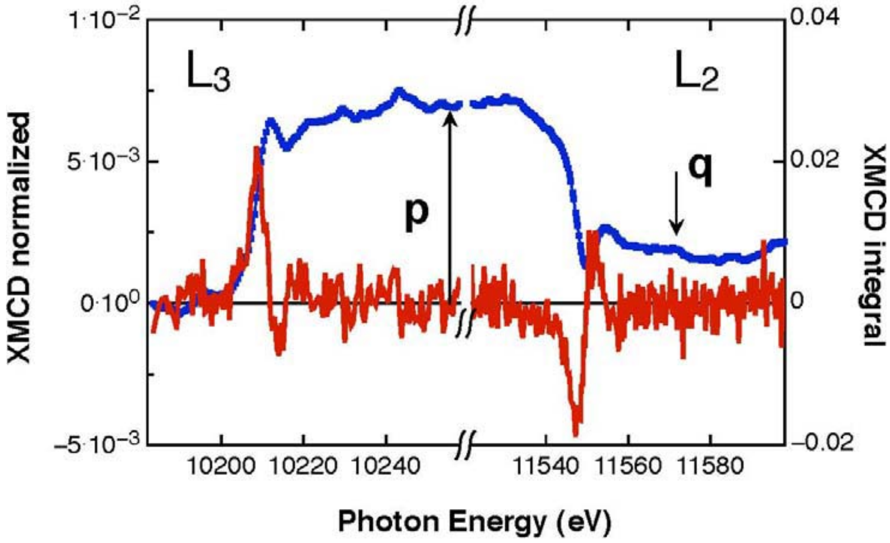

Fig 4. Normalized XMCD spectra (left) and XMCD integrated area (right) at the W $L_{2,3}$ edges in a sample with t_{Co}= 1.0 nm, and a capping film of t_W=1.5nm.

Reduced density of states governs light scattering in photonic crystals

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Contemporary photonic science is capable of addressing fundamental questions at the basis of light-matter interactions, of which the role of the photon density of states (DOS), in nanostructured media is one of the most intriguing.

Artificially engineered materials allow the control of light transport through interference in the internal nanostructure, rather than on the refraction in the body boundaries, engendering new materials properties. Photonic crystals, in which the dielectric constant is periodically modulated, manipulate electromagnetic states and the available phase space and control fundamental aspects of light-matter interaction like light emission [1] and light transport [2]. Unconventional light transport in partially-disordered photonic crystals has only been hinted at by pioneering experiments [3, 4].

Light scattering by weak topological disorder in a photonic crystal and the interplay between order and disorder has yet to be fully understood and explored. As an important step, the relation between scattering extintion and DOS has just been theoretically derived [6]. As pointed out by John [2] a dramatic change in light diffusion can occur for frequencies in or around the band-gap and eventually Anderson localisation of light can be reached, the photonic conductor becoming an insulator [7].

In this work we study the scattering mean free path, ℓ_s, the fundamental building block for any wave transport model, for the special case of photonic crystals with a controlled amount of disorder. We report experimental evidence of strong chromatic dispersion of ℓ_s from band-edge to band-gap, tightly linked to the projected density of states, and values of up to $\sim 100-500$ μm, i.e. ~ 300 times the lattice parameter (a), an order of magnitude higher than previously reported [8, 9, 10] and in a spectral region where the total density of states has just a hardly visible feature.

Single scattering events in a system with modified light modes and density of states, as in a photonic crystal, are expected to be very different from those occurring in vacuum due to: a) an increase of light-matter interaction and thus of scattering by defects, when LDOS is increased at the vicinity of band-edges and b) a suppression of the scattering channels, i.e. a increase of ℓ_s in the band-gap, where LDOS is strongly reduced.

The scattering strength can be studied via simultaneous reflection and transmission measurements, when absorption is negligible and for energies below the onset of diffraction. We assume that scattering losses follow Lambert-Beer's law, i.e. that after a thickness L, a ballistic beam attenuates as $I(L) = I_0 \exp(-L/\ell_s)$. The intensity balance can then be expressed as

$$T(L) + R(L) = \exp(-L/\ell_s), \tag{1}$$

where $T(L)$ and $R(L)$ are the ballistic transmission and reflection as a function of sample thickness in a given direction.

In our setup, the thickness of a photonic crystal with different vacancy concentration is accurately measured. This allows us to perform transmission and reflection measurements for different thicknesses and obtain ℓ_s through a fittting to the Lambert-Beer law (1).

Figure 1a shows the measured $\ln(T + R)$ for three different degrees of vacancy doping ?] i.e. for different degrees of extrinsic disorder, at a wavelength of 633 nm and for spheres of 237 nm in diameter ($a/\lambda = 0.52$). In this type of representation, the slope yields directly $(-\ell_s)^{-1}$ according to Eq. 1. This wavelength is chosen to exemplify a spectral region where no photonic band features are present, as, at such a low energy, the photonic crystal band dispersion is the same as in a uniform homogeneous effective medium. In figure 1a three scattering regimes are clearly distinguishable. For thicknesses lower than *ca.* 10 layers, (regime I), up to $\sim 25-30\%$ of the incident light is scattered due to surface effects. When the second regime (II) sets in, the slope ℓ_s^{-1} reaches a stationary value that characterises the photonic crystal. Eq. 1 holds and scattering losses scale with sample thickness like $\sim \exp(L/\ell_s)$. Finally, for larger thicknesses, a third scattering regime (III) appears. Apparently, for thick samples > 50 layers, the self-assembling process loses its effectiveness, as it evident by the increase of intrinsic disorder and by the cracks that appear on thick sample as they start to lift from the substrate.

The physical picture we propose can be checked against consistency if additional disorder is added to the photonic crystals. This can be done by doping the original photonic crystal with a controlled concentration of vacancies. At a wavelength of 633 nm the values of ℓ_s, calculated from the fit to the Lambert-Beer law, are plotted as a function of vacancy density in Fig. 1b. The "perfect" crystal (that with 0% added vacancies) is highly ordered as it presents a scattering mean free path of 63 μm, hundreds of times the lattice constant (in this case $a = 0.33$ μm), and in particular much larger than the Bragg length . An addition of a very little amount of defects rapidly decreases the mean free path, hence the quality of the crystal. In this figure, the inverse scattering mean free path scales linearly

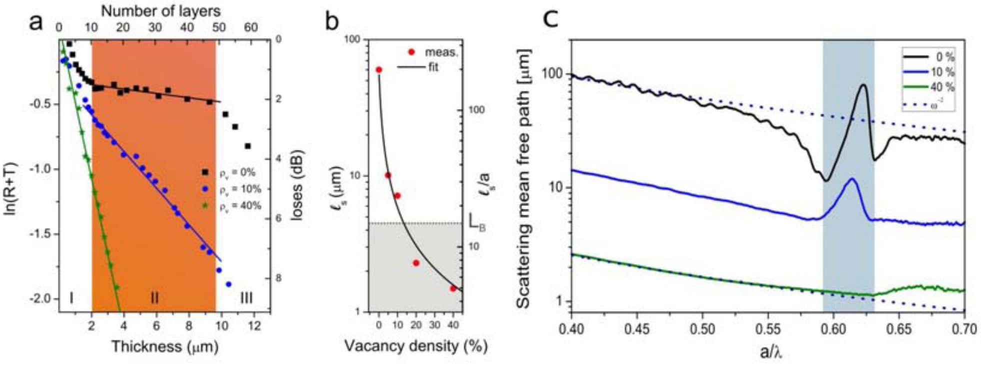

Figure 1: (a) Plot of $\ln(R+T)$ as a function of the sample thickness, at $\lambda = 633$ nm, for different vacancy density doped photonic crystals (from 0% to 40% vacancies doping), of 237 nm diameter. (b) ℓ_s obtained from linear fitting of the slope, for regime II. It also shows the Bragg length (L_B) in the case of $\rho_v = 0\%$ as shaded area. c) ℓ_s as a function of the light wavelength for 0%, 10% and 40% vacancy doped photonic crystals with $d = 237$ nm. The position of the pseudo-gap is shaded in cyan. The dotted line shows the ω^{-2} dependence ofℓ_s far from the band-gap.

with the vacancy concentration ρ_v, as shown by the black line, which is a fit for $\ell_s^{-1} = \rho_0\sigma_0 + \rho_v\sigma_v$ where ρ_0 and ρ_v are the density of intrinsic and intentionally added scatterers and σ_0 and σ_v their scattering cross-section respectively. From the fit of $\ell_s(\rho_v)$ as a function of the vacancy concentration we can estimate σ_v.

Fig. 1.c shows the strong chromatic dispersion of $\ell_s(\omega)$ in the visible range. This is the signature of the photonic crystal. In the low energy side of the pseudo-bandgap, ℓ_s takes on a value of the order of ~ 100 μm for sphere diameter d = 237 nm, the largest values reported so far. Far from the band-gap, $\ell_s(\omega)$ varies as $\sim \omega^{-2}$, dependence that has been confirmed also in previous experiments [8] and attributed to Rayleig-Gans type of scattering.

The large variation of ℓ_s cannot be attributed to the modified DOS only. It can be shown that, under some cirsumstances, the spatially averaged scattering cross section of a rayleigh scatterer is proportional to the DOS and to the reduced density of states (RDOS) which is the contribution to the DOS of modes propagating in the incident direction. Equivalently this magnitude is inversely proportional to the group velocity in this direction. This means that the main contributions to the scattering cross section are due to the coupling of the incident radiation to the scatterer (RDOS) and the total available modes to radiate from the excited scatterer (DOS).

In conclusion, we show that a controlled smooth transition from ballistic to diffuse transport in photonic crystals can be induced by the introduction of extrinsic disorder. We find that the strength of scattering is strongly determined by the projected density of states, which induces immense, up to 20-fold, variations in the scattering mean free path. We propose ℓ_s as a robust, easy to measure, figure of merit in assessing the quality of photonic crystals for technological applications. The possibility of controlling light scattering and diffusion in nano-structured optical media has important implications not only to test the quality of photonic devices, but also to properly address the proximity to the onset of Anderson localization in disordered lattices, or for the spectral control of lasing emission from disordered/ordered active media [5].

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FROM NANOLENTILS TO NANOCOLUMNS: TAILORING THE SHAPE OF METAL NANOPARTICLES BY PULSED LASER DEPOSITION

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The control of the size and shape of embedded structures within a few nanometers is one of the most challenging issues faced by nanoscience In particular, noble-metal nanoparticles embedded in a dielectric matrix have widely been studied during the last decade, since their unique optical properties make them promising materials for optical applications if a good control over the spectral response is achieved. The optical response of metallic nanoparticles is known to be dominated by an enhanced absorption at the surface plasmon resonance (SPR) wavelength that depends on the size and shape of nanoparticles. In the case of silver, the SPR is well separated from the absorption related to the interband transitions that eases the study of the dependence of the optical properties on NP morphological features such as size and shape.

In this work, we have successfully used pulsed laser deposition for embedding Ag nanoparticles in an amorphous Al_2O_3 host with controlled morphology. Nanolentils, nanospheres and nanocolumns oriented perpendicular to the substrate have been produced and this allowed us to study the relationship between the morphology and the surface plasmon resonance wavelength. Nanospheres have a diameter of 3.4 ± 0.2 nm, while nanolentils and nanocolumns have respectively diameters of 9.1 ± 1.0 nm and 2.7± 0.2 nm, and heights of 5.2 ± 0.2 nm and 7-65 nm. These values lead to aspect ratios of 0.6 and 2.5 to 25 for nanolentils and nanocolumns respectively.

Nanospheres are characterized by a single surface plasmon resonance in the extinction spectra, while the non-spherical shape of nanolentils and nanocolumns is evidenced through the presence of two absorption peaks corresponding to transverse and longitudinal SPRs. In the case of nanolentils, these peaks are respectively at higher and lower wavelengths than that of nanospheres, while the opposite occurs for nanocolumns. Although the results show clearly that SPRs are indeed tuned through the control of the aspect ratio, a detailed analysis of the optical response demonstrates that the number density of nano-objects also plays a significant role.

$RuO_2@SiO_2$ NANOMATERIALS AS CATALYTIC FILTERS FOR GAS SENSORS

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Institut Charles Gerhardt Montpellier, France

Metallic or semiconducting nanoparticles are the subject of intense research owing to their unique physical properties arising from factors like large surface to volume ratio and quantum effects on charge carrier confinement.[1] This research is driven by potential applications in electronics, optics, catalysis, ceramics and magnetic data storage.

In this respect, nanomaterials attract more and more attention for the development of new gas sensing systems able to respond to growing industrial and societal demands. Metal oxides are widely employed as sensitive elements in gas sensors[2] and commercial devices produced by classical ceramic process have been available for a long time.[3] If such devices are able to detect low concentration of flammable or toxic gases at a ppm level, their lack of selectivity and long term stability remains their major drawback and improving the cross sensitivities between gases such as CO, hydrocarbons and NO_2 is still a major problem.

The use of filters combining catalyst-loaded materials represents a very attractive way to improve the selectivity of the sensor toward a target gas and to overcome the classical problem of saturation exhibited by passive filtering membranes.[4] The filtering efficiency of such a material, in term of selectivity, reproducibility and long term stability, nevertheless asks for requirements of crucial importance regarding its composition and its morphology.[5]

Our last research efforts in the design of $RuO_2@SiO_2$ nanomaterials as catalytic filters for gas sensors will be presented following two distinct orientations. On one hand the in situ growths or Ru nanoparticles within mesostructured silica[6] and on the other hand the one pot hydrolysis and polycondensation of functionalised Ru nanoparticles[7] with their subsequent thermal treatment. Both nanomaterials synthetic routes will be described and a comparison of their efficiency as catalytic filter for gas sensors will be given.

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STRAIN DETERMINATION BY DARK-FIELD ELECTRON HOLOGRAPHY

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Accurate determination of strain in electronic devices has been the subject of intense work during the last decades. Few techniques are able to provide highly localized and accurate information at the nanoscale. Among these, convergent-beam electron diffraction (CBED) combines the advantages of very small probes and remarkable sensitivity to small variations in the lattice parameter [1]. However, elastic relaxation effects make the analysis extremely difficult, necessitating time-consuming dynamical simulations combined with finite element modeling [2]. Rather than collecting data at isolated points, strain distributions can be mapped in a continuous fashion using high-resolution transmission electron microscopy (HRTEM) [3]. Unfortunately, HRTEM suffers from limitations due to specimen preparation, field of view and noise. These problems are minimised using a Cs-corrected microscope [4]. Whilst this technique is highly accurate at the nanometre scale, mapping strain in real devices like multilayers and transistors requires fields of view that are not easily accessible to HRTEM, even with a Cs-corrected microscope. We have therefore thought to develop a new technique for measuring strain at lower magnification, for thicker samples and larger fields of view without sacrificing precision. The new method is a combination of the moiré technique and off-axis electron holography, called dark-field holography [5]. The experiments are carried out on the SACTEM-Toulouse, a spherical aberration corrected microscope fitted with a field emission gun (Schottky FEG) and rotatable biprism. The pseudo-Lorentz mode [6], corresponding to a special setting of the Cs-corrector, is essential to reach the desired field of view. Holograms are analysed using a modified version of GPA Phase 2.0 (HREM Research Inc.) for DigitalMicrograph (Gatan). As an example, the method has been applied to Si/$Si_{0.6}Ge_{0.4}$ multilayers grown on a virtual substrate of $Si_{0.8}Ge_{0.2}$. TEM specimens were prepared by a combination of tripod polishing and PIPS, though FIB preparation is preferable. The results using the (004) dark-field configuration are reported on Figure 1. In this case, the holographic fringes allow a spatial resolution of 2 nm for a precision of 0.07% strain over a half of a micron field of view.

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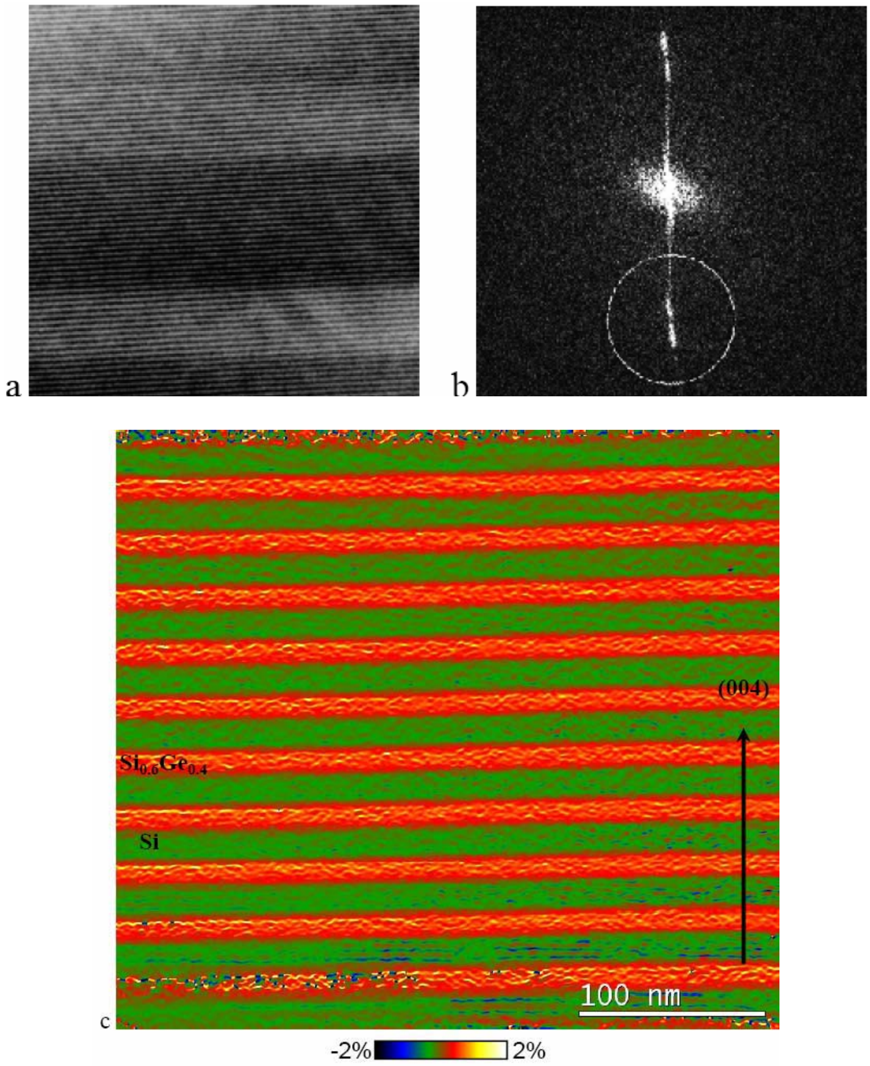


Figure 1. Dark-field holography of a $Si_{0.6}Ge_{0.4}$/Si multilayer using the (004) diffracted beam: (a) holographic detail showing two layers; (b) FFT of hologram; (c) deformation map relative to the substrate of $Si_{0.8}Ge_{0.2}$

INSTITUTE OF NANOSCIENCE OF ARAGON (INA)

Prof. M. Ricardo Ibarra García, Director of the Institute of Nanoscience of Aragon (INA) at the University of Zaragoza. Member of the Institute of Material Science of Aragón ICMA University of Zaragoza-CSIC.

INSTITUTO UNIVERSITARIO
DE INVESTIGACIÓN EN
NANOCIENCIA DE ARAGÓN

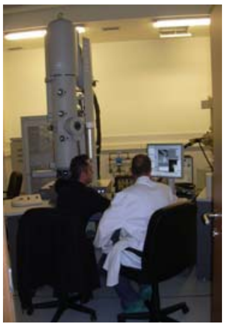
The Aragon Institute of Nanoscience (INA) is an Interdisciplinary research institute at the University of Zaragoza (Spain). It was founded in 2003.

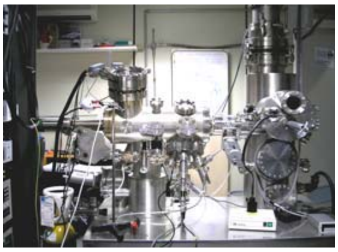
INA is dedicated to **R&D in Nanoscience and Nanotechnology**. Its activities are based on preparation and processing of micro- and nanoscaled structures, and studying fundamental fenomena related with the nanoscale and their applications, in collaboration with companies and other research Centers from different areas.

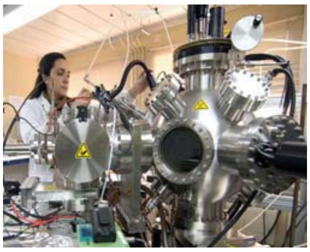
The three main research lines at INA are: **Nanobiomedicine, Nanostructured Materials and the Physics of Nanosystems**. Ours is a multidisciplinary research and so it covers different fields such as Physics, Chemistry, Materials Science, Biology, Biochemistry and Biotechnology.

40 staff researchers**,** 45 Postdoctoral Fellows, 22 PhD Students, 11 Laboratory Technicians work at INA. In addition, there is an administrative and a technology promotion department (7 persons) that supports the R&D activity.

At present, INA has seven **laboratories** equipped with latest-generation devices:







- Thin film growth: PLD, MBE, sputtering, PECVD
- Lithography: clean room
- Dual Beam Microscopy: Nanolitography (ion and e-beam)
- Local probe microscopy: AFM, STM
- Electronic microscopy: HRTEM, SEM, TEM.
- Biomedical applications Lab
- Synthesis and functionalization of nanosystems
- Characterization of nanostructures: XPS-Auger, XRD, VSM Magnetometer

Nowadays, INA, with its qualified staff and state-of-the-art instruments, is a benchmark in the fields of Nanoscience and Nanotechnology.

Research lines

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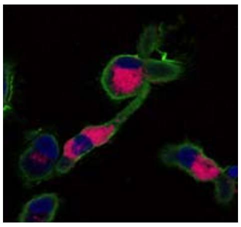
Diagnosis and therapy fields, which involve the use of nanostructured materials.

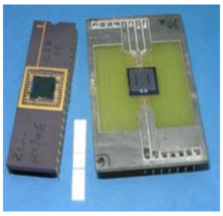
Therapy:

- Synthesis and functionalization of nanoparticles, nano- and microcapsules, and dendrimers for controlled drug delivery
- Magnetic Hyperthermia

Diagnosis:

- Biosensors for quantitative diagnosis
- Contrast agents to improve diagnosis by MRI





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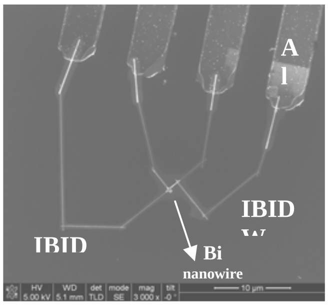
Physics of nanosystems

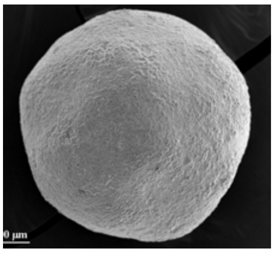
Research of new phenomena at the nanoscale:



- Spintronics
- Granular magnetoresistive sensors
- Magnetism in thin films and heterostructures
- STM (Scanning Tunneling Microscopy)
- Protein characterization with AFM
- MEMS and NEMS (Micro- and Nanoelectromechanical Systems)

Nanostructured Materials

Investigate and develop new materials and devices using "bottom-up" and "top-down" approaches with applications in: automotives, security, environment, footwear, communications, electrodomestics and others.



- Carbon nanotubes and Carbon nanofibers
- Nanoporous interphases
- Hybrid membranes
- Gas sensors using Micro- and Nanolithography
- Nanocomposites/polymers

SELF-ORGANIZED GROWTH IN MANGANITE THIN FILMS

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Oxides are one of the largest families of new materials which attract great attention due to their rich physics. Among them, the manganese perovskites showing colossal magnetoresistance and half metallic characteristics have emerged as good candidates for miniature spintronic devices. Well defined structures at nanometric scale present an increasing interest due to their unique physical properties and potential applications. Fabrication of artificial nanostructures of oxide materials requires sophisticated technology and has been recognized as a hard-attainable issue. For these reasons, the tendency of some oxides toward self-organized growth, forming regular arrays of three dimensional nanostructures, offers enormous potential for the implementation of new nanodevices, while at the same time constitutes a real scientific challenge.

Complex oxide thin films are often elastically strained and this lattice strain can, in some cases, select preferential growth modes leading to the appearance of different self-organized morphologies. In this work we report on the controlled fabrication of self-assembled nanostructures in highly epitaxial $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) thin films grown on top of SrTiO (100) oriented substrates. All nano-objects (mounds, antidotes, hatches) form long-range ordered arrays running in the steps direction defined by the miscut angle of underlying substrate. The antidots[1] have typical diameter around 50 nm and depth around 10 nm with the average density of ~150 antidots/μm^2 (Fig.1). The evolution of the structural and magnetic properties as a function of different parameters, such as deposition parameters, substrate miscut angle and annealing treatments, is analyzed with the goal to clarify the growth mechanism leading to the formation of this self-assembled network of antidotes[1]. The out-of-plane hysteresis loops (H‖(001)) are significantly changed due the existence of the antidote array, while the in-plane counterpart (H‖(100)) is almost unchanged. The sample exhibits a strong anisotropic character with in-plane easy magnetization direction.

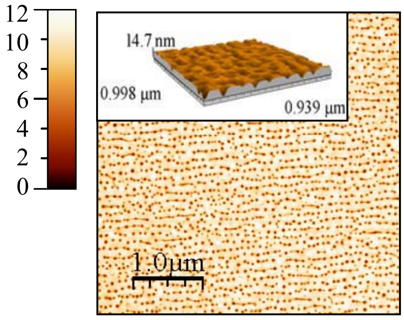

Figure 1: Atomic force microscopy images of LSMO film. Insets show the 3D AFM small area.

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NANOFUNCTIONAL MESOPOROUS FILMS WITH PHOTO-OXIDATIVE PROPERTIES

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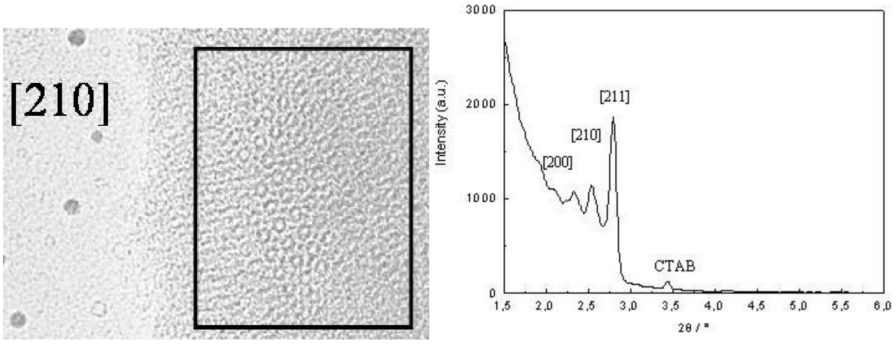
The photochemical generation under mild conditions of the first excited singlet state of oxygen (O2 ($^1\Delta g$) or $^1O_2$) is still a highly relevant topic for many applications, including photodynamic therapy, photodegradation, photooxidation of fine chemicals... Photosensitization is the most common way for producing $^1O_2$ under visible light conditions via energy transfer mechanism with an organic photosensitizer. It was previously shown[1] that hybrid monoliths materials were efficient for the oxidation of nauseous pollutants in the gas phase. $^1O_2$ lifetime and quantum yield could be determined at the gas solid interface, and the correlation between singlet oxygen production and oxidative properties was studied.[2]

In this work, an original organic photosensitizer was incorportated into Mesostructured Thin Films (MTFs) and the oxidative properties of the resultant nanofunctional hybrid films were successfully tested.

Functional MTFs were obtained using a sol-gel method either *via* a "one-pot" procedure (with a sylilated photosensitizer) or via a combined approach (*i.e.* "one-pot" synthesis with an aminopropyltriethoxysilane followed by a chemical post-modification with a carboxylic derivative of the photosensitizer). They were fully characterized by TEM, ellipsoporosimetry, XRD and electronic spectroscopy.

The photo-oxidative properties of functionalized MTFs were successfully tested through the oxidation reaction of two well-known pollutants particularly sensitive to singlet oxygen: dimethylsulfide (DMS) and dibutylsulfide (DBS). The formation of sulfoxide and sulfone was observed for both.

In summary, PS containing MTF's were prepared and characterized, and their photo-oxidative activity was demonstrated. Further work aimed at the determination of $^1O_2$ quantum yield and lifetime inside the film, depending on various surface modifications, will be undertaken in a near future.



TEM and XRD of the nanofunctional MTF's

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CARBOHYDRATE-CARBOHYDRATE INTERACTION PROMINENCE IN 3D SUPRAMOLECULAR SELF-ASSEMBLY

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Self-association in water of biologically significant carbohydrate molecules is a controversial topic due to the strong solvation of these molecules in this solvent and the difficulty to experimentally detect these very weak intermolecular forces by biophysical techniques. Carbohydrate-carbohydrate interactions are implied in biological phenomena as important as the cellular adhesion or the morula compacting.[1,2] Interaction between carbohydrates in water is usually considered to be non-stabilizing due to the strong solvation of these molecules by the excess of water. Recently it has been demonstrated that the interaction between multiple carbohydrate molecules is specific and stabilizing[3], however, these molecules were chemisorbed on gold surfaces. Herein we report the tremendous ability of amphiphilic carbohydrate molecules to form complex three-dimensional architectures which are based only on weak interactions[4]. We have experimentally observed the 3D self-assembly into multilayers of disaccharide neoglycolipid dimers on graphite by means of non-contact AFM. Such long-range associations between amphiphilic carbohydrates in water have never been observed before. We have also theoretically modeled the interaction between two dimers in order to learn about the structure and composition of these layers. A simple bilayer structure as observed for many amphiphilic lipids was discarded by the experiments. Instead, based on the good agreement between experiments and calculations, we propose that multilayer formation takes place through the assembly of building blocks consisting of two dimers each. We propose that, in addition to hydrophobic effects and van der Waals interactions between alkyl chains, carbohydrate-carbohydrate interactions are a fundamental key in the organization of this supramolecular structure. Moreover, the results indicate that H-bonding does not play an important role in this carbohydrate-carbohydrate interaction, as it is commonly stated.

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Figures:

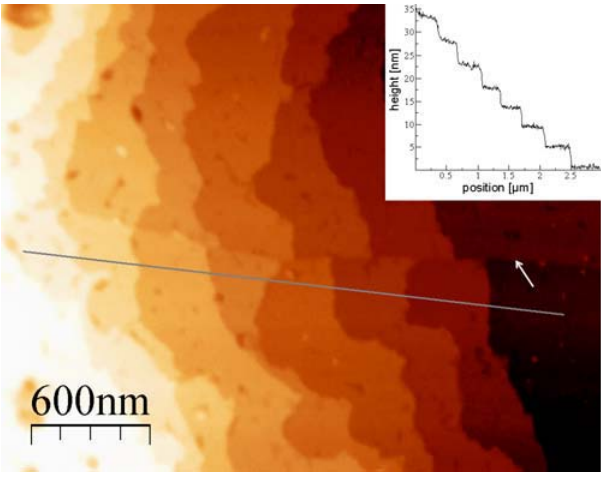
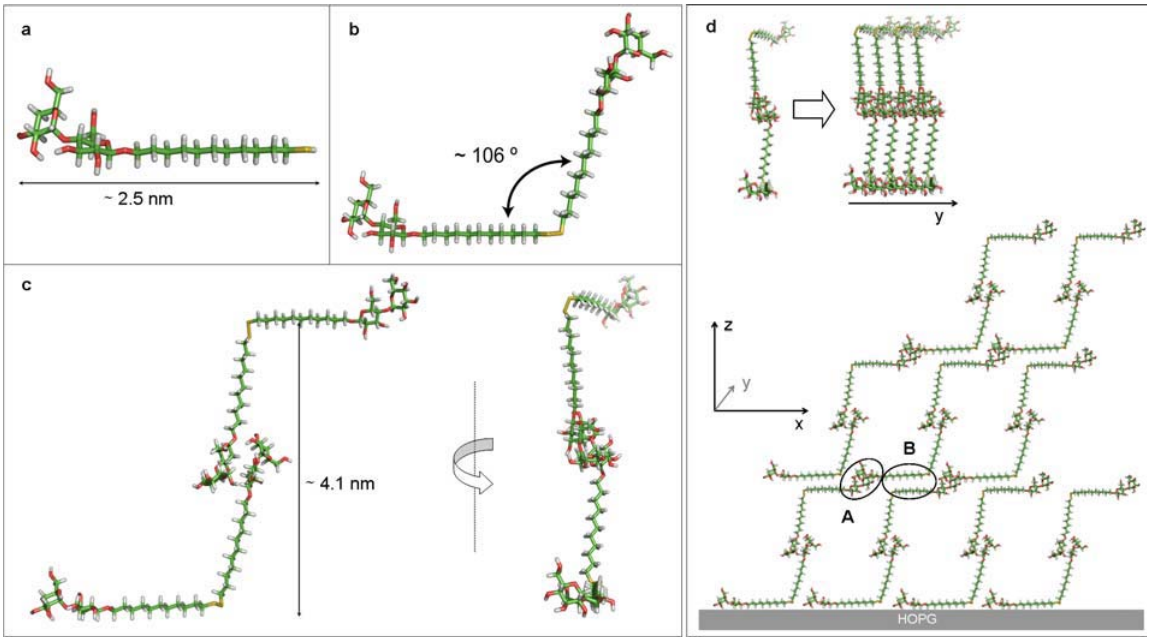


Fig. 1. $(maltoC_{11}S\text{-})_2$ molecules self-assembled into multilayers on graphite (HOPG) imaged by non-contact AFM. A graphite terrace (indicated by the arrow) can be seen crossing the image from side to side under at least nine layers of maltose disulfide molecules formed from the $(maltoC_{11}S\text{-})_2$ solution. In the inset, a profile drawn just below the graphite terrace (grey line) shows the uniform height of the multilayers (~4.2nm).



(a-c): Conformations calculated for (a) the maltose neoglycolipid and (b) the corresponding dimer $(maltoC_{11}S\text{-})_2$ (1). (c) Repetitive unit ("building block") obtained by theoretical calculations showing the interactions between two neoglycolipid dimers. In this minimum energy configuration, intermolecular interactions take place between the two disaccharide units leading to a bottom-to-top distance of 4.1 nm. (d): Cartoon of the proposed model for the multilayer formation of 1 on graphite. In *y*-direction, pairs of dimers as shown in (c) align in a parallel fashion. A suggested assembly in the *x*-*z*-plane is shown in the lower part of (d). Hydrophobic forces between the alkyl spacers and further carbohydrate interactions between the maltose units are thought to be responsible of self-assembling in all three directions. Together, they could provide the cohesion necessary both in *x*-direction and between layers (vertically) through the interactions at A and B.

SYNTHESIS AND CHARACTERIZATION OF LIGHT-EMITTING POLYMER MICROFIBERS USING POROUS SILICON

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The fabrication and characterization of micro and nanostructures based on porous templates have attracted great interest due to their significant potential applications such as chemical and biological sensors, electron emitting flat panel displays, and other electronic and photonic devices [1]. The deposition of specific materials, such as polymers and non-linear materials, into porous templates allows tailoring structures as inverse replicas of the porous [2]. In this context, we have used a technique for the fabrication of polymer microfibers made of Poly[(9,9-dioctylfluorenyl-2,7-diyl)-co-bithiophene] (F8T2) and Poly[2-methoxy-5-(3',7'-dimethyloctyloxy)-1,4-phenylenevinylene] (MDMO-PPV) by infiltration into the pores of macroporous silicon.

Templates were prepared by electrochemical etching of the p-type silicon with a resistivity of 10-20 Ωcm in a home-made electrochemical cell containing a mixed solution of HF:DMF (1:10) at room temperature with current density of 10 mA/cm^2 for 10 min. The size of the pore was controlled by the current density and the etching time [3]. F8T2 and MDMO-PPV were selected as photoluminescent conductive polymers. The combination of their conductivity and intense photoluminescence results in light emitting polymer (LEP) used for applications in flat panel displays. Polymeric microfibers were obtained by infiltration of the polymer solution in tetrahydrofurane (THF) at room temperature into the pores of the silicon followed by immersion into 40 wt% KOH(aq) at 40°C. All samples were inspected by using an environmental scanning electron microscopy (ESEM, FEI Quanta 600).

Figure 1 shows F8T2 and MDMO-PPV microfibers with heights about 6.5 μm and a diameter value of 1 μm.The intensity-normalized absorption and photoluminescence (PL) spectra of a solution of polymer in THF, a film of polymer and polymer microfibers on glass are compared in figure 2. For the F8T2, the film absorption and emission bands are red-shifted compared to the solution as a result of electronic perturbations due to π-stacking of polymer chains in the solid [4]. The emission spectra of the F8T2 microfibers and the F8T2 film are similar with the emission maximum at 541 nm. For the MDMO-PPV, the film absorption band is also red-shifted with regard to the solution 455 nm. This result agrees with previous works [5]. The emission spectra of the microfibers and the film are different to the MDMO-PPV solution. The emission band in the solid state reveal two emission peaks centred at 581 nm and 630 nm which are red-shifted respect to the solution polymer where the maximum is centred at 547 nm.

Acknowledgements:

This work is supported by Spanish Ministry of Education and Science (MEC) under grant number TEC-2006-06531 and HOPE CSD2007-00007 (Consolider-Ingenio 2010).

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Figures:

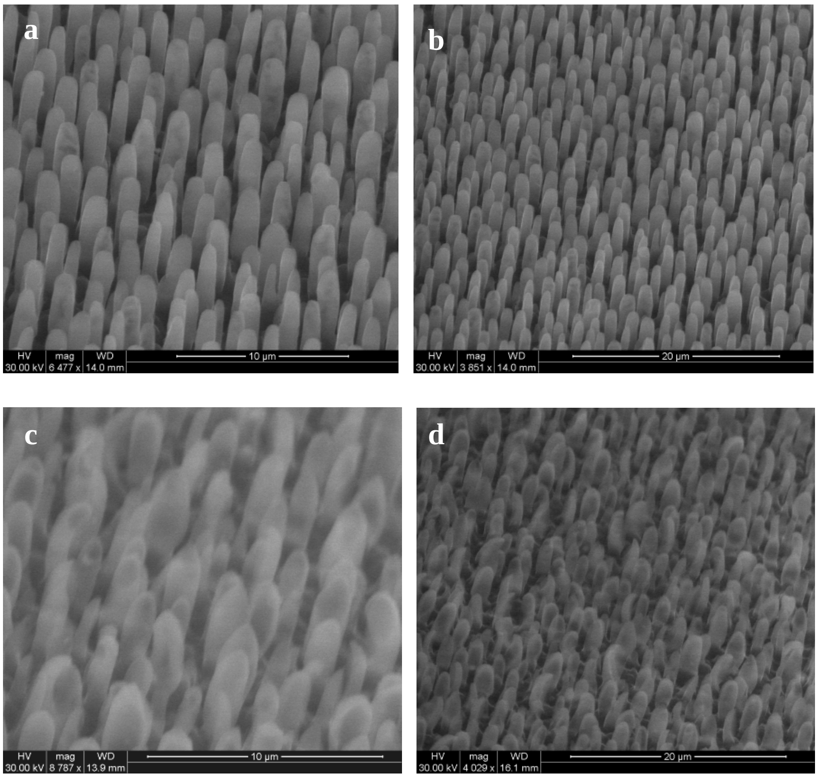

Figure 1. ESEM images of F8T2 microfibers (a, b) and MDMO-PPV microfibers (c, d) after removed the porous silicon template.

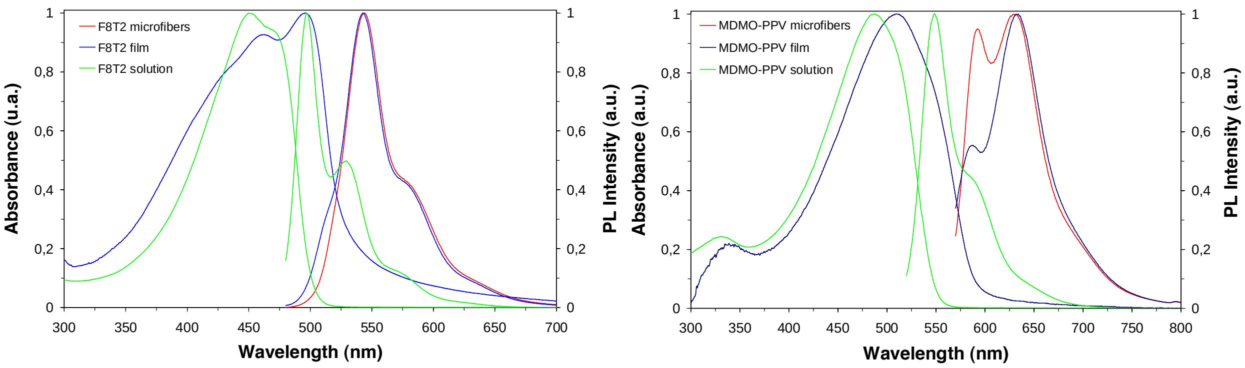

Figure 2. UV-Visible absorption and PL emission spectra of F8T2 and MDMO-PPV for a) solution in THF, b) films and c) microfibers.

ELECTROCHEMICAL POTENTIAL AND ELECTROLYTE EFFECT ON THE CONDUCTANCE OF AU NANOCONTACTS

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Conductance quantization of metal nanocontacts mechanically formed at RT has been studied recently in several electrochemical environments [1-5]. In these experiments, different reactions (i.e. adsorption or desorption of molecules or ions) at the metal surface can take place that can be controlled by the electrochemical potential of the nanocontact relative to a reference electrode in the electrolyte. At positive potentials, well defined peaks at integer multiples of G_0 ($2e^2/h$) are observed in the conductance histograms of Au (much like in air or vacuum), while under the hydrogen evolution reaction (negative potentials), a well defined fractional conductance peak has been reported near $0.5G_0$. In order to explain this fractional conductance several mechanisms (i.e. hydrogen incorporated wire, dimerized wire) have been proposed. However, the actual origin is not clear at present.

Gold nanocontact conductance histograms are reported in this work as a function of the electrochemical potential in both pH neutral (salts) and acidic electrolytes. In contrast to the effect of a salt electrolyte, where the histogram peaks at integer values of G_0 become sharper at negative electrochemical potentials and few plateaus of fractional conductance are observed (Fig.1), acid solutions exhibit an apparent broadening of the peaks, which is actually due to the appearance of extra peaks at non-integer values of the quantum of conductance. These are due to the formation of extra stable structures due to the adsorption of atomic hydrogen and H_2 at the gold nanocontact [6].

At positive electrochemical potentials, near and in the beginning of oxygen evolution, the peaks at integer values of G_0 become skew at the left part of integer quantum conductance values, which is a symptom of an increase disorder due to the incorporation of oxygen atoms in the nanocontact. No fractional conductance values are observed in this region.. This behavior could explain the increase in the width and background in the histograms with the negative potential in agreement with theoretical works [7].

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Figure:

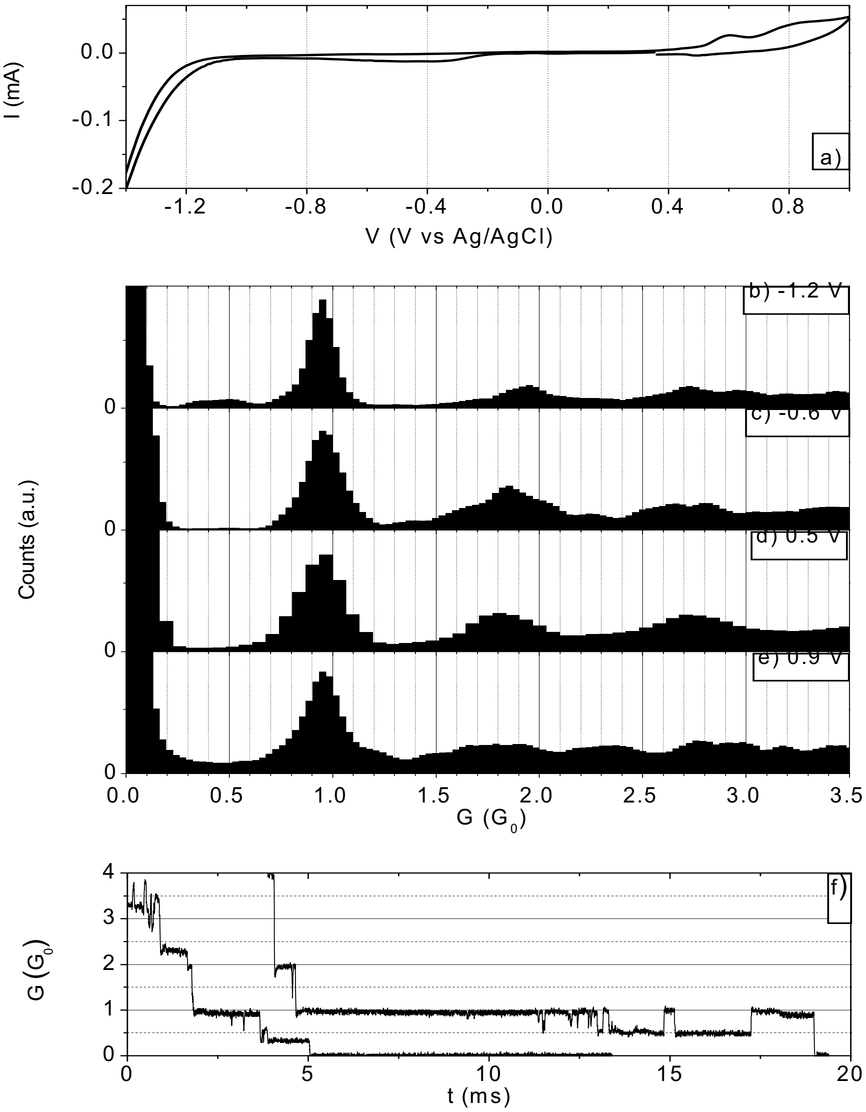

Fig.1. a) Cyclic voltammogram of the Au electrode in 0.1M $NaClO_4$. Conductance histograms of Au in this electrolyte at electrochemical potential: b) -1.2V, c) -0.6V, d) 0.5V, e) 0.9V and f) conductance traces of the Au nanocontacts in 0.1M $NaClO_4$ at electrochemical potential of -1.2V.

DESIGNING MICRO AND NANOPATTERNED SURFACES FOR CELL STUDIES AND BIOSENSOR APPLICATIONS

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New fabrication technologies and, in particular, new nanotechnologies, have provided biomaterial and biomedical scientists with enormous possibilities when designing customized surfaces that can be used as novel supports for cell culture studies or in other biomedical applications as biosensors. The main issue now is how to effectively design these components and choose the appropriate combination of structure and chemistry to tailor towards applications as challenging and complex as stem cell differentiation. In this talk, the main strategies developed by the Nanobioengineering group at IBEC for the design and fabrication of surfaces with controlled topography and chemistry at the micro and nanoscale will be reviewed. The group has been working in new applications of techniques as nanoimprint lithography, focused ion beam lithography, microcontact printing, piezo-jet deposition and dip-pen nanolithography in the biomedical field.

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MULTIFUNCTIONAL CORE-SHELL Fe-MgO NANOSPHERES FOR BIOMEDICINE

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There have been major advances in the availability of magnetic nanoparticles (Nps), both in quality and quantity, which in turn stimulated the worldwide pursuit of NPs for technological applications in fields as diverse as high density memory devices, spintronics or biotechnology. For instance, iron oxide nanoparticles have proven for several decades to be promising for biomedical applications such as tissue engineering, magnetic resonance imaging (MRI), magnetic separation of biological materials, and heating mediators for cancer therapy [R. K. Gilchrist, et al. Ann. Surg. 146 (1957) 596]. But in spite of the encouraging progress, expectations have not been fully accomplished: most of the magnetic nanoparticles intended to-date have the disadvantage of either being bio-incompatible or not providing a large enough magnetic stray field for high-resolution detection schemes. The first problem is the poisonous character of pure 3d and 4f ferromagnetic metals and the second one the super-paramagnetic fluctuations at the ambient detection temperatures.

One promising solution for overcoming these issues is the development of core-shell structures in which the shell will provide chemical stability and biocompatibility while maintaining the magnetic properties of the core. Here we report on Fe(Co) particles covered by a uniform 3 nm thick MgO epitaxial shell. Among commonly used schemes, we followed simple physics-derived solutions based on gas-aggregation methods that assure industrial scalability and ecology. Nearly spherical crystals with negligible shape anisotropy were obtained [Fig. 1]. MgO forms a continuous and epitaxial shell over the Fe islands, providing exceptional advantages such as environment stability, controlled interparticle interactions, and non-toxic hydroxyl surface groups that would allow for surface attachment of drugs or biomolecules. Hysteresis loops show a much stronger magnetic response (210 emu/g_{Fe}) than any composite material produced up to now involving magnetic nanoparticles encapsulated in inorganic matrices. Worthy, no diminish of the properties was detected over several months' storage under ambience conditions.

To elucidate whether our system is appropriate for *in-vivo* applications, the particles were dispersed in a biological suspension with 7.4 pH. *In-vitro* studies exploring the toxicity of the nanoparticles in 3T3 fibroblast cells and mouse cortical neurons cultures will be presented. Worthy, in vitro cultures remained healthy for 72h with solutions above 1 mM total-metal molar concentration. After these encouraging results, the Nps were used in veterinarian trials in mice as MRI contrast agents. In comparison to paramagnetic ion chelates and superparamagnetic iron oxides, our ferromagnetic NPs show higher molar relaxivities and may offer advantages at low concentrations. Thanks to the ferromagnetic character of the NPs, biodistribution could be easily evaluated through magnetic measurements of *ex-vivo* tissue [Fig. 2], from which urinary excretion is considered as possible clearance pathway. Besides, experiments will be presented on the RF-power absorption efficiency so that the performance of the final pharmaceutical product for magnetic cancer hyperthermia treatment can be evaluated.

Figures:

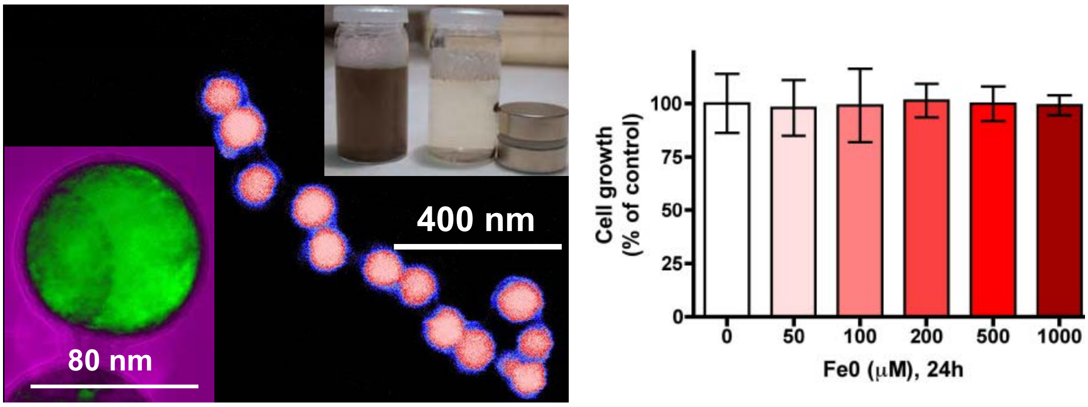

Fig. 1. On the left, electron micrograph of a chain of magnesia-coated Fe with average diameter close to 75 nm. Before these NPs can act as contrast agents, they must be stabilized in water at physiological pH. Inset shows the feasibility of magnetic separation in suspensions. On the right, fibroblast cell cultures demonstrate no toxic response.

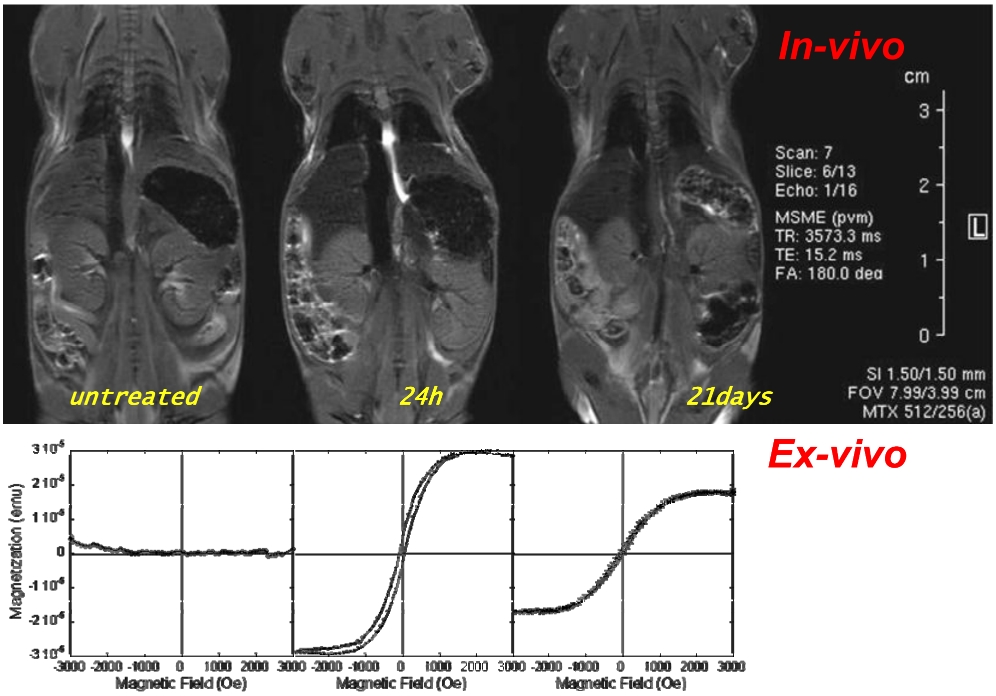

Fig. 2. In vivo 7 Tesla Brucker MRI T2-weighted images of mice injected with NPs (upper) and magnetic estimation of hepatic iron concentration measured from postmortem liver tissue (300K). Authors acknowledge the Servei de Resonancia Magnètica Experimental from IDIBAPS (Barcelona) for MRI measurements.

POLYELECTROLYTES AS BUILDING BLOCKS IN NANOTECHNOLOGY

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Polyelectrolytes, polymer molecules with charged repeating units, are particularly interesting for nanotechnological applications since they have the capability of changing conformation and size in response to external stimuli and mimic a wide range of natural occurring polymers. Indeed, in nature polyelectrolytes are already used as building blocks: DNA, proteins, and other biopolymers, together form working nanoscale devices such as viruses, bacteria and ultimately cells of higher organisms.

Two different nanofabrication techniques employing polyelectrolytes: the Layer by Layer (LBL) technique and the in situ brush synthesis will applied for the fabrication of bio nano devices for drug delivery and sensing.

The LBL technique is based on the alternative assembly of oppositely charged polyelectrolyte layers to form a thin polymer film. Brushes are monolayers of polymer chains with a side anchored to a surface and the other side free. Polymer chains in a brush retain much of the conformational freedom of macromolecules in solution and show a high capacity to adapt to changes in the environment (pH, ionic strength, temperature). While LBL films films provide the means to control composition and thickness at the nanoscale in vertical direction of a film, polyelectrolyte brushes have a dynamic character with the capacity of responding to the media with changes in the nanometric range.

Both techniques can be used to design in a hierarchical way complex surfaces with various physical and chemical functionalities, including biological and artificial materials.

In this presentation the tailoring of nanoparticles (PLGA, silica, CNTs, etc) and planar surfaces with LBL films or brushes will be presented. On top of the polymer cushion lipids layers, biomolecules and eventually virus particles have been assembled providing to the nanoparticles specific features. Flowcytometry, Confocal Microscopy, TEM and zeta potential measurements have been applied for the characterization of the nanoparticles and their functionalization. In addition, QCM-D, AFM and contact angle measurements have been performed on planar surfaces.

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ADIABATIC VERSUS NON-ADIABATIC DETERMINATION OF SPECIFIC ABSORPTION RATE OF FERROFLUIDS

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In magnetic fluid hyperthermia for cancer treatment [1] a biocompatible fluid based on magnetic nanoparticles is introduced into tumours, so that the heat generated by the nanoparticles under an alternating magnetic field destroys cancerous cells. The minimization of the invasive character of this technique requires the use of magnetic nanoparticles with large heating power, that allowing the clinical dose to be reduced.

The heating efficiency of these fluids is determined by the specific absorption rate (SAR), defined as $SAR = (1/m_{MNP})\cdot C\cdot(\Delta T/\Delta t)$, where m_{MNP} is the mass of dissipating material , C, the heat capacity of the whole sample, and ΔT, the sample temperature increase during the ac-field application interval, Δt.

Current non-adiabatic SAR installations (see [2,3] for example) cannot use the above incremental expression since heat losses (conduction, radiation, convection) are not minimized. Then, an approximate procedure is followed, in which SAR is calculated as SAR=$C\ \beta\ /\ m_{MNP}$, where β is the initial slope of the temperature-time curve during ac-field application. However, this initial-slope method may derive wrong SAR values, even in adiabatic conditions. On the one hand, if a sample does not present high diffusivity values and/or the heat sources (MNP) are heterogeneously distributed (for example, in nanocomposites), the onset of the magnetic field would create a transient-state temperature distribution. Then, depending on the part of the sample in contact with the sensor, different temperature-versus-time trends can be recorded, and initial slopes may not reproduce the real generated heating power. On the other hand, heat losses in non-adiabatic installations may be significant at early times, and be present in the temperature-versus-time slope even in the initial linear trend.

To overcome these limitations, we have developed the first adiabatic magnetothermal setup [4], in which the sample undergoes only a weak net heat exchange with the surroundings. In such conditions, the generated heat can be considered to be entirely invested in the sample temperature raise, allowing direct measurement of ΔT, and providing more precise SAR values.

The measurements performed on a copper sample provided comparison between experimental and theoretical values: adiabatic conditions gave SAR values only 3% higher than the theoretical ones, while the typical non-adiabatic method underestimated SAR by 21%. These results have allowed to evaluate for the first time the accuracy in SAR determination by calorimetric methods.

Moreover, we have pointed the improvement of the incremental over the initial-slope method by estimating the errors arising from the use of the initial-slope approximation both in adiabatic and in non-adiabatic conditions [5]. For this purpose, we carried out several experiments on a commercial magnetite aqueous ferrofluid from Chemicell GmbH, namely the fluidMAG-UC/A, with different isolating conditions, temperature sensors and sample-sensor contacts.

Our comparative experiments have demonstrated that non-adiabatic determination of SAR may cause small to appreciable errors, depending on factors such as sample characteristics, type of temperature sensor, sample-sensor contact, isolating degree, etc. Moreover, it is quite difficult to infer or control, and consequently, to correct such errors. Non-adiabatic determination allows comparison between different samples measured in the same setup and with the same conditions, but may not give the correct SAR values to be used to reproduce final temperatures in 'real' applications, that is, in tissues or patients. In addition, the use of different non-adiabatic setups and measuring conditions makes the comparison of results from different authors in the literature very difficult. All these problems could be minimized by using an adiabatic incremental determination of SAR.

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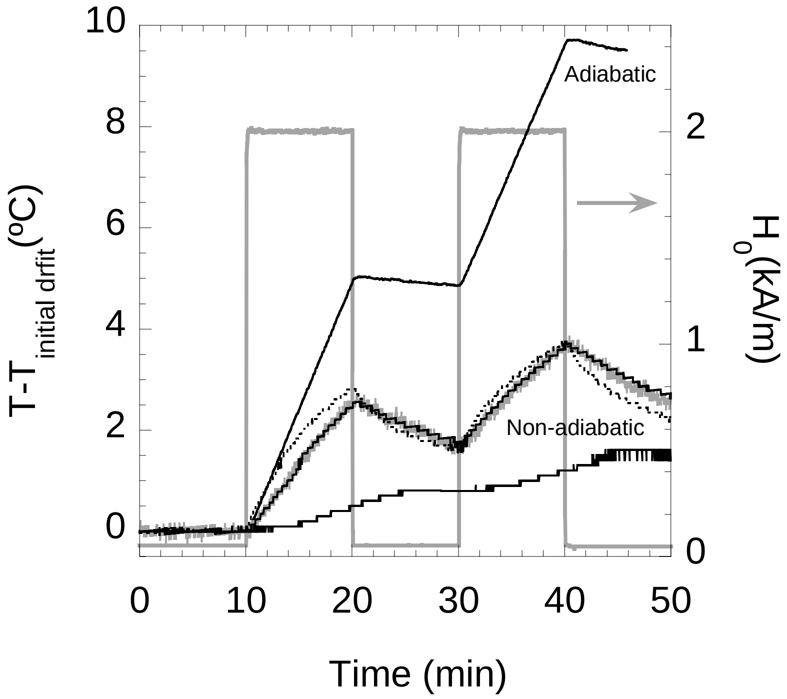
Figure:



Comparison between adiabatic and non-adiabatic temperature-versus-time characteristics of fluidMAG-UC/A at an ac-field frequency of 109 kHz. Non-adiabatic experiments were performed with different isolating conditions, temperature sensors and sample-sensor contacts. The ac-field amplitude sequence corresponds to the grey line, right scale.

NANOGAL: GALICIAN TECHNOLOGICAL PLATFORM ON NANOTECHNOLOGY.

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Nowadays, it is assumed that the nanotechnology will be one of the engines of economic growth in the XXI century. The Galician Technological Platform on Nanotechnology, Nanogal, was launched from the Laboratorio Oficial de Metroloxía de Galicia in July of 2008 with the financial support of Dirección Xeral de I+D (Xunta de Galicia). Nanogal is the framework of companies, technological centers, and university research groups which interest in nanoscience and nanotechnology.

Nanogal wants to build a new model of relationships in which are involved, companies with scientific, technological, political and social partners from inside and abroad Galician community. A model that will consolidate the exchange of knowledge and support create new business opportunities. A model based on intensive collaboration of all stakeholders.

Moreover, Nanogal wants to address technological challenges that can potentially contribute to a number of key objetives which are essential for Galicia's future competitiveness, including the timely developement and deployment of nanotechnologies, nanotechnology development with a view of sustainable development, new technology-based public goods and services, technological breakthroughs necessary to remain at the leading edge in high technology sectors and the restructuring of traditional industrial ones.

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The Catalan Institute of Nanotechnology (Institut Català de Nanotecnologia, ICN) is a research centre created by the Catalan Government within the framework of the III Research and Innovation Plan. Founded in 2003 as a private non-profit foundation, the ICN developed its research activities since mid 2005. At present, the ICN has an annual budget which permits to hire scientific researchers, the purchase of sophisticated scientific equipment and also to cover the running costs of the institute.

In 2006 the Spanish National Research Council (CSIC) joined the project. Both institutions agreed to create a new research centre shared between the two actors, the Research Centre in Nanoscience and Nanotechnology (Centre d'Investigacions en Nanociència i Nanotecnologia, CIN2). By 2008 there are around 90 researchers working in this centre and plans to grow up to 200 within the next few years, when the new building is operative. By then, there will be access to 30 laboratories distributed on four plants.

In this talk I will give a short overview of the internal structure of the two institutions and the different strategies that follow. I will give also information of current projects, publications, facilities and industrial activities as well as our participation in the European research area. Particular attention in the talk will be devoted to explain the five main research areas of the institute:

- Theory and Simulation at the Nanoscale.
  The aim of this research line is the development of efficient methods for atomistic simulations in nanostructured systems, taking advantage of the multiprocessor computer architecture, and their application to specific problems in nanoscience and nannotechnology.

- Scanning Probe Microscopy and Synchrotron Radiation Spectroscopy.
  The scientific goals are focused towards the fundamental studies of the physics and the chemistry of confined molecular systems and transition-metal compounds.

- Physical Properties of Fabricated Nanostructures.
  This research area covers the study of physical properties of nanostructures realised by nanofabrication methods. The underlying physics is that of state-variables including spins, electrons, ions, photons and phonons.

- Chemical Approaches to Nanosctructured Functional Materials and Devices.
  From the bottom-up approach we synthesize functional materials exhibiting functional properties that range from electroactivity, magnetic, electronic and/or optical properties to relevant implications in biological processes.

- Nanobiosensor Devices.
  This research line is focused on the research and development of novel sensors and biosensors based on photonic, electromechanical and nanomechanical transducing.

> The aim is to achieve high sensitive, selective, cost effective and user friendly devices with interest for applications in several fields.

This information will be illustrated with a few examples of current research.

ENCAPSULATION GOLD NANOPARTICLES IN THERMORESPONSIVE MICROGELS. MOLECULAR TRAPS FOR SERS

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Nanocomposite materials consisting of a colloidal metal nanoparticle within a synthetic polymer hydrogel shell have attracted great attention due to potential applications in several fields such as catalysis, photonics, electronics, optics and biomedicine. Within the polymeric nanoparticles the field concerning stimuli-responsive nanomaterials has been investigated intensively in the past years.[1] Among then one of the most commonly studied is the poly(*N*-isopropylacrylamide) (pNIPAM), that is, a thermoresponsive polymer that undergoes a phase transition from a hydrophilic, water-swollen state to hydrophobic, globular state when heated above its lower critical solution temperature (LCST) which is about 31-32ºC in water.

In this work we are proposing an easy two-step procedure to pNIPAM encapsulate cetyltrimethyl ammonium bromide (CTAB) stabilized metal nanoparticlesn;[2] the first step consisting of a CTAB promoted polystyrene coating of the metal nanoparticles in order to avoid aggregation and make them fully compatible with the precipitation polymerization of NIPAM in the second step. Figure 1 shows a representative TEM image of the Au-pNIPAM core-shell system.

Further confirmation of the core-shell structure of the obtained nanocomposite is given by the UV-Vis analysis of the influence of the temperature on the system (see Figure 1). A closer look at the position of the surface plasmon band of the gold nanoparticles reveals that as the microgel collapses the band red shifts ca. 10nm. This effect should be interpreted as a consequence of a core-shell structure since an increase in the local refractive index of the gold nanoparticles.

Control over the NIPAM shell thickness can be easily achieved by using appropriate amounts of NIPAM monomer. This allows us to control the thickness of the NIPAM shell, in the collapse state, between 20nm and 250 nm. Figure 2 shows representative TEM images of the gold nanoparticles with different thicknesses.

The thermoresponsive properties of the systems is expected to allow us to control the catalytic properties of metal nanoparticles, as well as to control the interparticle distance in order to obtained two dimensional arrays. Recently, we have shown its applicability as molecular traps for surface-enhanced, spectroscopic, ultra-sensitive analysis.[3]

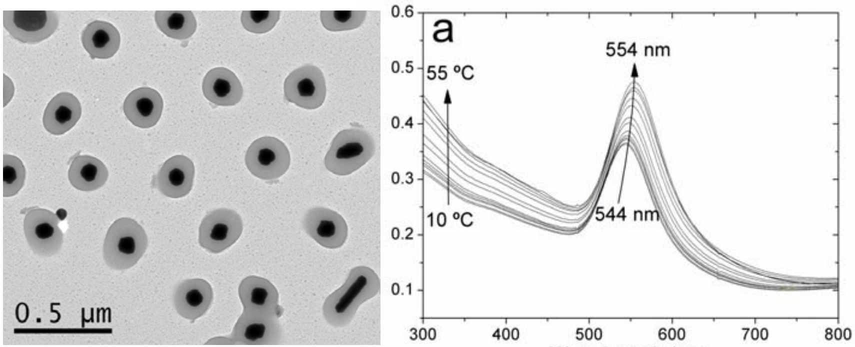

Figure 1. (left) TEM image of the Au-pNIPAM core-shell system, (right) influence of the temperature on the UV-Vis spectra on an aqueous dispersion of the core-shell microgel.

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IMAGING, MANIPULATION AND CHEMICAL IDENTIFICATION OF INDIVIDUAL ATOMS WITH DYNAMIC FORCE MICROSCOPY: A THEORETICAL PERSPECTIVE.

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Dynamic Force Microscopy is a powerful tool for the characterization and manipulation of matter at the nanometer scale [1]. The most-extended operation mode (amplitude modulation, AM-AFM, also known as “tapping”) allows the imaging with nanometer resolution of heterogeneous materials in their natural environment and state. Measuring the phase lag of the vibrating probe with respect to the external excitation, AM-AFM can map simultaneously the shape and the compositional variations of the surface and provide access to the dissipated energy [2].

In this talk, we focus on the frequency modulation mode (FM-AFM) that has fulfilled the long standing goal of achieving atomic resolution in all kind of surfaces. We’ll show how the combination of force spectroscopy measurements with our large-scale first principles calculations, can be used to understand and extend the FM-AFM capabilities in key areas including single-atom manipulation [3,4] and chemical identification [5]. Tip-sample interactions are also relevant to the STM operation in the near-to-contact regime, where they can induce a substantial decrease of the current when approaching semiconductor surfaces under low bias conditions [6].

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CIC NANOGUNE CONSOLIDER:
THE BIG CHALLENGE OF THE SMALL

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In the framework of the so-called nanoBasque initiative of the Department of Industry, Trade, and Tourism of the Basque Government and the Spanish Consolider-Ingenio program, the Nanoscience Cooperative Research Center (CIC) nanoGUNE Consolider has been opened recently with the mission of addressing both basic and applied nanoscience world-class research for the competitive growth of the Basque Country. In this talk, I intend to give an overview of the current status of this challenging project, which we call 'the big challenge of the small' not only because it refers to the science of the small but also because it represents a big challenge for a small but successful region that is currently aiming at becoming an innovation reference in Europe.

SURFACE MODIFICATION WITH ENGINEERED BACTERIAL BIOCOMPATIBLE NANOMATERIALS FOR CELL PROLIFERATION

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Bacterial inclusion bodies (IBs) are highly pure protein deposits produced in recombinant bacteria.[1] Being insoluble in water, they are observed as porous and highly hydrated amorphous particles in the size range of a few hundred nanometers. The polypeptide chains that form IBs fold into an unusual amyloid-like molecular architecture compatible with their native structure, thus supporting the biological activities of the embedded polypeptides (eg fluorescence or enzymatic activity).[2] Therefore, a wide spectrum of uses as functional and biocompatible materials might arise upon convenient engineering.[3] Although theoretically feasible through adjusting genetic and production conditions, the biophysical features of these proteinaceus nanoparticles, such as activity and size, have been never engineered. In this study we characterize the relevant nanoscale properties of IBs as novel particulate materials using AFM, SEM and fluorescence confocal microscopy (Figure 1). Moreover, we have also explored at which extent the produced particles can be tailored by simple approaches (Figure 1D). In addition, as an intriguing proof-of-concept, inclusion body-grafted patterned surfaces have been obtained using the microcontact printing (μCP) technique[4] (Figure 2). The obtained modified surfaces dramatically stimulate mammalian cell proliferation exclusively on the IBs patterned areas, proving the potential of IBs in tissue engineering and regenerative medicine among other promising biomedical applications.[5]

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Figures:

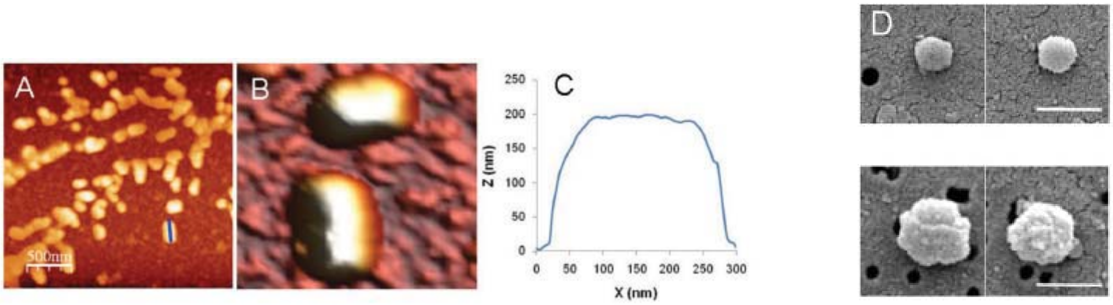

Figure 1. A-B-C: 3h-aged GFP IBs imaged by AFM; D: SEM images of 3h-aged IBs produced with different cells. White bars indicate 500 nm.

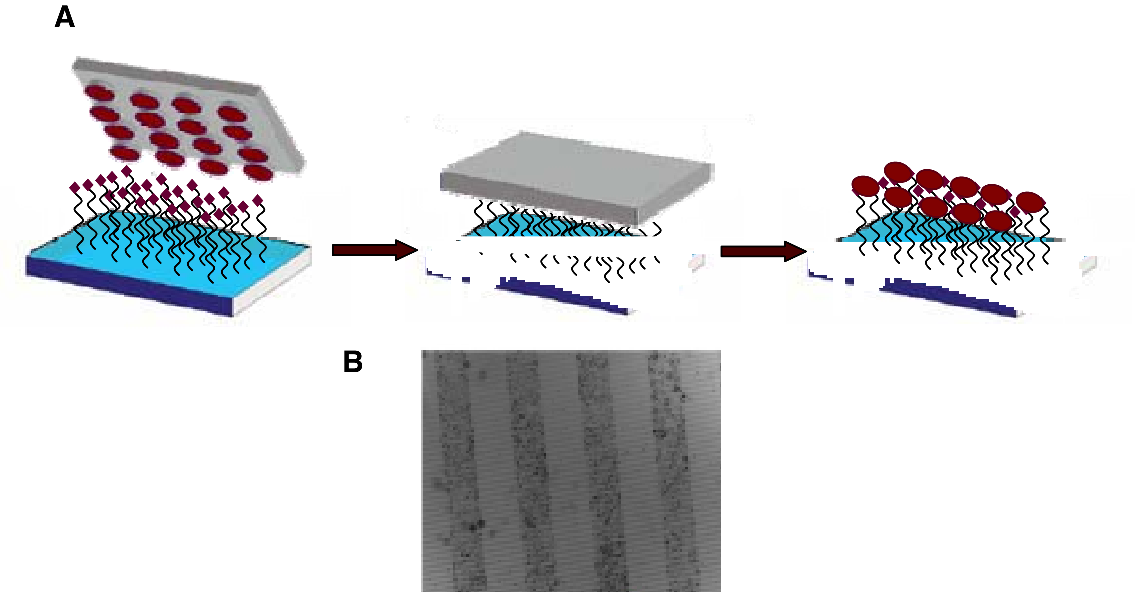

Figure 2. A: Scheme of the microcontact printing technique used to pattern IBs on pre-functionalized silicon with amino-terminated monoalayers. B: Optical microscopy image of 50 μm lined IBs patterned on amino terminated silicon surfaces using μCP.

GETTING A GRIP ON STRONGLY HYDRATED BIOMOLECULAR FILMS – THE EXAMPLE OF THE PERICELLULAR COAT.

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The plasma membrane is commonly considered the boundary of the living cell, although peripheral polysaccharides and glycoproteins often self-organize into an additional coating layer on the cell surface (Figure). These pericellular coats (PCC), several hundred nanometres or even a few micrometers thick, play a crucial role in the general protection of the cell, and act as a mediator in the communication with its environment. The highly hydrated nature of these coats, and the complex structure and dynamics of the living cell make them difficult to probe in their native environment or to determine the coat's structure with high resolution methods. Therefore, to understand structure/function inter-relationships of these supra-molecular assemblies, it is vital to move from living cells to simplified model systems.

We have recently developed a new method to create *in vitro* model systems of the PCC that is based on the end-grafting the polysaccharide hyaluronan, a key component of the PCC, to a supported lipid bilayer [1]. The model systems are well-controlled and capture characteristic properties of the PCC, including its dimensions and hydration. With these models, the dynamics of coat organization and relevant physico-chemical properties can be investigated in a quantitative manner.

Here, I will present data on the detailed characterization of such model systems using a toolbox of characterization techniques. Using techniques such as QCM-D, ellipsometry, microinterferometry and colloidal AFM, we investigate *in vitro* the properties of hyaluronan films, including its mechanical properties, its permeability to solutes, and its response to hyaluronan-binding proteins. These characterization approaches are also promising beyond the scope of this work, for the characterization of the soft and hydrated films in general.

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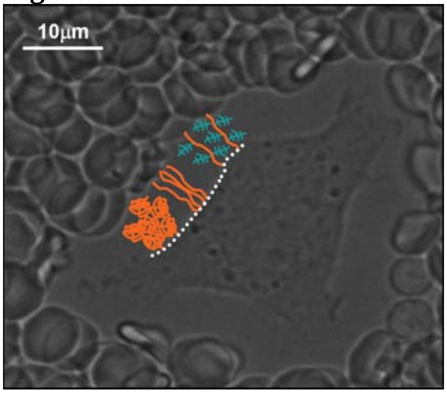
Figures:



The pericellular coat, visualized by a particle exclusion assay: red blood cells that have been added in abundance to a living chondrocyte (centre) cannot penetrate into a zone of several micrometers in thickness around the cell. They mark the outer limit of the strongly hydrated pericellular coat. The sketches represent but a few supramolecular conformations that are thought to give rise to the coat. Our work aims at understanding the structure, the physico-chemical properties and eventually the biological function of these soft and hydrated architectures at the nanoscale. Micrograph by H. Boehm (Max Planck Institute for Metals Research, Stuttgart, Germany).

BIODEGRADABLE CAPSULES FOR MEDICAL APPLICATIONS

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Polyelectrolyte capsules are made by layer-by-layer assembly of oppositely charged polyelectrolytes onto a template, which is at the end of the synthesis dissolved to obtain hollow capsules. These capsules can be filled with different bioactive molecules like drugs, antigens or genetic material for different purposes such as disease treatment, vaccination or gene delivery.

Using biological charged materials such as dextran and L-arginine, biocompatible and biodegradable hollow capsules are synthesized. By encapsulation of DQ^{TM}-Ovalbumine, a fluorogenic substrate for proteases the degradation of the capsules can be spectroscopically controlled. These data show that upon cellular internalization of the capsules, cargo molecules are released not only from the capsule but also from intracellular compartments where the capsules are located due to active degradation of the capsule wall by the cell.

PH-RESPONSIVE MOLECULAR FLUORESCENT ARRAYS FABRICATED BY DIRECT-WRITE PARALLEL DIP-PEN AND OTHER MICRO-/NANOLITHOGRAPHIC TECHNIQUES

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Attachment of optical sensing materials on solid supports has led to significant advances in the development of sensor systems with promising applications in the detection of small biomolecules, metal ions, organic vapours and explosives, and pH changes as well as in medical diagnosis. Simultaneously, with the introduction of several lithographic techniques such as microcontact printing, lithographically controlled wetting and dip-pen nanolithography (DPN), researchers have recently started to consider the organization of these materials into ordered arrays and their miniaturization down to the micro- and nanometer scale.

Herein we demonstrate that one can use such techniques to fabricate large ordered arrays of small optical sensing molecules that display a switching-like behavior in response to an external stimulus, such as pH. With this aim two different molecules that can interconvert between three different states with different fluorescent properties have been used. The first of such molecules was fluorescein (see Figure 1), which was chosen as the proof-of-concept candidate because it has been proposed for the construction of future pH sensors and molecular calculators. As a second molecule of choice, we have synthesized a new compound (see Figure 2) that reversibly interconverts between three different protonation states: the cationic (c1), the neutral (n1), and the anionic (a1) forms in response to pH changes (see Figure 2). Finally, we have also shown the possibility to combine up to three of such active fluorescent molecules within the same arrange.

The interest of these and their scalability to a massively parallel process opens the door for the development of novel surface molecular optical sensors with relevance not only for pH changes detection but also in different fields such as ion recognition, temperature modification, etc.

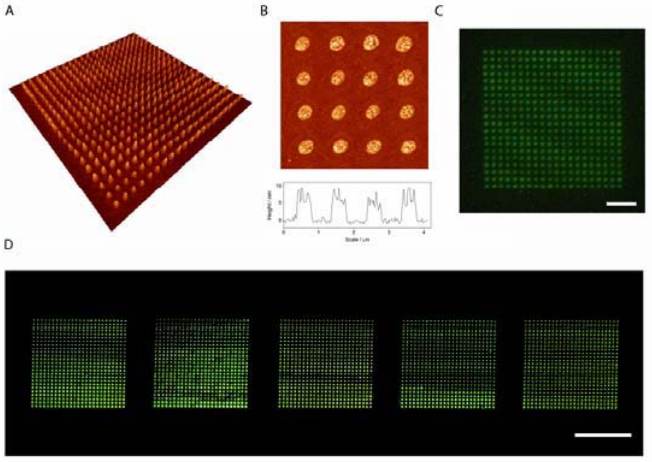

Figure 1 (a) Three-dimensional AC-AFM topography image of a fluorescein dot (400 nm in diameter) array (20 x 20 dots, 20 µm x 20 µm) fabricated via direct-write DPN. (B) AC-AFM topography image of a zoomed region (4 x 4 dots) and height profiles of the imprinted fluorescein features. (C) Corresponding fluorescence image of the whole fluorescein array. (D) 12 replicates of a fluorescein array (25 dots x 25 dots, 50 µm x 50 µm) have been generated. Scale bars are 10 µm in (C) and 30 µm in (D).

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Figure 2 Consecutive fluorescence images of a 14x14 µm^2 area of a sample prepared by LCW deposition of a1 onto a glass cover slide from an acetonitrile solution (ca1=1x10^{-4} M): (a) initially; (b) after exposure to an acid gas flow (HCl/N$_2$); (c) after exposure to a basic gas flow (triethylamine/N$_2$).

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SELF-ASSEMBLED SELF-TUNED RANDOM LASERS

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The special care needed to produce high quality photonic crystals is, surprisingly, also needed to produce photonic glasses[1], random and solid arrangement of dielectric spheres, because, upon sedimentation, certain colloidal particles show a strong tendency to order which has to be broken. Only conscientious attempts to fully remove order lead to structures fully devoid of any remnants of order as evidenced by optical properties or microscopy.

Light transport in photonic glasses becomes resonant, the diffusion constant and the transport mean free path show minima and maxima when the Mie modes of the spheres are excited. Also the energy velocity in such media shows a resonant behaviour[2]. With this material it is possible to create random lasers in which the lasing wavelength can be decoupled from gain profile and selected at will.

A random laser is a system formed by a random assembly of elastic scatters dispersed into an optical gain medium. Multiple light scattering replaces standard optical cavity of traditional lasers and the interplay between gain and scattering determines its unique properties. Random lasers studied to date, consisted of irregularly shaped or polydisperse scatters, with some average scattering strength that is constant over the frequency window of the laser. We consider the case where the scattering is resonant. Photonic glasses can sustain scattering resonances over the gain frequency window, since it is formed by monodisperse spheres of relatively high refractive index contrast that are randomly assembled. The unique resonant scattering of this material allows controlling the laser emission via the diameter of the particles and their refractive index. Our system is therefore a random laser with a-priori designed lasing peak within the gain curve [3].

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NANOARACAT

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Nanoaracat is a collaboration agreement framework among the Spanish Communities Aragon and Catalonia, to encourage a series of joint actions in I+D+i in the area of the Nanoscience and the Nanotechnology.

Since 2006 this initiative promotes the research collaboration and the technology transfer among 12 research centres and 5 universities from both communities participating in the project.

www.nanoaracat.com

Current projects and activities:

- Organization of Nanoscience scientific conferences and technology transfer sessions with the academic and industrial sectors. (See events in the Web).
- Promotion of scientific interchanges to provide facilities and equipment of other centers, including the payment for the journey and the accommodation.
- Financing training courses for researchers and technicians in Catalonia and Aragon.
- Financing visits to set projects.
- Financing scientific exchanges among these communities.

Researchers in Nanoscience and Nanotechnology areas from Catalonia and Aragon can request budget for those activities applying at http://www.nanoaracat.com/solicitudes.html

The applications will be revised by the scientific commission, which will decide the appropriateness of the request, as we as the amount of the financing of the action in about 10 days.

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icma
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ICMAB

iQAC

MATGAS

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CAESARAVGVSTANAE STVDIVM GENERALE CIVITATIS

NANOMECHANICAL DEVICES: LABEL- FREE ULTRASENSITIVE BIOSENSORS

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In the last years, a large variety of ultrasensitive nanomechanical sensors have been developed and used as biological sensors. The results demonstrate that rapid detection of biomolecules with high sensitivity and specificity without need of sample pre-treatment and labeling with fluorescent dyes is attainable[1]. This technology has the potential to revolutionize the fields of molecular biology and preventive medicine. Here, we present results in several of the battle fronts of nanomechanical biosensors faced by our group in collaboration with several multidisciplinary scientific and industrial partners. We split the results into the dynamic and static modes used for nanomechanical sensing. In the dynamic mode, we have found that the added mass is not the sole responsible for the changes in the resonant frequency. Actually, the mechanical properties of adsorbates not only play a relevant role in the dynamic response, they can be taken advantage off in order to obtain more specific biosensors. In the static mode, we have found a new detection method to track DNA hybridization that is based on hydration induced tension in nucleic acid films. These results are under exploitation by the CSIC spin-off company Mecwins S.L.

Dynamic Nanomechanical Biosensors

In order to develop nanomechanical devices for ultrasensitive pathogen detection, we have measured the effect of the bacteria adsorption on the resonant frequency of microcantilevers as a function of the adsorption position and vibration mode. The resonant frequencies were measured from the Brownian fluctuations of the cantilever tip. Our results indicate that the resonance shift is not solely depending on the adsorbed mass and adsorbate location. Our results indicate that there exist three mechanisms that can produce a significant resonant frequency shift: **the stiffness**, the surface stress gradient and the mass [3,4].. The combination of high vibration modes and the confinement of the adsorption to defined regions of the cantilever allow detection of single bacterial cells by only measuring the Brownian fluctuations, i.e., without any use of external energy. The results of this study have been applied for a new design of arrays of nanomechanical resonators, with a volume about 10^4 times smaller for ultrasensitive detection of nucleic acids. The fabricated arrays have alternate nanomechanical resonators with differently sensitized regions to obtain a double signature of the target based either on its mass or the stiffness of the molecule. We have been able to detect DNA hybridization at the level of few femtograms in air and without any external excitation, which implies one of the highest sensitivities obtained in these conditions [5].

Static Nanomechanical Biosensors

The change in the structural and dynamic properties of water at nanoscale is crucial in a wide variety of phenomena, from the stability of a sandcastle to the structure and function of nucleic acids and proteins. Advances in nanotechnology, in particular those based in micro- and nanomechanical sensors, can potentially be used to analyze the role played by water molecules in macromolecular interactions. Here we show that adsorption of water on a highly-packed self-assembled monolayer (SAM) of single stranded (ss) DNA has an extraordinary effect on the intermolecular interactions. We have followed the process by measuring the nano-scale bending of a silicon microcantilever, on which the ssDNA monolayer is attached, under controlled relative humidity. More importantly, the hydration-induced tension pattern undergoes dramatic changes when complementary and single mismatched DNA hybridizes with the ssDNA monolayer. Based on these new phenomena we have developed a novel nucleic acid biosensor with two key features: its optimal specificity (one mutation or single-nucleotide polymorphism, SNP), as well as its outstanding sensitivity (in the sub-picomolar range, at least 100 times more sensitive than the label-dependent DNA microarrays) [2].

Figures:

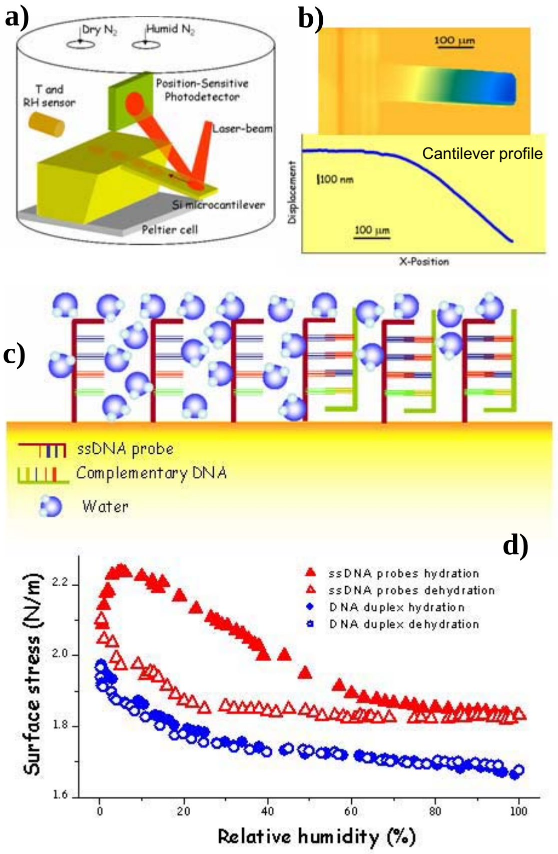

Fig. 1. **a)** Schematic depiction of the experimental set-up. The cantilever is placed in a humidity-controlled chamber. The relative humidity (RH) was controlled by adjusting the ratio between dry and water saturated nitrogen. **b)** The cantilever profile was obtained by scanning a laser beam over the cantilever and measuring the reflected beam deflection by a position-sensitive photodetector (patent pending). A three dimensional image of the cantilever obtained by this technique is also shown. **c)** A cartoon of the ssDNA oligonucleotides on the gold-coated side of the cantilever is shown. **d)** Surface stress measured under hydration and dehydration cycles for the cantilever sensitised with the ssDNA probes and for the same cantilever after hybridization upon exposure to a solution containing the complementary ssDNA target. We obtain a qualitatively distinct signal when hybridization occurs on the cantilever surface.

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MAGNETOSTATIC DIPOLAR DOMAIN WALL PINNING IN CHAINS OF PERMALLOY TRIANGULAR RINGS MICROMAGNETS

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Manipulation of magnetic domain walls (DWs) in nanostructures has recently become the focus of intense research due to its great potential for application to spintronics and also because of the basic physics involved in the phenomenon. Crucial for application is the possibility to induce a controlled and reproducible DW displacement by either using magnetic fields or injecting polarized currents. Magnetic nanorings are particularly apt geometry to such investigations [1]. If the effects of magnetocrystalline anisotropy are negligible, only the geometry of the ring determines the microscopic spin structure of the magnetic states and the effects of geometrical constrictions, such as notches and corners, on DWs in nanorings have been intensively investigated [2].

In an earlier work we have studied the magnetization reversal in Permalloy (Py) triangular rings and we observed that head-to-head DWs can be positioned at selected corners and moved between corners by applying a field along a particular direction [3]. In this contribution we present the results of a combined experimental and numerical study with which we determined the details of the pinning of domain walls in isolated and interacting Py triangular rings (side 2 um, width 250 nm and thickness 25 nm) [4]. In the former case the rings form a square lattice with a period of ~4.2 um so that inter-element interactions are negligible; in the second sample the rings are arranged in chains with a corner tip of each triangle in proximity of the edge centre of the triangle above with inter-element spacing of 50 nm. Using the longitudinal and diffraction magneto-optics Kerr effect (L- and D-MOKE, respectively [5,6]), magnetic force microscopy (MFM), and micromagnetic simulations [7] we determined the field dependence of the spin structure in the rings. The results show that magnetization reverses from an onion state to the reversed state via the formation of a vortex. Each onion state is characterized by DWs (one head-to-head and the other tail-to-tail) geometrically pinned at two corners of the ring [see MFM image in Fig. 1 panel (a)]. We prepared each sample in a well defined onion state (monitored with D-MOKE) and determined the DW motion and pinning potentials recording the L-MOKE loops obtained by sweeping the wall with a field H1 applied along a branch of the ring. We studied this process as a function of a second field H2 applied perpendicularly to the branch of the ring along with the DW is swept and kept fixed during the sweeping, to prevent oblique segments from switching, as sketched in panel (b) of Fig. 1 for the chains of rings. In the case of isolated rings a DW moves freely between the geometric pinning potential wells determined by adjacent corners as the external field H1 reaches a critical value Hd and a single transition is observed in the loops at any value of H2 [solid line in Fig. 1 panel (c)]. For interacting rings, when the wall is swept in the branch closer to the corner tip of the nearest neighbor ring, the loops show an intermediate step for H2 above a certain value caused by the pinning of the wall by the magnetostatic dipolar field emanating from the corner of the nearest ring neighbor [see open symbols in Fig. 1 panel (c)]. Quite interestingly, the depinning of the DW from the starting corner is always (viz. at any value of H2) anticipated in the chains with respect to isolated rings [compare open dots (Hd) and open triangles (Hd1) in Fig. 1 panel (d)], due to the presence of the potential well created by the magnetostatic interaction. We observed that H2 affects appreciably only the depinning field Hd1 from the corner but not the depinning field Hd2 from the potential well due to the magnetostatic interaction [compare open and solid triangles in Fig.1 panel (d)]. Qualitatively, the process can be modeled as a domain wall in a triple potential well landscape with the depth of the two wells at the adjacent corners delimiting the branch, function of the vertical applied field H2. Micromagnetic simulations reproduce the behavior observed and provide additional details on the DW spin structure during its motion.

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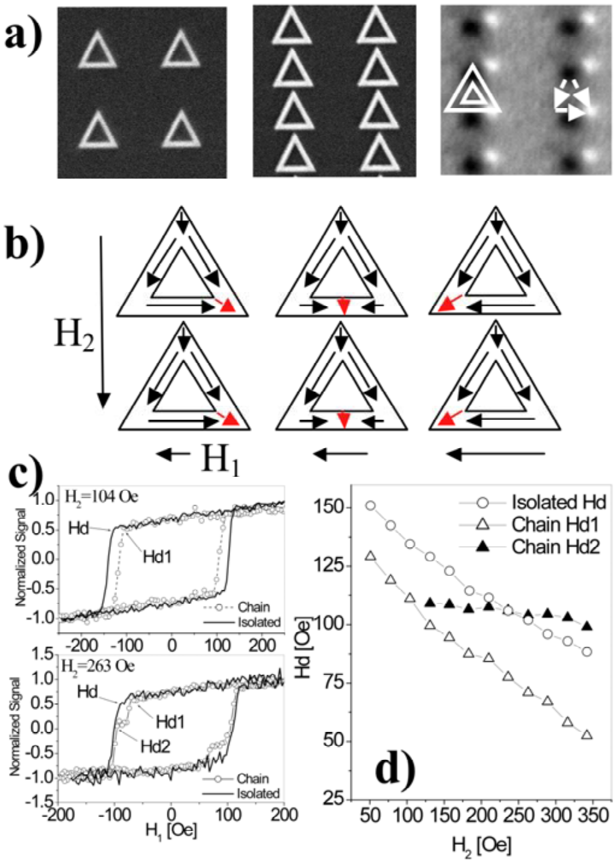

Fig. 1 Panel (a): SEM images of the two arrays and MFM image of the remanent state of the sample with chains of rings. Panel (b): schematic of the experiment described in the text. Panel (c) : loops of the two samples recorded at two different values of H2. Panel (d) : plot of the domain wall depinning fields for the two samples.

ORAL CONTRIBUTIONS (PARALLEL SESSIONS)

NANOSOST: TOWARDS A SUSTAINABLE, RESPONSIBLE AND SAFE NANOTECHNOLOGY

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The great potential of the Nanotechnology is becoming a reality in the form of new materials with innovative and, in some cases, amazing characteristics. Nowadays, this is a technological area with a fast growing with more than 700 consumer products currently in market [1]. Moreover, new diagnosis systems with extremely sensitive and specific properties, highly selective and efficient chemical catalysts, drug carriers able to recognize their targets, clean energy nanovectors, chemically inert and mechanically tough coatings, carbon nanotubes and nanowires with unprecedented properties, nanoporous interfaces for molecular recognition and sieving or even high performance composite nanomaterials, are just some examples of the Nanotechnology that is currently under development.

Nevertheless, the question arises from the same properties that make nanomaterials so attractive constitute a potential risk for the health and the environment. This is especially worrying for the nanoparticles and nanotubes/nanowires, which ability to penetrate through the cell and nuclear membrane has been widely proved [2]. Five grand challenges have been proposed to stimulate the research and the progress of innovative nanotechnologies regarding aspects relative to the safety and to the environment [3]. The needed knowledge basis must be created for the expansion of new technologies that allow a sustainable development of Nanotechnology and for ensuring the production processes, workplaces and harmless products to the human health and environment safety. It is worth noting that it could not be accepted without further questions the validity of standard procedures of Industrial Hygiene related to atmospheres containing breathable solids when particle sizes are several magnitude orders smaller. The unsuitability of the current methods and the need to tackle this problem as soon as possible has been stated by official institutions in other countries, as in the United States and the United Kingdom.

The objective of Nanosost (PSE-420000-2008-3) is the development of scientific and technical basis for assuring the safety in both processing and production in Nanotechnology. Indeed, the techniques and technologies derived from the results of this research will set up the necessary means to help in the early decision of the viability of nanostructured products in the research and development stage, to design environmentally friendly and health harmless industrial processes and to ensure the safety in the final products. This work will be carried out taking into account three fundamental aspects of the Nanotechnology effects:

(a) Exposure effects on the health of workers
(b) Effects on the industrial processes, with the objective of controlling the risk that the use of Nanomaterials could cause in the people, installations and the environment.
(c) The release of harmful agents to the people and environment.

The overall structure of the project is based in seven work-packages for tackling all the related aspects of nanotechnology, from the development of safer synthesis processes of nanomaterials to the elaboration of a good laboratory practice guides for nanotechnology. Nanosost will also take into account other important aspects for safety like the chemical and toxicological risks, the production of undesirable nanoparticulate aerosols in laboratory and industrial environments and the development of new personal protective equipments for workers. The following is an overview of the subprojects considered in Nanosost.

1. Characterization, metrology and generation of references
2. Chemical risks
3. Toxicological risks
4. Scientific basis for risk assessment
5. Scientific basis for risk control
6. Materials for barrier applications
7. Technical basis for the risk management

The members of Nanosost belong to 21 Spanish research groups distributed among Universities, Technological centers and companies from Aragon, the Basque Country, Catalonia and Madrid. All the participants have a wide experience in several areas of the Nanotechnology that cover the seven work packages of Nanosost.

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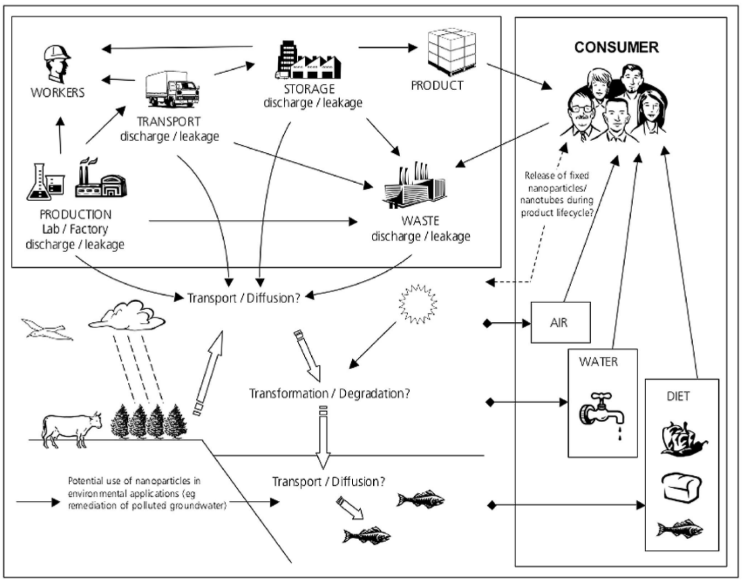

Figure 1. Exposition routes to nanomaterials (adapted from the National Institute for Resources and Environment of Japan, http://www.nire.go.jp/eco_tec_e/hyouka_e.htm)

CONTROLLING MAGNETIC HYSTERESIS BY NANO-SCALE MATERIALS DESIGN

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Magnetic hysteresis, i.e. the multi-valued magnetization vs. applied magnetic field dependence, is one of the core properties of ferromagnetic materials, both in terms of their fundamental properties as well as their technological relevance. Hereby, the needs of specific applications reach from complete suppression of magnetic hysteresis, such as in transformer magnets to avoid energy losses or in field sensors to achieve signal linearity, to hard magnets with maximized hysteresis for the stable generation of high magnetic fields without the need for an external current source or energy supply. To allow for the whole bandwidth of these requirements, magnetic materials are designed specifically by means of their shape, their micro- and nanostructure, and the materials used.

Besides local magnetic properties, in particular the magneto-crystalline anisotropy, it is the ferromagnetic exchange interaction and the dipole-dipole coupling of the elementary magnets that determines macroscopic hysteresis loop characteristics. Hereby, the ferromagnetic exchange favors parallel alignment of all spins even during the magnetization reversal process, which generally results in very rectangular hysteresis loops. On the other hand, the dipole-dipole interaction generally favors the creation of non-uniform intermediate magnetization states that result in very sheared hysteresis loops. It is for this reason that magnetic thin films are particularly well suited to study certain fundamental properties of magnetic hysteresis and ferromagnetism in general, because the influence of dipole-dipole interactions is strongly suppressed. This allowed, for instance, the first experimental observations of hysteresis loop criticality [1] and the dynamic phase transition [2]. Hereby, it is interesting to observe that even in perpendicularly magnetized magnetic films, the influence of the dipole-dipole interaction is suppressed, i.e. allowing for very rectangular hysteresis loops, because a domain formation does not allow for any substantial reduction of the dipolar energy, even though this energy is actually rather large [2,3]. The hysteresis loop criticality itself describes the phenomenon that in films without (or with strongly suppressed) dipolar interaction, there is a critical level of local disorder such as anisotropy or grain orientation, at which the system transitions to a fully correlated magnetic reversal despite the fact that local properties are not uniform [1]. The behavior shows all the characteristics of a (non-equilibrium) phase transition. The dynamic phase transition on the other hand shows that even a system with perfectly uniform magnetic properties can undergo a transition into non-uniform magnetization states if it is cycled at high enough frequencies [2].

For an observation of these fundamental aspects of magnetic hysteresis, it is generally very important to produce macroscopically extended materials with extremely uniform magnetic properties, which is a very substantial materials fabrication challenge. The same is true for the exact opposite of the spectrum, in which one tries to limit the local correlation of magnetic reversal to the smallest possible length scale, namely individual nano-magnets with less then 10 nm diameter. This is of crucial significance for magnetic recording, because one tries to write extremely small magnetic pattern with highly localized magnetic fields [4]. Thus, it is important that these highly localized fields only produce a very localized response. Such a behavior is accomplished by growing granular materials with highly oriented nano-scale grains that are separated from each other by non-magnetic grain boundaries formed by means of alloy segregation. In the most modern designs though, the optimized materials do not just have a distinct lateral grain structure, but also consist of a vertical layer sequence to optimize their hysteresis properties. For instance, the recently introduces exchange spring media consist of three separate functional layers in about 15 nm thickness: main recording layer, coupling layer, and soft-magnetic exchange spring layer [5]. This specific design enables a non-uniform magnetization reversal at high magnetic fields, i.e. in the magnetic write process, that is not accessible in the low field case under normal storage conditions. Correspondingly, the highly problematic correlation of magnetic writability and stability is broken, which would otherwise limit magnetic recording technology [6].

Another nano-scale design tool that allows for the tuning of hysteresis properties of magnetic materials is the so-called exchange bias effect. Here, the coupling of ferromagnets to adjacent antiferromagnets is utilized to shift and/or broaden magnetic hysteresis loops [7]. This effect however relies heavily on the quality of the interface and basically requires almost atomic control over it. An alternative approach was recently introduced by using a very hard magnetic material as a replacement for the antiferromagnet, which allows for easier processing and better interface coupling control [8]. Subsequently, these all-ferromagnetic exchange bias systems have been successfully used to study the fundamentals of the exchange bias phenomenon [9,10].

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DFT MODELING OF CuO CATALYST NANOPARTICLES

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Copper oxide is an active component of different catalysts, especially of those promoting reactions of CO at mild temperatures. In particular, cerium dioxide-supported copper oxide facilitates the preferential oxidation of CO (PROX reaction) by O_2 at $T<375$ K in presence of a large excess of H_2, a process of large industrial interest as it is needed to purify from CO the H_2 gas used by polymer membrane fuel cells. Although this type of catalyst has been subjected to many studies using different techniques, the structure and characteristics of the CuO_x active phase are not known in detail. Within a study trying to correlate catalytic activity with the size and shape of the constituent nanoparticles, previous work from our laboratory using HR-TEM, XPS, ESR, IR and XANES [1] has indicated that the catalytically relevant species exists, at least in the initial catalyst state, as small ill-crystallized or amorphous CuO nanoparticles dispersed on the CeO_2 surface, that become partially reduced during the reaction. A DFT-based modeling of such dispersed nano-entities is undertaken here.

The theoretical approach uses DFT at the GGA level (PBE functional) supplemented with an on-site Coulomb interaction (Hubbard term U) to correct for the known inadequacy of standard DFT when describing partially filled *d* or *f* shells of transition or lanthanide elements. Effective U_{eff}=U-J terms are used, with values equal to 4.5 and 7 eV for Ce and Cu respectively. The plane wave code VASP, with PAW potentials to describe the core region, was used; the calculations used high plane wave cutoff values (400 eV) and gamma point-centred Monkhorst-Plank samplings of the reciprocal space dense enough to ensure convergence to within <3% of the energy differences of interest.

First the structure and energetics of standalone CuO and its surfaces were modelled. CuO has a centred monoclinic lattice, with four formula units per unit cell; the latter is derived from a fcc packing of Cu atoms in which 50% of the tetrahedral interstices are filled with O atoms ordered in a specific way, so that distorted tetrahedral and near-square planar coordinations result for O and Cu atoms respectively. An antiferromagnetic ordering of the spins at the copper ions (that have a $3d^9$ configuration) occurs at low temperature ($T_c \approx 220$ K), with up and down spins forming alternating double layers parallel to the (1 0 -1) planes so that a superstructure magnetic cell with double volume appears [2]. This structure, that cannot be reproduced using standard DFT theory but does appear if self-interaction or Hubbard corrections are used, was obtained also here. To model its surfaces periodic slab models were constructed from the magnetic cell, with symmetric slabs of 9-10 Å thickness parallel to all non-equivalent low index Miller planes of the crystallographic unit cell. Some of the surfaces ((1 0 1), (1 0 -1), (0 1 1), (1 1 1) and (1 1 -1)) are non polar and have all surface atoms 3-fold coordinated; surface (0 1 0) is nonpolar but contains 2-fold coordinated atoms, and the others ((1 0 0), (1 0 0) and (1 1 0)) besides having 2-coordinated atoms are polar and can become stable only upon reconstruction (with elimination of 50% of the atoms in the outer plane).

After relaxation of the atomic positions, the surface energy of each surface was obtained. The values lie in the range 0.74-1.7 J/m^2, increasing in the order (1 1 1)<(1 1 -1)≈(0 1 1)<(1 0 -1) ≈(1 1 0)<(1 0 1)<(0 1 0)<(1 0 1). With these energies the nanocrystallite equilibrium shape at low temperature predicted by a Wulff construction is as given in Fig. 1. However, shapes of very varied types (plates, rods, spindles, spheres, etc) have been found experimentally, as they are affected by the temperature and molecular environment present during crystal growth.

The energy necessary to create an anion vacancy at the surface (a basic elementary step in most redox reactions catalyzed by CuO) was then evaluated for all the lowest energy surfaces, and found to be relatively similar (between 2.0 eV for (1 1 0) and 2.7 eV for (1 1 1)), the values being lower than for a bulk vacancy (ca. 3.0 eV). Thus one finds energies similar to or lower than those necessary to form vacancies on the most stable ceria surface [3]. Formation of the vacancy leads to the formation of Cu^+ ions (in some cases with partial delocalization of the added electron over nearby cations) that appear located at sites neighbour to the vacancy.

The situation of a CuO nanoparticle on a CeO_2 surface was modeled also with a periodic slab model (Fig. 2), containing a slab of the CeO_2 fluorite structure in (1 1 1) orientation (that provides the most stable surface), with 20 Ce atoms per unit cell, and a rod of CuO in contact with the slab, with 12 Cu atoms per unit cell and having its structure and faces oriented so that there is a good epitaxy (achieved through a (1 0 1) face) with the underlying CeO_2 and low energy CuO surfaces (in particular, (2 1 0) and its symmetry equivalent (-2 1 0)) are exposed. This allows to keep minimal the distortions of the Cu-O distances. Then the formation of vacancies in the surface of this composite material was modeled, testing for them all relevant nonequivalent oxygen positions.

It was found here that the lowest energy for vacancy formation corresponded to sites in the middle of the exposed (2 1 0) surface of CuO, where this energy was somewhat lower than for the same surface in pure CuO; again, reduced Cu ions appeared in the neighbourhood. It was followed in energy by sites of the CuO rod at the borderline with the CeO_2 surface; here either two Cu^+ ions or one Cu^+ and one Ce^{3+} appeared, depending on the exact location at the bordeline. Forming the vacancy at the bare CeO_2 surface, which led to the generation of two Ce^{3+} ions at nearest-neighbour positions as shown previously [3], was the least favourable option. These energy differences are ascribed to the higher strength of the Ce-O bond compared to the Cu-O bonds, due to the higher cationic charge of the Ce ions. The need to have in real catalysts very small CuO entities over the ceria surface, in order to maximize the ratio between borderline sites and bare CuO surface sites, is thus explained. Studies to model the adsorption of O_2 and CO on the partially reduced catalyst surface have been undertaken.

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Figures:

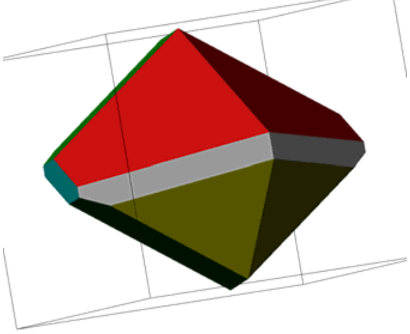

Fig. 1- CuO particle shape according to a Wulff construction based on the surface energies computed for the different faces.

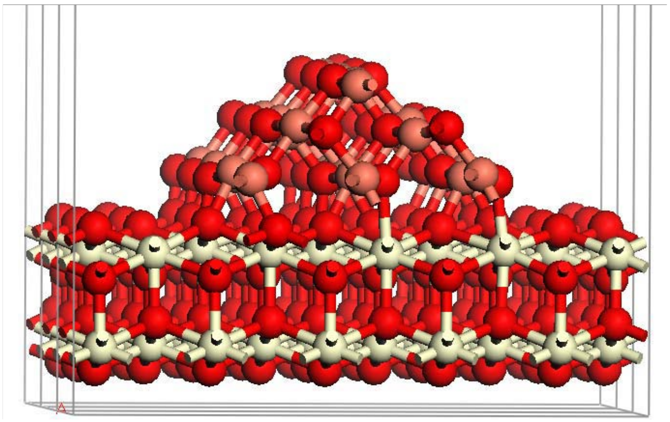

Fig. 2-Periodic model of the CuO/CeO_2 catalyst used in the calculations. Red: O; white: Ce; pink-beige: Cu.

ELECTRICAL TRANSPORT PROPERTIES OF METALLIC NANOWIRES AND NANOCONSTRICTIONS CREATED WITH FIB/SEM DUAL BEAM

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Fascinating phenomena such as large ballistic magnetoresistance have been recently studied in nanoconstrictions based on magnetic materials [1]. However, the lack of systematic and reproducible results in these constrictions calls for further investigation before implementation in real working devices [2]. We use focused-ion-beam techniques in combination with in-situ electrical measurements to create atomic-sized magnetic metallic constrictions and explore their magneto-transport properties (see Figure 1). We have recently reported that by means of low-energy focused-ion-beam (FIB) Ga etching of a metallic electrode it is possible to control the formation of atomic-sized constrictions with milling-time, observing steps in the conductance in the range of the conductance quantum ($G_0=2e^2/h$), just before entering the tunneling regime [3]. Such behaviour has been observed in particular in Fe-based electrodes (see Figure 2). These constrictions are highly stable with time due to the adherence to a substrate, which allows further studies such as the detailed current-voltage transport investigation, thus being a promising route to study physical phenomena in the verge of the metal-tunnel conduction crossover. In this contribution, we will report the two procedures followed by our group to obtain Fe-based constrictions using FIB-based techniques and the corresponding in-situ transport measurements. In the first procedure, a 4 x 1 μm^2 electrode area is FIB-milled, which brings about continuous and smooth resistance variations but the exact position of the nanoconstriction inside the milling box is not controlled [3]. In the second procedure, a progressive narrowing of the sides of the electrode is carried out, which allows the control of the exact position of the nanoconstriction [4]. This is also desired to have a defined current direction, which is required for ballistic anisotropic magnetoresistance measurements. The possibilities to stabilize the formed nanocontacts for ex-situ applications will be subsequently discussed and the obtained magnetoresistance data presented. In particular, first results in the ballistic tunnelling regime show magnetoresistance values ten times larger than before performing the FIB milling.

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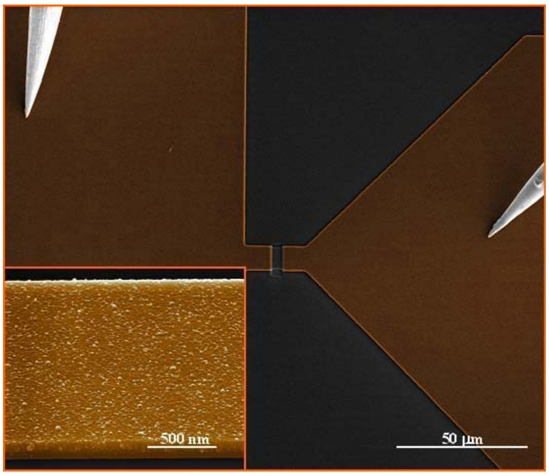

Figure 1. *An SEM image of the micrometric electrodes patterned by optical lithography. The two microprobes are contacted for real-time control of the electrode resistance. The inset is an SEM image of the electrode previous to the Ga etching.*

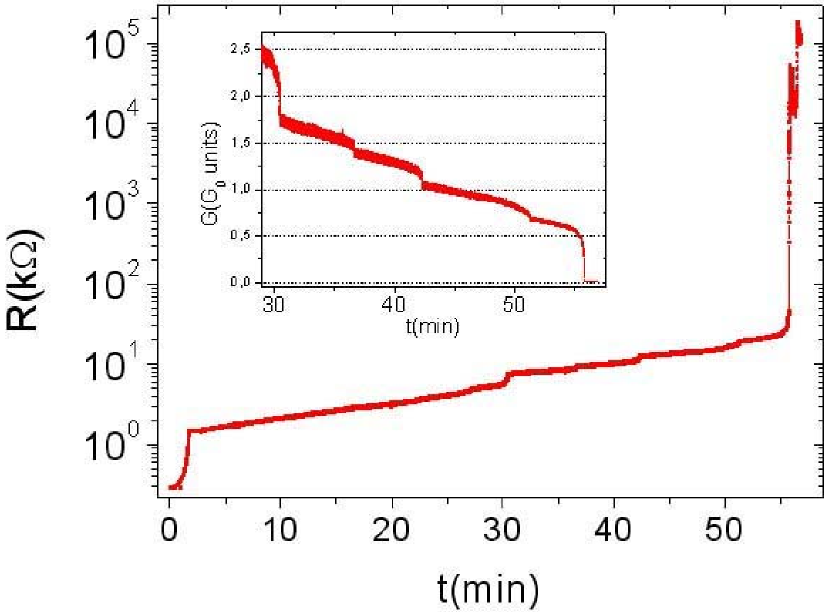

Figure 2. *Resistance versus time in a typical ion etching process of an Fe electrode, where discrete jumps are observed before the tunnelling regime is reached. The inset shows the corresponding conductance (in $G_0=2e^2/h$ units) versus etching time. In this stage of milling, steps of the order of some fraction of G_0 are seen, corresponding to discrete thinning of the contact area of the order of one or a few atoms. The last step is followed by a sharp decrease of conductance, corresponding to the crossover to the tunnelling regime.*

TOPOGRAPHIC FEATURES AT THE MICROMETER SCALE INDUCE CHANGES IN CELL CYTOSKELETON AND GOLGI COMPLEX MORPHOLOGIES

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It is now well recognized that cellular behaviour on topographically modified materials is of great importance for fields as tissue engineering and regenerative medicine. Surface features at the micro and nanometer scale have been shown to influence and even determine cell behaviour and cytoskeleton organization [1]. However, a poorly studied area is the response, function and distribution of sub-cellular organelles to topographically modified surfaces.

Nanostructures and microstructures are present in the natural environment of the cells: cell membranes contain nanosize molecules and the ECM is formed by biomolecules configured in different geometrical arrangements (nanopores, nanofibers, nanocrystals…). Therefore, it is of particular interest to study the effect of nano and microscale topographic structures on the cell behaviour and its internal structure. Indeed, several techniques derived from the microelectronic industry have been applied to create topographically modified substrates that are used in cell culture systems. The effects of micro and nanostructures in cell orientation and adhesion and the cytoskeleton organization have been widely studied [2,3]. However, very little has been reported about the influence of different topographies in the disposition of subcellular elements. The fact that on one hand, the cell adhesion and morphology depend on the substrate topography and on the other hand there is a tight relationship reported between the morphology and function of the Golgi complex with the actin cytoskeleton organization and its dynamics[20] led us to postulate a correlation between topographically modified substrates and the subcellular positioning and organization of this organelle.

In this study, we have used nanoimprint lithography to generate a variety of physical features on poly (methyl methacrylate) PMMA at the microsize range with geometries of post and holes, specifically chosen for their complementary geometries and the same specific area. Normal rat kidney fibroblasts (NRK) were cultured onto the patterned substrates during 24 hours and their morphology was studied by means of scanning electron microscopy (Figure 1). Single or double immunostaning assays were performed to visualize the Golgi complex, the microtubules, the intermediate filaments and the actin cytoskeleton organization and focal contacts.

The experiments showed a direct correlation between the proportion of compact Golgi and the alteration in the cytoskeleton organization in cells cultured onto microstructured samples (Figure 2). Based on the obtained results, which suggested that Golgi complex contain assembly complexes to link to actin microfilaments [4], our hypothesis is that microstructures may induce physicochemical alterations in the F-actin that disrupts the Golgi complex mechanical stability, which ends with its collapse. To our knowledge, up to now, naturally derived substances obtained from fungi and sponges that contain toxins that either depolymerise (latrunculus, cytochalasin) or stabilize (jasplaknolides) were the only experimental tools used to study dynamics of actin cytoskeleton and its involvement in many cellular events such as changes in cell shape, motility or polarity by dramatically disturbing its structure and organization [5]. Here we show that physical agents such as topographically modified surfaces at the micrometer range can also be used to induce alterations in the actin cytoskeleton, then changing dramatically Golgi complex morphology without adding chemical substances. Results showed that physical modifications on polymer surfaces alter internal organization of the cell thus they are a tool that can be applied to study cellular events without adding chemical agents.

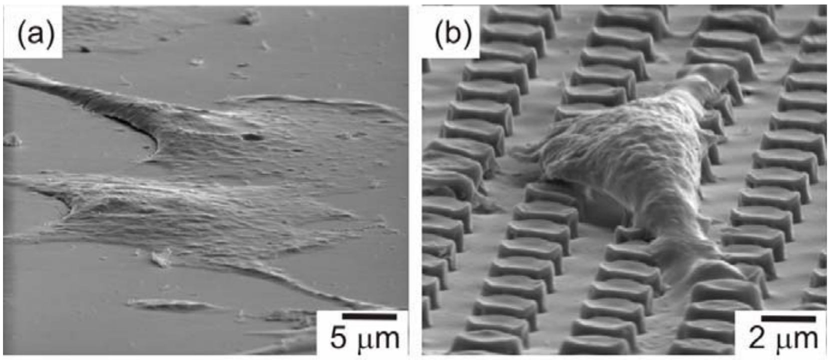

Figure 1. SEM image of NRK cells cultured on a) flat PMMA, b) posts 2 μm

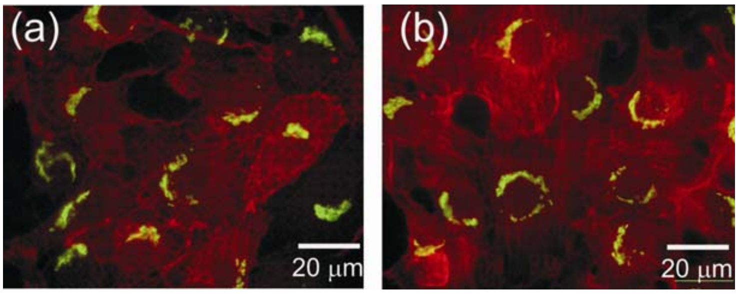

Figure 2. Double staining of actin filaments and Golgi complex of (a) sample structured with post 2 micrometer in size, (b) flat sample

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MAGNETOSTRICTIVE DRIVE OF AFM CANTILEVERS FOR LIQUID OPERATION

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Dynamic mode Atomic Force Microscopy (AFM) has proven to be a powerful technique for imaging soft biological samples with AFM [1]. In liquid environments, small oscillation amplitude images can achieve 1nm lateral resolution or better [2]. AFM cantilevers are often driven in liquid by either electrical (with a piezoelectric ceramic) or magnetic excitation (applying an alternating magnetic field to a cantilever coated with a magnetic material) methods. However, it has been shown that the latter allows easier identification of the cantilever resonant frequency [3,4].

In this work, a novel magnetostrictive drive of dynamic mode AFM cantilevers has been developed for topographic images and force spectroscopy in liquid environment. This method overcomes further limitations superposed to those inherent to operation in liquids: low quality factor (Q) and the shift of the resonant frequency to lower frequencies, due to the large damping and the added inertial mass of the liquid. In particular, those arisen from the difficulty to select from the various mechanical resonances of the cantilever/ cell system excited by an external piezo-actuator. Our direct magnetostrictive excitation method employs commercial silicon nitride cantilevers that were top side sputtered with amorphous iron-boron-nitrogen alloy magnetostrictive magnetic thin film.This amorphous alloy present soft magnetic properties and controlled anisotropy [5], good corrosion resistance in liquid environments, and nearly zero accumulated stress [6] when properly deposited. A new AFM liquid cell, with a set of miniature solenoids that create an in plane AC magnetic excitation field has been designed and built. It is demonstrated that this magnetic field drives the mechanical resonance of the coated cantilever through the film magnetostriction. The dynamic response of the magnetostrictive cantilevers and the ability to obtain topographic images of a surface in water are studied.

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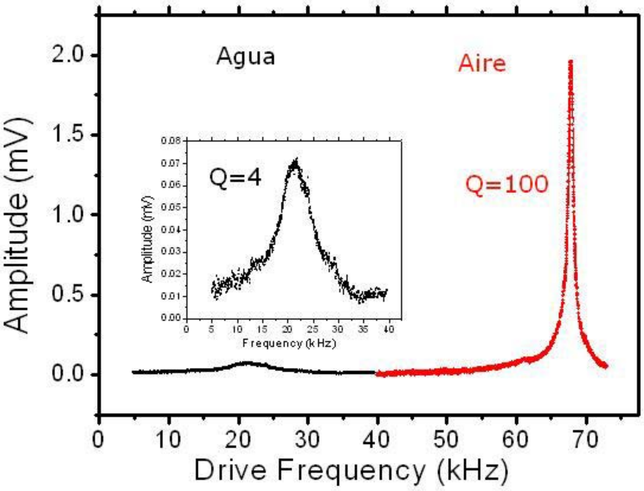

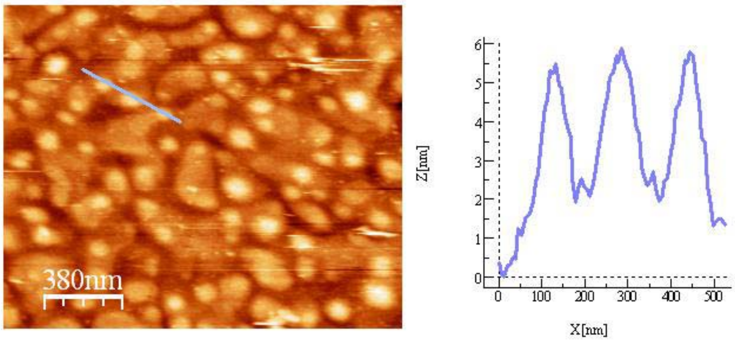

Figures : Up: Cantilever oscillation amplitude versus drive frequency of the applied magnetic field. Inset shows the amplitude and Quality factor (Q) is reduced when immersed in water solution while the resonant frequency shifts to lower values. Down: Topographical image of a gold surface in water obtained with the magnetostrictive drive method. A topographic scan profile is shown.

FORMATION OF TERNARY NANO-COMPLEX GOLD NANOPARTICLES-COPPER IONS-HISTAMINE

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The unique properties exhibited by noble-metal nanoparticles, in particular, their spectroscopic properties, make them a useful tool in the analytical field. The possibility of functionalize the nanoparticle surface with chemical moieties such as carboxylic or amine, provides a way to induce the interaction of the nanoparticles with different kind of analytes. The plasmon in the nanoparticles surface presents a resonance band whose maximum wavelength depend on several factors such as size and shape of nanoparticles. Furthermore, it has been described that interparticle distance may also affect the intensity and the position of the surface plasmon resonance band. In some cases, even a new plasmon resonance band may arise when the interaction analyte-nanospheres distort the shape of the nanospecies [1].

Previous works of our research group demonstrate the ability of carboxylic derivatized gold nanoparticles to interact with metal ions such as europium and amine compounds such as lysine [2]. Based on that experience, in this work we describe the interaction of a complex between copper ions and histamine [3] with gold nanoparticles (functionalized with mercaptoundecanoic acid, MUA-GNPs). The modification of the absorption spectra (spectral shifts and absorbance increase/decrease) was used to study the interaction mechanism. In Figure 1 the TEM image and the diameter size histogram of MUA-GNPs are shown. Parameters such as reagents addition order, pH, kinetics, presence and absence of stabilizers were studied. Furthermore, a novel analytical method based on this nano-interaction is outlined for the determination of histamine.

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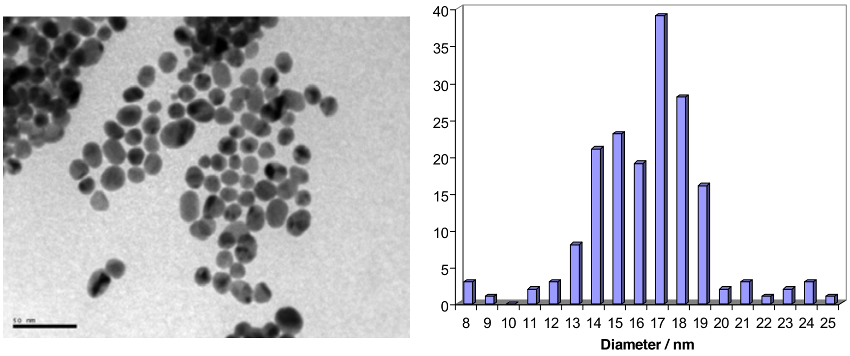

Figure 1- TEM image of MUA-GNPs and size histrogram

DOUBLE SHELL FeNi NANOPARTICLES

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INTRODUCTION

Nanoscale materials and magnetic nanoparticles particularly, have attracted significant scientific and industrial interest due to unique properties compared with bulk materials.
Due to large coercivity, remanence, and time stability at room temperature, magnetic nanoparticles have been considered especially attractive for applications in magnetic recording density, recording speed, noise suppression and sensors.
Thermal decomposition, sonochemical method, laser pyrolysis and reduction of salts with borohydride derivates are some synthetic techniques use to synthesize magnetic metal nanoparticles.
Last years, these nanoparticles embedded in a polymeric matrix were used to obtain new material with potential applications as microwave absorbing and shielding also and in electromagnetic devices. In order to obtain this kind of devices and improve dispersion of nanoparticles inside organic matrix a new type of nanoparticles has been synthesized.
In the present work, synthesis of FeNi alloy nanoparticles by reducing iron and nickel salts with borohydride derivates and their surface modification are shown.

METHODS

Synthesis of FeNi nanoparticles by reduction of salts with borohydride derivates presents several advantages such as synthesis at room temperature and one step reaction.
Several authors demonstrated that sol-gel process could be directly applied to coat iron oxide nanoparticles or silver nanowires with well-controlled silica shells. This technique that praised as a route for the fabrication of novel materials with a tremendous potential application, was used to generate the first SiO_2 shell on FeNi nanoparticles.
A second organic shell was grown on surface of nanoparticles by atomic transfer radical polymerization.
Techniques such as Fourier Transform Infrared (FTIR) spectroscopy, termogravimetric analysis (TGA) and atomic force microscopy (AFM), Inductively Coupled Plasma (ICP) were used to characterize the functionalized particles.

RESULTS AND DISCUSSION

FeNi nanoparticles were synthesized by reducing iron and nickel salts with borohydride derivates and characterized.

Afterwards, FeNi nanpoarticles were covered by SiO_2 shell by sol–gel process. As Figure 1 shows, two new peaks were observed in the FeNi nanoparticles covered by SiO_2 shell (FeNi-SiO_2). One of them was attributed to asymmetric stretch vibration of Si–O–Si (1080 cm^{-1}) and second one is attributed to symmetric stretch vibration of Si–O–Si (800 cm^{-1}). FTIR analysis allows to confirm that FeNi nanoparticles were covered by SiO_2 shell.

Surface of FeNi-SiO_2 was modified with an initiator (2-(4-chlorosulfonylphenyl)ethyl trichlorosilane) (FeNi-CTCS) that allows the initiation of ATRP polymerization.

The modification of FeNi-CTCS with PS (FeNi-PS) was confirmed by FTIR, where an increase of the characteristic stretching bands of aromatic chains over 3000 cm^{-1} is observed in FeNi-PS, furthermore, three new peaks at 1600, 1500, and 1450 cm^{-1}, attributable to characteristic bands of PS, can be seen.

CONCLUSIONS

A double shell was grown onto surface of synthesized FeNi nanoparticles powders using sol-gel to generate SiO_2 shell and “graft from” technique to grown Ps brushes by ATRP. Composition of FeNi alloy nanoparticles was determinate by ICP. Modified and unmodified FeNi nanoparticles were characterized using FTIR, confirming that a double shell was covered FeNi nanoparticles. TGA allowed to analyze the difference of organic material between FeNi, FeNi-SiO_2, FeNi-CTCS and FeNi-PS.

ACKNOWLEDGMENTS

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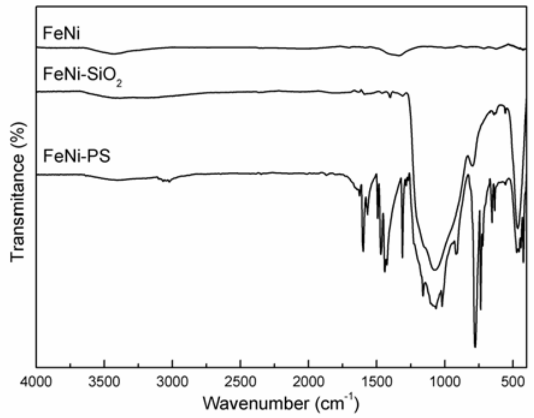

Figure 1. FTIR spectra of FeNi, FeNi-SiO_2 and FiNi-PS spectra.

MAGNETO-OPTICAL ACTIVITY EMERGING FROM PLASMONIC GOLD NANODISKS

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The excitation of surface plasmons has become very useful to enhance many other physical phenomena like surface enhanced Raman scattering (SERS), enhanced fluorescence emission, high harmonic generation or the magnetooptical Kerr effect (MOKE). If we focus on the latest subject, it has been shown the influence of surface plasmons on the enhancement of the magnetooptical (MO) actitivity for single ferromagnetic nanoparticles[1], or more recently for combined noble metal-ferromagnet nanofilms and nanodisks[2,3].

Up to now, this kind of systems has needed the incorporation of a ferromagnetic metal or a garnet, due to their high MO response at very low magnetic fields. No attempt has been performed for other materials as the field required to obtain such response is extremely high (more than 100T). However, the excitation of a surface plasmon in a metal could lead to the apearance of MO activity even for low magnetic fields. This is the scope of this work, where we present for the first time the MO response of a series of pure gold nanostructures. The emergence of MO effects in pure plasmonic nanostructures may then find important applications in plasmonic modulators or in the improvement of the biosensing performance of metal nanostructures [5].

We apply a magnetic of 0.8T to analize the Kerr rotation and ellipticity of disordered gold nanodisks and nanoholes obtained from continuous gold films grown over a glass substrate using colloidal lithography. We show that the MO response is controlled by the surface plasmon excitation, its spectral position depending on the aspect ratio of the particles/holes. Figure 1 show this dependence compared to a bare glass film. A peak and a S-like structure for the Kerr rotation and ellipticity respectively appear at the same energy region where the surface plasmon is excited. As the diameter of the nanodisks/holes increases, these features shift to lower energies (higher wavelengths), in accordance with the modification of the spectral position of the plasmon excitation due to the variation of the aspect ratio.

This work has been financially supported by CAM (Microseres) and EU (NMP3-SL-2008-214107-Nanomagma)

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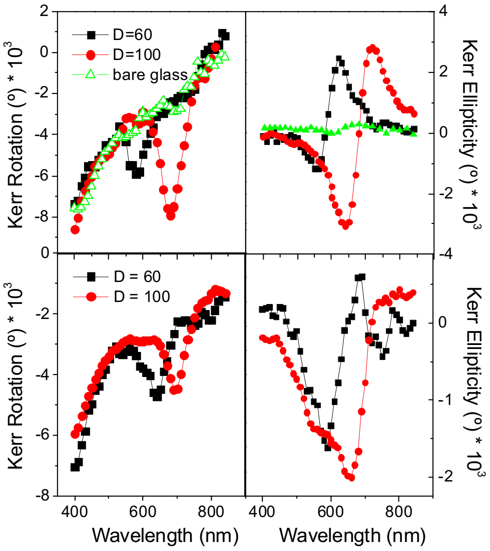

Fig. 1: MO Kerr rotation and ellipticity of gold nanodiscs (up), and nanoholes (down)

IMMOBILIZATION OF HIGH AMOUNTS OF CORRECTLY ORIENTATED ANTIBODIES

ON FULLY INERT SURFACES:

USE OF HYDROPHILIC SUPPORTS CONTAINING GLYOXYL GROUPS.

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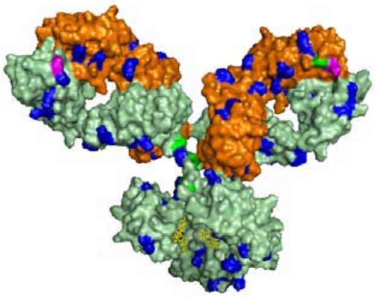
Supports containing hydroxyl groups are easily activated (with glycidol or epyclorhydrine) to generate glyoxyl groups (aliphatic aldehyde groups having very short spacer arms) after a reduction with periodate. These glyoxyl-supports can not immobilize proteins at neutral pH value. However, these supports rapidly immobilize proteins at alkaline pH values, directing their immobilization by the area of the protein surface that is the richest in Lysine groups These immobilizations produce an intense multipoint covalently immobilization of the proteins on the supports. This usually produces dramatic stabilizations of the three-dimensional structures of the immobilized proteins. Moreover, the glyoxyl groups are very stable and permit a full coating of the support with the protein that we intend to immobilize. The final reduction of the immobilized preparations with low concentrations of borohydride transforms all the glyoxyl groups on inert hydroxyl groups and transforms the Schiff bases, formed between the protein and the support, in secondary amino bonds, (that are physically very similar to the primary amino groups of the no modified Lys).

The antibodies are very stable at alkaline pH value and have a high density of Lys residues distributed by their light and heavy chains,

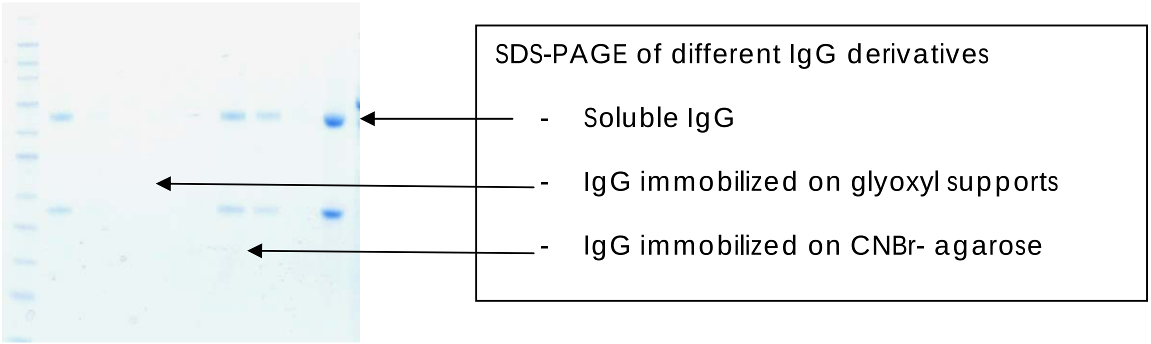


3D structure of an IgG

Blue spots correspond to Lys residues

The antibodies (e.g., anti-peroxidase) rapidly immobilized on supports containing high superficial densities of glyoxyl groups (e.g., 2 μEquivalents / m^2) and in less than 2 hours it is possible to immobilize 1.5 mg of antibody per m^2 of support at pH 10. After an additional incubation of 5 h (to favour an intense multipoint covalent attachment) the derivatives are reduces with borohydride. These immobilized antibodies are able to adsorb 1 molecule of antigen per molecule of antibody: e.g. 1 μmol of peroxidise per each 1 μmol of immobilized antiperoxidase.

The immobilized derivatives were boiled in the presence of SDS and mercaptoethanol, and the supernatants were analyzed by SDS-PAGE.



SDS-PAGE of different IgG derivatives

The Figure shows that no antibody chains can be released from the support after this treatment, suggesting that all the subunits have covalently reacted with the support. However, this immobilized antibody preserves a good capacity of antigen adsorption. It seems that the antibodies are immobilized by the largest region of their surface but that at least one Fab region is fully intact and able to recognize even large antigens. The unspecific adsorption on these supports was analyzed using a crude protein extract from E. coli, bovine serum albumin or other antibodies. The immobilized antibodies did not adsorb any protein except their corresponding antigen. This immobilization method seems very suitable for the design of any kind of immuno-sensors. Moreover, these immobilized antibodies are highly stable versus thermal inactivation: they only lost 5% of antigen adsorption capacity after 24 h at 60ºC.

This immobilization protocol seems very suitable to conjugate antibodies and nanostructures and to prepare any kind of immuno–nano-sensors for the detection of traces of pathogen microorganisms, marker proteins or toxins. For example, using 10 μg of magnetic nanoparticles containing immobilized antiperoxidase, we have been able to detect more than 90% of 1 μg of peroxidase contaminated with 10 g of proteins from an *Escherichia coli* protein extract and diluted in 10 L. By one hand, the antibodies may be easily immobilized on magnetic nanoparticles coated of polyvinyl alcohol and activated with glyoxyl moieties. On the other hand, the orientation of the immobilized antibody (with the intact Fab region very near to the support) appears very suitable for their immobilization on carbon nanotubes if the antigen is going to be detected by nanotube field effect transistors. In this case, the adsorbed antigen will be placed very near to the nanotube surface and must modify the properties of these semiconductors.

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SAFE PRODUCTION AND USE OF NANOMATERIALS: HEALTH AND SAFETY MANAGEMENT

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Nanotechnology is a fast growing field with emerging development of modern materials for electronics, information technology industries, cosmetics, health and medicine and in a variety of manufactured goods. The issue of nanoparticles and nanomaterial exposure in occupational settings has gained increasing attention due to this increased production and use.

Currently, most activity in nanotechnology workplaces is related to the research, development, production and use of nanomaterials. The occupational exposure to these nanomaterials may constitute a possible health and safety hazard during the complete life cycle of the material. These scenarios include:

- Universities and research organisations, institutes or laboratories where nanomaterials and nanoestructures are developed and new applications, properties or characteristics are investigated.
- Pilot plants where these materials and processes are scaled up.
- Manufacturing plants for nanomaterials
- Industries where nanomaterials are included in products (cosmetics, construction, electronic devices, etc)
- Waste management plants

In this presentation an insight on those factors related to nanoparticle monitoring, potential hazards and risk management and risk assessment related to occupational exposures issues is provided, as well as the main relevant standards, regulations and any other specifications that are applicable to the use, production and safe handling of nanomaterials.

For this purpose, a revision of different guidelines/recommendations on safe production and handling of nanomaterials issued by the principal institutions such as: NIOSH (USA), BSi (UK), ISO, DEFRA and HSE (UK), The nordic Council, BauA (Germany), OCDE, European Commission through the FP6 projects (Nanosafe2) is provided.

From this revision, and following the EU and other international institutions, it is concluded that the “precautionary principle” is deemed to be applied in order to manage nanotechnology risks to workers (researchers included) and integrating health and safety into nanomaterial production and research.

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PREPARATION OF FLUORESCENT, FUNCTIONALIZED, SILICA-COATED MAGNETIC NANOPARTICLES MARKED WITH MONOCLONAL ANTIBODIES

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Magnetic nanoparticles have been intensively studied for their potential applications in biomedicine. These magnetic nanoparticles are tested for in-vivo use, either in diagnosis as contrast agents for NMR imaging, or in therapy, for targeted drug delivery and for the treatment of cancer cells with magnetic hyperthermia. There are also many applications where these magnetic nanoparticles are used in-vitro, for example, in various types of bioseparations, cell sorting and purification, enzyme immobilization, and many others [1,2]. However, the properties of the magnetic nanoparticles need to be adapted for a specific application. The most important properties in the biomedical application of nanoparticles are their magnetic properties, size, biocompatibility and capacity for the selective binding of different molecules onto their surfaces [3]. For intravenous and intra-arterial applications, which are the most common for drug administration, magnetic nanoparticles of a suitable size are applied in the form of a stable aqueous suspension. For the preparation of a stable suspension, nanoparticles are expected to exhibit superparamagnetic properties in order to avoid inter-particle magnetic interactions that could cause agglomeration. Moreover, the nanoparticles should not be recognized by the immune system and eliminated from the blood. To ensure long circulation times, the nanoparticles should be coated with biocompatible molecules, such us polyethylene glycol. For the selective binding of different molecules (drugs, antibodies, etc.), the nanoparticles' surface should contain specific functional groups, i.e., they have to be functionalized. Usually, the nanoparticles for biomedical applications are composed of a magnetic core and an organic or inorganic shell, which provides biocompatibility and functionalization [4].

Superparamagnetic nanoparticles of maghemite (γ-Fe_2O_3) are the most frequently used core materials [5]. They are believed to be nontoxic and were approved for in-vivo applications by the Food and Drug Administration (FDA). The surface of the maghemite core is relatively inert and usually does not allow strong covalent bonds with biological molecules. The reactivity of the maghemite nanoparticles can be improved by coating a thin layer of silica onto their surfaces. This rigid layer of silica provides reactive –OH surface groups for strong covalent binding. The silica layer should be continuous and homogeneous, but as thin as possible so as not to impair the magnetic properties.

In this work, the coating of maghemite nanoparticles with a thin layer of silica was investigated. The magnetic nanoparticles were synthesized with co-precipitation from aqueous solutions of Fe^{2+} and Fe^{3+} ions with a concentrated ammonia solution. The synthesized nanoparticles were dispersed in an aqueous medium using citric acid as a surfactant. A thin layer of silica was coated onto the nanoparticles using hydrolysis and the condensation of tetraethyl orthosilicate (TEOS) and the nucleation of the formed silica on their surfaces. The coatings were characterized with transmission electron microscopy and magnetization measurements, and the homogeneity of the layer was evaluated using leaching tests. The coated nanoparticles were leached in HCl. The iron oxide is very soluble in acid, whereas the silica is practically insoluble. Thus, the nanoparticles coated with the more homogeneous silica layer were dissolved to a lesser extent.

First, the influence of various experimental parameters on the homogeneity of the coating was evaluated. The optimization of the coating procedure enabled a decrease in the thickness of the layer, even to a monolayer of -Si-OH, without significantly impairing its homogeneity.

The reactivity of the silica-coated nanoparticles was tested by grafting (3-aminopropyl) triethoxysilane (APS) onto their surfaces. The surface concentration of APS was determined using conductometric titrations. Even when the nanoparticles' surfaces were only covered by a monolayer of Si-OH, the surface concentration of bonded APS reached values suggesting full surface coverage (4.5 molecules of APS / nm^2), whereas with uncoated nanoparticles a much lower surface concentration of APS (< 1 molecule of APS / nm^2) can be grafted.

The suitability of the APS-functionalized, silica-coated nanoparticles was tested for the subsequent bonding of different molecules. To enable tracking of the nanoparticles using optical microscopy, fluorescein isothiocyanate (FITC) was attached to the nanoparticles' surface. FITC binds to the terminal amino group of the APS with its isothiocyanate functional group.

Finally, monoclonal antibody (mAb) [6] was covalently bound to the fluorescently labelled nanoparticles using a water-soluble crosslinking agent for covalent binding between the amino group of the APS and the amino group of the mAb. Recognition of the epitope on cancer cells by the mAb-marked fluorescent nanoparticles was investigated using MCF-7 cells. In a co-culture of breast tumor MCF-7 cells and pro-monocytic U937 cells, mAb-marked nanoparticles specifically recognized and internalized tumour cells.

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FULLERENES FORMATION FROM AROMATIC PRECURSORS BY A SURFACE CATALYSED CYCLODEHYDROGENATION PROCESS

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Controlled synthesis of fullerenes and heterofullerenes on surfaces is a preceding step towards the development of a true fullerene-based molecular electronics. New methods are required for the rational, size-controlled synthesis of fullerenes, heterofullerenes, and endohedral fullerenes that cannot be accessed by the current method of graphite vaporization. Recently, pioneering experiments have shown that C_{60} fullerene can be formed by flash vacuum pyrolysis of a trichlorinated precursor $C_{60}H_{57}Cl_3$. However, this precursor was prepared in 11 steps from commercially available materials and the final dehydrogenation/dehydrochlorination proceeds in the gas phase in ca. 0.1-1.0% yield[1].

Here we report a highly efficient (<100%) dehydrogenation mechanism leading to the formation of fullerene C_{60} and for the first time triazafullerene $C_{57}N_3$ in a one-step from their corresponding planar polycyclic aromatic precursors by a surface catalysed process[2]. We have visualized the whole process by in-situ Scanning Tunneling Microscopy (STM) and X-Ray Photoemission spectroscopy (XPS). The cyclodehydrogenation has been confirmed by the thermal desorption of HD and D_2 from hexadeuterated 1-d6 precursors, by the mass-spectrometric detection of C_{60} in the platinum-catalysed dehydrogenation, and the whole process followed by first principles DFT calculations.

The process is catalysed by reactive substrates, as Pt, which favours strong surface-molecule interactions. We have deeply studied by STM and DFT the interaction of the polycyclic planar precursors with different surfaces. The number of established bonds between the substrate and molecule seems to play a key-role in the catalytic properties of the system.

The mechanism we describe opens the door to size-controlled production of fullerenes and heterofullerenes, it could allow the encapsulation of different atomic and molecular species to form endohedral fullerenes and to the formation of different carbon-based nanostructures, such as graphene or doped graphene, which nowadays are not readily available on surfaces by other methods.

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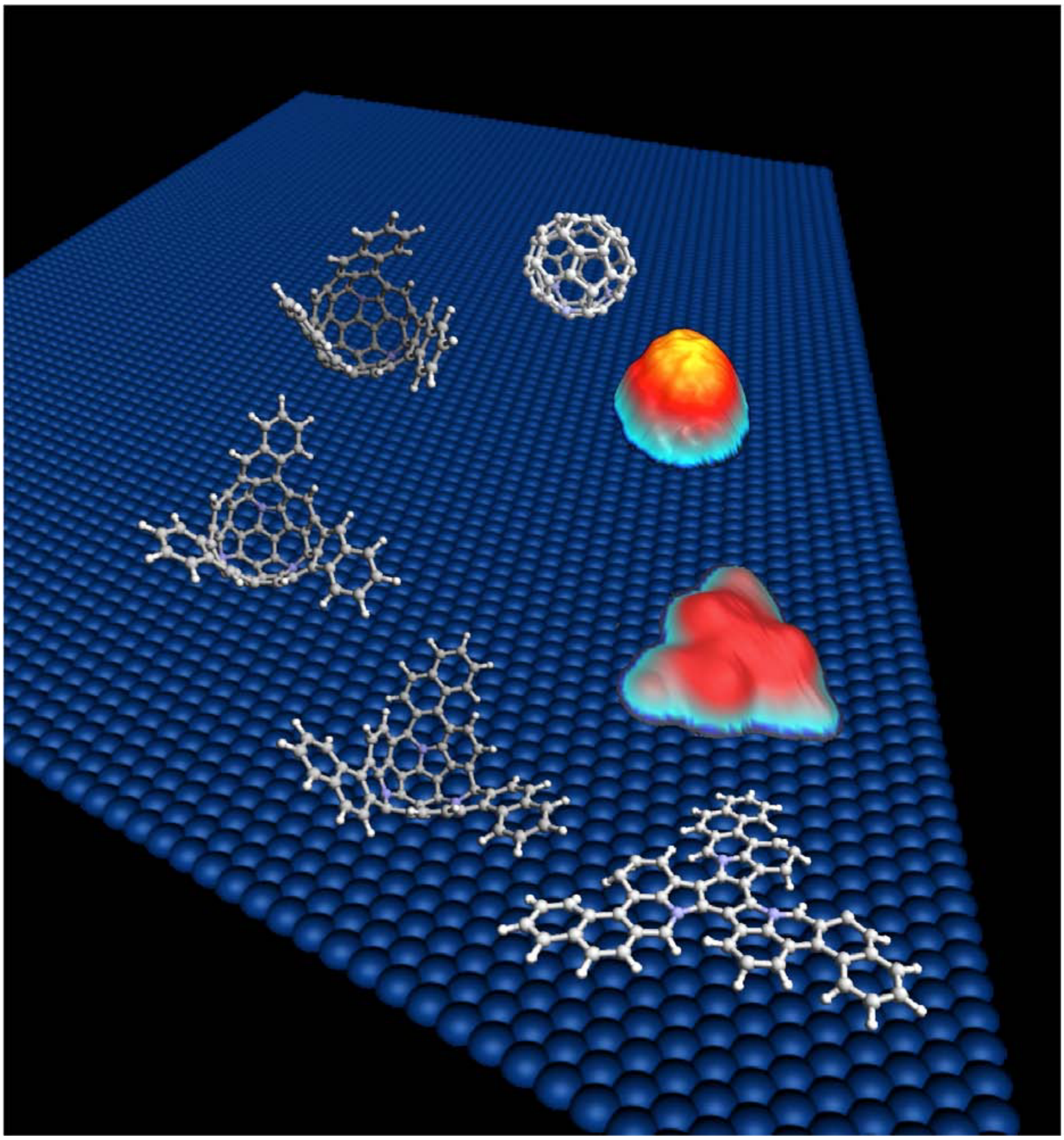

GUIDING PLASMONS WITH SUBWAVELENGTH LATERAL CONFINEMENT IN THE OPTICAL AND THZ REGIMES

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The guiding of light within a subwavelength cross section has recently been attracting a great deal of attention because of ever increasing demands for miniaturization of photonic circuits.

In this talk we present theoretical results for the modal shape, dispersion relation and losses of bounded electromagnetic modes in a V-shaped channel in a metal film (the so called Channel Plasmons). It will be shown that modes spatially located closed to the opening of the channel hibrydize with modes appearing at the edges of the channel. These modes, termed Wedge Plasmons will be studied separately in a wedge (the inverse geometry to the V-channel). Strategies for coupling into this modes and for further focusing the electromagnetic field will be discussed.

Finally, the transferring of this ideas to the THz regime will be considered. It will be shown that it is possible to create waveguides for THz electromagnetic waves by proper texturing of a channel or a wedge in a metal.

PROTEIN-CARBOHYDRATE INTERACTION STUDIES BY MEANS OF SUPERPARAMAGNETIC NANOPARTICLES CLUSTERING.

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Magnetic nanoparticles offer a wide range of new opportunities including the quality improvement of contrast agents for MRI, hyperthermic treatment, and site-specific drug delivery. All these biological applications of these nanoparticles require the fulfilment of several features: high magnetization values, size smaller than 20 nm, narrow particle size distribution, simple biofunctionalization, a special surface coating to prevent nanoparticles aggregation, opsonization and toxicity effects [1]. Very recently, Sun and co-workers [2] had markedly improved the synthesis of monodispersed magnetite particles with size around 4 nm by thermal decomposition of iron (III) acetylacetonate in phenyl ether in the presence of oleic acid and oleylamine. As these nanoparticles are coated with a hydrophobic organic layer, they are only stable in hexane and other non-polar or weakly polar organic solvent. We report the optimization of a procedure to prepare magnetite nanoparticles with an average size of 8 nm, a narrow size distribution and high stability in water and physiological media. The procedure to stabilize the nanoparticles in physiological media is based on a previously reported strategy [3], which takes advantage of the hydrophobic surfactant layer of these nanoparticles to introduce an amphiphilic polymer shell. On top of that we propose these nanoparticles as good candidates for further applications in molecular imaging and biosensing.

It is well known that superparamagnetic iron oxide nanoparticles could be used as transversal relaxation (T_2) MRI contrast agents [4]. The superparamagnetic behaviour of our nanoparticles (Nps) suggested that they could be an efficient T_2 relaxation agent. ^{1}H NMR relaxation times studies were performed using a 1.5 Tesla in a Bruker Minispec NMR spectrometer. The Nps showed exceptionally high r_2 relaxivity values which clearly demonstrate the potential of our Nps as a T_2 MRI contrast agent.

Taking advantage of their T_2 relaxation times, these nanoparticles were also used to evaluate carbohydrate-protein interactions. The low affinity of the biological interactions where carbohydrates are involved makes very difficult the study of these kinds of interactions. Nps are good platforms to be used in these studies, as could compensate the low affinity of the interactions by multivalent presentation of the ligands [5]. Moreover, it had been already described that clustering strongly affects the transverse (T_2) relaxation times induced by superparamagnetic Nps [6]. Therefore by coupling the presence of carbohydrate binding proteins to the induction of aggregates between the corresponding ligand-functionalized superparamagnetic nanoparticles, very sensitive aggregation-based sensors could be designed in order to detect such extreme low affinity interactions. To perform these studies we have selected concanavalin A (Con A) as model of carbohydrate binding protein. This plant lectin binds specifically to certain structures found in various sugars, namely internal and non-reducing terminal mannosyl or glucosyl residues [7]. A range of concentrations of Con A was added to a solution of glucose-functionalized Nps, and T_2 relaxation times were recorded. The results showed changes in T_2 relaxations, even using extreme low concentrations of ConA. If enough glucose was added the Np aggregates were undone, as the free glucose could bind to the active sites of Concanavalin A, which makes the system reversible (Figure 1). Moreover, the high specificity of the system was proved as no changes in T_2 value were observed when using galactose-functionalized Nps. All these results make us think that very sensitive aggregation-based sensors of carbohydrate binding proteins could be designed using these Nps functionalized with the corresponding ligand.

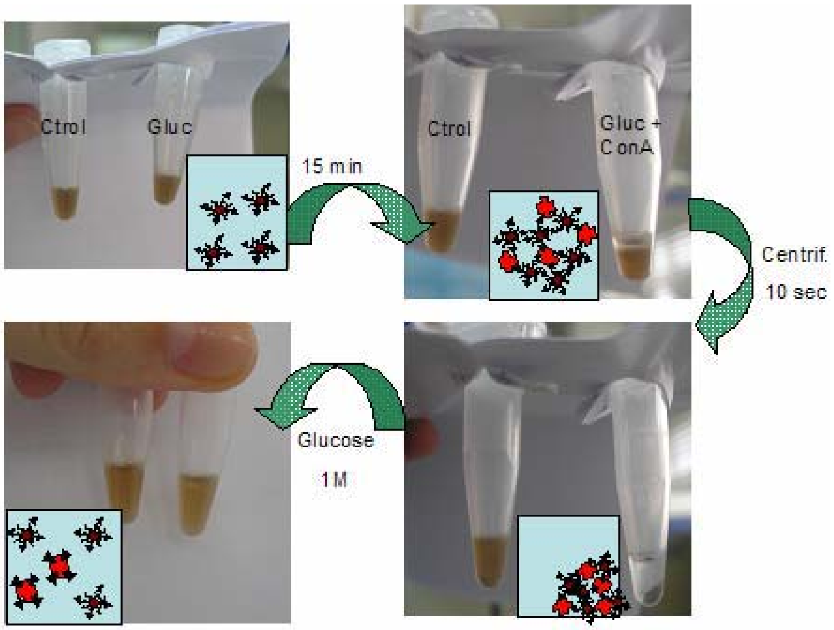

Figure 1. Aggregation of glucose-functionalized superparamagnetic nanoparticles due to the presence of Concanavalin A.

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GOLD NANOPARTICLES - STRUCTURED ELECTROCHEMICAL BIOSENSORS FOR APPLICATIONS IN THE FOOD INDUSTRY

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The use of nanomaterials for the construction of biosensing devices is nowadays one of the most exciting features of modern bioanalytical chemistry. The extremely promising prospects of these devices accrue from the unique properties of the nanomaterials. In particular, the ability of gold nanoparticles to provide a stable surface for immobilization of biomolecules retaining their biological activity is a major advantage for the preparation of biosensors [1]. Moreover, gold nanoparticles permit direct electron transfer between redox proteins and bulk electrode materials, which allows electrochemical sensing to be performed with no need for electron transfer mediators. Besides this, gold nanoparticles have shown to constitute useful interfaces for electrocatalysis of redox processes of molecules involved in biochemical reactions with analytical significance.

On the other hand, biosensor technologies provide powerful analytical tools with numerous applications in agricultural and food chemistry. The more remarkable characteristics of biosensing devices which convert them in unique attractive options to compete with other technologies in the agricultural and food market are: high selectivity, high sensitivity, short time of analysis, ability to be included in integrated systems, automation easiness, capability of response in real time, versatility allowing the design of “à la carte” devices and low cost [2].

In this communication, several examples of electrochemical biosensors based on the use of gold nanoparticles-structured electrodes designed for specific applications in the agricultural and food industry will be reviewed. Both enzymatic sensors for the determination of analytes such as hypoxanthine or inuline [3, 4], and immunosensors for the quantification of progesterone in milk [5, 6] will be presented. Finally, the potentialities of hybrid gold nanoparticles/carbon nanotubes materials for the development of electrochemical biosensors will be also outlined [7].

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FUNCTIONALIZATION OF MAGNETIC NANOPARTICLES WITH ANTIBODIES: DOES THE ANTIBODY ORIENTATION MATTER?

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For the last 30 years, there is a growing interest in the use of magnetic nanoparticles (Nps) for applications in drug delivery, MRI contrast agents and quantitative and highly-sensitive biosensors. There has been a great effort for the development of strategies to provide nanoparticles with excellent physical properties, high magnetization values, perfect size distribution and high stability [1]. However, it is also very important the development of strategies for the adequate bio-functionalization of these nanoparticles to provide them with the appropriate features for biotechnological and biomedical applications.

Different biomolecules have been used to provide specificity and bioactivity to magnetic nanoparticles, going from aptamers, peptides to carbohydrates. However, the star of these biomolecules due to their extremely high specificity and high recognition efficiency, are antibodies [2, 3]. Antibodies are proteins used by the immune system to identify and neutralize foreign objects, such as bacteria and viruses. They are typically made of two large heavy chains and two small light chains. Although the general structure of all antibodies is very similar (Fc zone), a small region at the tip of the protein is extremely variable (Fab zone), providing specificity to the protein. Each of these Fab zones can recognize to a specific antigen. This huge diversity of antibodies plus the high efficiency in the antigen-antibody interaction make antibodies an excellent biomolecule to be incorporated to magnetic nanoparticles and explode them for biotechnological applications.

Different strategies have been reported for the incorporation of antibodies on surfaces and supports [4]. Among the reported protocols, adsorption of the antibody through immobilized protein A or protein G, site directed biotinilation, or covalent immobilization through the sugar chains present in the Fc region of the antibody, are the preferred options to immobilize the antibody by the Fc region leaving free the site where the antigen molecular recognition take place (Fab regions) [5,6,7,8,9]. But all these protocols are more or less sophisticated and in many cases involve the antibody modification. Moreover, few examples have been reported for nanoparticles, probably due to the difficulties of this kind of research [9,10]. There is a need, therefore, to develop very easy methodologies for the immobilization of non modified antibodies onto magnetic Nps without involving the IgG Fab regions during the immobilization process. We report a simple way to functionalize magnetic Nps via a two step strategy that involves a first ionically exchange (anionic or cationic) of the antibody followed by its further covalent attachment using epoxy or NHS/carbodiimide chemistry. Antiperoxidase from horseradish antibody has been used as model. Nps functionalized with anti-peroxidase immobilized through its more reactive amine groups or through its sugar chains were also prepared as control for ***random*** and ***oriented immobilization*** respectively. The capacity of the immobilized antibodies to capture peroxidase was evaluated, calculating the enzyme/antibody molar ratio. We have confirmed that Nps functionalized with antibodies anchored through their carbohydrate moieties are the only that retained 100% functionality. However, the biological activity of antibodies anchored to Nps through positive or negative charged riches zone was not strongly affected (> 80% of retained functionality in both cases).

The obtained results imply that the previous ionic adsorption of the antibody to carboxilated or aminated Nps followed by its further covalent attachment, did not involve the Fab regions of the antibody. These easy functionalization techniques are applicable to almost all antibodies, and they will be very useful for the development of more bioactive nanoparticles conjugated with antibodies, improving selectivity and sensitivity of new nanodevices.

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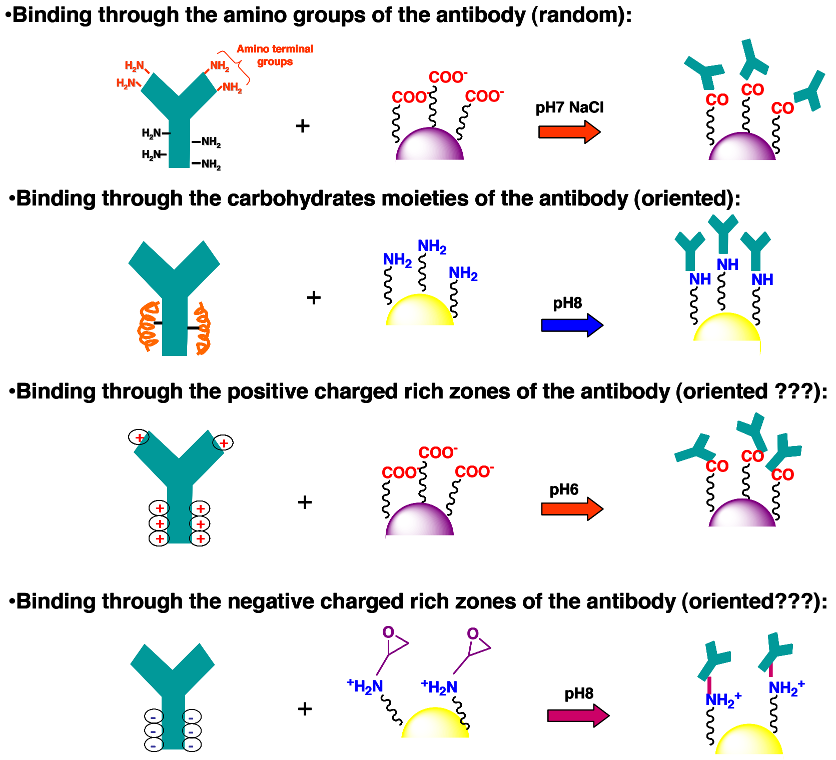
•Binding through the amino groups of the antibody (random):

•Binding through the carbohydrates moieties of the antibody (oriented):

•Binding through the positive charged rich zones of the antibody (oriented ???):

•Binding through the negative charged rich zones of the antibody (oriented???):

Figure 1. Different immobilization strategies used.

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NANOTECHNOLOGY: FROM NANOTOXICOLOGY TO NANOMEDICINE

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Nanoparticles. New species in contact with biological systems. As society begins to use nanomaterials in greater quantities and in consumer products, interest in the broader implications of this emerging technology has grown together with unfounded “nanoeuphoria” and “nanoscares”. The central question is whether the unknown risks of engineered nanoparticles (NP), in particular their impact on health and the environment, outweigh their established benefits for society. Therefore, for any application and future developments, a key issue is to accurately evaluate the utility of these materials and it is necessary to assess their potential toxicity –whether due to their inherent chemical composition (e.g., reactive metals), their physical size (e.g., Au_{55} attaching to DNA), their large and accessible inorganic surfaces (e.g., TiO_2 NP versus microparticles) or as a consequence of their particular nanoscale characteristics (e.g., carbon nanotubes that have reached the lungs appear significantly more toxic than carbon black and graphite). While there is a significant body of research on the effects of natural and incidental NP –those that occur as unintentional byproducts of other processes, such as combustion– only a few engineered nanomaterials have been studied in this way. In fact, some incidental NP are central to many natural processes, from marine aerosols to volcanoes and forest fires, and they do not have a great effect on health. Thus, it has been observed that nanomaterials, including fullerenes, are produced naturally in combustion processes, while burning paraffin and diesel produces carbon nanotubes (CNT). Nanomaterials can also be found perfectly integrated into biological structures. For example, biogenic magnetic NP occur naturally in many organisms ranging from bacteria through protozoa to animals. A biological model of coated nanomaterials also found in humans is ferritin, which is an iron storage protein, approximately 12-nm in diameter, that contains 5- to 7-nm-sized hydrous ferric oxide inside a protective protein shell. Obvious differences between natural, unintentional NP and intentional, anthropogenic NP are: i) the polydisperse and chemically complex nature of the former in contrast to the monodisperse and precise chemically engineered characteristics of the latter, and ii) particle morphology (often a branched structure from combustion particles versus spherical forms of engineered NPs, although other shapes, such as tubes, wires, rings and disks, are also manufactured). Despite these differences, the same toxicological principles are likely to apply for both types of NP.

If nanomaterials have received enormous attention it is because of their potential interaction with living systems. This gives rise to potential applications in biology and medicine, due to their ability to detect the state of biological systems and living organisms optically, electrically and magnetically, thanks to recent developments in materials physics and chemistry. Thus, NP can be designed with different properties, such as fluorescence or possessing a magnetic moment, and these properties can be harnessed and used as local nano-probes or nano-manipulators in biological and medical applications (e.g.: fluorescence labeling of cellular compartments; the use of fluorescent or magnetic particles as contrast agents; magnetic separation; and targeted drug delivery). Derivatization of NP with biological molecules has successfully been applied in materials science and biological research in recent years. Conjugates of NP biopolymers (like proteins or DNA) show great promise in both fields: biological diagnostics, where NP can provide unique detection signatures; and nanotechnology, where the information content of biomolecules can be harnessed for the spatial patterning of NP. There are many strategies available for bioconjugation of NP, including attachment to elastin, antisenses, biotin-avidin, antigen-antibodies, peptides, proteins, etc.

Thus, the characteristic biokinetic behavior of NP promises applications in diagnostic and therapeutic devices, and in tools to investigate and understand molecular processes and structures in living cells. However, precisely this unique biokinetic behavior of NPs (cellular endocytosis, transcytosis, neuronal, lymphatic and circulatory translocation and distribution, etc.) which makes them so attractive for medical applications, may be associated with potential toxicity. Not only bacteria, viruses and parasites, but also inorganic foreign bodies can be the cause of various pathologies: silicosis, asbestosis and inflammatory reactions to the debris from worn out prostheses or related to diesel exhaust fumes are only a few among many possible examples. Thus, for example, NP-facilitated drug delivery to the central nervous system (CNS) raises the question of the fate of the NP after their translocation to specific cell types or to sub-cellular structures in the brain. This and other aspects will be discussed in this presentation.

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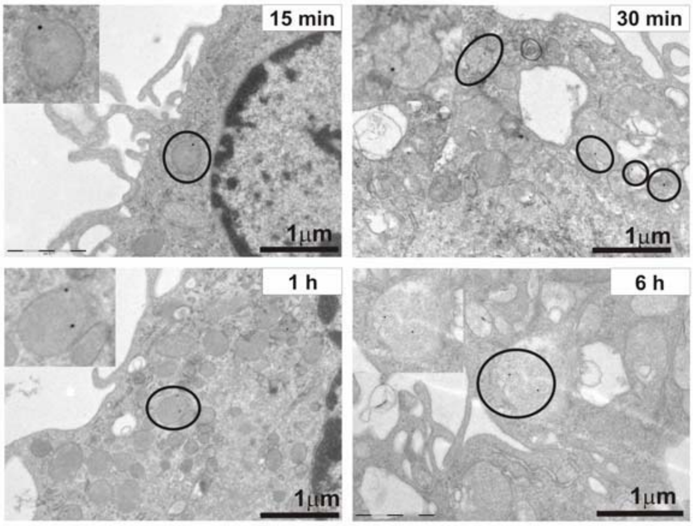

TEM image of Internalization of Au NPs conjugates in macrophages. Macrophages were incubated for a range of times: (A) 15 min, (B) 30 min, (C) 1 h and (D) 6 h with AuNPCysAGIP

SHAPING THE OPTICAL AND THERMAL PROPERTIES OF PLASMONIC NANOSTRUCTURES FOR BIOLOGICAL APPLICATIONS

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Metallic nanostructures supporting localized surface plasmon resonances have the potential to both generate intense local optical fields and act as efficient nano heat sources, opening up to plenty of new science and applications in areas ranging from integrated optics to biomedicine. In this contribution, we discuss the specific engineering of both optical and thermal properties of resonant plasmonic nanosystems and detail some of their respective biological applications that have been developed within the group.

In a first part, we will focus on the control of the subwavelength optical confinement in different configurations of electromagnetically coupled metal nanostructures. Special attention is paid to gap antennas formed by two adjacent gold nanorods separated by a subwavelength dielectric gap. We discuss the use of two-photon induced luminescence (TPL) micro-spectroscopy as an efficient tip less method to probe the actual electromagnetic mode distribution along the structures and monitor its evolution with the illumination wavelength. Our experimental data are very well corroborated by 3D numerical simulations [1].

The efficient concentration of light fields down to the nanoscale volumes is particularly attractive for applications involving the interaction of photons with very small amounts of matter, down to the single molecule level. Here after, we will discuss the applicability of optimized structures to both ultra sensitive nano-optical trapping and label less bio-chemical sensing. The strong field intensity gradient within the gap of coupled antennas has been first used to create 3D sub-wavelength optical traps able to overcome the limits of conventional optical tweezers created by focusing a laser beam with a high NA objective. In a first stage, we demonstrate efficient parallel trapping in water of 200nm polystyrene beads in a array of gold antennas. Beyond, we also show that our approach applies to the non-invasive manipulation of living E-coli bacteria [2]. We also investigate how the near-field coupling between adjacent plasmonic nanostructures could be used to enhanced the sensitivity of plasmonic sensors in detecting single or few molecular binding events.

Beyond their ability to create strongly confined and enhanced optical fields, plasmonic nanoparticles can be used as efficient nano heat sources of particular interest to material sciences and biomedical photothermal therapy. While several prior works have demonstrated first evidences of thermal assisted growth of semiconductor nanowires and cancer cells destruction, to date there is no unified study of the thermal properties of plasmonic nanoparticles aiming at optimizing their heating properties. Here, we first present a systematic numerical study of the heating efficiency of different geometries of gold nanoparticles, focusing on the morphology effect at constant volume. Interestingly, our results reveal that the criteria for achieving high temperatures are significantly different from those to get strong field enhancement at the particles surface. In order to verify our numerical predictions, we have developped a novel optical method which enable for the first time to map the distribution of the temperature increase near plasmonic nanoparticles with a spatial resolution of 300nm and an accuracy of 0.1ºC [3].

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TECHNOLOGY TRANSFER IN NANOTECHNOLOGY: FROM THE RESEARCH TO THE MARKET

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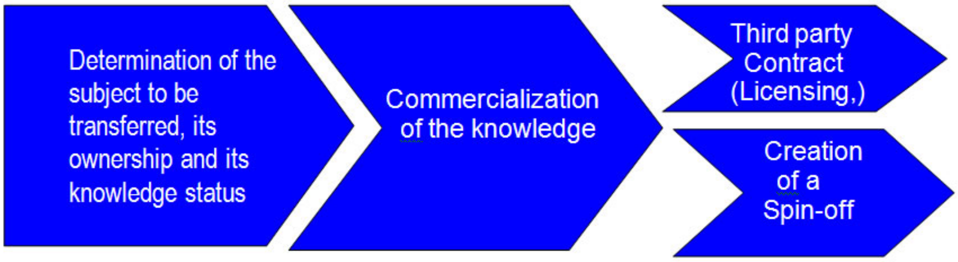
The presentation is divided in three main parts as follows:

1. Technology Transfer
    1.1 Knowledge transfer: general considerations.
    1.2 Commercial exploitation of technology: from the public sector and from the private sector.
    1.3 Consortiums and project collaborations.

2. The impact of Nanotechnology. Business opportunities.
    2.1.Importance and applications of the Nanotechnology.
    2.2.Size of the market. Impact on Industry, Environment and Society.
    2.3.Nanotechnology and the world in the new millennium.

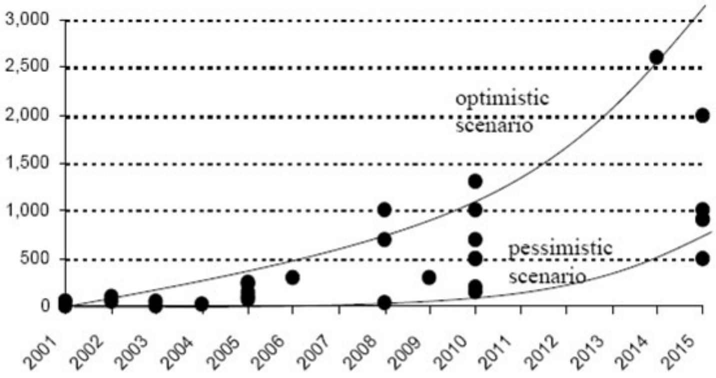
3. Safety & Regulations in Nanotechnology
    3.1.EU legislation and public concern.
    3.2.Some recommendations.

In the first section, we present general considerations about what we mean when we talk about Technology Transfer and its roadmap, from a general and legal point of view. We review the concepts of knowledge, ownership, protection, patents, exploitation, IP, NDAs and the negotiation process. This can be applied to Nanotechnology but not necessarily.

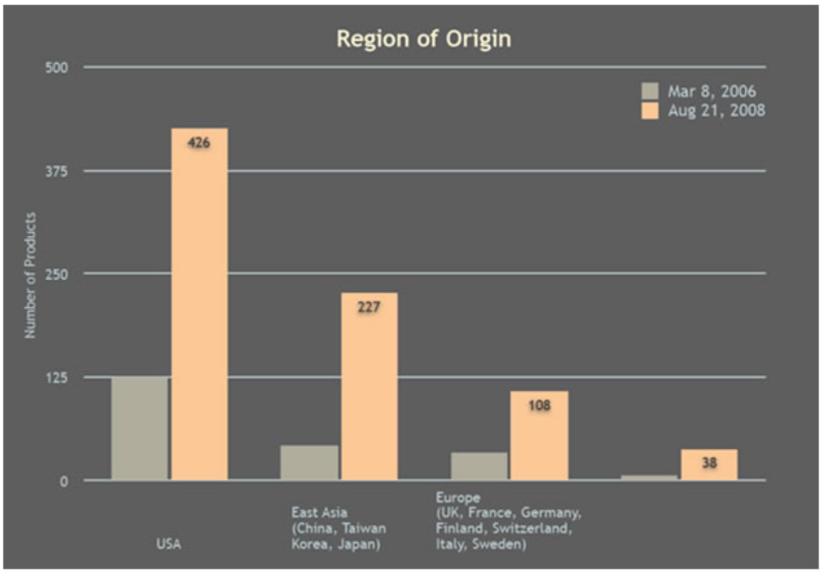


The different options of knowledge transfer from the public and from the private sector are following reviewed: licensing, hand over, spin-off creation. The creation of University-based spin-offs, their problematic and actual solution is reviewed. Different models of technology transfer in the private sector are reviewed: transmission of ownership, transmission with license reserve, license of exploitation. Subject of transmission, method, scope and range of transmission, payment, guarantees and responsibilities. The contract of development. Consortiums and collaborative projects within Spain and the EU.

The second section is focused in Nanotechnology at all. Governments and industry are pouring billions of Euros into developing nanotechnology, while the media and consumer goods companies use the word "nano" with ever-increasing regularity. Yet nanotechnology is well understood by very few outside the scientific community even though its impacts, both positive and negative, are likely to affect many aspects of our lives within a decade. This section aims to give a comprehensive overview of nanotechnology – what it is, what its impacts will be on industry, the economy, the environment and society - and suggests some actions that can be implemented on a local basis to address the key issues of concern



: World market forecasts for nanotechnology in billion US Dollar. Diverse sources



Inventory of nanotechnology-based consumer products by region of origin (www.nanotechproject.org)

The last section of this presentation is concerned to Safety & Regulation of Nanotechnology. Safety in regards to nanotechnology has many aspects: safety in the laboratory, safety in the workplace, safety for consumers and safety for the environment. The broad scope and variety of nanotechnologies, combined with their rapid rate of advancement and commercialization, is creating concern in many segments of society that safety issues are being ignored at the expense of commercial gain. The EC has issued two key communications in recent years that define its policy in regards to health and safety; ***Towards a European Strategy for Nanotechnology (May 2004)*** [1] and ***Regulatory Aspects of Nanomaterials (June 2008)*** [2]**.** In order to assist the process of monitoring new products, the reviews identify that the relevant legislation can be grouped under four categories - *chemicals, worker protection, products* and *environmental protection* – and that when all are applied simultaneously the result is an acceptable level of protection of public health and safety.

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SURFACE PLASMON RESONANCES OF METAL NANOPARTICLE DIMERS THROUGH THE HYBRIDIZATION MODEL AND GENERALIZATION TO NANOPARTICLE CHAINS

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The study of plasmon resonances in metallic structures at the nanoscale has recently attracted huge efforts from the Nano-Science community for the obvious impact that such resonances may have on a variety of applications in Nano-Photonics and (Bio)-Sensing. Generally speaking, numerical methods have been developed in order to describe this kind of resonances in metallic nanostructures, commonly based upon Maxwell equations, such as extended Mie, discrete dipole approximation, multiple-multipole methods, surface and volume integral equation formulations, etc. On the other hand, approximate methods have also proven successful in given configurations.

In particular, the hybridization method, developed by Nordlander at al. [1], introduces a microscopic model based upon the description of nanoparticle resonances as a set of vibrational modes in the sea of electrons on the surface of the nanoparticles. In this method, the hybridization concept, used in molecular physics since long ago, is applied to the calculation of nanoparticle resonances in complex configurations consisting of a combination of simpler nanostructures with known plasmon resonances. The resulting plasmon modes take the role of molecules in the orbital theory; namely, the initial (known) plasmon modes interact with each other in order to yield the plasmon modes of the entire nanostructure, much in the same way that electrons interact one to each other leading to the molecular energy levels. This method has been successfully applied to different configurations, as for instance: spheres, nano-shells and dimers. In order to calculate the plasmon resonances of a nanoparticle dimer, we have to build the lagrangian of the system; the kinetic part contains the single modes of the isolated nanoparticle, whereas the potential part describes the Coulomb interaction that strongly depends on the interparticle distance.

In this comunication we have used the dimer model appearing in Ref. [1] in two different experiments. Firstly, we describe the design and tuning with interparticle distance of the plasmon resonances of dimers composed by two silver nanospheres with radii around 25nm; specific amines take the role of nanoparticle linkers. Our results confirm the red-shift of the longitudinal plasmon resonance with closing distance in the ~2 nm range [2], in agreement with the experimental UV-visible absorption spectra. At resonance, in turn, these nanoparticle dimers provide a huge increase of the EM field in between the nanoparticles, leading to larger surface-enhanced Raman scattering (SERS), as revealed by SERS signals of complex molecules allocated therein by the molecular linker.

Secondly, we try to explain the trend of the red-shift of plasmon resonances appearing in aggregates of silver nanoparticles, as the temperature is varied [3]. We emulate this variation in the model by choosing the main interparticle distance properly in connection with temperature.

Finally, we propose a generalization of this model increasing the number of solid spheres in the system, and we use it in order to study the plasmon resonances in a chain of silver nanoparticles [4].

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CONTROL OF LOCAL NEAR FIELDS IN OPTICAL ANTENNAS BY LOAD ENGINEERING: BRIDGING THE GAP

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Transmission-mode scattering-type near-field optical microscopy (s-SNOM) is applied for mapping the near-field distribution in amplitude and phase of infrared nanoantennas that are loaded with metallic bridges at their central gap. By varying the size of the bridge we trace the changes in the near-field distribution of the antennas, showing that targeted antenna loading is a promising means to engineer local near fields.

Our s-SNOM [1] is based on an atomic force microscope (AFM) where a dielectric Si tip scatters the local near fields of the antenna structures. Homogeneous antenna illumination from below through the substrate (transmission mode) avoids phase-retardation effects inherent to the backscattering geometry in typical s-SNOM experiments. In combination with a pseudoheterodyne interferometric detection scheme [2], we are able to map the near-field distribution in both amplitude and phase.

The experiments were performed with gold nanorods (1550nm x 230nm x 60nm) designed for fundamental dipolar resonance at $\lambda = 9.6\ \mu m$ [3]. By focused-ion-beam (FIB) milling at the center of the nanorods, we fabricated narrow, electrically isolating gaps. Loading the gap with metallic bridges was achieved by only partially FIB milling, leaving a small gold bridge of variable size at the gap that still electrically connects both antenna segments. With s-SNOM imaging the rods at the fixed wavelength of $\lambda = 9.6\ \mu m$, we monitor the changes in the amplitude and phase of the near-field patterns.

The near-field images of the unmodified nanorod (Fig. 1a) show the fundamental dipolar near-field mode of a $\lambda/2$ antenna [4], yielding high amplitudes at the antenna extremities and a phase jump of 180° at the center of the antenna. By introducing an 80 nm wide isolating gap (Fig. 1c), the near-field mode splits up into two dipolar-like modes. A highly interesting near-field distribution is observed with the nanorod loaded with a tiny metal bridge (Fig. 1b). The amplitude signal on the antenna surface is always non-zero, including at the gap. Apparently, the gap is not short-circuited despite of the electrical connection made by the metal bridge. Moreover, a prominent phase gradient of 80° is observed along the antenna segments (see line plot), indicating a time delay between the near fields at the gap and the antenna extremities. Obviously, the near-field distribution depends very much on the characteristics of the gap load. Antenna loading provides an excellent means to locally control near fields which can have successful application in the development of compact and integrated nano-photonic devices.

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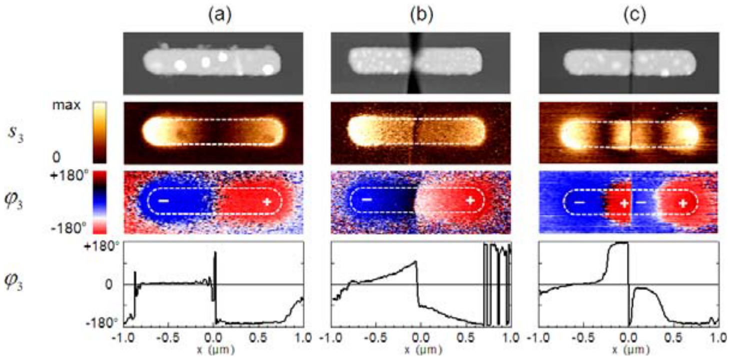

Figure 1: (from top to bottom) Topography, IR near-field amplitude s_3 and phase φ_3 images, line plot of phase φ_3 along the antenna axis.

ANALYTICAL POTENTIAL OF THE CARBON NANOPARTICLES-IONIC LIQUID COMBINATION

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Carbon nanotubes have exceptional properties which make them excellent candidates for numerous applications in nanotechnology and material sciences. However, purification and characterization of CNTs bundles presents still an analytical challenge. In this communication, the potential of ionic liquids as a medium with a capacity to debundling CNTs is discussed fundamentally for SWNTs, which exist in heavily entangled aggregates of ropes or bundles.

The dispersions and the possible interactions between $bmimBF_4$ and the SWNTs were studied by Raman spectroscopy. The spectra of dispersions containing different SWNT concentrations were recorded. The presence of ionic liquid bands also hindered the study of the RBM mode. In order to avoid interference from the ionic liquid, we focused our study in the G and G' bands. Although no significant changes in the G-band position were observed a decrease in the band width was noticed. In fact, this seems to be due to a loss of the high frequency side of the band. This effect could be attributed to a decrease of the intertube interactions in the dispersions. Furthermore, in the dispersions the G'-band is clearly blue-shifted.

The fact that especially at lower SWNTs concentration, the ionic liquid strongly affects the Raman spectra of SWNTs can be attributed to specific interactions between the imidazolium ion component and the π-complex of the SWNT. Such interaction give rise to the presence of a new system, SWNT coated with IL, consisted in isolated or weakly interacting SWNTs. The extend of the π-complex depends on the degree of overlap between p_z orbitals in the carbon atoms or in others words on the cylindrical shape of the SWNTs.

From the Raman results, debundled of the SWNTs at lower concentration and milder sonication treatment can be assured. Therefore, these dispersions were appropriate for further analyses of SWNTs by CZE. After encapsulation of the nanotubes in sodium dodecyl sulfate micelles, separation of the solubilized SWNT was accomplished using as background electrolyte a 50 mM formic acid solution at pH 2.0 and working at -10 kV. Separation was achieved in only 4 min being possible to distinguish more than 8 peaks of SWNTs from the analysis of commercial SWNT bundles.

On the other hand, It is well known that ionic liquids containing CNTs above 0.5-1 wt % concentration form a gel that can be used to create new soft materials. Therefore, the analytical material of these materials will be also discussed in this communication. These materials present a high capacity to adsorb but also to absorb analytes. The most important aspect is the synergic effect that exists between the carbon nanotubes and the ionic liquid which result in a high capacity to preconcentrate analytes.

THEORETICAL STUDY OF MAGNETODYNAMICS IN BCC IRON NANOPARTICLES

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Abstract The theory of magnetodynamics is a well established area of magnetism and is based on the Landau-Lifshitz equation (LLE) of motion. This dynamical theory forms the basis of the formalism of ferromagnetic resonance (FMR) and spin wave resonance (SWR). The classical theory has been adapted to many magnetic systems, from bulk samples to magnetic thin films and multilayers. Low dimensional systems such as the latter require additional considerations of the surface or boundary conditions which permit the evaluation of the allowed standing spin wave mode wave vectors. In the case of thin films and multilayers the problem can be reduced to one dimension, i.e. in the direction perpendicular to the film plane. Other low dimensional systems, such as nanogranular, nanoparticles and nanostructured materials will be more complex since we must take into account the three dimensional nature of the problem. In recent years, with interest in nanometric systems increasing enormously, attention has been directed to these ends. Of particular concern is the manner in which the surface spins should be treated, since for such small structures the number of surface spins, with reduced magnetic coordination compared to bulk spins, will be a significant number of the total. As such surface magnetic properties in these systems can dominate, thus allowing us to manipulate magnetic properties via a control of particle size. In this paper we outline the formalism for obtaining the excitation spectrum, and in particular, the FMR characteristics, of a nanoparticle using a many-spin approach. In addition to this we simulate BCC iron nanoparticles taking account the environment of each spin, and in particular its positionally specific resonance condition. We present the results of simulations which show that we can determine the separate contributions from core and surface.

NANOSCALE INFRARED NEAR-FIELD MAPPING OF FREE-CARRIER CONCENTRATION IN SINGLE SEMICONDUCTOR NANOWIRES

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Semiconductor nanowires have gained tremendous interest in recent years due to their promising electronic and opto-electronic properties [1, 2]. For the implementation of semiconductor nanowires into devices it is crucial to precisely control the doping concentration of the nanowires. For tuning the fabrication process, new analytical tools are needed to quantitatively determine the doping concentration.

Dopants in single nanowires can already be measured using atom probe microscopy (APM) or transmission electron microscopy (TEM). But due to surface and shielding effects [3] not all dopants are ionized yielding a lower number of free-carriers. For the performance in electrical and opto-electronic devices the number of free carriers therefore is of utmost importance. Scanning-probe methods like scanning capacitance microscopy (SCM) and scanning spreading resistance microscopy (SSRM) can map the free-carriers. However, quantitative imaging is hardly achieved with SCM, and SSRM is a destructive method. Here we demonstrate that scattering-type scanning near-field optical microscopy (s-SNOM) can map free-carriers in single modulation-doped InP nanowires with nanoscale resolution, quantitatively and non-destructively.

s-SNOM offers an excellent optical resolution in the 10nm range independent of the wavelength [4] and allows for mapping the chemical composition [5], structural properties such as strain [6], and free-carriers in semiconductor devices [7]. It is typically based on atomic force microscopy (AFM) where the tip is illuminated with a focused laser beam and the tip-scattered light is detected simultaneously to topography. Using metallic tips, the strong optical near-field interaction between tip and sample modifies the scattered light allowing for probing the local dielectric properties with nanoscale resolution. Unavoidable background contributions are suppressed by vertical tip oscillation at frequency Ω and subsequent higher-harmonic demodulation of the detector signal at $n \cdot \Omega$ with $n \geq 2$ [8]. Combining this higher harmonic demodulation with interferometric detection, background-free near-field optical amplitude s_n and phase φ_n contrast imaging is possible.

Using s-SNOM we study the free-carrier properties in single modulation-doped InP nanowires, which were grown using the vapor-liquid-solid (VLS) method. For s-SNOM imaging, the nanowires were mechanically transferred onto a silicon substrate. Fig. 1 shows simultaneously recorded topography and IR images of a single nanowire. While the topography shows a homogeneous wire surface, the IR images reveal the differently doped wire segments. We also observe a material contrast between the InP wire and the gold particle. The latter is used to catalyze the wire growth. Within this contribution we will discuss the contrast mechanisms as well as the sensitivity of s-SNOM to free-carrier properties.

In conclusion, we demonstrate free-carrier profiling of individual doped InP nanowires. With s-SNOM we provide a contactless, non-destructive method, which allows quantitative local measurements of the free-carrier concentration in nanowires with nanoscale resolution. Improved modelling and spectral extension of s-SNOM to the THz frequency range could make the method a powerful tool for free-carrier profiling not only of nanowires, but also of other doped nanostructures and nanodevices.

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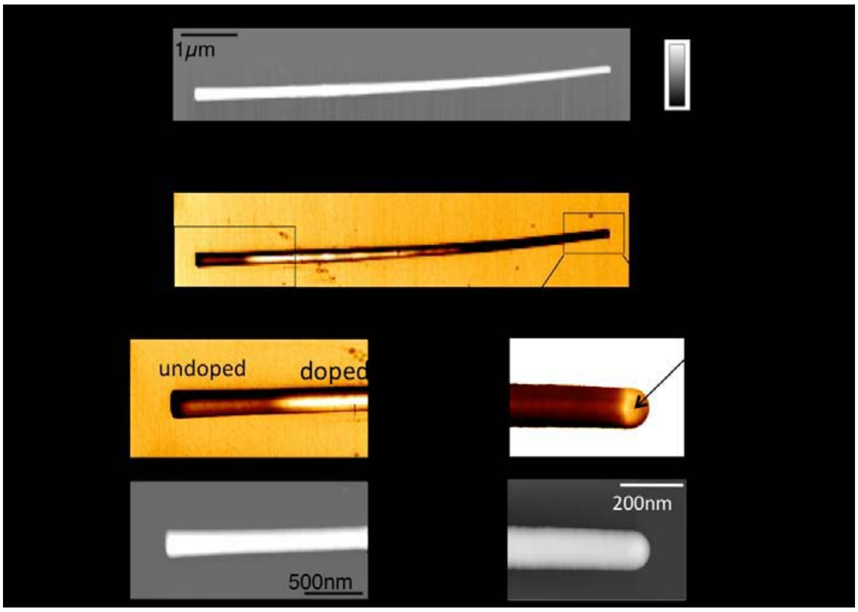

Fig 1: Topography and infrared amplitude s_2 of a representative InP nanowire recorded simultaneously at an IR laser frequency of 933.7cm^{-1} (10.71μm wavelength). The infrared images clearly reveal the differently doped nanowire sections and the material contrast between InP and the gold particle used to catalyze the nanowire growth.

PROTEIN PATTERNING BY THERMAL NANOIMPRINT LITHOGRAPHY AND NH_3-PLASMA FUNCTIONALIZATION OF POLYSTYRENE

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The ability to spatially orient and anchor proteins on sub-micro to nanometric sized areas has become a major challenge for the development of bioengineered surfaces. The driving force for the ongoing advances concerning methods for biomolecule array fabrication is their prominent application in a variety of fields, including biomedical diagnostics, DNA analysis, drug discovery and environmental monitoring. Moreover, many applications of biomolecule patterns can be enhanced by improving the resolution of the protein features. Smaller feature sizes enable, for example, the fabrication of high density protein arrays for biosensors or proteomic screening, or facilitate studies of cellular interactions with small precisely located clusters of extracellular matrix proteins. Several patterning strategies have been developed to produce biologically relevant patterns. Among them, a major advantage of nanoimprint lithography (NIL) is that the feature size can be reduced to the nanoscale while still retaining high throughput and reproducibility. Most previous work in protein patterning by NIL [1-4] relied on using a sacrificial imprinted polymer to create a pattern of specific protein binding sites. The present work shows a new approach: patterned polystyrene (PS) is functionalized with amino groups incorporated via an NH_3/N_2 plasma treatment [5, 6]; a biotin linker covalently bound to the formed amino groups is used to bind streptavidin (SAv) onto the PS structures. The SAv is used as a versatile anchor for biotinylated functional proteins, as demonstrated in a sandwich-type immunoassay (Fig. 1).

The imprintings were carried out at 180 ºC using a stamp with five different grating periods (ranging from 3.3 to 11.3 μm and 270 nm in depth) on 4” Si wafers having thermally grown SiO_2 on top. The residual layer was removed under an O_2 plasma. The ammonia plasma treatment was performed for 1 min at 20 W in a 4:10 mixture of NH_3 and N_2. X-ray photoelectron spectroscopic (XPS) measurements confirmed the formation of surface amino groups. SAv was immobilized via a sulfo-succinimidyl-biotin derivative linked to the amino groups. To increase the protein binding selectivity between the functionalized PS and the SiO_2 support, treatments of the samples with fluorosilanes and addition of a detergent (Tween 20) to the solutions proved to be most efficient. Fig. 2 includes representative micrographs showing the high affinity to the functionalized PS and the low background fluorescence signal. In order to demonstrate the anchoring capabilities of the immobilized SAv the fluorescence immunoassay depicted in Fig. 1 was performed. First a biotinylated anti-rabbit-IgG antibody is bound. After incubation of a test sample with the analyte solution, bound rabbit-IgG is detected with a second, fluorescence-labelled antibody. Fig. 3 shows the concentration dependence of the recorded signal, yielding a detection limit at about 50 ng/ml.

The presented work shows the great potential of NH_3-plasma functionalized PS for the fabrication of biofunctional structured surfaces, e.g. based on biotin-SAv binding and antigen-antibody recognition.

Acknowledgments

The partial support of the project NILSIS (TEC2006-13910-C03) is acknowledged. The authors thank Dr. A. Foelske (PSI) for performing the XPS measurements.

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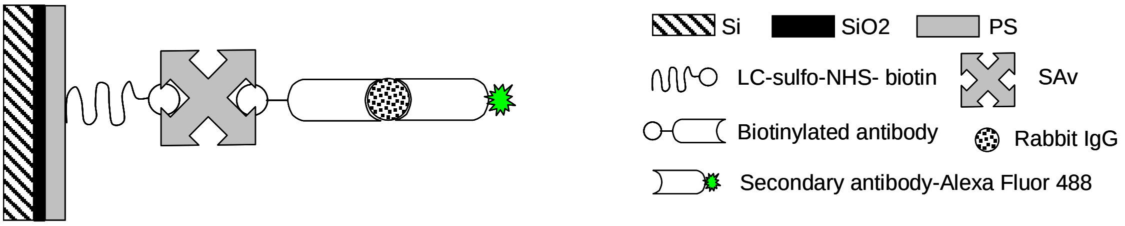
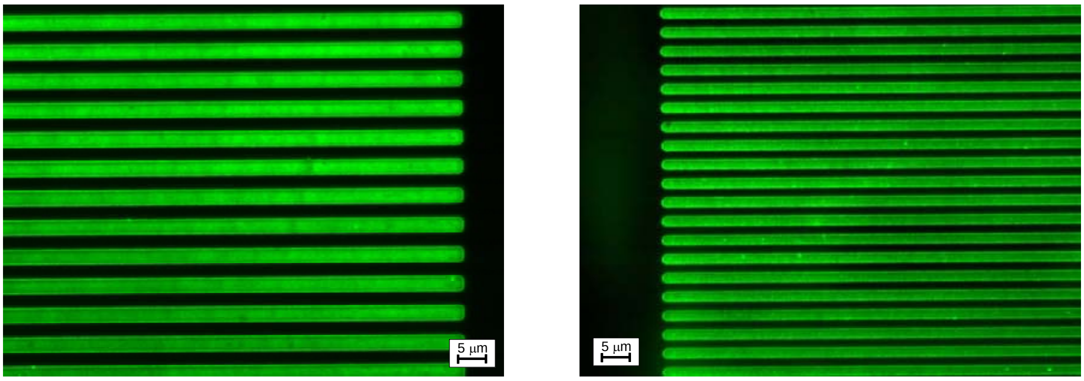


Figure 1. Scheme for the immunoassay aiming at detecting the presence of rabbit IgG in a solution.



a) b)

Figure 2. Fluorescence micrographs of patterned samples after NH_3 plasma treatment and immobilization of fluorescent labeled protein: a) Period 5.1 µm; b) Period 3.3 µm.

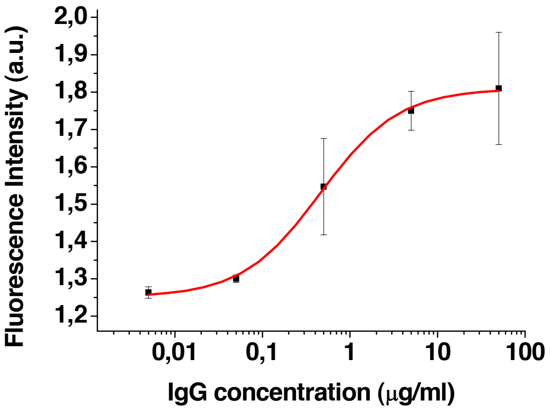


Figure 3. Immunoassay performed on NH_3-plasma functionalized polystyrene: Fluorescence signal with increasing IgG concentration.

AG-COATED CdSe/ZnS QUANTUM DOTS: OPTICAL PROPERTIES AND ANALYTICAL POTENTIAL

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If semiconductor quantum dots (QDs) are coated with a nobel metal, coupling between the plasmon resonance effect from the metal and the quantum size effect of the semiconductor QD may develop new aspects and types of nano-composite material systems and also widen applications for noble nano-devices. At present, therefore, there is much ongoing effort to synthesize semiconductor-metal nano-composite materials [1-4].

In this article, semiconductor-metal hybrid nanoparticle "CdSe/ZnS/Ag" have been prepared in a simple way by reducing (*in situ*) Ag^+ to Ag in presence of QDs. Optical properties of the obtained nanocomposite have been examinated.

It was found that the intensity and position of the PL emission peak was function of the Ag coating. High Resolution Transmission Electron Microscopy (HRTEM) has been used to verify formation of CdSe/ZnS/Ag nanoparticles and to evaluate the Ag thickness coating.

When low amounts of Ag were deposited on the QD's surface, an enhancement of PL emission of the nanocomposite was observed regards to non-coated nanoparticles. In addition to the increase of PL intensity a red-shift of the peak was observed. However, when QDs were coated by using high amount of Ag, the PL emission dramatically decreases.

Contrary to the fluorescent behaviour of the nanocomposite, QDs coated with high amounts of Ag allows a high enhancement of the Raman spectrum of organic molecules by SERS mechanism. However, QDs coated with low amounts of Ag increases the PL emission but does not produce any effect in Raman spectroscopy.

These results open new possibilities to develop more sensitive (bio)sensors. In addition, the special properties of these nanoparticles could be used for new industrial applications such as the development of solar panels.

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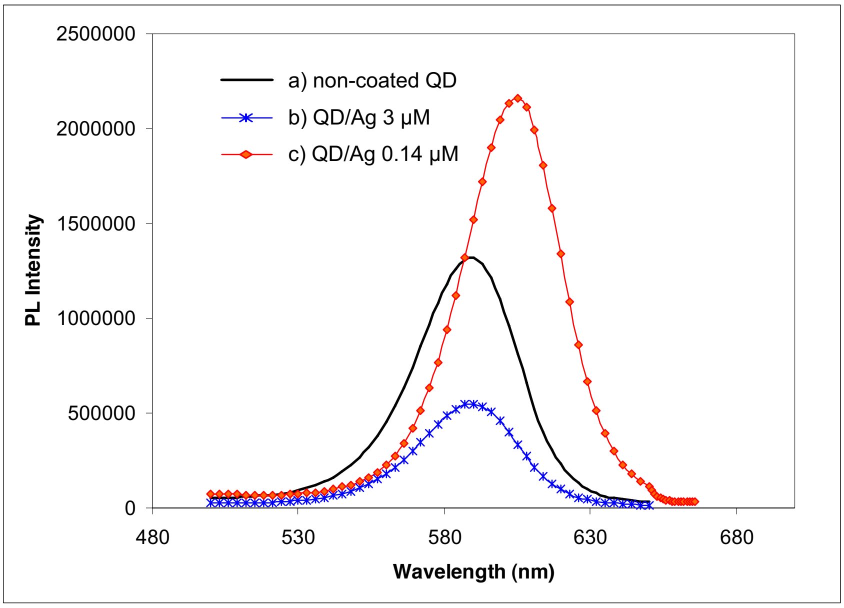

Figure 1. PL emission of syntetized CdSe/ZnS-Ag hybrid nanoparticles with different Ag concentrations: a) 0 (called non-coated QD), b) 3 µM (high amount of Ag), c) 0.14µM (low amount of Ag). The concentrations of Ag are really the concentrations of Ag^+ added to the QDs solutions before its reduction to Ag.

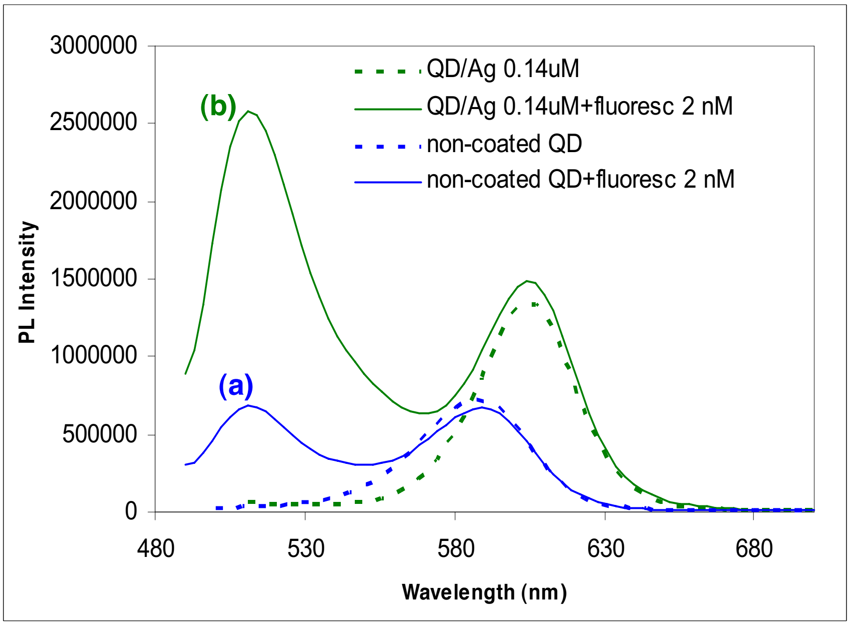

Figure 2. PL emission spectra of fluoresceine (2 nM) in presence of non-coated QDs (a) and in presence of CdSe/ZnS/Ag 0.14 µM (b). The dotted lines show the PL emission of non-coated QDs and CdSe/ZnS/Ag before adding the fluoresceine.

UNIFORM SHAPE AND SIZE DRUG PARTICLES PREPARED BY A NEW PRESSURE INDUCED WATER ANTI-SOLVENT PRECIPITATION (PIWASP) METHODOLOGY

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The poor water solubility of many drugs is a challenge in pharmaceutical research. Because of their low bioavailability, several potential drugs have to be abandoned in pharmacological screenings because of their lipophilicity. Their dissolution rate is the limiting factor since drugs with a high lipophilicity can permeate biomembranes quickly. Thus, the research on strategies for drug dissolution enhancement is of high interest. The administration of a drug in a reduced particle size is a very promising way to improve drug bioavailability of poorly soluble substances [1]. For instance, in the case of nanosuspensions, the drug is delivered suspended in an aqueous media, and has a particle size small enough for pharmaceutical acceptability. In addition to overcoming issues of solubility, nanosuspensions enable a higher mass per volume loading in comparison to solutions, allowing reduced administration volumes, which is crucial for low-volume intramuscular and ophthalmic applications. On the other hand, the particulate nature of the dosage form might offer alternative pharmacokinetic profiles; both in intravenous delivery, where one might expect lower toxicity and more efficacious regimens, and in oral delivery, where we might find potential for first-pass hepatic metabolism [2].

In principle there are two strategies for producing fine particulate therapeutically active materials, with particle size in the range of 50nm-1μm: 1) mechanical milling of the raw material by wet or drying processes; 2) the conversion of the molecular products or educts dissolved in suitable solvents into micro- or nanoparticulate materials by precipitation, condensation, or by specific synthesis procedures. Milling techniques have several disadvantages resulting from the mechanical disruption process. The micronization process using mills is extremely inefficient because of the high-energy input that can alter the surface properties as a thermodynamically activated surface is created [3]. Thus milling affects several physical properties of the drug, such as powder flow, agglomeration behavior, or electrostatic behavior. Besides these effects, the chemical reactivity, crystallinity and physico-chemical stability can also be affected by milling [4,5]. Because of the disadvantages of milling processes, there is a strong concern on the development of new bottom-up strategies that produce directly the particulate drug [6]. In any «bottom-up» process involving precipitation from solution particle characteristics depend on the evolution, during the precipitation process, of the supersaturation rate (β), which drives nucleation rate and crystal growth, at each point in the solution [7]. Therefore, in the design of a precipitation technology, the control over β profile, by process parameters, is a crucial issue with a strong relevance in the scale-up. Compressed fluids (CF) have shown to be promising solvent media for the straightforward preparation of micro- and nanoparticulate molecular materials. The solvent power of CF, in contrast with liquid solvents, can be tuned by pressure changes, which propagate much more quickly than temperature and composition solvent changes [8,9].

Here, we present a new procedure, called Pressure Induced Water Anti-Solvent Precipitation (PIWASP), which enables the straightforward production of micro- and nanosized crystalline powders [10]. The driving force of this new methodology is the anti-solvent character of water coming-out, by a pressure change, in a pressurized solution of the drug, dissolved in a "water/organic solvent/compressed fluid" mixture. Because ibuprofen is a widely used non-steroidal anti-inflammatory drug with a poor solubility in water, it has been used as a model drug to show the goodness of this new methodology. In fact, as it can be observed in the SEM images represented in the Figure, ibuprofen could be straightforward prepared as uniform spherical nanosized particles, using acetone as organic solvent and CO_2 as compressed fluid. Surprisingly, by powder X-ray diffraction and differential scanning calorimetry, it was observed that these particles have a high crystallinity degree. In contrast with conventional antisolvent precipitation techniques by liquid mixing [6], in the PIWASP process, the quality and characteristics of the final particles do not depend on the mixing efficiency. Indeed, in this new technology the antisolvent character of water emerges homogeneously over all the solution, and homogeneous supersaturation is achieved at molecular level.

P-PIWAS can be regarded as a "green" technology because the process wastes can be easily recycled, and the comminution and homogenization downstream process steps, which are required after conventional crystallization procedures, can be avoided.

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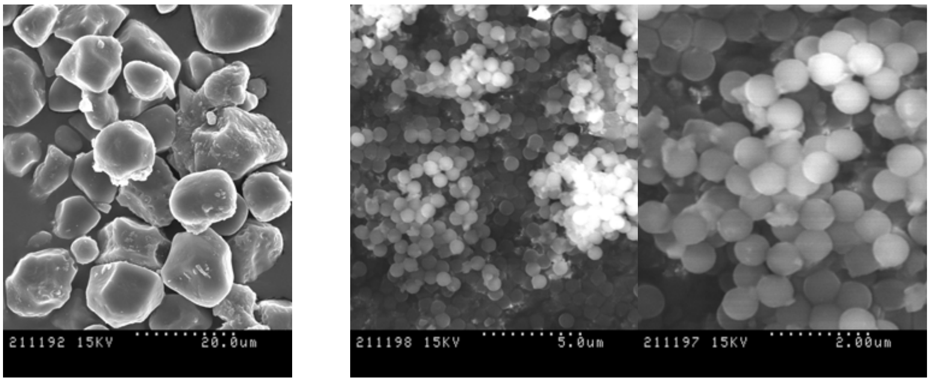

Figure. Unprocessed ibuprofen (left); processed ibuprofen by PIWASP (right)

CONTROL OF COVALENT FUNCTIONALIZATION OF SWCNT THROUGH REDUCTION

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Covalent functionalization of carbon nanotubes (CNTs), either single or multi-walled, is used extensively to solubilize or disperse and therefore manipulate these exceptional materials. In addition, it is necessary to connect strongly nanotubes between them, for example to increase CNTs composites mechanical properties, or to give the nanotubes additional physical and/or optical properties, such as possible photo-induced electron transfer, through the grafting of functional groups. Both are of interest for the CNTs fibers developed in our laboratory.[1] Although many reported functionalization routes are known,[2] most involving highly reactive intermediates, the functionalized ratio is not controlled, while this latter point is fundamental for most applications using the extended π-system of CNTs.

To this aim, we focused on the reaction of various halogenated species with SWCNTs-alkali metals salts[3] with varying stoechiometries. Indeed, chemical analyses and XPS data of these salts show that the stoechiometry of alkali metal with respect to carbon can be varied and controled. Furthermore, spectroscopic, chemical and thermogravimetric analysis of the reaction products indicate functionalization has indeed taken place. TGA, photoelectron and Raman spectroscopy are corroborating each other and prove that the functionalization of the carbon nantubes follows the stoechiometry of the SWNTC-alkali metal salts. Additionnaly, an anomaly is reproducibly observed for a specific salt stoechiometry. We will discuss its origin.

The functionalization of CNTs through their reduction into salts represents a convenient way to control the functionalization ratio. Functionalized carbon nanotubes are soluble in different organic solvents. Application of these results to various functions and therefore various applications such as photo-voltaics can be envisionned.

Current projects and activities:

- PhD student under the direction of Alain Pénicaud and Olivier Roubeau : Functionalization of carbon nanotubes with organic dyes or inorganic complexes
- Member involved in the ANR project NATALI about the incorporation of carbon nanotubes into a liquid crystal

Figures:

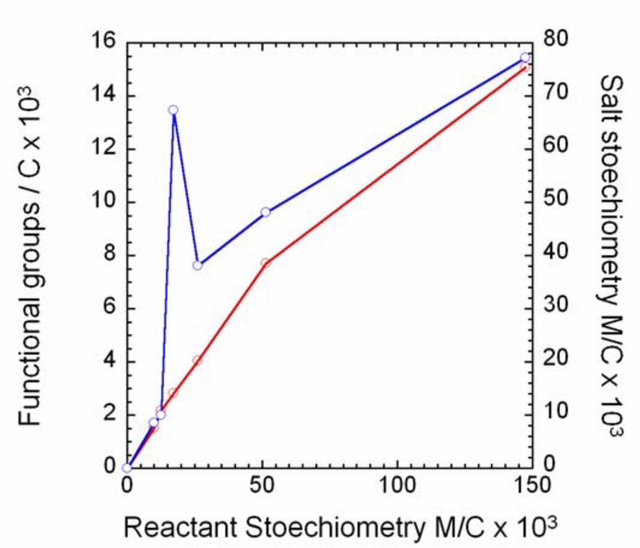

Figure 1. Number of functional groups vs. reactant stoechiometry. Blue: Functional groups of decylcarboxylic acid per 1000 carbons measured by TGA under Ar at 800ºC, Red : Salt stoechiometry measured by elemental analyses as function of the reactant stoechiometry M/C (x10^3)

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ADVANCES IN FOCUSED ION BEAM NANOPROTOTYPING

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The number of applications to which the advantages of having a tool that can directly pattern any kind of material presents unique benefits is growing at an increasing pace. Along with the diversity of use cases grow the demands for dedicated FIB patterning strategies [1] for larger and more complex patterns and techniques for different material systems. Figure 1 shows the combination of an interdigitated nanofluidic structure milled into glass with a FIB deposited metal line as an example for process automation for accurate pattern placement. We present examples of techniques that allow the application of FIB techniques to new material systems. New material systems do not only include materials that can be milled with good control, but also new gaseous precursors for beam induced deposition.

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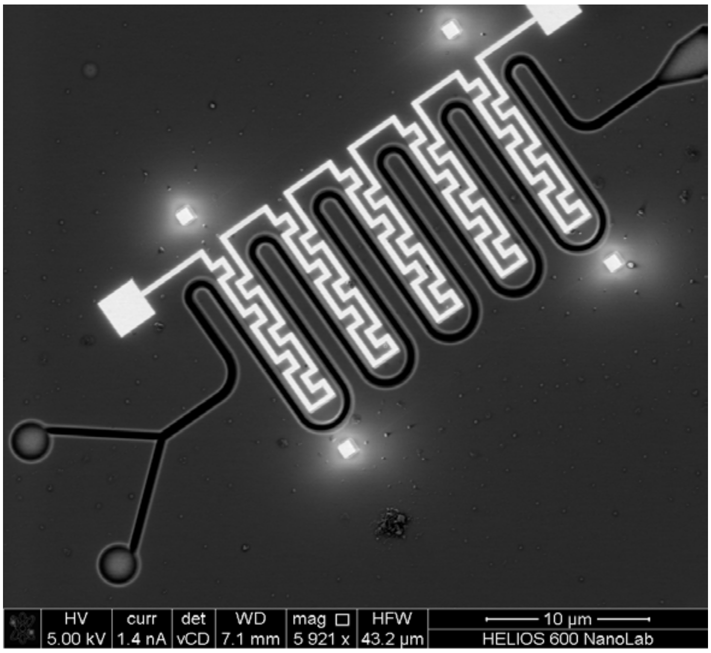

Figure 1. A nanofluidic device consisting of a FIB milled channel and a FIB deposited metal line.

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Garcia-Bordeje	Enrique	Spain	NanoChemistry	*Nanoingeneering the growth of a carbon nanofiber layer on micro-structured reactors*
García-Cámara	Braulio	Spain	Nanophotonics	*Directional effects in the scattering produced by nanosystems with double negative optical properties*
Gil	Marta	Spain	NanoMaterials	*CO2 adsorption by amine modified mesoporous silica materials: Synthesis optimization*
Golbang	Atefeh	Iran	NanoMaterials	*The Effect of Nanoclay Presence on Extensibility and Shape Recovery of Cross Linked Low Density Polyethylene Shape Memory Nanocomposite*
González	Mónica	Spain	NanoBiotechnology	*Optical detection of DNA hybridization on carbon nanotubes*
Gonzalez Dominguez	Jose Miguel	Spain	NanoMaterials	*Advanced trifunctional epoxy – swnts composite materials. preparation and characterization*
González-Díaz	Juan Bautista	Spain	Nanophotonics	*Magneto-Optical activity emerging from Plasmonic Gold Nanodisks*
Gracia Lostao	Ana Isabel	Spain	Scanning Probe Microscopies (SPM)	*Protein Immobilization Methods for Biological Atomic Force Microscopy*
Heredia-Guerrero	José Alejandro	Spain	Scanning Probe Microscopies (SPM)	*Self-Assembly and Self-Esterification of Plant Lipids on Mica Surface*
Herranz Cruz	Tirma	Spain	NanoMaterials	*In-situ spectroscopy of monodispersed cobalt nanoparticles during reduction and carbon monoxide hydrogenation*
Insausti	Maite	Spain	NanoMaterials	*Ag Nanoparticles Functionalized with Amines and Thiols: Structural and Magnetic Characterization*
Izquierdo	Irene	Spain	NanoMaterials	*Chemically-driven formation of silver nanoparticle dimers with tuned interparticle distance for SERS sensing applications*
Jiménez	Pablo	Spain	NanoMaterials	*Improved processing of polyaniline-carbon nanotube nanocomposites via water dispersions*
Jiménez Díaz	Román	Spain	NanoElectronics	*High Performance in Self-heated Single Nanowire Based Sensors*
Jos	Angeles	Spain	Nanotubes	*Oxidative stress induction in Caco-2 cells by single wall carbon nanotubes*
Juanola-Feliu	Esteve	Spain	Scientific Policy and Infrastructure	*Nanotechnology: pathways for economic challenges and scientific policies in Spain*
Jung de Andrade	Mônica	France	Nanotubes	*Highly electrical conductive Spark-Plasma Sintered CNTs-SiO2 nanocomposites*
Kehagias	Nikolaos	Spain	NanoMaterials	*Towards heterogeneous integration with functionalized nanoimprinted polymer surfaces*

Kirilov	Plamen	France	NanoMaterials	*Colloidal nanoparticles of gelled oil – elaboration process and characterization*
Kovylina	Miroslavna	Spain	Nanomagnetism	*Magnetoresistance in positive and negative exchange bias*
Kovylina	Miroslavna	Spain	Nanomagnetism	*Exchange bias in core/shell ferromagnetic/antiferromagentic Co/Co-O*
López Ramírez	María Rosa	Spain	NanoChemistry	*Nanostructured metallic substrates for micro-SERS biological applications*
López-Bosque	María Jesús	Spain	NanoBiotechnology	*Surface characterization techniques at the micro/nano scale: a complete set of tools at Parc Científic de Barcelona*
Luis	Fernando	Spain	Nanomagnetism	*Magnetic aging of self-organized arrays of Co nanoparticles:*
Magen	Cesar	Spain	Nanomagnetism	*Z-contrast STEM imaging of B cation ordering and microstructure*
Marcano Aguado	Noelia	Spain	Nanomagnetism	*Transport properties of individual Bi nanowires contacted by Dual Beam*
Marco Sanz	Jose Francisco	Spain	Nanomagnetism	*Effect of the nature and the particle size on the properties of uniform magnetite and maghemite nanoparticles*
Marquina	Clara	Spain	NanoMaterials	*Fe3O4 Nanoparticles for Biomedical Applications.*
Martín Fernandez	Iñigo	Spain	Nanotubes	*Carbon nanotube integration for bio-sensing applications*
Martín Gil	Jesús	Spain	NanoElectronics	*Use of Red-Emitting OLEDs for Illumination of Plants Growing in the Greenhouse*
Martínez Morillas	Rocio	Spain	NanoMaterials	*Size controlled deposition of partially oxidized Fe and Ti nano-clusters by a high vacuum sputtering gas aggregation technique.*
Martínez Morlanes	Maria José	Spain	NanoMaterials	*Influence of gamma irradiation on carbon nanotube/reinforced ultra high molecular weight polyethylene*
Martinez Perez	Maria Jose	Spain	Nanomagnetism	*Ultrasensitive microsusceptometer for magnetic AC measurements at very low temperatures and high frequencies*
Martín-Rodríguez	Rosa	Spain	NanoMaterials	*Synthesis, characterization and optical properties of luminescent nanocrystals*
Megson	Zoë	Spain	NanoBiotechnology	*Combined methods in maximizing DNA loading on to gold Nanoparticles*
Mehdipour-Ataei	Shahram	Iran	NanoChemistry	*Nanoporous Silane-Containing Polyimides Films with Low-dielectric Constant and High Heat-resistant*
Mercader	Celia	France	Nanotubes	*Millifluidic characterizations for the production of macroscopic super tough nanotube fibers*
Merino	Santos	Spain	NanoBiotechnology	*Protein patterning on the micro and nanoscale by thermal nanoimprint lithography on a new functionalized copolymer*
Mesa	Mª Cristina	Spain	NanoMaterials	*Nanofibrilar Al2O3-ZrO2-Er3Al5O12 eutectics processed by the laser floating zone method*
Miguel Sancho	Nuria	Spain	NanoBiotechnology	*Production of dispersions formed by isolated magnetic nanoparticles for biomedical applications*
Mihail	Elisa	Romania	NanoMaterials	*Infrared and Raman spectroscopy investigations on SiO2-P2O5 sol gel powders*
Mokhtari	Mozaffar	Iran	NanoMaterials	*The Effect of Epoxidized Natural Rubber (ENR) on the Morphology and Curing Characteristics of Natural Rubber / Organoclay Nanocomposite Systems*

Montemayor	Sagrario M.	Mexico	NanoMaterials	*CoFe2O4 nanoparticles: ball milling (assisted by NaOH) vs. polymerized complex*
Moreno	Fernando	Spain	Nanophotonics	*Polar Decomposition and Interference Model Applied to Metallic Nanospheres*
Moros	Maria	Spain	NanoBiotechnology	*Protein-carbohydrate interaction studies by means of superparamagnetic nanoparticles clustering*
Muñoz	Edgar	Spain	Nanotubes	*Carbon Nanotube/β--Cross Sheet Peptide Dispersions and Assemblies: Preparation, Characterization, and Potential Biosensor Applications*
Neves	Cristina	Portugal	NanoChemistry	*Synthesis and Characterisation of ZnO-Au Bifunctional Nanocomposites*
Nieto Carvajal	Inés	Spain	Scanning Probe Microscopies (SPM)	*Precise measurement of electrostatic tip-sample interaction using 3D-SFM mode*
Orna Esteban	Julia Maria	Spain	Nanomagnetism	*Epitaxial growth of Fe3O4 Thin Films and Fe3O4/MgO/Fe heteroepitaxial structures for magnetic tunnel junctions*
Otero Leal	Marta	Spain	Scientific Policy and Infrastructure	*Nanogal: Galician Technological Platform on Nanotechnology.*
Pellejero Alcázar	Ismael	Spain	NEMS / MEMS	*Mechanical Properties Study of Silicalite Microcantilevers*
Penedo Garcia	Marcos	Spain	Scanning Probe Microscopies (SPM)	*Magnetostrictive drive of AFM cantilevers for liquid operation*
Peña	Luis	Spain	Nanomagnetism	*Assembling Monolayers of Magnetic Nanoparticle onto Technological Substrates*
Pereira	Eulalia	Portugal	NanoMaterials	*Influence of the concentration of CTAB and photocatalyst on the size of Au nanotriangles synthesized by a photocatalytic method*
Perez Murano	Francesc	Spain	NEMS / MEMS	*Nanomechanical Mass Sensor for Spatially Resolved Ultrasensitive Monitoring of Deposition Rates in Stencil Lithography*
Pescatori	Luca	Italy	NanoChemistry	*Synthesis and Characterization of Multipodand Calix[4]arene-protected Gold Nanoparticles*
Peymani	Payam	Iran	NanoBiotechnology	*Pharmaceutical Characterization of (P53) Gene-loaded chitosan Nanoparticles*
Pingarrón	José Manuel	Spain	NanoChemistry	*Gold nanoparticles - structured electrochemical biosensors for applications in the food industry*
Polo	Ester	Spain	NanoBiotechnology	*Gold Nanoparticles funcionalized with antibodies: Studying the stoichiometry between antibodies and particles.*
Postigo	Pablo Aitor	Spain	Nanophotonics	*Ultra high quality factor on photonic crystal microcavities and lattices: a path for ultra low threshold lasing and observation of cavity-mediated strong coupling*
Pozo	David	Spain	NanoBiotechnology	*Chemical synthesis and functional characterization of vasoactive intestinal peptide (VIP) silver-protected nanoparticles*
Pozo	David	Spain	NanoBiotechnology	*The immune response induced by Toll-like receptor ligands is differentially regulated by tiopronin monolayer-protected silver nanoparticles*
Primc	Darinka	Slovenia	NanoMaterials	*Hydrothermal synthesis of ultrafine particles of hexagonal ferrites (BaFe12O19, SrFe12O19) and the preparation of their stable suspensions.*
Puertas	Sara	Spain	NanoBiotechnology	*Functionalization of Magnetic Nanoparticles with Antibodies: Does the Antibody Orientation Matter?*

Quaresma	Pedro	Portugal	NanoChemistry	*Deposition of gold nuclei on magnetite nanoparticles and growth to a core-shell system.*
Rahimi	Rahmatollah	Iran	NanoChemistry	*Preparation and Optical Properties of Porphyrin Nanoparticles using Microwave Method*
Reboud	Vincent	Spain	Nanophotonics	*Two and three dimensional polymer devices by means of Nanoimprint Lithography*
Renvez	Guillaume	France	NanoBiotechnology	*Prediction of Biomolecular Induced-fit Flexibility Through Static Modes*
Rodríguez García	Josefa María	Spain	NanoMaterials	*Magnetic coupling between antiferromagnetic and a ferromagnetic material studied by means of spin-polarized scanning tunneling microscopy*
Román Falcó	Iván Pablo	Spain	NanoChemistry	*Analysis of UV-Filters in water samples by Solid Phase MicroExtraction with Coated-Magnetic Nanoparticles*
Rosario Amorin	Daniel	France	NanoMaterials	*Recycling of metallodendritic catalysts by their grafting onto superparamagnetic nanoparticles*
Ruano	Cristina	Spain	Nanotubes	*Charge transfer effects on (zig-zag) single-walled boron nitride nanotubes (SWBNNTs)*
Rubín	Javier	Spain	Nanomagnetism	*CEMS study of the substrate temperature dependence of the magnetization in nanostructured oxidized iron films.*
Rubio	Marta	Spain	NanoMaterials	*Metal-organic spheres as new functional micro- and nanomaterials for encapsulation*
Ruiz	Carlos	Spain	NanoMaterials	*Thin Film Deposition Study of C60 on Silicon Wafers by Spin Casting*
Saint-Aubin	Karell	France	NanoMaterials	*Stabilization of carbon nanotubes by polyelectrolytes*
Saiz-Poseu	Javier	Spain	Scanning Probe Microscopies (SPM)	*Self-assembly of 4-heptadecylcatechol: thermal symmetry breaking*
Salado	Javier	Spain	NanoMaterials	*Superparamagnetic behaviour of water soluble Fe3O4@Au nanoparticles*
Sánchez Navarro	Magdalena	Spain	NanoMaterials	*New anticounterfeiting system for adhesives*
Sangiao	Soraya	Spain	Nanomagnetism	*Anomalous Hall effect in Fe(001) epitaxial thin films over a wide range of conductivity*
Santos	Benito	Spain	NanoMaterials	*Hydrogen Incorporation Into Palladium Ultra-Thin-Films By Low Energy Electron Microscopy*
Schnell	Martin	Spain	Nanophotonics	*Control of local near fields in optical antennas by load engineering: bridging the gap*
Sebastian Cabeza	Victor	Spain	NanoMaterials	*Zeolite films as catalytic coating on micro-reactors for SELOX reaction*
Sebastian del Rio	David	Spain	NanoMaterials	*Advantageous use of carbon nanofibers in fuel cells as catalyst support*
Secchi	Andrea	Italy	NanoChemistry	*Self-Assembled Monolayers of Calix[n]arene (n=4,6) derivatives on Si(100) and Polycrystalline Copper*
Seral-Ascaso	Andrés	Spain	NanoMaterials	*Laser Ablation Production of Metal-doped Nanostructured Carbon Foam*
Setién	Beatriz	Spain	Nanophotonics	*Linear polarization degree of right-angle scattering for silver nanodimmers: changes induced by quadrupolar excitation.*
Silva	Jaime	Portugal	Simulation at the Nanoscale	*Carbon nanotube networks dispersed in a polymer matrix: dielectric properties simulations and experiments*
Simonet	Bartolomé	Spain	NanoChemistry	*Analytical potential of the carbon nanoparticles-ionic liquid combination*
Skatkov	Leonid	Israel	NanoMaterials	*Intracrystalline Pore Formation in Nanocrystal Metal Films*

Soares	Leonor	Portugal	NanoChemistry	*Stable Ag and Au Nanospheres Synthesized by Porphyrin-Assisted Photocatalysis*
Sotomayor Torres	Clivia M	Spain	NanoMaterials	*Quantifying ordering in self-assembly of colloidal crystals: towards nanometrology*
Sousa	Nuno	Portugal	Nanomagnetism	*Theoretical study of magnetodynamics in BCC iron nanoparticles*
Sousa	Célia	Portugal	NanoBiotechnology	*Ordered Assembly of Oxide Nanotubes in Porous Alumina Membranes for Biomedical Applications*
Stiegler	Johannes	Spain	Nanophotonics	*Nanoscale infrared near-field mapping of free-carrier concentration in single semiconductor nanowires*
Synak	Anna	Spain	NanoMaterials	*Fast to Ultrafast Dynamics of Palladium Phthalocyanine Covalently Bound to MCM-41 Mesoporous Material*
Tellechea	Edurne	Spain	NanoBiotechnology	*Over-expression of recombinant proteins by a self-induction method for nanotechnology applications*
Torres	Teobaldo	Spain	NanoBiotechnology	*Biodistribution of magnetic core-shell nanoparticles used as MRI contrast agents*
Trabadelo	Vera	Spain	NanoBiotechnology	*Protein patterning by thermal nanoimprint lithography and NH3-plasma functionalization of polystyrene*
Trelka	Marta	Spain	Scanning Probe Microscopies (SPM)	*Epitaxial Growth of Organic Nanocrystals on Surfaces*
Urban	Christian	Spain	NanoChemistry	*The formation of functionalized surfaces: The adsorption of oxalic acid onto Cu(111) and Cu(100)*
Urbiztondo Castro	Miguel	Spain	NEMS / MEMS	*Sensing of an explosive precursor with zeolite-modified cantilevers*
Valcárcel Cases	Miguel	Spain	NanoChemistry	*Ag-coated CdSe/ZnS quantum dots: optical properties and analytical potential*
Varón	Miriam	Spain	NanoMaterials	*Exploring the Length of Gold Nanorods*
Vázquez	Ester	Spain	Nanotubes	*Efficient Functionalization of Carbon Nanohorns via Microwave Irradiation*
Voiry	Damien	France	Nanotubes	*Control of covalent functionalization of SWCNT through reduction*
Yagüe	Clara	Spain	NanoBiotechnology	*Synthesis and characterization of SiO2@Au core-shell nanoparticles for biomedical applications*

Poster Session (159)

Presenting Author		Country	Poster Title
TOPIC: NanoBiotechnology / Nanomedicine			
Afifi	Saba	Iran	*Preparation and Evaluation of Alginate-Methotrexate Microspheres*
Asin Pardo	Laura	Spain	*Dendritic cell uptake of magnetic nanoparticles for magnetic hyperthermia*
Carmona	Daniel	Spain	*Nanostructured Large-pore Silica Nanomaterials for Drug Release*
Chevalier	Sebastien	France	*Do all cadherins bind through the same adhesive interface?*
Cuestas	Carlos	Spain	*Bio-surface engineering for cell adhesion studies*
de Miguel	Rocío	Spain	*Synthesis and Characterization of Ferritin Dimers: a New Approach Towards Multifunctional Materials*
del Barrio	Melisa	Spain	*Immobilization of labeled glucose oxidase to magnetic nanoparticles for development of a glucose nanobiosensor*
Dementieva	Olga	Russia	*Silver nanoshells: Synthesis, Plasmonic Properties and Prospects in Cancer Therapy*
Doria	Gonçalo	Portugal	*Au-nanoprobe optimization for SNP detection at room temperature by non-cross-linking aggregation*
Douas	Maysoun	Spain	*MC simulation of water meniscus in nanocontainers: explaining the collapse of viral particles due to capillar forces.*
Franco	Ricardo	Portugal	*pH-Switched Adsorption of Cytochrome c to Self-Assembled Monolayers on Gold Surfaces and Nanoparticles*
González	Mónica	Spain	*Optical detection of DNA hybridization on carbon nanotubes*
López-Bosque	María Jesús	Spain	*Surface characterization techniques at the micro/nano scale: a complete set of tools at Parc Científic de Barcelona*
Megson	Zoë	Spain	*Combined methods in maximizing DNA loading on to gold Nanoparticles*
Merino	Santos	Spain	*Protein patterning on the micro and nanoscale by thermal nanoimprint lithography on a new functionalized copolymer*
Miguel Sancho	Nuria	Spain	*Production of dispersions formed by isolated magnetic nanoparticles for biomedical applications*
Moros	Maria	Spain	*Protein-carbohydrate interaction studies by means of superparamagnetic nanoparticles clustering*
Peymani	Payam	Iran	*Pharmaceutical Characterization of (P53) Gene-loaded chitosan Nanoparticles*
Polo	Ester	Spain	*Gold Nanoparticles funcionalized with antibodies: Studying the stoichiometry between antibodies and particles.*
Pozo	David	Spain	*Chemical synthesis and functional characterization of vasoactive intestinal peptide (VIP) silver-protected nanoparticles*
Pozo	David	Spain	*The immune response induced by Toll-like receptor ligands is differentially regulated by tiopronin monolayer-protected silver nanoparticles*
Puertas	Sara	Spain	*Functionalization of Magnetic Nanoparticles with Antibodies: Does the Antibody Orientation Matter?*
Renvez	Guillaume	France	*Prediction of Biomolecular Induced-fit Flexibility Through Static Modes*
Sousa	Célia	Portugal	*Ordered Assembly of Oxide Nanotubes in Porous Alumina Membranes for Biomedical Applications*
Tellechea	Edurne	Spain	*Over-expression of recombinant proteins by a self-induction method for nanotechnology applications*
Torres	Teobaldo	Spain	*Biodistribution of magnetic core-shell nanoparticles used as MRI contrast agents*

Trabadelo	Vera	Spain	*Protein patterning by thermal nanoimprint lithography and NH3-plasma functionalization of polystyrene*
Yagüe	Clara	Spain	*Synthesis and characterization of SiO2@Au core-shell nanoparticles for biomedical applications*

TOPIC: NanoChemistry			
Aran Ais	Francisca	Spain	*Synthesis of nanocapsules containing almond oil by miniemulsion polymerization*
Bonel	Laura	Spain	*An electrochemical nanostructured aptamer biosensor-based sandwich assay for detection of c reactive protein (CRP) and ochratoxine a (OTA)*
Cavaliere-Jaricot	Sara	France	*Ultrathin hematite and goethite-hematite core-shell nanorods and composite nanowires by electrospinning*
Conesa	Jose Carlos	Spain	*DFT modeling of CuO catalyst nanoparticles*
Cornejo	Alfonso	France	*Silica coating of FeCo magnetic nanoparticles in non-alcoholic media*
Cros	Arnaud	France	*InP/MS core/shell nanocrystals (M = Zn, Cd) : synthesis, surface chemistry and luminescence*
Duato	Patricia	Spain	*Amperometric Inmunosensors for Ochratoxin A (OTA) based on Screen Printed Electrodes (SPCEs) Nanostructured with Gold Nanoparticles*
Elsaeed	Shimaa M.	Egypt	*Synthesis and Characterization of Crosslinked (NIPA-co-AAc) Copolymer as a Thermoresponsive Nanohydrogel*
Escuin Melero	Miguel	Spain	*Pt-ZY and Pt-ZSM-5 as potential catalysts for VOCs elimination in a microchannel reactor*
Fernández-González	Alfonso	Spain	*Immobilization of a laser-dye on gold nanoparticles. Analytical applications.*
Fernández-González	Alfonso	Spain	*Formation of ternary nano-complex gold nanoparticles-copper ions-histamine*
Garcia-Bordeje	Enrique	Spain	*Nanoingeneering the growth of a carbon nanofiber layer on micro-structured reactors*
López Ramírez	María Rosa	Spain	*Nanostructured metallic substrates for micro-SERS biological applications*
Mehdipour-Ataei	Shahram	Iran	*Nanoporous Silane-Containing Polyimides Films with Low-dielectric Constant and High Heat-resistant*
Neves	Cristina	Portugal	*Synthesis and Characterisation of ZnO-Au Bifunctional Nanocomposites*
Pescatori	Luca	Italy	*Synthesis and Characterization of Multipodand Calix[4]arene-protected Gold Nanoparticles*
Pingarrón	José Manuel	Spain	*Gold nanoparticles - structured electrochemical biosensors for applications in the food industry*
Quaresma	Pedro	Portugal	*Deposition of gold nuclei on magnetite nanoparticles and growth to a core-shell system.*
Rahimi	Rahmatollah	Iran	*Preparation and Optical Properties of Porphyrin Nanoparticles using Microwave Method*
Román Falcó	Iván Pablo	Spain	*Analysis of UV-Filters in water samples by Solid Phase MicroExtraction with Coated-Magnetic Nanoparticles*
Secchi	Andrea	Italy	*Self-Assembled Monolayers of Calix[n]arene (n=4,6) derivatives on Si(100) and Polycrystalline Copper*
Simonet	Bartolomé	Spain	*Analytical potential of the carbon nanoparticles-ionic liquid combination*
Soares	Leonor	Portugal	*Stable Ag and Au Nanospheres Synthesized by Porphyrin-Assisted Photocatalysis*
Urban	Christian	Spain	*The formation of functionalized surfaces: The adsorption of oxalic acid onto Cu(111) and Cu(100)*
Valcárcel Cases	Miguel	Spain	*Ag-coated CdSe/ZnS quantum dots: optical properties and analytical potential*

TOPIC: NanoElectronics / Molecular Electronics			
Abdollahvand	Somayeh	Iran	*Efficient MVL Circuit Design with Use of p-CNTFETs and n-CNTFETs*
Andrzejewska	Ewelina	Spain	*Characterization of organic/organic/substrate interfaces of thin p-n heterostructures*
Estévez Nuño	Virginia	Spain	*Spin accumulation, current oscillations and negative differential in transport through nanoparticle arrays*
Jiménez Díaz	Román	Spain	*High Performance in Self-heated Single Nanowire Based Sensors*
Martín Gil	Jesús	Spain	*Use of Red-Emitting OLEDs for Illumination of Plants Growing in the Greenhouse*

TOPIC: Nanomagnetism			
Alija	Alejandro	Spain	*Vortex dynamics and vortex lattice reconfiguration in superconducting-magnetic hybrids.*
Balas	Francisco	Spain	*X-ray absorption spectroscopy for characterizing iron oxide nanoparticles*
Blanco-Gutierrez	Veronica	Spain	*Synthesis and magnetic propreties of CoFe2O4 spinel with nanometric size*
Chamarro	Maria	France	*Spin of hole: a new paradigm in quantum computation ?*
Fernandez	Ivan	Spain	*Magnetostrictive drive of AFM cantilevers for liquid operation*
Fernández Barquín	Luis	Spain	*Critical slowing down of the spin relaxation in nanoclustered Fe-Al-B alloys*
Fernández-Pacheco	Amalio	Spain	*Magnetic properties of Cobalt nanodeposits created by Focused Electron Beam Induced Deposition*
Garcia	Ignacio	Spain	*Double Shell FeNi Nanoparticles*
García	Alberto	Spain	*Structural, magnetic and magnetotransport characterization of Fe/MgO granular multilayers*
Kovylina	Miroslavna	Spain	*Magnetoresistance in positive and negative exchange bias*
Kovylina	Miroslavna	Spain	*Exchange bias in core/shell ferromagnetic/antiferromagentic Co/Co-O*
Luis	Fernando	Spain	*Magnetic aging of self-organized arrays of Co nanoparticles:*
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Marco Sanz	Jose Francisco	Spain	*Effect of the nature and the particle size on the properties of uniform magnetite and maghemite nanoparticles*
Martinez Perez	Maria Jose	Spain	*Ultrasensitive microsusceptometer for magnetic AC measurements at very low temperatures and high frequencies*
Orna Esteban	Julia Maria	Spain	*Epitaxial growth of Fe3O4 Thin Films and Fe3O4/MgO/Fe heteroepitaxial structures for magnetic tunnel junctions*
Peña	Luis	Spain	*Assembling Monolayers of Magnetic Nanoparticle onto Technological Substrates*
Rubín	Javier	Spain	*CEMS study of the substrate temperature dependence of the magnetization in nanostructured oxidized iron films.*
Sangiao	Soraya	Spain	*Anomalous Hall effect in Fe(001) epitaxial thin films over a wide range of conductivity*
Sousa	Nuno	Portugal	*Theoretical study of magnetodynamics in BCC iron nanoparticles*

TOPIC: NanoMaterials			
Alvarez	Lucia	Spain	*Metalorganic nanostructures: 2d- extended structures*
Alvarez Mateo	Ruben	Spain	*Characterization of self-assembled nanostructures exhibited by model recombinant Elastin-like polymer E50A40.*
Amirshaghaghi	Ahmad	Iran	*The Production Mechanism of* Al_2O_3*-*ZrO_2 *Nanopowder Via Metal-Containing Polymer Precursors*
Apolinário	Arlete	Portugal	*Ferromagnetic resonance study of Fe/FePt coupled films with perpendicular anisotropy*
Araujo	Ana Claudia	Brazil	*AC electrical properties characterization of Polyaniline-*Fe_3O_4 *nanocomposite*
Barbadillo	Marta	Spain	*Gold nanoparticles-induced enhancement of the analytical response of an electrochemical biosensor based on a new organic-inorganic hybrid composite material*
Batista	Carlos	Portugal	*Structure, morphology and optical properties of* $V_xMo_{1-x}O_2$ *thermochromic coatings synthesized by DC reactive magnetron sputtering*
Campelj	Stanislav	Slovenia	*The aggregation of superparamagnetic particles in a ferrofluid*
Casals	Eudald	Spain	*Nanotoxicology: Exploring New Paradigms in Toxicology*
Cerny	Frantisek	Czech Republic	*Preparation and Properties of Nanostructured Hydrogenated Carbon Thin Films*
Córdoba	Rosa	Spain	*Focused-Electron/Ion-Beam-Induced nanodeposits studied with Transmission Electron Microscopy*
Gil	Marta	Spain	CO_2 *adsorption by amine modified mesoporous silica materials: Synthesis optimization*
Golbang	Atefeh	Iran	*The Effect of Nanoclay Presence on Extensibility and Shape Recovery of Cross Linked Low Density Polyethylene Shape Memory Nanocomposite*
Gonzalez Dominguez	Jose Miguel	Spain	*Advanced trifunctional epoxy – swnts composite materials. preparation and characterization*
Herranz Cruz	Tirma	Spain	*In-situ spectroscopy of monodispersed cobalt nanoparticles during reduction and carbon monoxide hydrogenation*
Insausti	Maite	Spain	*Ag Nanoparticles Functionalized with Amines and Thiols: Structural and Magnetic Characterization*
Izquierdo	Irene	Spain	*Chemically-driven formation of silver nanoparticle dimers with tuned interparticle distance for SERS sensing applications*
Jiménez	Pablo	Spain	*Improved processing of polyaniline-carbon nanotube nanocomposites via water dispersions*
Kehagias	Nikolaos	Spain	*Towards heterogeneous integration with functionalized nanoimprinted polymer surfaces*
Kirilov	Plamen	France	*Colloidal nanoparticles of gelled oil – elaboration process and characterization*
Marquina	Clara	Spain	Fe_3O_4 *Nanoparticles for Biomedical Applications.*
Martínez Morillas	Rocio	Spain	*Size controlled deposition of partially oxidized Fe and Ti nano-clusters by a high vacuum sputtering gas aggregation technique.*
Martínez Morlanes	Maria José	Spain	*Influence of gamma irradiation on carbon nanotube/reinforced ultra high molecular weight polyethylene*
Martín-Rodríguez	Rosa	Spain	*Synthesis, characterization and optical properties of luminescent nanocrystals*
Mesa	Mª Cristina	Spain	*Nanofibrilar* Al_2O_3*-*ZrO_2*-*$Er_3Al_5O_{12}$ *eutectics processed by the laser floating zone method*
Mihail	Elisa	Romania	*Infrared and Raman spectroscopy investigations on* SiO_2*-*P_2O_5 *sol gel powders*

Mokhtari	Mozaffar	Iran	*The Effect of Epoxidized Natural Rubber (ENR) on the Morphology and Curing Characteristics of Natural Rubber / Organoclay Nanocomposite Systems*
Montemayor	Sagrario M.	Mexico	*CoFe2O4 nanoparticles: ball milling (assisted by NaOH) vs. polymerized complex*
Pereira	Eulalia	Portugal	*Influence of the concentration of CTAB and photocatalyst on the size of Au nanotriangles synthesized by a photocatalytic method*
Primc	Darinka	Slovenia	*Hydrothermal synthesis of ultrafine particles of hexagonal ferrites (BaFe12O19, SrFe12O19) and the preparation of their stable suspensions.*
Rodríguez García	Josefa María	Spain	*Magnetic coupling between antiferromagnetic and a ferromagnetic material studied by means of spin-polarized scanning tunneling microscopy*
Rosario Amorin	Daniel	France	*Recycling of metallodendritic catalysts by their grafting onto superparamagnetic nanoparticles*
Rubio	Marta	Spain	*Metal-organic spheres as new functional micro- and nanomaterials for encapsulation*
Ruiz	Carlos	Spain	*Thin Film Deposition Study of C60 on Silicon Wafers by Spin Casting*
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Sánchez Navarro	Magdalena	Spain	*New anticounterfeiting system for adhesives*
Santos	Benito	Spain	*Hydrogen Incorporation Into Palladium Ultra-Thin-Films By Low Energy Electron Microscopy*
Sebastian Cabeza	Victor	Spain	*Zeolite films as catalytic coating on micro-reactors for SELOX reaction*
Sebastian del Rio	David	Spain	*Advantageous use of carbon nanofibers in fuel cells as catalyst support*
Seral-Ascaso	Andrés	Spain	*Laser Ablation Production of Metal-doped Nanostructured Carbon Foam*
Skatkov	Leonid	Israel	*Intracrystalline Pore Formation in Nanocrystal Metal Films*
Sotomayor Torres	Clivia M	Spain	*Quantifying ordering in self-assembly of colloidal crystals: towards nanometrology*
Synak	Anna	Spain	*Fast to Ultrafast Dynamics of Palladium Phthalocyanine Covalently Bound to MCM-41 Mesoporous Material*
Varón	Miriam	Spain	*Exploring the Length of Gold Nanorods*

TOPIC: Nanophotonics

García-Cámara	Braulio	Spain	*Directional effects in the scattering produced by nanosystems with double negative optical properties*
González-Díaz	Juan Bautista	Spain	*Magneto-Optical activity emerging from Plasmonic Gold Nanodisks*
Moreno	Fernando	Spain	*Polar Decomposition and Interference Model Applied to Metallic Nanospheres*
Postigo	Pablo Aitor	Spain	*Ultra high quality factor on photonic crystal microcavities and lattices: a path for ultra low threshold lasing and observation of cavity-mediated strong coupling*
Reboud	Vincent	Spain	*Two and three dimensional polymer devices by means of Nanoimprint Lithography*
Schnell	Martin	Spain	*Control of local near fields in optical antennas by load engineering: bridging the gap*
Setién	Beatriz	Spain	*Linear polarization degree of right-angle scattering for silver nanodimmers: changes induced by quadrupolar excitation.*

Stiegler	Johannes	Spain	*Nanoscale infrared near-field mapping of free-carrier concentration in single semiconductor nanowires*

TOPIC: Nanotubes

Assali	Mohyeddin	Spain	*Non-covalent functionalization of carbon nanotubes with glycolipids: glyconanomaterials with specific lectin-affinity*
Cano	Manuela	Spain	*Pd Nanoparticles Deposited in Multiwalled Carbon Nanotubes as Catalysts for C-C Coupling Reactions*
Jos	Angeles	Spain	*Oxidative stress induction in Caco-2 cells by single wall carbon nanotubes*
Jung de Andrade	Mônica	France	*Highly electrical conductive Spark-Plasma Sintered CNTs-SiO2 nanocomposites*
Martín Fernandez	Iñigo	Spain	*Carbon nanotube integration for bio-sensing applications*
Mercader	Celia	France	*Millifluidic characterizations for the production of macroscopic super tough nanotube fibers*
Muñoz	Edgar	Spain	*Carbon Nanotube/β--Cross Sheet Peptide Dispersions and Assemblies: Preparation, Characterization, and Potential Biosensor Applications*
Ruano	Cristina	Spain	*Charge transfer effects on (zig-zag) single-walled boron nitride nanotubes (SWBNNTs)*
Vázquez	Ester	Spain	*Efficient Functionalization of Carbon Nanohorns via Microwave Irradiation*
Voiry	Damien	France	*Control of covalent functionalization of SWCNT through reduction*

TOPIC: NEMS / MEMS

Pellejero Alcázar	Ismael	Spain	*Mechanical Properties Study of Silicalite Microcantilevers*
Perez Murano	Francesc	Spain	*Nanomechanical Mass Sensor for Spatially Resolved Ultrasensitive Monitoring of Deposition Rates in Stencil Lithography*
Urbiztondo Castro	Miguel	Spain	*Sensing of an explosive precursor with zeolite-modified cantilevers*

TOPIC: Scanning Probe Microscopies (SPM)

Eaton	Peter	Portugal	*Magnetic Force Microscopy of Mixed Systems: Does It Work?*
Gracia Lostao	Ana Isabel	Spain	*Protein Immobilization Methods for Biological Atomic Force Microscopy*
Heredia-Guerrero	José Alejandro	Spain	*Self-Assembly and Self-Esterification of Plant Lipids on Mica Surface*
Nieto Carvajal	Inés	Spain	*Precise measurement of electrostatic tip-sample interaction using 3D-SFM mode*
Penedo Garcia	Marcos	Spain	*Magnetostrictive drive of AFM cantilevers for liquid operation*
Saiz-Poseu	Javier	Spain	*Self-assembly of 4-heptadecylcatechol: thermal symmetry breaking*
Trelka	Marta	Spain	*Epitaxial Growth of Organic Nanocrystals on Surfaces*

TOPIC: Simulation at the Nanoscale

Albareda	Guillem	Spain	*A Novel Approach for Many-electron transport in Nanoelectronic Devices with full Coulomb Interaction*

Alburqueque de Assis	Thiago	Spain	*Nanoscale Irregularity Effects in the Field Emission of Metal Surfaces.*
Benjalal	Youness	Morocco	*STM manipulation of molecular moulds on metal surfaces*
Bordat	Patrice	France	*Nano-confinement of water in silicalite and AlPO4-5 zeolites: Investigation of the structure and the dynamics by molecular modelling*
Silva	Jaime	Portugal	*Carbon nanotube networks dispersed in a polymer matrix: dielectric properties simulations and experiments*

TOPIC: Other			
Juanola-Feliu	Esteve	Spain	*Nanotechnology: pathways for economic challenges and scientific policies in Spain*
Otero Leal	Marta	Spain	*Nanogal: Galician Technological Platform on Nanotechnology.*

Figure: Pt-Mordenite layer in a MSR.

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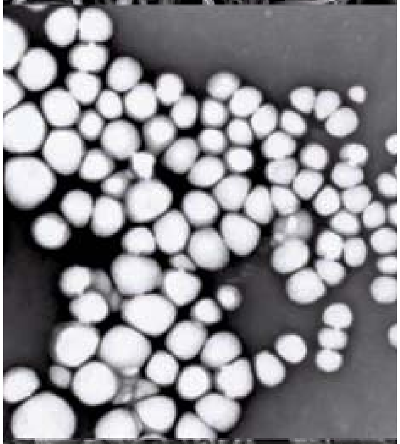

Figure: SEM micrograph of gelled nanoparticle aqueous dispersions.

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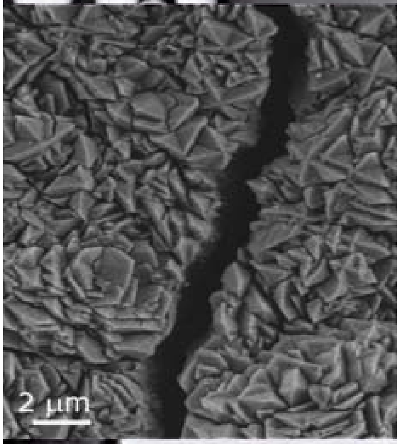

Figure: Pt-ZeoliteY layer in MSR.

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Figure: TEM micrograph of gold beaded nanochains contained within polymer vesicles of gold-ELP hybrid.

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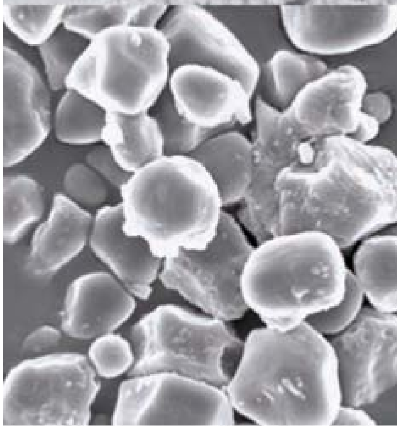

Figure: Unprocessed ibuprofen.

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