2nd NanoSpain Workshop

Barcelona (Spain) - March 14-17, 2005

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On behalf of the Advisory and the Technical Committees, we take great pleasure in welcoming you to Barcelona for the second meeting of the Spanish Nanotechnology Network NanoSpain.

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.

The five year-old NanoSpain network aims to agglutinate and coordinate the efforts made in the field of the Nanotechnology by Spanish groups from universities, research institutes and companies. Moreover, this network has tried to help the government institutions in defining potential actions and plans referring to this area. Currently the NanoSpain network, comprising 150 Spanish groups with near 1000 researchers in total, is one of the widest Spanish scientific networks.

As a direct and most effective way to enhance the interaction between our network members, a first network meeting was organised in San Sebastian (2004) with around 210 participants registered. Due to this success, the network decided organising its second meeting in Barcelona (March 14-17, 2005) with a similar format.
Its objective will be to facilitate the dissemination of knowledge and promot interdisciplinary discussions among the different NanoSpain groups. 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. Advanced Nanofabrication Methods
2. NanoBiotechnology
3. NanoMaterials
4. NanoChemistry
5. NanoElectronics / Molecular Electronics
6. Scanning Probe Microscopies (SPM)
7. Scientific infrastructures and Scientific Parks
8. Simulation at the nanoscale

Working Groups (WG) will also be organised to enhance information flow between network partners 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 WG will be organised:
1. Molecular Electronics *(Coordinators: Julio Gómez & Pablo Ordejon)*
2. NanoBiotechnology *(Coordinator: Josep Samitier)*
3. NanoFabrication *(Coordinators: Francesc Perez-Murano & Fernando Briones)*

Another objective of this meeting will be to permit considering the situation of Nanotechnology in our country, as well as in reaching conclusions concerning the future of the NanoSpain network, in order to guarantee its continuity by means of concrete proposals and a renovation of its structures.

In addition, thanks must be directed to the staff of all the organising institutions whose hard work has helped the smooth organisation and planning of this conference and in particular to Prof. Pedro Serena (ICMM-CSIC) for all the support provided during these last five years.

THE ORGANISING COMMITTEE

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José Luis Roldán	Fundación PHANTOMS

Invited Speakers

Last Name	Name	Organisation	Country
Antonietti	Markus	Max Planck Institute of Colloids and Interfaces	Germany
New Approaches to oxidic nanoparticles and functional mesoporous crystalline layers			
Bennink	Martin	MESA+ Institute for Nanotechnology	Netherlands-
Unraveling molecular details of chromatin structure using atomic force microscopy and optical tweezers			
Hofmann	Heinrich	EPFL	Switzerland
Nanoparticles for biomedical applications			
Montelius	Lars	University of Lund	Sweden
Nanoimprint lithography: technology, prospects and some applications			
Salmeron	Miquel	Lawrence Berkeley University	USA
Diffusion and reactions of simple molecules on Pd(111)			
Scheffold	Frank	University of Fribourg	Switzerland
Optical and Mechanical Properties of Bulk Nano- and Mesosized Particle Assemblies			
Tomellini	Renzo	European Commission - NMP	Belgium
Evolutions towards an European Strategy for Nanotechnology			

Exhibitors

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- Particle counting

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Le plan d'Aigues, RN 7.
13760 St.-Cannat
France
Phone:0033 442 50 68 64
Fax:0033 442 50 68 65
E-mail: omicron.nanotechnology@wanadoo.fr
WEB: http://www.omicron.de

2^{nd} NANOSPAIN WORKSHOP: PROGRAMME

Sunday – March 13, 2005	
19h00-20h30	**Cosmo Caixa Museum Visit**
20h30	**Welcome Reception**

SCIENTIFIC PROGRAMME	
Monday – March 14, 2005	
09h00-11h00	***Registration / Coffee Break***
11h00-12h00	**Heinrich Hoffmann** (EPFL, Switzerland): *Nanoparticles for biomedical applications*
12h00-13h00	**Frank Scheffold** (University of Fribourg, Switzerland): *Optical and mechanical properties of bulk nano- and mesosized particles assemblies*
13h00-15h00	***Lunch***
15h00-15h20	**Maria José Alonso** (USC, Spain): *Nanomedicines for overcoming biological barriers: nanoparticles as carriers for intestinal drug absorption*
15h20-15h40	**Anisha Thayil** (IFCO, Spain): *Two-Photon Fluorescece Spectroscopy by resonant grating waveguide structures*
15h40-16h00	**Xavier Fernandez Busquets** (UB, Spain): *Application of the atomic force microscope to the study of autoaggregative proteins*
16h00-16h20	**Neus Gomez Bastus** (UB, Spain)**:** *Nanoparticles - local and remote energy sources.*
16h20-16h40	**Eduardo Ruiz-Hitzky** (ICMM-CSIC, Spain)**:** *Bio-nanohybrid materials*
16h40-17h00	**Isabel Pastoriza** (Universidad de Vigo, Spain): *Formation and Characterization of Silver Nanoparticles in DMF with Shape Control*
17h00-17h30	***Coffee Break***
17h30-20h00	**WG Meetings (parallel sessions)**
	Molecular Electronics
	Nanofabrication
	Nanobiotechnology

SCIENTIFIC PROGRAMME	
Tuesday – March 15, 2005	
09h00-10h00	**Miquel Salmeron** (Lawrence Berkeley University, USA): *Diffusion and reactions of simple molecules on Pd(111)*
10h00-11h00	**Martin Bennink** (MESA+ Institute for Nanotechnology, Netherlands): *Unraveling molecular details of chromatin structure using atomic force microscopy and optical tweezers*
11h00-11h30	***Coffee Break***
11h30-11h50	**Javier Méndez** (ICMM-CSIC, Spain): *Organic Nanodots*
11h50-12h10	**Javier Martinez** (IMM-CSIC, Spain): *Length control and sharpening of AFM carbon nanotube tips for high resolution imaging*
12h10-12h30	**Ricardo García** (IMM-CSIC, Spain): *Attomol chemistry and Nanofabrication by Atomic Force Microscopy*
12h30-12h50	**Luis Hueso** (Cambridge, UK): *Fully Polarized Spin Injection Into Carbon Nanotubes*
12h50-13h10	**Maria Teresa Gonzalez** (University of Basel, Switzerland): *Behaviour of break-junctions gold contacts in liquid environment*
13h10-13h30	**Xavier Cartoixa** (UAB, Spain): *(111) Heterostructures for Rashba spin injectors and resonant spin lifetime transistors*
13h30-15h30	***Lunch***
15h30-15h50	**Yamila Garcia Martinez** (UA, Spain): *Doping metallic chemically active nanocontacts: Platinum and gold in a Hydrogen environment*
15h50-16h10	**Riccardo Rurali** (Universite Paul Sabatier, France): *A theoretical study of surface reconstructed silicon nanowires*
16h10-16h30	**Eduardo Machado** (UB, Spain): *Conductance in Gold monoatomic wires containing Oxygen and Carbon impurities*
16h30-17h30	Flash Contributions (5 minutes each)
17h30-19h30	***Poster Session / Coffee Break***

Flash Contributions			
Last Name	**Name**	**Title**	**Topic**
Arbiol	Jordi	HRTEM and EELS Analysis of non-Cassiterite SnO2 Nanowires for Nanosized Gas Sensors	Nanomaterials
Garcia	Jordi	Structural study of carbon nanotubes produced by chemical vapour deposition from ammonia and acetylene.	Nanomaterials
Garcia del Muro	Maria	Magnetic properties of granular Co-ZrO2 films	Nanomaterials
Jurado	Mª Jesus	The influence of the recycling on PA nanocomposites	Nanomaterials
Konstantinovic	Zorica	Structural properties of granular Ag-ZrO2 and Au-ZrO2 thin films	Nanomaterials
Murua	Olatz	Manufacturing of ceramic foams for tissue regeneration	Nanomaterials
Serna	Rosalia	Controlling the structure at the nanoscale to improve the response of Optical systems	Nanomaterials
Soriano	Leonardo	Electronic Structure of TiO2 Nanoparticles as Observed by X-ray Absorption Spectroscopy (XAS)	Nanomaterials
Bausells	Joan	Fabrication of electrodes with controllable sub-20 nm gap spacing	Nanofabrication
Bernabeu	Eusebio	Optical considerations on dye-SiO2 nanospheres in water solution	Nanofabrication
Lizuain	Ion	Development of Nanoimprimt Lithography technique:fabrication of an optical micro-encoder	Nanofabrication
Riús	Gema	Combination of e-beam and UV lithography for the prototyping of nano-mechanical devices	Nanofabrication

SCIENTIFIC PROGRAMME

Wednesday – March 16, 2005

09h00-10h00	**Markus Antonietti** (Max-Planck-Institute of Colloids and Interfaces, Germany): *New Approaches to oxidic nanoparticles and functional mesoporous crystalline layers*
10h00-10h20	**Luis Fernandez-Barquín** (UNICAM, Spain): *Direct evidence of the existence of correlated nanometric magnetic grains in Fe-based amorphous and crystalline alloys by SANS*
10h20-10h40	**Victor Franco Puntes** (UB, Spain): *Subnanometric Co Nanoparticles, beyond superparamagnetism*
10h40-11h00	**Antonio Hernando** (RENFE-UCM-CSIC, Spain): *Magnetic properties of metallic nanoparticles*
11h00-11h30	***Coffee Break***
11h30-11h50	**Daniel Ruiz-Molina** (ICMAB, Spain): *Multiple Length Scale Patterning of Single-Molecule Magnets*
11h50-12h10	**Juan Bartolomé** (UNIZAR, Spain): *Magnetic dynamics of Co nanospheres: origin of the enhanced anisotropy*
12h10-12h30	**Jordi Esquena** (IIQAB-CSIC, Spain): *Highly Concentrated Emulsions as Templates for the Preparation of Hierarchically Ordered Materials*
12h30-12h50	**Natalia Galiana** (ICMM-CSIC, Spain): *MBE fabrication of self-assembled Si and metal nanostructures*
12h50-13h10	**Wolfgang Maser** (CARBON-ICB-CSIC, Spain): *Polyaniline-Carbon Nanotube Composites: From Wrapping and Self-Alignment to Solubility and Enhancement Effects*
13h10-13h30	**Veronique Abad Langlais** (UAB, Spain): *Self–organized calix[4]arenes on Au(110):fully resolved structure by a combined stm, leed, and gixrd study*
13h30-15h30	***Lunch***
15h30-16h30	Flash Contributions (5 minutes each)
16h30-19h00	***Poster Session / Coffee Break***
19h00-20h00	Meeting NanoSpain network (Plenary)
21h30	***Conference Dinner***

Flash Contributions

Last Name	Name	Title	Topic
Alonso	Maria	PLGA-Mannosamine nanoparticles as new carriers for oral immunization	Nanobiotechnology
Casuso	Ignacio	DC current-voltage characteristics of purple membrane obtained by conducting atomic force microscopy	Nanobiotechnology
De la Fuente	Maria	Hyaluronate-Chitosan nanoparticles as new vehicles for ocular administration	Nanobiotechnology
Prego	Cecilia	Chitosan nanocapsules as transmucosal carriers for oral peptide delivery	Nanobiotechnology
Conesa	Juan Carlos	Behavior of catalytic cerium-containing mixed oxide nanoparticles upon high temperature treatments	Nanochemistry
Molina	Ricardo	Self-arrangement of surface chemical groups generated on air plasma treated wool	Nanochemistry
De la Cruz	Rosa Mª	Confinement and polaron energies in truncated conical semiconductor quantum dots	Nanoelectronics
Esplandiu	Mª Jose	Single-Walled Carbon Nanotubes as nanotools for Scanning Probe Microscopies	SPM
Garcia	Ricardo	Multipurpose Force Tool for Quantitative nano-scale analysis and Manipulation of Biomolecular and Polymeric surfaces	SPM
Ritort	Felix	Condensation transition in DNA-PAMAM dendrimer fibers studied using Optical tweezers	SPM
Iglesias	Oscar	Exchange bias and surface anisotropy effects in the hysteresis loops of nanoparticles	Simulation at the nanoscale

SCIENTIFIC PROGRAMME	
Thursday – March 17, 2005	
09h00-10h00	**Lars Montelius** (Lund University, Sweden): *Nanoimprint lithography: technology, prospects and some applications*
10h00-10h20	**Maria Villaroya** (UAB, Spain): *Patterning of nanometer-scale cantilevers integrated in CMOS circuit by e-beam lithography*
10h20-10h40	**Juan Carlos Martinez** (FIS-UCM, Spain): *Evanescent wave lithography. Towards the 3D nano-patterning of surfaces*
10h40-11h00	**Xavier Battle** (UB, Spain)*: Fabrication of magnetic nanodots over macroscopic area.*
11h00-11h30	***Coffee Break***
11h30-12h00	**Renzo Tomellini** (EU-NMP, Belgium): *Evolutions towards an European Strategy for Nanotechnology*
12h00-12h15	**Jose-Manuel Baez** (FECyT, Spain): *Survey on actual infrastructures and human resources in nano-sciences and nano-technologies in Spain*
12h15-12h30	**Marta Aymerich** (CIRIT, Spain)
12h30-12h45	To be defined
12h45-13h00	To be defined
13h00-14h00	**"2nd NanoSpain Workshop & WG" Conclusion Remarks** **Closing**

MARCH 14, 2004: SCIENTIFIC PROGRAMME

SCIENTIFIC PROGRAMME

Monday – March 14, 2005

09h00-11h00	***Registration / Coffee Break***
11h00-12h00	**Heinrich Hoffmann** (EPFL, Switzerland): *Nanoparticles for biomedical applications*
12h00-13h00	**Frank Scheffold** (University of Fribourg, Switzerland): *Optical and mechanical properties of bulk nano- and mesosized particles assemblies*
13h00-15h00	***Lunch***
15h00-15h20	**Maria José Alonso** (USC, Spain): *Nanomedicines for overcoming biological barriers: nanoparticles as carriers for intestinal drug absorption*
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17h30-20h00	**WG Meetings (parallel sessions)**
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	Nanofabrication
	Nanobiotechnology

NANOPARTICLES FOR BIOMEDICAL APPLICATION

Heinrich HOFMANN
Ecole Polytechnique Fédéral Lausanne
Institute of Materials, Powder Technology Laboratory
Switzerland
Heinrich.hofmann@epfl.ch

Quantum-dots and other nanosized particles with unique physical have a large impact on some important development in different medical areas like diagnostic tools (magnetic resonance imaging, MRI), in in-vitro and in-vivo detection and analysis of biomolecules, development of nonviral vectors for gene therapy, as transport vehicles for DNA, protein, drugs or cells and finally in different therapeutic tools for cancer treatment. Beside the unique physical properties induced by size ore quantum effects of the nanoparticles, the size of the particles which is with 2 to 30 nm comparable to the size of biological building blocs (protein, DNA) allows to investigate the cellular machinery without too much interfere the biological mechanisms or to interact directly with these biological unit. Understanding of biological processes on the nanoscale level is one of the strong driving forces behind development of nanotechnology. Out of the impressive number of size-dependant physical properties available for practical use of nanoparticles, optical and magnetic effects are the most interesting for biological applications. In this presentation, the use of such particles as analytical tool, as transport vehicle and for cancer treatment will be presented

In order to interact with biological target, a biological or molecular coating which acts as a bioactive and selective interface should be attached to the nanoparticles. Examples of such coatings may include antibodies, biopolymers like collagen, or monolayers of molecules that make the nanoparticles biocompatible and colloidal stable in a biological environment. The approaches used in constructing nanoparticles for biomedical and/or biotechnological application are shown schematically in Figure 1. The inorganic core of the nanosized particles allows the user to apply different external fields so that specific nano effects can be used for there detection or active therapeutic tasks For example, using gold as core material, surface plasmon resonance and their changes is used in biosensors, semiconducting core materials (ZnS, CdSe) are useful for photoluminescent effects used in biosensors or finally superparamagnetic iron oxide particles are used for imaging and drug delivery using the strong saturation magnetisation of these nanoparticles. Because the physical properties depend strongly from the size of the particles, it is evident that the size as well as the size distribution of the core particles has to be controlled carefully during the synthesis. The protective layer which gives to the particles the necessary biocompatibility is mostly consisting of biocompatible or biodegradable polymers or silica. Beside the biocompatibility, the protective layer has also to lead to a colloidal stability of the particles in water or even more important in blood or body liquid. The development of such layers is still challenging because the physical properties of the core material will be also influenced by the coating. Finally, linkers (long chain polymers) with functional groups like thiol, amino or carboxylic groups or proteins which allow a site specific binding at the cell membrane or even the translocation penetration of the particles through the membrane, (endocythosis) have to attach to the protective layer. The range of the used biomolecules is as large as the range of potential application and depends strongly from the applications, the biomolecules in contact as well as the type of cell which has to be treated. Some examples will be given in the talk describing the application of the particles.

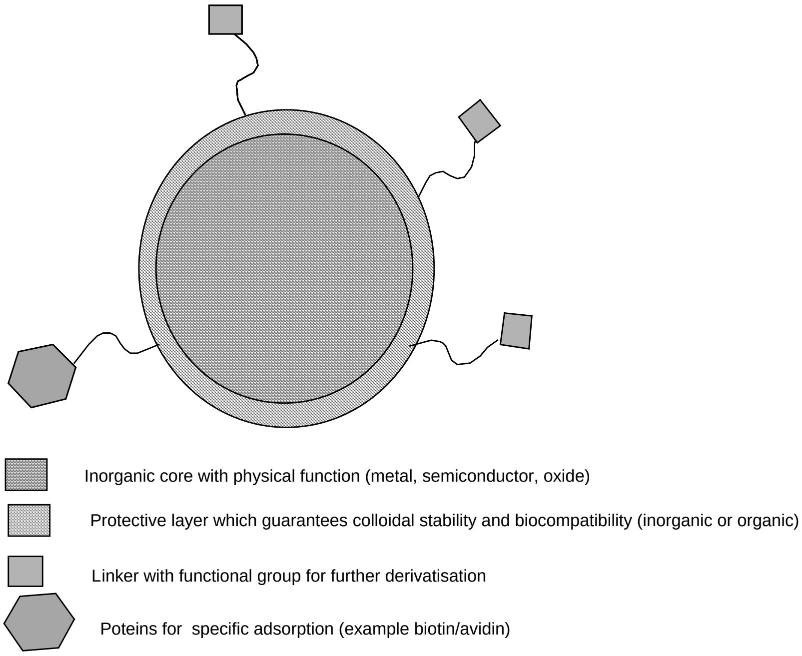

Figure 1: Typical configuration used for nanoparticles for biomedical application.

Beside single particles beads, nanoparticles embedded in a biocompatible matrix are also used. Such particles can show several functions at the some time like superparamagnetic properties useful for transport in a gradient of a magnetic field and photoluminescence for tracking or local treatment of diseases. Such multifunctional particles are mainly used for biosensors or for separation tasks. In-vivo applications are difficult because the size of the beads is very often several 100 nm and therefore to large for translocation, but still small enough for transport tasks in blood vessels.
Finally, it needs to be addressed whether certain nanoparticles have adverse health effects.

OPTICAL AND MECHANICAL PROPERTIES OF BULK NANO- AND MESOSIZED PARTICLE ASSEMBLIES

R. Vavrin[1], L.F. Rojas[1], M. Reufer[1], N. Ben Braham[1], Pedro Díaz-Leyva[1], I. Lynch[2], P. Schurtenberger[1], J.J. Saenz[2] and F. Scheffold[1]

[1]*Physics Department, University of Fribourg, CH-1700 Fribourg, Switzerland, +41263009117,*
Frank.Scheffold@unifr.ch
[2]*Physical Chemistry 1, Center for Chemistry and Chemical Engineering, Lund University, Box 124, S-22100 Lund, Sweden*
[3]*Departamento de Fisica de la Materia Condensada, and Instituto``Nicolas Cabrera'', Universidad Autonoma de Madrid, E-28049 Madrid, Spain*

We show how macroscopic properties of materials can be influenced in a predictable way by self-assembly of nano-particles with well defined – and tunable- interactions. Light and neutron scattering is used to characterize the structural properties in-situ. A quantitative discussion relating micro- and macro behavior will be given with special emphasis on mechanical and optical properties. We show that the processes and phenomena studied here can be useful in such different areas as consumer products, optics, food science, dispersion technology and materials (for example ceramics).

Tailoring nanoparticle structures with an appropriate degree of order gives rise to new material properties. We study the self-assembly of spherical as well as of non-spherical particles to larger arrays using colloidal methods. More specifically the aim of our research is to understand the mechanism and kinetics of self-assembly of nanoparticles during the increase in the concentration and for modified interparticle interactions. In-situ optical methods SAXS, SANS, light scattering and photon correlation spectroscopy are used to investigate the assembling processes.
Here we will focus on two examples of how macroscopic properties of nano-particle assemblies can be controlled by tailoring local order. The first example deals with mechanical properties of nano-particle gels. In the second example we show that liquid order in nano- and mesoparticle assemblies leads to photonic properties that can be used tune the optical transmission.

MECHNICAL PROPERTIES OF NANOPARTICLE GELS

Gels are formed by chemical or physical reactions of small sub-units such as molecules, polymers or colloids. The macroscopic features that tie together such different materials are based on the microstructural properties of all gels, which can be described as random networks built up by aggregation of individual sub-units.

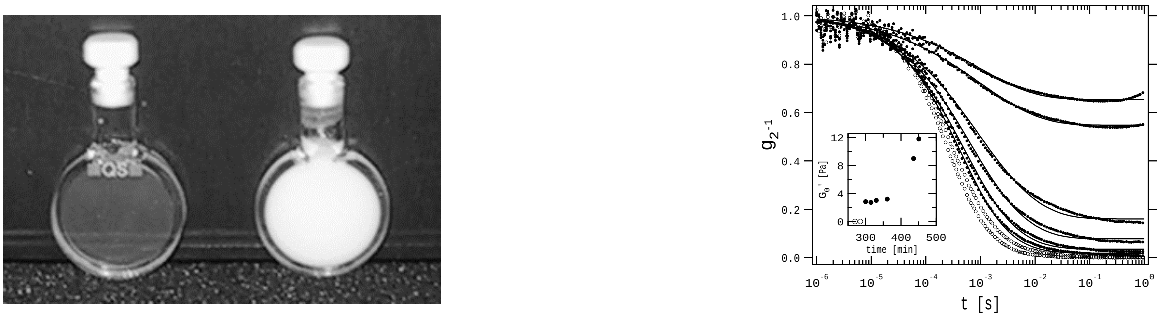

FIGURE 1 Left: Nanoparticle suspension (particle size 20nm) before and after gelation. Right: Diffusing Wave Spectroscopy intensity autocorrelation function before (open symbols) and after gelation (solid symbols). Inset: Gel elastic modulus derived from light scattering.

Here we focus on the fascinating problem of the liquid to solid transition in destabilized nanoparticle suspensions. The destabilisation rapidly leads to aggregation, cluster formation and gelation. At the gel point a liquid-solid transition is observed which can be characterized by the appearance of an elastic modulus in mechanical measurements (and also in a much increased scattering of visible light for the nanoparticle case, Fig 1). We have studied the sol gel-transition for dense particle suspensions. From a detailed analysis of microscopic dynamic properties of these materials we extract information about the macroscopic viscoelastic behavior. Subsequent comparison to classical oscillatory shear measurements yields excellent agreement over the range accessible to both techniques. The many inherent advantages of a light scattering characterization are discussed in detail: non-invasive sample access, extremely fast data acquisition time and an extended range of accessible frequencies. This enables us to study extremely slow gelation processes but also the critical power law scaling of the elastic moduli of weak physical gels formed within minutes [1,2].

PHOTONIC LIQUIDS –TUNING THE OPTICAL TRANSMISSON BY LOCAL ORDER

When mesoscopic variations of the dielectric constant can be neatly controlled over macroscopic distances, totally new, so called photonic properties may appear. At the core of the design of new photonic materials lies the intelligent way structures are assembled on length scales comparable to the wavelength of light. There are two main promising concepts to achieve lossless guidance and manipulation of light based on seemingly opposite principles: order or disorder. Photonic bandgap materials (PBG) are based on periodic structures predicted to inhibit light propagation completely. In the case of disorder, light cannot propagate in the material due to recurrent interference called strong Anderson localization (SAL).

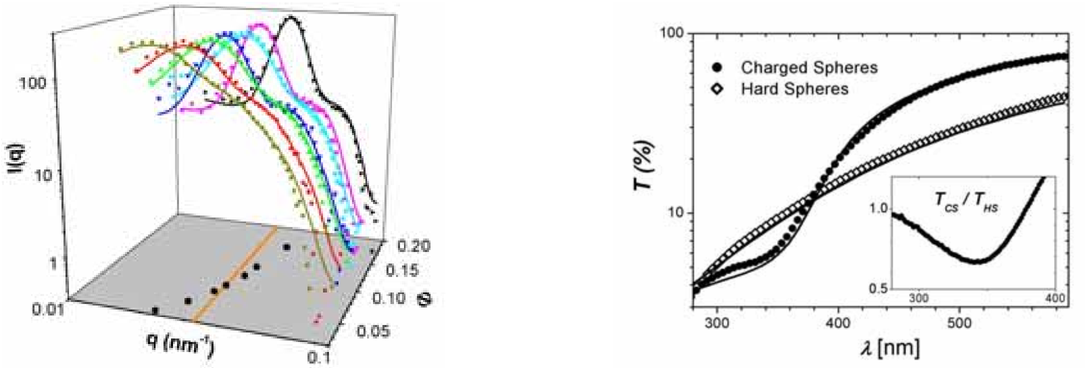

Figure 2 Left: Neutron scattering intensity for different particle densities. Right: Transmission wavelength dependence for a suspension of 240nm polystyrene particles. Experimental values for charged spheres (solid symbols) and hard spheres (open symbols), $\Phi = 9.8\%$. Cell thickness L=2mm.

Tailoring microstructures with an appropriate degree of order and disorder should result in new class of materials with unusual transport properties for light. We have recently demonstrated that short-range-order induced Bragg backscattering resonances can lead to a strong wavelength dependence of the optical transmission of colloidal liquids [3] as shown in Fig. 2. By tuning the interaction potential between the particles we are able to control the degree of order or disorder and thus explore photonic properties in a completely new regime. The unusual properties of photonic liquids could lead to interesting applications. Titanium dioxide nanoparticle based sunscreen lotions for example require efficient blocking of UV light while retaining a high transparency for visible wavelengths. As we shown in Fig. 2 photonic liquids fulfill this requirement significantly better than random particle assemblies. Photonic liquids could also be used as tuneable optical filters and switches, for example in windows that change from opaque to clear, provided particle interactions can be controlled externally. As an example for a tunable model system we will discuss preliminary results from a nanoparticle system with a temperature sensitive coating (PNIPAM).

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This work is financially supported by the KTI-TopNano21 Initiative (Project TE744) and the Swiss National Science Foundation. We thank A. Stradner, F. Muller and J. Kohlbrecher for their help with the SANS measurements and the data treatment.

NANOMEDICINES FOR OVERCOMING BIOLOGICAL BARRIERS: NANOPARTICLES AS CARRIERS FOR INTESTINAL DRUG ABSORPTION

C. Prego, M. Alonso-Sande, A. Vila[#], D. Torres, C. Remuñán, M. J. Alonso*
Drug Delivery Unit. Dept. Pharmacy and Pharmaceutical Technology. Campus Sur.
15782 Santiago de Compostela. Spain. *Email : ffmjalon@usc.es
[#]Avancell. Campus Sur. 15782 Santiago de Compostela. Spain

A definition of nanomedicine is the science and technology of complex systems of nanoscale size that can be used for the prevention, diagnosis and treatment of diseases. The complex system consisting of a nanocarrier and a drug enter, therefore, in this definition. Our group has developed a number of nanocarriers intended to transport and deliver drugs across mucosal barriers (1, 2). These nanocarriers are particularly important in the case of drugs that are very unstable in biological fluids and can not cross epithelial barriers. Biotech compounds such as peptides, proteins, and nucleic acid based-drugs enter within this category of drug. In fact, despite the great potential of these macromolecules their clinical application has been greatly restricted by their extremely short action and the necessity of being administered by injection.

Taking this information in mind, a major goal of our research has been to design nanocarriers intended for the oral administration of macromolecules. The criteria for the design of these nanocarriers were: (i) they should protect the associated peptide from degradation in the gastro-intestinal fluids (ii) they should facilitate the intestinal absorption of the associated peptide. As a basic material for the formation of these nanocarriers we chose the polysaccharide chitosan. The selection was based on the fact that chitosan exhibits mucoadhesive properties and, hence, it was thought to facilitate the contact of the associated peptide with the absorptive intestinal epithelium (3). Two different types of structures were designed: (a) Chitosan nanocapsules, consisting of an oily core surrounded by a chitosan wall and (b) chitosan nanoparticles, which are nanomatrices of cross-linked chitosan alone or in association with other hydrophilic polymers such as poloxamers and glucomanann. For the preparation of chitosan nanocapsules (Fig. 1.A) we used the solvent displacement technique (4), whereas the formation of chitosan nanoparticles (Fig. 1B) was based upon the principle of ionic gelation (5). Three different macromolecules have been associated until now to these nanostructures: the peptides insulin and salmon calcitonin and the polysaccharide heparine. Insulin and heparin are examples of molecules which have a great market potential but whole exploitation is highly limited by their necessity of being injected. On the other hand, salmon calcitonin is presently being administered intranasally, although its bioavailability and, hence, clinical efficacy is still quite reduced. The nanocarriers have been tested in vivo (rats) for their ability to enhance the absorption of the selected macromolecules, following oral administration. The results obtained until now represent a proof of concept of the efficacy of these new nanomedicines for overcoming the intestinal barrier. As an example, in figure 2, it is shown the pharmacological effect (decrease in the serum calcium levels) following oral administration of salmon calcitonin-loaded chitosan nanocapsules. In summary, nanosciences and nanotechnologies offer great opportunities in the design of new medicines aimed at resolving the biopharmaceutical problems of drugs.

Figure 1:

TEM micrograph of chitosan nanocapsules (A) and chitosan/glucomanann nanoparticles (B)

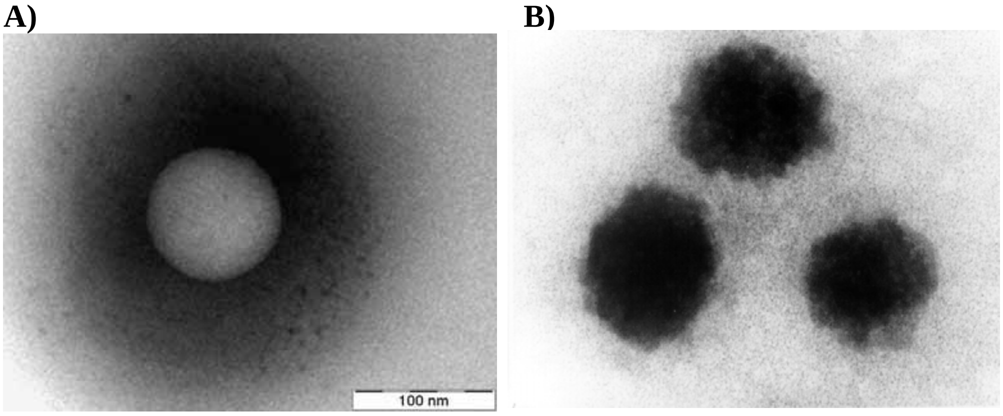
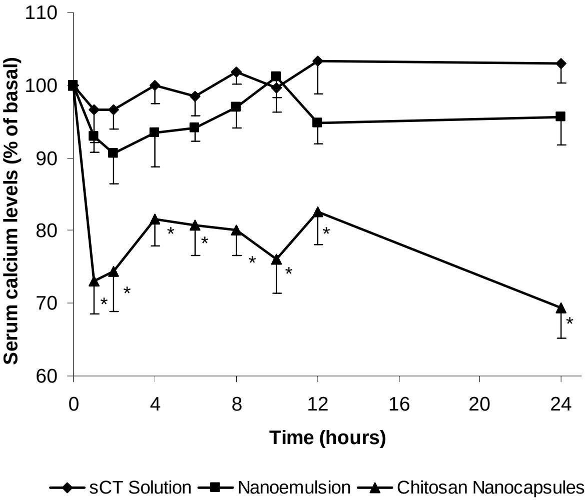


Figure 2:

Pharmacological response (decrease in the serum calcium levels) of salmon calcitonin associated to chitosan nanocapsules, following oral administration to rats



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Two-Photon Fluorescence Spectroscopy by Resonant Grating Waveguide Structures

A. Thayil K.N., S. Soria, andGonçal Badenes
ICFO-Insitut de Ciències Fotòniques, Jordi Girona 29, Nexus II, 1-D 08034 Barcelona, Spain
Silvia.Soria@icfo..es

T. Katchalski and A. A. Friesem
Department of Physics of Complex Systems, Weizmann Institute of Science, 76100 Rehovot, Israel

Compared to conventional fluorescence methods, two-photon fluorescence (TPF) increases the signal-to-noise ratio due to a complete rejection of background noise, and reduces dynamic photobleaching and photo-induced processes like auto-fluorescence in most biological systems. However, TPF excitation requires high photon densities. In order to achieve the required high instantaneous photon flux densities and to avoid tight focusing, we resort to low loss high finesse resonant polymeric grating-waveguide-structures (GWS) (period 523 nm, height 450 nm). The resonant GWS are basically multilayered structures consisting of a substrate, a polymeric waveguide and a grating layer on top. When such devices are illuminated with an incident light beam, part of the beam is directly transmitted through the structure and part is diffracted by the grating and is trapped in the waveguide layer. At a specific wavelength and angular orientation of the incident beam, GWS show resonant behavior where complete destructive interference occurs such that no light is transmitted, but rather is fully reflected from the GWS.

Our presentation is focused on demonstrating how such polymeric GWS can be exploited for the enhancement of TPF. We chose the conventional tetramethylrhodamine (TMR) dye for our experiments. A drop of nanomolar TMR solution in milli-Q water (ph=7.5) was deposited on top of the GWS. After evaporation of the solvent, the TMR molecules remained immobilized on the GWS surface. A mode-locked Ti:Sapphire laser (76 MHz, 150 fs pulse duration, 690-980 nm wavelength range) operating at the resonant wavelength was used as excitation source. In order to ensure that the fluorescence is indeed due to the GWS enhancement we tuned the incident laser wavelength for a fixed polarisation and changed polarization for a fixed wavelength. Figure 1 shows the results with the GWS. As evident, near and at resonance the TPF from the GWS could be readily observed. On the other hand, far away from resonance no TPF signal could be observed. Near resonance, the TPF intensity increases strongly, reaching its maximum at the resonance wavelength of 826 nm, indicating a strong field enhancement. Also shown are TPF signals obtained at 831, and at 828nm which are two and one FWHM away from the resonance excitation wavelength. The TPF signal at the excitation wavelength of 826nm (suitable for resonance with TE polarization) was detected as background noise signal for TM polarization. Similarly, no TPF was detected when using a reference glass with a deposited TMR thin layer under identical experimental conditions, indicating clearly the enhancement of the TPF detection with GWS [1]. In this case the TPF in resonance is enhanced by a factor of 160 with respect to the non-resonant TPF.

Since the TPF signal is proportional to the convolution of the GWS transmission spectrum and the pulse intensity envelope, considerable TPF signal is also present at wavelengths close to the resonance wavelength. Since the resonance bandwidth is considerably narrower than the pulse envelope the TPF signal is expected to resemble a slightly broadened pulse envelope (see Fig. 2.).[2]

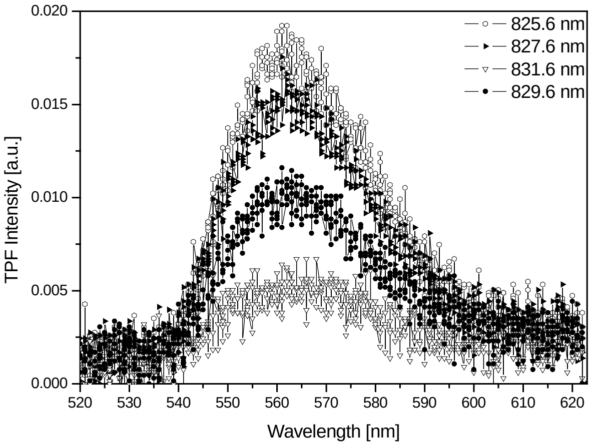

Fig. 1. Two-photon fluorescence signal with GWS, for different excitation wavelengths. Hexagons denote excitation wavelength of 826 nm; down-side triangle 832 nm ; left sided triangle 827.6 nm ; crosses 829.6 nm (maximum absorption wavelength).

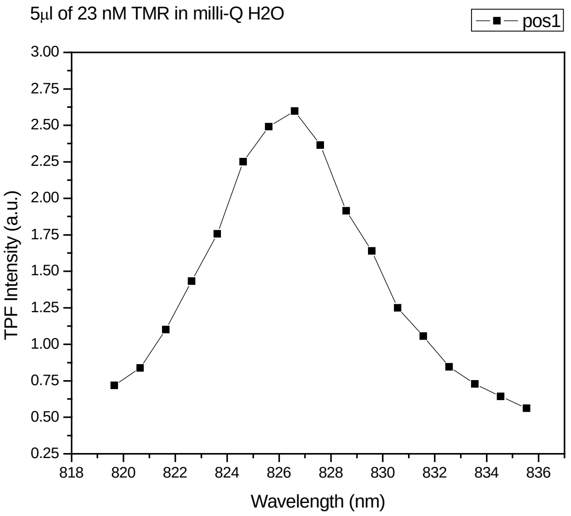

Fig. 2. Integral TPF signal as a function of central excitation wavelength of a DGWS**.**

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APPLICATION OF THE ATOMIC FORCE MICROSCOPE TO THE STUDY OF AUTOAGGREGATIVE PROTEINS

Muriel Arimon[1], Iwona Bucior[2,3], Ismael Díez-Pérez[4], Sergi Garcia-Manyes[1], Marcelo Kogan[5], Robert Ros[6], Fausto Sanz[4], Ernest Giralt[5], Núria Durany[7], Dario Anselmetti[6], Max M. Burger[2,3], and **X. Fernàndez-Busquets**[1,3,4]

[1]Research Centre for Bioelectronics and Nanobioscience, Barcelona Science Park, University of Barcelona (UB), Josep Samitier 1-5, E-08028 Barcelona, Spain. http://www.nanobiolab.pcb.ub.es. [2]Friedrich Miescher-Institut, CH-4002 Basel, Switzerland. [3]Marine Biological Laboratory, Woods Hole, MA-02543, USA. [4]Departament de Química Física, UB, Martí i Franquès 1, E-08028 Barcelona. [5]Departament de Química Orgànica, UB, Martí i Franquès 1, E-08028 Barcelona. [6]Experimental Biophysics & Applied Nanoscience, University of Bielefeld, Physics Faculty, Universitätsstrasse 25, D-33615 Bielefeld, Germany. [7]Universitat Internacional de Catalunya, Gomera s/n, E-08190 Barcelona.

e-mail address corresponding author: busquets@qf.ub.es

The anomalous folding of proteins into toxic conformations has been proposed as the molecular basis of a number of pathologies that include, among several others, Alzheimer's disease, Creutzfeld-Jacob disease and other prionic afflictions, Huntington's disease, amyloidoses, type II diabetes, Parkinson's disease, and Down's syndrome. Here we present one of our lines of research that is based on the use of the atomic force microscope (AFM) for the imaging of the self-aggregation process of a peptide related to Alzheimer's disease (1), and in force spectroscopy studies of the calcium-dependent self-aggregation of cell adhesion proteoglycans.

One of the hallmarks of Alzheimer's disease is the self-aggregation of the amyloid β peptide (Aβ) in extracellular amyloid fibrils. Among the different forms of Aβ, the 42-residue fragment ($A\beta_{1-42}$) readily self-associates and forms nucleation centres from where fibrils can quickly grow. The strong tendency of $A\beta_{1-42}$ to aggregate is one of the reasons for the scarcity of data on its fibril formation process. We have used AFM visualization on hydrophilic and hydrophobic surfaces in liquid environment to study in vitro the fibrillogenesis process of synthetic $A\beta_{1-42}$. The results presented provide nanometric resolution of the main structures characteristic of the several steps of fibril formation from monomeric $A\beta_{1-42}$ to mature fibrils. Oligomeric globular aggregates of $A\beta_{1-42}$ are the precursor species of protofibrils, the first fibrillar species. The protofibril dimensions deduced from our AFM images are consistent with a model that postulates the stacking of the peptide in a hairpin conformation perpendicular to the long axis of the protofibril, forming single β-sheets ribbon-shaped. The most abundant form of $A\beta_{1-42}$ fibril exhibits a nodular structure with a ~100-nm periodicity. This length is very similar (i) to the length of protofibril bundles that are the dominant feature at earlier stages in the aggregation process, (ii) to the pitch of helical structures that have been observed in the core of fibrils, and (iii) to the distance between regularly spaced, structurally weak fibril points. Taken together, these data are consistent with the existence of a ~100-nm long basic protofibril unit that is a key fibril building block.

Specific carbohydrate-carbohydrate interactions are rarely reported in biologically relevant situations such as cell recognition. However, carbohydrate structures have immense structural diversity, a ubiquitous distribution in vertebrate and invertebrate tissues, and are associated with the cell surface, as required of cell recognition molecules. Carbohydrate-carbohydrate interactions are characterized by relatively weak forces which, when multimerized, can be easily potentiated by orders of magnitude, representing a highly versatile form of cell recognition and adhesion given the extraordinary plasticity of their structures. Sponge cells associate in a species-specific process through multivalent interactions of carbohydrate structures on a type of extracellular proteoglycan molecules termed spongicans (2,3). Here we present evidence of a spongican carbohydrate structure involved in cell adhesion that is polymorphic between individuals. Force spectroscopy and surface plasmon resonance measurements reveal that the carbohydrate self adhesion is highly specific when compared with the binding to other sulphated carbohydrates such as chondroitin sulphate. The strength of the binding per surface area between two spongican molecules is comparable to that of focal contacts between vertebrate cells.

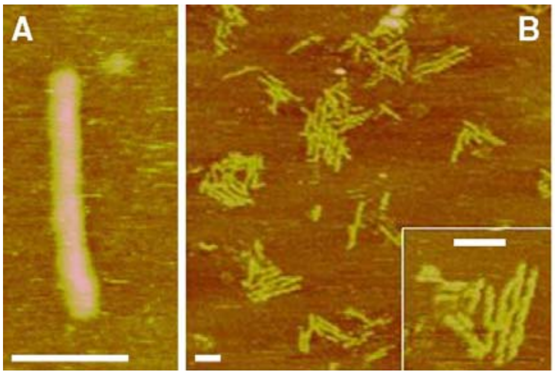

Figure 1. AFM images in liquid of A$\beta_{1\text{-}42}$ protofibrils. **A**, Single protofibril and globular structure on mica after an incubation time (t_i) of 20 h. **B**, Protofibril bundles on graphite (t_i = 2 days). Bar: 50 nm. Z scale: 6 nm **(A, B)**, 5 nm **(B inset)**.

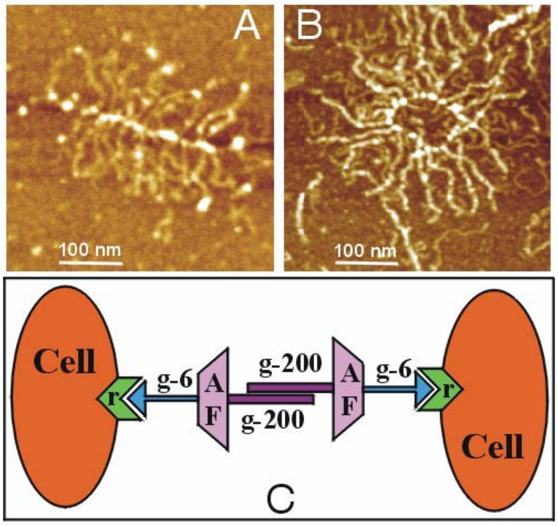

Figure 2. Structure of spongicans. AFM images in air of spongicans from *Halichondria panicea* (**A**) and from *Microciona prolifera* (*Microciona* aggregation factor, MAF) (**B**). Z scale: 3 nm. **C**, Schematic representation of spongican-mediated cell adhesion; g-200, glycan mediating homologous MAF-MAF interactions; g-6, glycan binding the cell surface receptor (r); AF, core protein (aggregation factor).

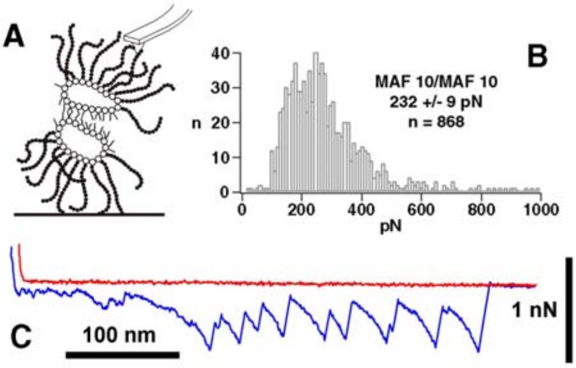

Figure 3. Force spectroscopy analysis of the interaction of native MAF molecules in the presence of 10 mM Ca^{2+}. **A**, Scheme of the experimental set-up for the MAF-MAF force spectroscopy measurements. **B**, Characteristic histogram representing the occurrence of interaction forces in pN for the last binding events of MAF self-adhesion curves. **C**, Typical profile of MAF self-interaction curves.

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This work was supported by grant BIO2002-00128 from the Ministerio de Ciencia y Tecnología, Spain, that included FEDER funds.

NANOPARTICLES: LOCAL AND REMOTE ENERGY SOURCES.

Neus G. Bastús[1], Víctor F. Puntes[* 1], Roger Amigó[1], Xavier Batlle[1], Amílcar Labarta[1], Marcelo J. Kogan[2,3], Eyleen Araya[2], Dolors Grillo-Bosch[3],Ernest Giralt[3,4], Antonio Turiel[5].

[1] Departament de Física Fonamental, Universitat de Barcelona, 647 Av Diagonal, 08028 Barcelona, Spain.

[2] Departamento de Farmacología y Toxicología, Facultad de Ciencias Químicas, Universidad de Chile. Olivos 1007, Santiago, Chile.

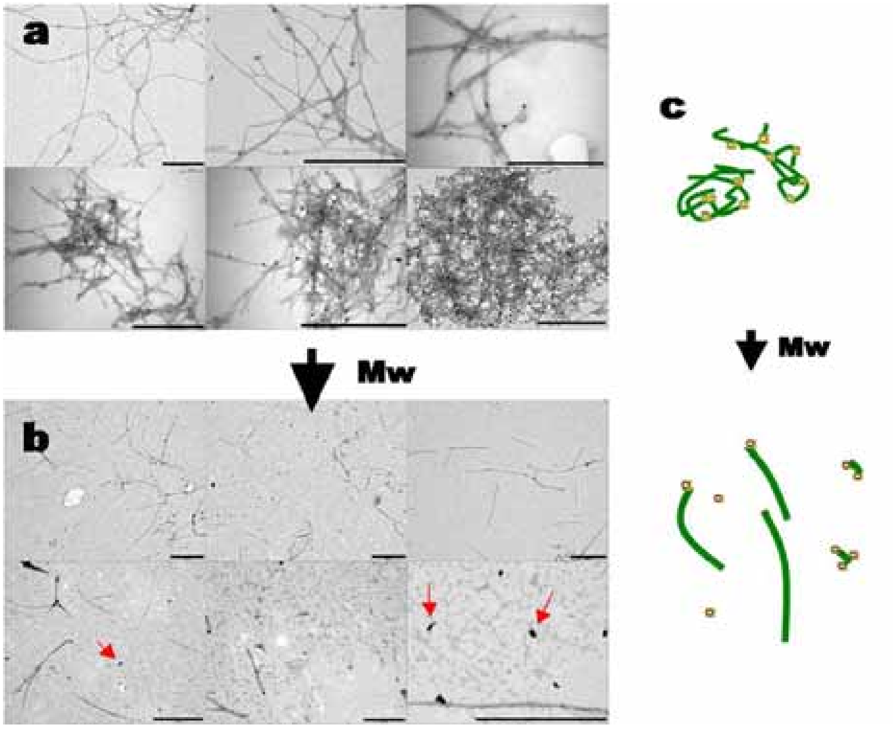
[3] Institut de Recerca Biomèdica de Barcelona, Parc Científic de Barcelona-UB, Josep Samitier 1-5, 08028 Barcelona, Spain.

[4] Departament de Química Orgànica, Universitat de Barcelona, Martí i Franquès, 1-11, 08028 Barcelona, Spain.

[5] Centre Mediterrani d'Investigacions Marines i Ambientals, CMIMA-CSIC, Passeig Marítim de la Barceloneta, 37-49, 08003 Barcelona, Spain.

Nanoparticles can be made to respond resonantly to a time-varying electromagnetic field, with advantageous results related to the transfer of energy from the exciting field to the nanoparticles [1]. Thus, the surface of each particle can be heat up, this heat being transmitted into the immediately surrounding tissue. This enables their use as hyperthermia agents, delivering toxic amounts of thermal energy to targeted bodies such as tumours; or as chemotherapy and radiotherapy enhancement agents, where a moderate degree of tissue warming results in more effective destruction of malignant cells [2]. The heating effects depend strongly on the structural properties of the particles, which may vary appreciably for different samples depending on particle size and microstructure. Heating of nanoparticles in an external magnetic field is mainly due to inductive coupling (via eddy currents), loss processes during the reorientation of the magnetization (hysteresis losses) or frictional losses (relaxational losses) if the particle can rotate in an environment of sufficiently low viscosity.

As an exemple, we use this method to apply heat *locally and remotely* [3], dissolving toxic protein deposits of A□$_{1□□}$ (amyloid diposits) via the combined use of weak microwave fields and gold nanoparticles (AuNP) without any bulk heating. In particular, we linked AuNP to a N-terminal Cys (conjugates), which attached selectively to the Aß aggregates. These conjugates were then incubated with a solution of A□$_{142}$ where fibrils spontaneously start growing and slowly form precipitates. Afterwards, weak microwave fields (0.1 W) were applied. AuNP-link conjugates, attached to the fibrils, absorbed the radiation and dissipated energy causing disaggregation of the growing deposits. Our method [4] can be extended to a number of systems where it may be desirable to remove proteins and other aggregates involved in different phatologies. Besides, it is simple (gold colloids are used as anthireuma drug and radiofrequencies machines are common in hospitals) and the remote action makes it non invasive.



Electron Microscopy Images of a) AuNP conjugated with a linker peptide attached to amyloid fibrils and b) the result of 8h irradiation of sample showed in a). In c) there is a cartoon where the basics of the process are described.

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Mail:* vfpuntes@ffn.ub.es

BIO-NANOHYBRID MATERIALS

Eduardo Ruiz-Hitzky*, Margarita Darder, Pilar Aranda

Instituto de Ciencia de Materiales de Madrid, CSIC, 28049-Cantoblanco, Madrid, Spain
(*) e-mail: eduardo@icmm.csic.es

In the last decades, the design and synthesis of hybrid organic-inorganic nanostructured materials is becoming a research field of growing interest due to the enhanced characteristics of the developed nanocomposites and their potential applications. The organization of the organic and the inorganic moieties at the nanosize level is crucial to provide the hybrid material with the desired properties, such as mechanical and chemical resistance, thermal stability, hydrophobic or hydrophilic character, etc. Within this topic, our research group has recently developed a new class of hybrids based on the combination at the nanometric scale of natural polymers and layered inorganic solids. This emerging class of hybrid materials named as “Bio-Nano-Composites” show interesting properties useful for advanced applications as functional materials such as active phase of chemical sensors.

This communication intends to introduce different examples of biopolymer-clay nanocomposites derived from 2D solids (layered silicates and double hydroxides) and sepiolite. The first example refers to the intercalation of cationic or anionic natural polysaccharides in the layered solids provided with the opposite ionic charge (smectites and hydrotalcite-like solids) yielding the corresponding bio-nanocomposites. In this way, several biopolymers, including chitosan, pectin, alginate and ι-carrageenan, could be incorporated in the layered solid by means of ion-exchange mechanisms for smectites or by a “co-organised assembly” method, in the case of layered double hydroxides. The main feature of the resulting biopolymer-clay nanocomposites is that the ionic exchange behaviour of the pristine solid is reversed to the opposite exchange ability due to the presence of available charged groups in the polysaccharide structure. Such functional property, together with the good mechanical stability, makes possible the use of these bio-nanocomposites as active phases in potentiometric sensors applied to the determination of ionic species in aqueous solution.

A second group of bio-nanohybrids has been prepared by combination of cationic bio-polymers (chitosan) with sepiolite, a natural microfibrous magnesium silicate. The control of the surface coverage by one or several layers of biopolymer provides bio-nanohybrids with tunable positive/negative electrical charge. This property is crucial to design new sensing agents for selective ionic recognition. On the other hand, it is observed a significant enhancement of the mechanical behaviors of these hybrid materials with respect to the pristine inorganic solids, that could be related with the nano-structural arrangement between its two components.

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2. a) M. Darder, M. Colilla, E. Ruiz-Hitzky *Biopolymer-clay nanocomposites based on chitosan intercalated in montmorillonite* **Chem. Mater. 15,** 3774 (2003) b) M. Darder, M. Colilla, E. Ruiz-Hitzky Chitosan-*clay nanocomposites: application as electrochemical sensors* **Appl. Clay Sci. 28**, 199 (2005).
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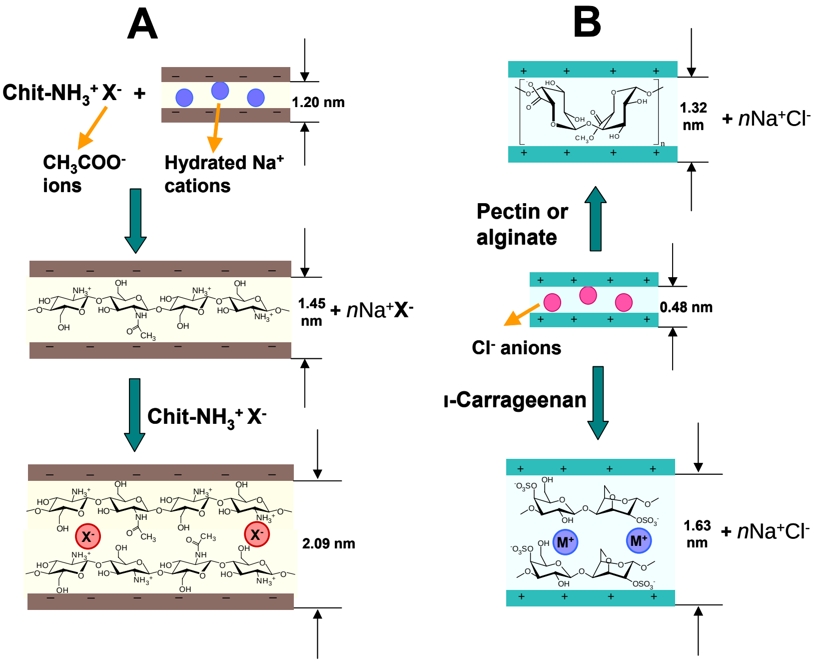
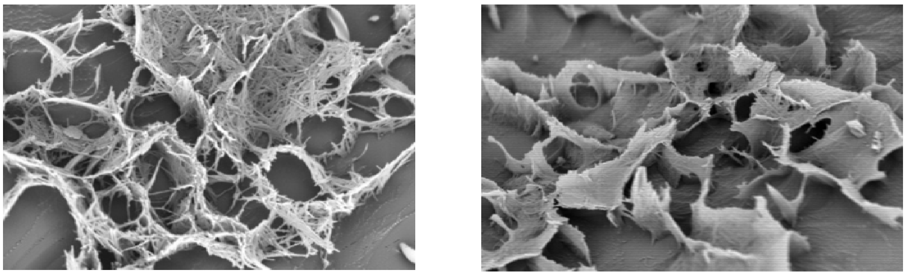
4. M. Darder, M. López-Blanco, P. Aranda, A.J. Aznar, J. Bravo, E. Ruiz-Hitzky *Microfibrous sepiolite-chitosan nanocomposites* **(***in preparation)*



(A) Intercalation of chitosan into Na$^+$-montmorillonite and (B) incorporation of anionic polysaccharides in the [Zn$_2$Al] LDH network.



LT-SEM images of sepiolite-chitosan bio-nanocomposites at different clay/bio-polymer ratio.

FORMATION AND CHARACTERIZATION OF SILVER NANOPARTICLES IN DMF WITH SHAPE CONTROL

Isabel Pastoriza-Santos and Luis M. Liz-Marzán
Departamento de Química Física, Universidade de Vigo, 36310, Vigo, Spain
e-mail:pastoriza@uvigo.es

Spherical and anisotropic silver nanoparticles were synthesized by reduction of silver salt by N,N-dimethylformamide (DMF), which also acts as the solvent, in the presence of different stabilizers. It was observed that while the absence of stabilizer led to the formation of nanostructured thin films, the presence of either oxide precursors (3-aminopropyltrimethoxisilane, APS, and titanium tetrabutoxide, TOB) or a polymer (poly(vinylpyrrolidone)) produced the formation stable dispersions of silver nanoparticles. In the case of APS and TOB, a thin and porous shell of silica and titania, respectively, was formed on the nanoparticle surface. The porosity of the shell allows the manipulation of the chemical nature of the core to obtain new composite materials. PVP was not only capable to stabilize silver nanoparticles but it could also induce the formation of spherical or anisotropic silver nanoparticles depending on the silver salt concentration, PVP concentration and reaction temperature.

It was observed that the optical properties of the silver nanoparticles are highly influenced by the shape of the particles. While spherical particles only display a surface plasmon band, the anisotropic silver nanoparticles show different plasmon bands due to the different surface plasmon resonances. While the optical properties of spherical nanoparticles can be explained through the simple Mie theory, the modelling of anisotropic particles requires use of the DDA approximation.

MARCH 15, 2004: SCIENTIFIC PROGRAMME

SCIENTIFIC PROGRAMME

Tuesday – March 15, 2005

09h00-10h00	**Miquel Salmeron** (Lawrence Berkeley University, USA): *Diffusion and reactions of simple molecules on Pd(111)*
10h00-11h00	**Martin Bennink** (MESA+ Institute for Nanotechnology, Netherlands): *Unraveling molecular details of chromatin structure using atomic force microscopy and optical tweezers*
11h00-11h30	***Coffee Break***
11h30-11h50	**Javier Méndez** (ICMM-CSIC, Spain): *Organic Nanodots*
11h50-12h10	**Javier Martinez** (IMM-CSIC, Spain): *Length control and sharpening of AFM carbon nanotube tips for high resolution imaging*
12h10-12h30	**Ricardo García** (IMM-CSIC, Spain): *Attomol chemistry and Nanofabrication by Atomic Force Microscopy*
12h30-12h50	**Luis Hueso** (Cambridge, UK): *Fully Polarized Spin Injection Into Carbon Nanotubes*
12h50-13h10	**Maria Teresa Gonzalez** (University of Basel, Switzerland): *Behaviour of break-junctions gold contacts in liquid environment*
13h10-13h30	**Xavier Cartoixa** (UAB, Spain): *(111) Heterostructures for Rashba spin injectors and resonant spin lifetime transistors*
13h30-15h30	***Lunch***
15h30-15h50	**Yamila Garcia Martinez** (UA, Spain): *Doping metallic chemically active nanocontacts: Platinum and gold in a Hydrogen environment*
15h50-16h10	**Riccardo Rurali** (Universite Paul Sabatier, France): *A theoretical study of surface reconstructed silicon nanowires*
16h10-16h30	**Eduardo Machado** (UB, Spain): *Conductance in Gold monoatomic wires containing Oxygen and Carbon impurities*
16h30-17h30	Flash Contributions (5 minutes each)
17h30-19h30	***Poster Session / Coffee Break***

Flash Contributions

Last Name	Name	Title	Topic
Arbiol	Jordi	HRTEM and EELS Analysis of non-Cassiterite SnO2 Nanowires for Nanosized Gas Sensors	Nanomaterials
Garcia	Jordi	Structural study of carbon nanotubes produced by chemical vapour deposition from ammonia and acetylene.	Nanomaterials
Garcia del Muro	Maria	Magnetic properties of granular Co-ZrO2 films	Nanomaterials
Jurado	Mª Jesus	The influence of the recycling on PA nanocomposites	Nanomaterials
Konstantinovic	Zorica	Structural properties of granular Ag-ZrO2 and Au-ZrO2 thin films	Nanomaterials
Murua	Olatz	Manufacturing of ceramic foams for tissue regeneration	Nanomaterials
Serna	Rosalia	Controlling the structure at the nanoscale to improve the response of Optical systems	Nanomaterials
Soriano	Leonardo	Electronic Structure of TiO2 Nanoparticles as Observed by X-ray Absorption Spectroscopy (XAS)	Nanomaterials
Bausells	Joan	Fabrication of electrodes with controllable sub-20 nm gap spacing	Nanofabrication
Bernabeu	Eusebio	Optical considerations on dye-SiO2 nanospheres in water solution	Nanofabrication
Lizuain	Ion	Development of Nanoimprimt Lithography technique:fabrication of an optical micro-encoder	Nanofabrication
Riús	Gema	Combination of e-beam and UV lithography for the prototyping of nano-mechanical devices	Nanofabrication

DIFFUSION AND REACTIONS OF SIMPLE MOLECULES ON Pd(111)

Miquel Salmeron
Lawrence Berkeley University
USA
E-mail: MBSalmeron@lbl.gov

UNRAVELING MOLECULAR DETAILS OF CHROMATIN STRUCTURE USING ATOMIC FORCE MICROSCOPY AND OPTICAL TWEEZERS

Martin L. Bennink

Biophysical Engineering, MESA+ Institute for Nanotechnology, Science and Technology department, University of Twente, PO Box 217, 7500 AE Enschede, The Netherlands

In contrast to prokaryotic organisms, the DNA in cells of eukyotic species is sequestered in a nucleus, which occupies about 10% of the total cell volume. Each DNA molecule is packaged into a separate chromosome, which is a large complex consisting of a single DNA molecule and many protein molecules, such as histones, RNA and DNA polymerases, gyrases, topoisomerases and many other non-histone chromosomal proteins.

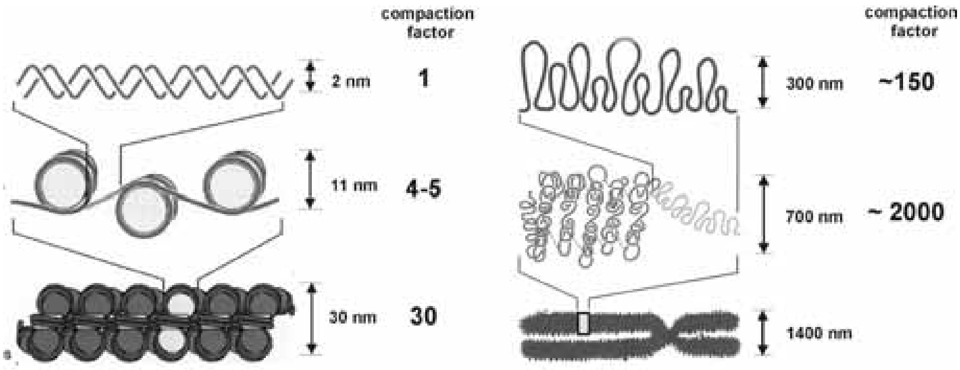


Figure 1
Different levels of DNA packaging into chromatin. (a) DNA double helix (b) “beads-on-a-string” structure (c) “30 nm fiber” (d) extended form of the chromosome (e) section of condensed chromatin (as in metaphase chromosome) (f) entire metaphase chromosome.

Starting from a protein-free DNA molecule different levels of chromatin compaction have been distinguished (Fig. 1). Eight histone proteins form a core particle around which the DNA is wrapped, which is called the nucleosome. A nucleosome is formed about every 200 bp along the DNA strand. The next level of compaction is the socalled ’30 nm’ fiber. The individual nucleosomes start to stack into a toroid-shaped structure resembling a fiber. Further compaction of the structure is achieved by folding this 30 nm fiber back and forth.

In the early days of chromatin research this structure was assumed to be static and have only one single function: packaging. Nowadays researchers are convinced that chromatin structure plays an active role in gene regulation by changing its structure on a local level. This means that chromatin is not a passive mechanism to keep the DNA packaged but is actively involved in activating and suppressing specific genes. Chromatin is not a stand-alone structure but is dynamic as a result of many external inputs, other proteins, histone-modifications, etc.

Here I will provide an overview of chromatin research ongoing in our lab. We have applied both atomic force microscopy (AFM) imaging and force spectroscopy using optical tweezers (OT) to study interactions between DNA and histone proteins on the single molecular level. These interactions play an important role in the formation of nucleosomal arrays, which is the first packaging level of DNA into a more compact chromatin structure.

Tapping mode AFM in air was used to image nucleosomal arrays in which 208-12 DNA fragments were folded (Fig. 2). Detailed analysis of the AFM images led to the conclusion that the DNA exhibited different binding modes, suggesting a dynamic, non-rigid structure. These dynamics were studied in a more direct way using AFM imaging in a liquid environment. Tuning the buffer conditions such that the molecules are able to move allowed the observation of packaging of the DNA into a compact chromatin structure in real-time.

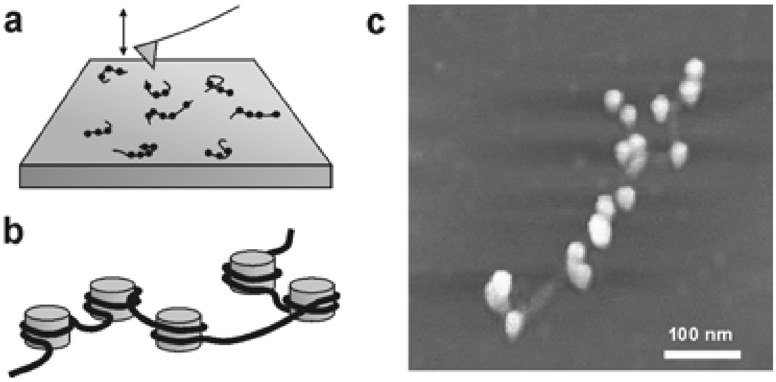
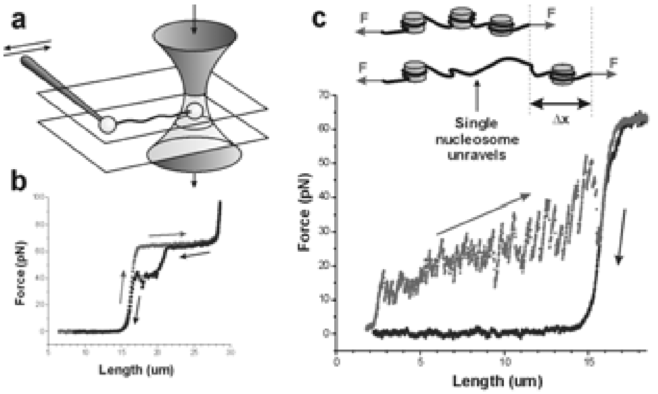


Figure 2
Atomic force microscopy of DNA-protein complexes (a) Principle of tapping mode AFM. (b) Schematic representation of the nucleosomal fiber. Cylinder represents a core histone particle, consisting of 8 histone proteins, around which the DNA is wrapped. (c) Typical AFM image of a nucleosomal fiber.

A single DNA molecule (16 um long) was attached on either end to a 2.6 um polystyrene bead. One bead was immobilized on the tip of a micropipette while the second one was held using optical tweezers. Increasing the end-to-end distance of the molecule by moving one bead away from the other, and measure simultaneously the force using the optical tweezers, allowed us to obtain a force versus length characteristic of a single DNA molecule (Fig. 3a-b). A *Xenopus laevis* cell extract was added that was known to form nucleosomal arrays on naked DNA. This caused the two beads to move towards one another, indicating compaction of DNA into a nucleosomal structure. The force versus length curve upon stretching the compacted fiber revealed forces needed to disrupt the structure and discrete opening events, which we attributed to the discrete opening of individual nucleosomes (Fig. 3c).

Figure 3
Force spectroscopy of individual DNA molecules and chromatin using optical tweezers (a) Schematic representation of a single suspended DNA molecule. (b) Typical force extension curve of a single DNA molecule. (c) Force extension curve of a chromatin fiber, revealing a stepwise opening of the structure.



ORGANIC NANODOTS

Gonzalo Otero, José Ángel Martín-Gago, and **Javier Méndez**
Instituto de Ciencia de Materiales de Madrid - CSIC, Spain
E-mail: jmendez@icmm.csic.es

In the last years, an intensive research was focused on organic materials with promising applications in optoelectronic devices [1]. These materials incorporate interesting properties such as self-organization, flexibility, electronic (semiconducting or metallic) properties and the mentioned optoelectronic properties.

At the other hand, a reduction of the dimensionality of materials result in the emergence of new properties, or modification (even amplification) of the existing. Thus, thin films (2D), nanowires (1D) and dots (0D) exhibit new properties due to their low-dimensional character.

In our study we are investigating the combination of both principles, by reducing the dimensionality of organic materials. We show that we are able to form ordered arrays of organic molecules on a surface by means of a self-organization process. To achieve this, we have used the nanostructure induced on the Au(111) surface, by depositing iron on the $(22\times\sqrt{3})$ reconstruction. Fe-islands are formed at the edges of the reconstruction [2], developing metallic ordered array as showed in figure 1.

We have deposited PTCDA molecules (3,4,9,10 perylene tetracarboxilic dianhydride) on the ordered arrays of Fe/Au(111). PTCDA exhibits a high mobility at room temperature on gold, forming ordered (self-organized) molecular layers with a “zig-zag” periodicity [3]. On the other hand, on the Fe/Au(111) substrate, the PTCDA molecules nucleate preferentially around the iron islands acquiring its nanostructure.

We study these nanostructured systems made of functional organic molecules by means of scanning tunneling microscopy (STM). We investigate the growth of such systems and how the different parameters (rate, dose, temperature) play a role in the final ordering and properties of these *nanodots*.

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Figures:

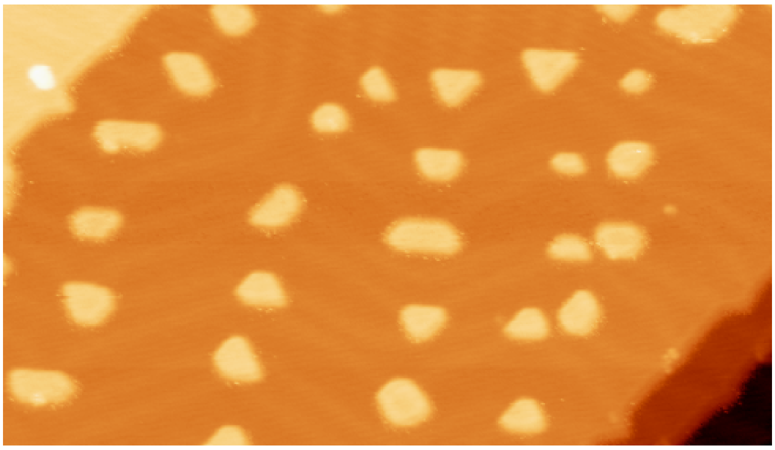

Figure1: iron islands grown at the edges of the reconstruction Au(111)-(22×√3).

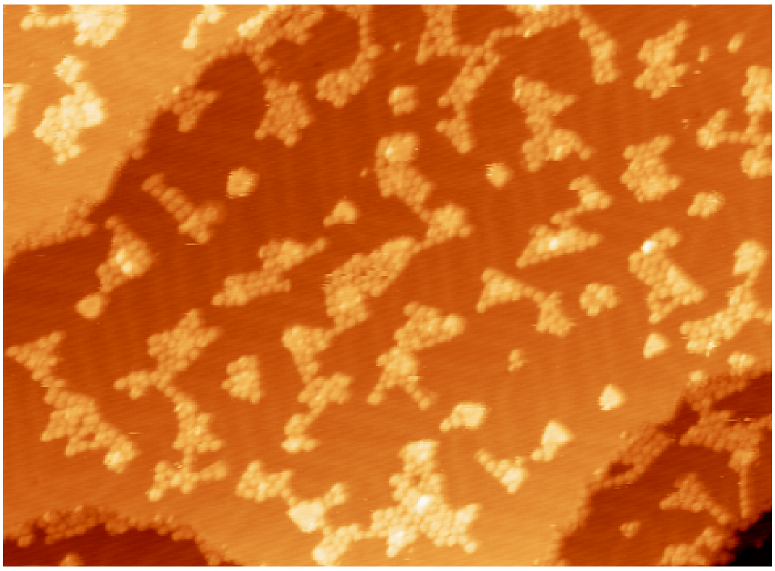

Figure 2: organic molecules of PTCDA nucleated around the iron islands, nanostruturing the organic material.

LENGTH CONTROL AND SHARPENING OF AFM CARBON NANOTUBE TIPS FOR HIGH RESOLUTION IMAGING

Javier Martinez[1], Alex Zettl[2], Carlos Bustamante[2] and Ricardo Garcia[1]
[1]Instituto Microelectronica Madrid, CSIC. Isaac Newton 8, Tres Cantos, Madrid. Spain
[2]University of California Berkeley. Physics Division, 94720 Berkeley, CA. USA

Since their discovery [1], carbon nanotubes (CNT) have been used for their remarkable electrical and mechanical properties in a wide variety of applications such as transistors elements [2], field emission tips [3], biosensors [4], and linear and rotational nanoelectromechanical systems [5]. Despite the progress in the fabrication of CNT, the precise placement of the CNT as well as their directionality and the length control are still unsatisfactory. Even the selection of a single nanotube, as opposed to bundles of nanotubes, remains a challenge.

The high aspect ratio and the stiffness of CNTs make them ideal for their use as scanning probe microscope tips, especially in AFM. Several methods have been used to fix the nanotubes to the end of an AFM tip, ranging from gluing [6], to growing via chemical vapour deposition [7] or by electron beam deposition (EBD) [8]. Nevertheless, to improve the spatial resolution for AFM imaging requires not only affix the CNT in the axis of the tip but also to control precisely the nanotube’s length [9].

Here we report on the successful placement of an individual CNT onto the end of a silicon AFM tip by using a nanomanipulator inside a scanning electron microscope. This method allows to retrieve a single CNT with the AFM tip from an electrode covered with CNTs. Once the CNT is on the tip, we have developed a new technique to control the desired length of the nanotube and sharpening its end. This method permits the fabrication of CNT AFM tips from 40 nm till 2 um in length and final diameter around 2nm (Fig.1). The performance of these tips is demonstrated by imaging the DNA molecules with amplitude modulation mode AFM in air.

As an example (Fig.2), the twisted structure of double stranded DNA on mica can be observed.

Figures:

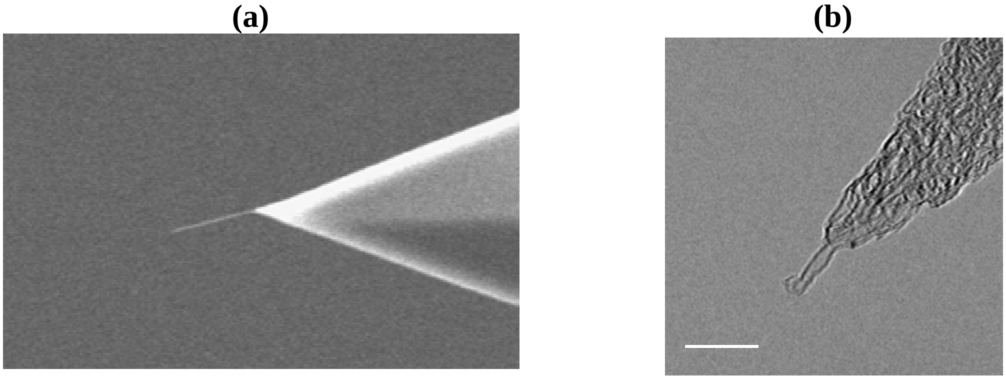

Figure 1. (a) SEM image of AFM CNT tip of 1um length, (b) TEM image of the end of the carbon nanotube tip after the sharpening process, bar is 10 nm.

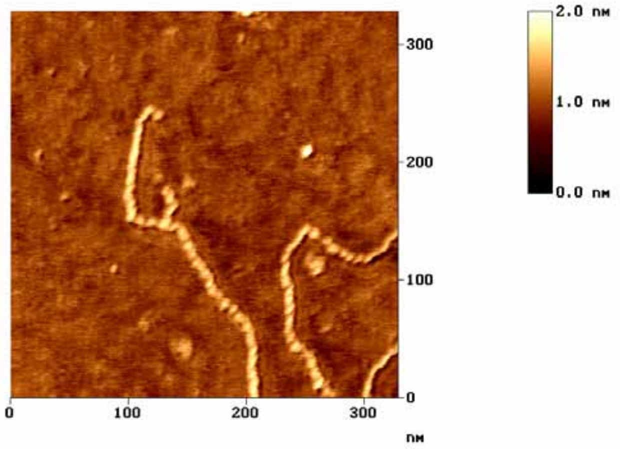

Figure 2. Tapping mode AFM image of DNA on mica acquired with a 50 nm CNT tip

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ATTOMOL CHEMISTRY AND NANOFABRICATION BY ATOMIC FORCE MICROSCOPY

Ricardo García, Marta Tello, Ramsés V. Martínez and Fernando García,
Instituto de Microelectrónica de Madrid, CSIC
28760 Tres Cantos, Madrid

Here we describe our activity in the development of the local chemical nanolithography when this is performed with the AFM tip several nanometers above the sample surface. This requires the use of a dynamic AFM tip and its operation the low amplitude solution or non-contact mode [1]. The local chemical modification is mediated by the formation of a field-induced liquid bridge. Once a liquid bridge is formed, its length and neck diameter can be modified by changing the tip-sample separation [2]. The liquid bridge provides the ionic species and the spatial confinement to modifiy a Si(100) surface. The small number of active ionic species within the bridge, a few attomoles allows a very precise control of the lateral and vertical size of the motive. Different chemical reactions such as oxidation or formation of carbides can be accomplished [3].

Several applications of local chemical modification in the fabrication of nanometer-scale devices will be presented [3], such as: (i) arrays of 5000 dots with a periodicity of 40 nm and an average width of 10 nm, (ii) masks for template growth of organic molecules, (ii) silicon wires and (iv) single electron transistors.

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FULLY POLARIZED SPIN INJECTION INTO CARBON NANOTUBES

L.E. Hueso [a, *], S.N. Cha [b], J.E. Jang [b], G. Burnell [a], J.L. Prieto [a], D.-J. Kang [c],
G.A.J. Amaratunga [b] and N.D. Mathur [a]

[a] Department of Materials Science, University of Cambridge, Cambridge CB2 3QZ, UK
[b] Department of Engineering, University of Cambridge, Cambridge CB2 1PZ, UK
[c] Nanoscience Center, University of Cambridge, Cambridge CB3 0FF

*e-mail: leh29@cam.ac.uk

New materials are required in order to permit miniaturization beyond the silicon era [1, 2]. Carbon nanotubes (CNTs) are uniform molecular conductors that can be successfully employed to build transistors and logic gates [3]. Moreover, their one-dimensional (1-D) character makes them an interesting playground for new physical effects [4].

The electronic transport properties of CNTs have been studied using partially spin-polarised electrons from cobalt electrodes [5, 6]. A modest magnetoresistance effect has been found, as well as coherent transport in distances up to 1 micron. Including the spin as well as the charge degree of freedom opens new avenues for exploration, but for cleaner investigations, it is desirable to work with fully spin-polarised electrons.

Appropriately doped perovskite oxides of manganese such as $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) are ferromagnetic metals in which the conduction electrons tend to be 100% spin polarised at low temperature [7]. It is therefore desirable to fabricate CNT devices with LSMO electrodes. However, to integrate these two very different material systems into a single device is very challenging since their growth conditions are potentially mutually exclusive.

I will describe the fabrication of CNT-LSMO and CNT-palladium devices (see Figure 1) and present electronic transport data (see Figure 2). The behavior of the nanotubes is very different when connected to different electrodes, showing the peculiarities of the CNT-LSMO contact and the great potential of manganite-nanotube devices.

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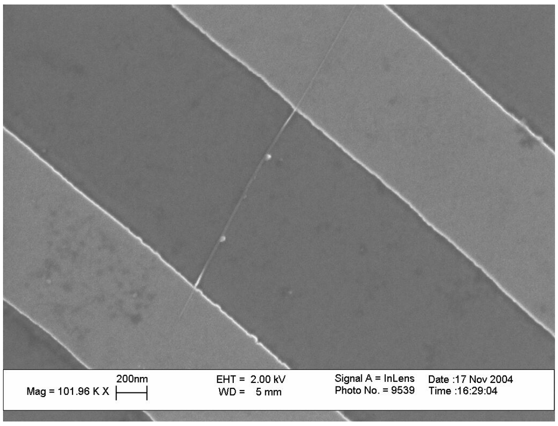

Figure 1. SEM micrograph of a carbon nanotube contacting two manganite electrodes.

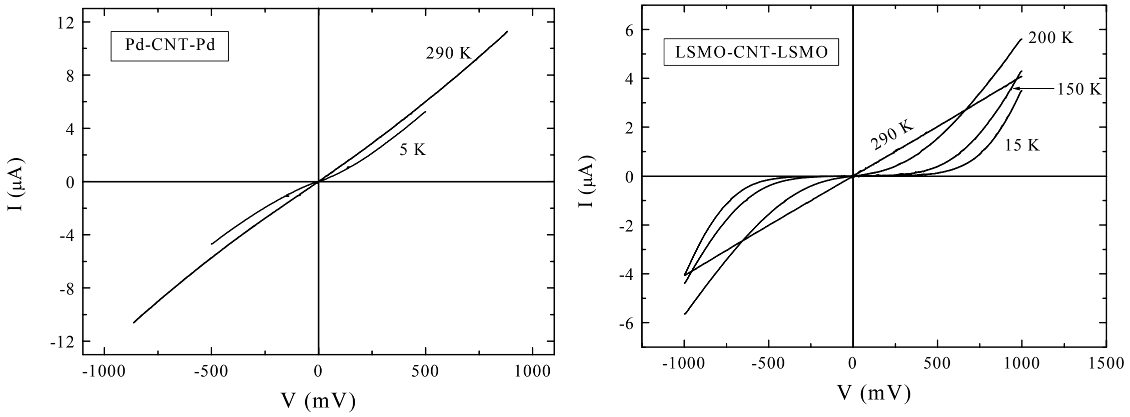

Figure 2. Left: Current (I)-Voltage (V) characteristics of a nanotube with Pd contacts. Right: I-V curves of a similar nanotube with manganite contacts in the same geometry.

Behaviour of break-junctions gold contacts in liquid environment

L. Grüter, M. T. González[1], R. Huber, M. Calame, C. Schönenberger

Institut für Physik, Universität Basel, Klingelbergstr. 82, CH-4056 Basel, Switzerland

Abstract

The Mechanically Controllable Break Junction (MCBJ) technique [1, 2, 3] has demonstrated to be particularly suitable to study the electronic properties of single molecules [4, 5, 6]. The addition of a chemically controllable environment in break junctions experiments would offer a variety of interesting possibilities as, for instance, to tune the electronic properties of a molecule by adjusting its redox state using a liquid gate. The excellent efficiency of such a liquid gate has been demonstrated previously on carbon nanotube field-effect transistors [7], and has been recently tested for organic molecules using a Scanning Tunneling Microscope [8]. A liquid environment will offer also a better control on the anchoring of the molecule to metallic contacts.

In this work, we present the first conductance measurements of MCBJ performed in a liquid environment. Gold break junctions have been fabricated on phosphor bronze substrates using lithography techniques. These devices have been studied at room temperature in vacuum and various organic solvents for molecules relevant to molecular electronics. The solvents also cover a wide range of polarities. At conductance values nearby the conductance quantum $G_0 = 2e^2/h$, the junctions show little dependence on the environment [see Fig. 1(a)] , whereas the solvent significantly affects the tunneling current [see Fig. 1(b)]. We discuss the effect of the junction-to-junction variability. In the case of octane, our observations provide good evidence for a layering effect of the solvent molecules at small inter-electrodes separations. Our results show that micro-fabricated break junctions can be operated in a liquid environment, opening interesting perspectives to study single-molecule devices in a chemically active environment.

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[1] `teresa.gonzalez@unibas.ch`

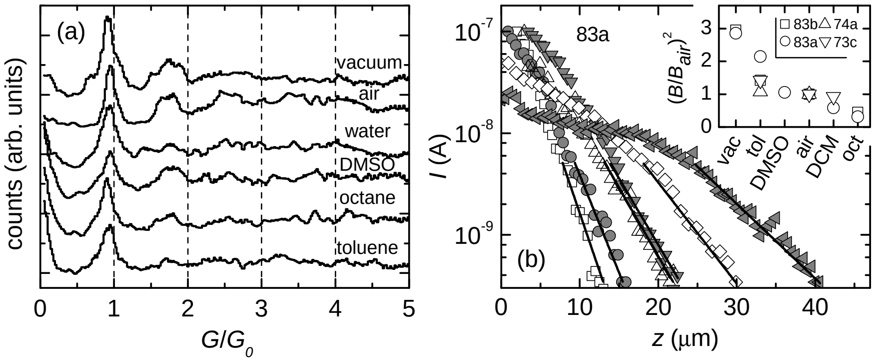

Figure 1: (a) Conductance histograms, shifted vertically for clarity, of three junctions in several environments. The data for dimethylsulfoxide (DMSO), octane and toluene correspond to one junction, those for air and water to a second one and those for vacuum to a third one. (b) Tunneling regime: Raw data for the current versus the vertical displacement of the push-rod z (proportional to the gap size between the gold tips) for a gold junction in different environments: □ vacumm (vac), ○ toluene (tol), △ DMSO, ▽ air,◇ dichoromethane (DCM), and ◁ octane (oct). The lines are obtained from fits of the current to an exponential law. The curves are shifted horizontally for clarity, and the zero in z has been arbitrarily chosen. The inset shows the resulting mean value of the slope B from fitting an exponential law $\ln(I) \propto -Bz$ to several sets of curves similar to that shown in part (b), respect to that of air, for four different junctions.

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[111] heterostructures for Rashba spin injectors and resonant spin lifetime transistors

X. Cartoixà*, D. Z.-Y. Ting†, J. Suñé
Departament d'Enginyeria Electrònica,
Universitat Autònoma de Barcelona
08193 Bellaterra (Barcelona), Spain
†*Jet Propulsion Laboratory,*
California Institute of Technology,
Pasadena, CA 91109, USA
*e-mail: Xavier.Cartoixa@uab.es

In recent years, interest in developing spin-sensitive devices (spintronics) [1] has fueled renewed investigations into spin phenomena in semiconductors. The aim is to control not only the spatial degrees of freedom of the electron, but also the spin degree of freedom. Useful spintronic devices such as spin transistors [2, 3], spin LEDs [4], low threshold current lasers [5] can be devised if such control is attained.

One of the barriers that must be overcome for these prospects to become reality is the establishment of reliable injection of spins into semiconductors. While some success has been achieved in this field [6, 7], good results normally require cryogenic temperatures together with the use of magnetic materials and external magnetic fields, which would be impractical for commodity devices.

There exist proposals for nonmagnetic spin injectors [8, 9] based on the Rashba effect [10]. The proposal based on the asymmetric resonant interband tunneling device (aRITD) version [9] relies on a strong spin dependence of the transmission coefficient (see Fig. 1) rather than the amount of splitting between the levels, which should make it more robust to operation at higher temperatures. This strong spin dependence, which does not appear in the intraband case, is only beginning to be understood.

We present calculations of the spin-resolved transmission coefficient for aRITDs with the different substrate orientations [001], [110] and [111]. The results indicate that, as $k_{||}$ grows and under the presence of structural inversion asymmetry (SIA), the two barriers become more symmetric for one of the spins and less symmetric for the other one. The high (low) level of symmetry translates into a strong (weak) resonance peak. The [111] orientation is specially interesting because the structure can be designed to have very little spin splitting while keeping strong spin selectivity, which limits the amount of D'yakonov-Perel' (DP) spin relaxation that the electron can suffer while tunneling.

The unusual features of [111] heterostructures for spintronics come because the bulk inversion asymmetry (BIA) and SIA (e.g. Rashba) contributions to the spin Hamiltonians have the same functional form [11, 12]. We show how this can be used to zero out the linear splitting component in two-dimensional electron gases and thus suppress the DP spin relaxation mechanism for *all* spin components at the same time—as opposed to a single component for the [001] and [110] cases (Fig. 2). Finally, we discuss how this feature can be used to relax some design restrictions on the recently proposed resonant spin lifetime transistor [3, 13].

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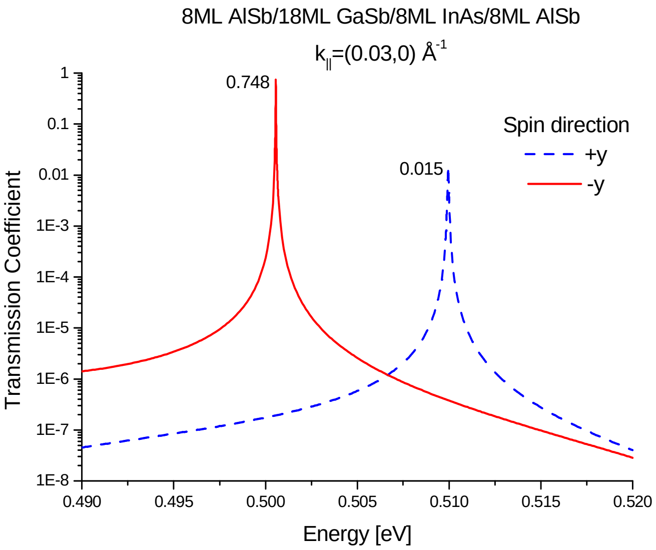

FIG. 1: Tunneling transmission coefficients for an InAs/8ML AlSb/18ML GaSb/8ML InAs/8ML AlSb/InAs asymmetric double barrier at zero bias. The electrons are taken to come with $\mathbf{k}_{\|} = (0.03, 0)\mathring{A}^{-1}$. The Rashba effect splits the transmission peak into two for spins pointing along $+y$ (dashed curve) and $-y$ (solid curve). The peak strength is also heavily dependent on the incoming spin direction.

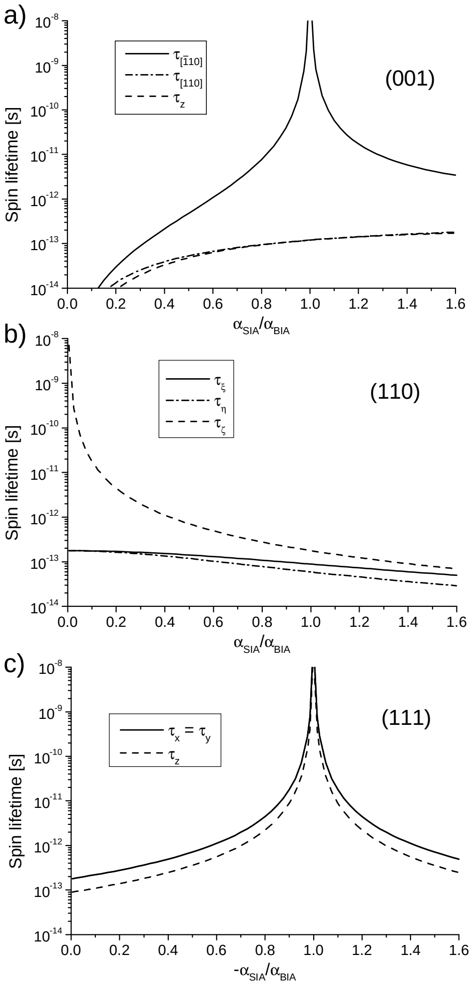

FIG. 2: Spin lifetimes for 2DEGs grown along [001], [110] and [111] substrates.

Doping metallic chemically active nanocontacts: Pt and Au in a H_2 environment.

Yamila García*,[1, 2] J. J. Palacios,[1, 2] E. SanFabián and,[3, 2] E. Louis,[1, 2] A. J. Pérez-Jiménez and,[3, 2] and J. A. Vergés.[4]

[1]*Departamento de Física Aplicada, Universidad de Alicante,*
San Vicente del Raspeig, Alicante 03690, Spain.
[2]*Instituto Universitario de Materiales and Unidad Asociada UA-CSIC,*
Universidad de Alicante, San Vicente del Raspeig, Alicante 03690, Spain.
[3]*Departamento de Química-Física, Universidad de Alicante,*
San Vicente del Raspeig, Alicante 03690, Spain.
[4]*Departamento de Teoría de la Materia Condensada,*
Instituto de Ciencias de Materiales de Madrid ICMM-CSIC, Cantoblanco, Madrid 28049, Spain.

Single atoms/molecules are the next step in reducing active parts of electronic circuits[1]. The functionality of nanostructures built from, let's say, Hydrogen atoms or heavier molecules like BDT's or carbon nanotubes placed in between metallic electrodes has been by recently shown[2, 3]. Nevertheless, an industrial application of these devices requires systematicity at experimental and theoretical levels. In the manufacturing process this behaviour is suppported by the development of techniques like STM, AFM, etc. which allow control of nanosized structures. From a theoretical point of view, characterization and, therefore **prediction ability**, will be only supported with a description at the quantum level[4].

In this work we show a first principles method developed by our group to study electronic transport intended to provide a powerful tool for dimension-reduced systems, where an *ab-initio* description is essential[5, 6]. Considering the existence of discrepancies between theoretical groups[3, 7–9], presumably working at an *ab-initio* level, we center the discussion in two points:

- Quantum chemistry tools in use. The problem derived from the Shrödinger equation for the infinite system must be simplified in order to compute a numerical solution. DFT theory is currently one of the most useful tools in this respect. The many body problem due to interactions among electrons is typically reduced to local exchange and correlation potentials through density functional theory. With our results we showed the non-validity of approximations like purely LSDA or GGA, (sometimes the only ones used by physicists), for the selection of the functional[10]. We propose another kind of functionals, more adjusted for atomic/molecular bridged systems, where nonlocality of exchange energy is better taken into consideration. Finally, in this topic we remark the validity of DFT theory, at least for systems under typical approximations (zero bias and zero temperature).
- Chemistry at the contact. There is no doubt about the influence of the atomic arrangement in electronic transport[8, 11]. For pure metalic systems the structural arrangement lies between the bulk system and the monoatomic contact and also, generally, can be directly observed. In cases where atom/molecules are "placed in between" metallic electrodes the number of final arrangements increase as a consequence of a chemical reaction at the neck, and unfortunately can not be directly determined. For this reason, here we apply methods established by quantum chemistry to study and predict chemical reactions of finite systems to our infinite metallic nanocontacts. Models assuming the existence of energetically well-defined molecular orbitals are employed throughout the analysis of the density of states in the zone to be chemically studied.

Finally we present numerical results quantitative supporting previous statements.

The atomic/molecular system selected is Hydrogen attacking metallic systems like Platinum and Gold nanocontacts. Hydrogen could be the building block of the smallest atomic/molecular bridged system. Also these elements remain, even in cases where ultra vacuum seems attained. Since both statements are recently experimentally suggested[3, 12] , and not theoretically well supported, we focus our studies on these systems. The disocciation of the Hydrogen molecule is proposed as a barrierless process in Platinum nanocontacts and, from our analysis, noble metals like Gold are also activated due to mechanical stresses. Due to final arrangements proposed at the neck, electronic conductance is drastically reduced in both cases[8, 13].

Our message is that the process of **formation of nanocontacts** is a **mechanical** way of **inducing catalytic activity**. Also within this context we explain electronic transport in atomic/molecular bridged systems where **atoms/molecules** are presented as very **well localized dopants on metallic nanocontacts**.

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[*] email:yamila.garcia@ua.es

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A theoretical study of surface reconstructed silicon nanowires

R. Rurali and N. Lorente
Laboratoire Collisions, Agrégats, Réactivité,
IRSAMC, Université Paul Sabatier,
118 route de Narbonne, 31062 Toulouse cedex, France

Abstract

One-dimensional nanostructures are attracting a great interest for their potentially high impact in future molecular electronics applications, such as nanoswitches and nanocontacts.

Silicon nanowires (SiNWs) appear to be a special appealing alternative, due to the ideal interface compatibility with conventional Si-based technology and to the possibility to tune their conductive properties by means of electrical doping.

While it has been extensively demonstrated that in H-terminated SiNWs quantum confinement induces a gap-broadening effect[1], very little is known about surface reconstruction of non-passivate wires and their electronic structure features. We present a theoretical study based on density-functional calculations of realistic $\langle 100 \rangle$ SiNWs[2], with a bulk Si core and a diameter of ~ 1.5 nm. Particularly, we focus our attention on the features of the electronic properties of the wire as determined by the different possible lateral surface reconstruction. We find two competing geometries for the $\{100\}$ facets. One of them shows a semi-metallic behavior with one state approaching the Fermi level at the zone boundary, while the other has four metallic states. These states show a great degree of surface localization. Therefore, current flow is almost entirely sustained by the outer layers of the SiNW[3].

The possibility to obtain one-dimensional metallic Si nanostructures opens up the way to a wide range of novel nanoscience applications that require stout and atomic-scale contacts. Metallic SiNWs are a promising path to usher Si in nanotechnology applications.

Preliminary results of non-equilibrium electron transport calculations will also be presented[4].

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CONDUCTANCE IN GOLD MONOATOMIC WIRES CONTAINING OXYGEN AND CARBON IMPURITIES

E. Machado[1], S. Garcia[1], M. Brandbyge[2] and P. Ordejon[1]

1. Institut de Ciència de Materials de Barcelona-CSIC, Campus UAB, 08193
Barcelona, Spain
2. MIC-Technical Univ., Denmark

E-mail: sgarcia@icmab.es, machado@icmab.es, mbr@mic.dtu.dk, ordejon@icmab.es

Some important aspects of the experiments in atomic-sized gold nanowires are still controversial [1, 2, 3]. The main reason is that different procedures are followed to obtain the samples in which different kinds of measurements are performed. Conductance measurements (which consistently find values very close to the quantum of conductance Go=2e2/h) are done in wires obtained in mechanically controllable break junctions. In these samples, the atomic distances are not directly measured, but can be estimated using indirect approaches to be around 2.5 Å, in good agreement with theoretical predictions [4]. On the other hand, direct visualization by TEM is possible in samples obtained by electron beam drilling in thin films, where unusually long distances are often observed. Several explanations for these long distances have even presented to date[2, 5, 6], and some of them involve the presence of light impurities such as O or C in the gold chain.

Here, we consider the issue whether the presence of these impurities affects the transport properties of the gold wires. Our results show that the conductance changes dramatically in the presence of impurities [7], which lead us to propose that transport measurements could be a way to verify experimentally the presence of impurities in atomic gold wires.

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MARCH 16, 2004: SCIENTIFIC PROGRAMME

SCIENTIFIC PROGRAMME

Wednesday – March 16, 2005

09h00-10h00	**Markus Antonietti** (Max-Planck-Institute of Colloids and Interfaces, Germany): *New Approaches to oxidic nanoparticles and functional mesoporous crystalline layers*
10h00-10h20	**Luis Fernandez-Barquín** (UNICAM, Spain): *Direct evidence of the existence of correlated nanometric magnetic grains in Fe-based amorphous and crystalline alloys by SANS*
10h20-10h40	**Victor Franco Puntes** (UB, Spain): *Subnanometric Co Nanoparticles, beyond superparamagnetism*
10h40-11h00	**Antonio Hernando** (RENFE-UCM-CSIC, Spain): *Magnetic properties of metallic nanoparticles*
11h00-11h30	***Coffee Break***
11h30-11h50	**Daniel Ruiz-Molina** (ICMAB, Spain): *Multiple Length Scale Patterning of Single-Molecule Magnets*
11h50-12h10	**Juan Bartolomé** (UNIZAR, Spain): *Magnetic dynamics of Co nanospheres: origin of the enhanced anisotropy*
12h10-12h30	**Jordi Esquena** (IIQAB-CSIC, Spain): *Highly Concentrated Emulsions as Templates for the Preparation of Hierarchically Ordered Materials*
12h30-12h50	**Natalia Galiana** (ICMM-CSIC, Spain): *MBE fabrication of self-assembled Si and metal nanostructures*
12h50-13h10	**Wolfgang Maser** (CARBON-ICB-CSIC, Spain): *Polyaniline-Carbon Nanotube Composites: From Wrapping and Self-Alignment to Solubility and Enhancement Effects*
13h10-13h30	**Veronique Abad Langlais** (UAB, Spain): *Self–organized calix[4]arenes on Au(110):fully resolved structure by a combined stm, leed, and gixrd study*
13h30-15h30	***Lunch***
15h30-16h30	Flash Contributions (5 minutes each)
16h30-19h00	***Poster Session / Coffee Break***
19h00-20h00	Meeting NanoSpain network (Plenary)
21h30	***Conference Dinner***

Flash Contributions

Last Name	Name	Title	Topic
Alonso	Maria	PLGA-Mannosamine nanoparticles as new carriers for oral immunization	Nanobiotechnology
Casuso	Ignacio	DC current-voltage characteristics of purple membrane obtained by conducting atomic force microscopy	Nanobiotechnology
De la Fuente	Maria	Hyaluronate-Chitosan nanoparticles as new vehicles for ocular administration	Nanobiotechnology
Prego	Cecilia	Chitosan nanocapsules as transmucosal carriers for oral peptide delivery	Nanobiotechnology
Conesa	Juan Carlos	Behavior of catalytic cerium-containing mixed oxide nanoparticles upon high temperature treatments	Nanochemistry
Molina	Ricardo	Self-arrangement of surface chemical groups generated on air plasma treated wool	Nanochemistry
De la Cruz	Rosa Mª	Confinement and polaron energies in truncated conical semiconductor quantum dots	Nanoelectronics
Esplandiu	Mª Jose	Single-Walled Carbon Nanotubes as nanotools for Scanning Probe Microscopies	SPM
Garcia	Ricardo	Multipurpose Force Tool for Quantitative nano-scale analysis and Manipulation of Biomolecular and Polymeric surfaces	SPM
Ritort	Felix	Condensation transition in DNA-PAMAM dendrimer fibers studied using Optical tweezers	SPM
Iglesias	Oscar	Exchange bias and surface anisotropy effects in the hysteresis loops of nanoparticles	Simulation at the nanoscale

NEW APPROACHES TO OXIDIC NANOPARTICLES AND FUNCTIONAL MESOPOROUS CRYSTALLINE LAYERS

Markus Antonietti *, Markus Niederberger, Bernd Smarsly

Max-Planck-Institute of Colloids and Interfaces
Research Campus Golm, D-14424 Potsdam, Germany

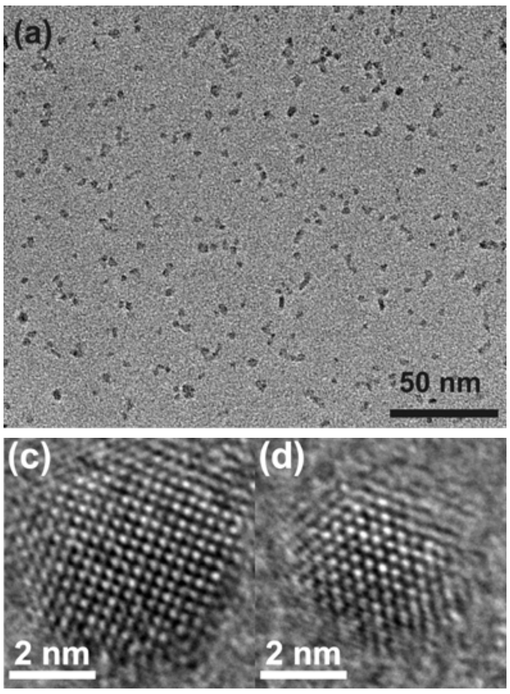
Bringing nanodimensions to functional inorganic materials shows a number of promises for both basic science and applications. Solid state properties as magnetism, ferroelectricity, or optoelectronics depend on the size and can be vice-versa fine tuned by size quantization.

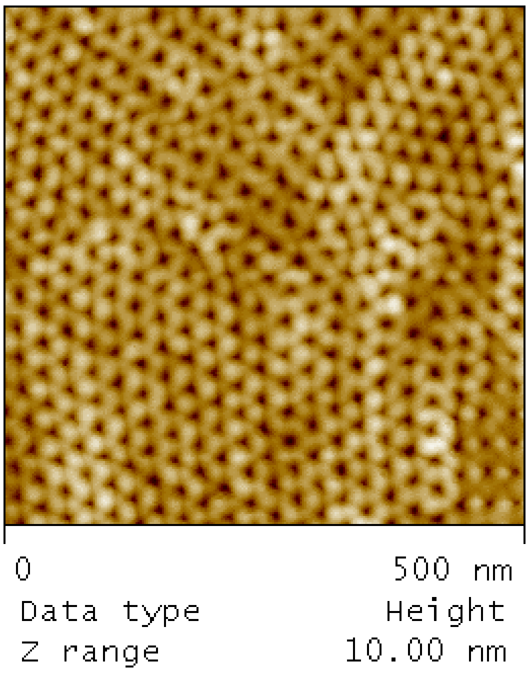
In this talk I will report on two novel approaches to approach such systems

1) Non aqueous sol-gel routes turned out to be a very convenient and simple way to generate stable oxidic nanoparticles even with complex composition, including Ta_2O_5, Nb_2O_5, V_2O_3, HfO_2, SnO_2, or In_2O_3, and even perovskites and spinells such as $(Ba,Sr)TiO_3$, $LiNbO_3$, and $Pb(Ti,Zr)O_3$. Details and applicability of this synthetic technique will be discussed

2) Nanocasting of organized mesophases of amphiphilic block copolymers and subsequent calcination under controlled conditions allows the generation of mesoporous thin films of crystalline oxides where both pore size and wall thickness are of the order of relevant length scales, e.g. the exiton length. It is expected that such films will be imparted in the next generation of inorganic device technology, e.g. for improved sensing or solar energy conversion.

The following pictures show two examples for such nanoproducts, on the left some ferroelectric $(Ba,Sr)TiO_3$ nanoparticles, on right some mesoporous crystalline titania films for solar cells.





DIRECT EVIDENCE OF THE EXISTENCE OF CORRELATED NANOMETRIC MAGNETIC GRAINS IN Fe-BASED AMORPHOUS AND CRYSTALLINE ALLOYS BY SANS

R. García Calderón[1], L. Fernández Barquín[1], S. N. Kaul[2] and Q. A. Pankhurst[3]

[1] Departamento CITIMAC, Universidad de Cantabria, Santander 39005, Spain
[2] School of Physics, University of Hyderabad, Hyderabad 500046, INDIA
[3] Dept. Phys. & Astronomy, Univ. Coll. London and London Centre for Nanotechnology, Gower Street, London WC1E 6BT, U. K.

There is growing experimental evidence that (i) magnetic inhomogeneity or the so-called ‘magnetic microstructure’ is an attribute that is *inherent* to magnetic systems as different as amorphous (or crystalline) ferromagnets, nanocrystalline soft magnetic alloys, nanostructures, fine ferromagnetic particles, granular giant magnetoresistance (GMR) materials, colossal magnetoresistance (CMR) manganates and frustrated pyrochlore oxides, and (ii) the nature of magnetic inhomogeneity basically decides the magnetic behaviour of a given system [1]. In this sense, we have synthesized two types of alloys, the FeCuAg nanocrystalline granular alloys, $Fe_{13}Cu_{10}Ag_{77}$ and $Fe_{22}Cu_{14}Ag_{64}$ [2], and an amorphous alloy of $Fe_{91}Zr_9$ [3]. In the FeCuAg case, the system is constituted by Fe(Cu) magnetic nanometric grains in a diamagnetic Ag matrix. These alloys present an *interacting* superparamagnetic behaviour with the existence of dipolar interactions among the Fe(Cu) grains. The intensity of the interactions increases when the concentration of magnetic grain diluted in the matrix increases, as it is observed when going from $Fe_{13}Cu_{10}Ag_{77}$ to $Fe_{22}Cu_{14}Ag_{64}$. However, the $Fe_{91}Zr_9$ alloy is formed by ferromagnetic clusters in a ferromagnetic matrix and behaves as a re-entrant ferromagnet. For the characterisation and analysis of the inhomogeneities in these systems and of how they are responsible of the observed magnetic behaviour, the alloys have been studied by Small Angle Neutron Scattering (SANS). This is a unique technique to characterise *directly* magnetic inhomogeneities of sizes from 1 to 1000 nm. Measurements have been carried out at different temperatures and it has been possible to separate the magnetic and nuclear contributions to the total scattering intensity by applying a large enough magnetic field to saturate the samples. From the magnetic component to the intensity is possible to obtain values for the size distribution of magnetic grains/clusters embedded in the matrix.

In the case of the Fe-Cu-Ag alloys, the SANS data show no evidence of changes in the size of the nanometric magnetic grains with temperature above and below the blocking temperature. The signal corresponds to particles in different environments, most of them (95 vol. %) are small single-domain (approx. 4 nm) superparamagnetic particles (low degree of interparticle interactions), and there is a minor fraction, in which the grains are larger (< 14 nm) and will present enhanced magnetic correlations among the grains. Respect to the $Fe_{91}Zr_9$ alloy, the SANS intensity displays important changes for different temperatures (10, 90, 160, 300 K), characteristic of a re-entrant spin-glass state for low temperatures ($T < 50$ K), ferromagnetic behaviour ($50\text{ K} < T < T_C = 210\text{ K}$), and paramagnetic for the pattern at RT, respectively. In this alloy two types of clusters coexist, on one hand, 2 nm clusters *completely isolated* from the ferromagnetic matrix and, on the other, *partially isolated* clusters that increase their size from 2 nm when increasing temperature through two processes: merging together because of the strong coupling between the neighbouring clusters to form a bigger cluster or polarizing an increased number of spins originally belonging to the FM matrix via direct exchange interactions. However, the temperatures in excess of T_C disorder not only the ferromagnetic matrix but also the clusters and hence the cluster size decreases for temperatures above T_C.

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SUBNANOMETRIC Co NANOPARTICLES; BEYOND SUPERPARAMAGNETISM

Eva Barea[1] , Patricia Concepción[1] , Carlos López[1] , Avelino Corma[1] , Neus G Bastús[2] , Víctor Puntes[2] , Xavier Batlle[2] , Amílcar Labarta[2].

[1]Instituto de Tecnología Química, UPV-CSIC, Av. los Naranjos, s/n, Valencia.
[2]Departament de Física Fonamental, Universitat de Barcelona, 647 Av Diagonal, 08028 Barcelona, Spain.

vfpuntes@ffn.ub.es

Cobalt is an interesting material since Co nanocrystals display a wealth of size-dependent structural, magnetic, electronic, and catalytic properties [1].

We recently presented a Co containing zeolite that after annealing produced a collection of small Co clusters (below 2 nm) stabilized in the SiO_2 matrix, displaying a particular magnetic behaviour. In detail, we observed that the difference in the magnetization at 10 K and 300 K could not be attributed only to thermal agitation of the cluster dipoles, thus indicating that the clusters had reached their Curie temperature in between [2].

In this work, we present the synthesis technique to obtain highly stable sub-nanometric Co clusters, and the magnetic study of their behaviour, which is characterized by a Curie temperature (Tc) of 20 K, in the case of the BetaCo zeolite containing 5% of atomic Cobalt in the initial zeolitic framework. Tc is also around 20 K for zsm5Co, for which there is a total 3% of atomic Co.

In these samples, we have a distribution of sub-nanometric Cobalt clusters (about 30 atoms in average, Fig.1). The sample looses its magnetization *faster than it would do by thermal agitation* of the cluster magnetic dipoles [3], as in superparamagnetic (SP) materials. This gives place to a more abrupt transition to a blocked state (in 10 K the sample looses over 80 % of the magnetization) than that occurring in SP assemblies of nanoparticles. Abrupt transitions are usually desired for sensors and devices.

This is observed in Fig.2., in the magnetization versus T curve measured at low fields (50 Oe), after zero field cooling (ZFC) or field cooling (FC) the sample. In the ZFC at 1.8 K, there is a random distribution of cluster dipoles which point progresively towards the direction of applied field (without reversal) as temperature increases. But, above the blocking temperature, a maximum in the magnetization is reached at Tmax (Tmax for BetaCo is 8.6 K and 9,8 K for zsm5Co) as a significant amount of the clusters become SP. Above Tmax, the cluster dipoles start to vanish faster than it would correspond to SP relaxation, since Tc of the clusters is approached (Tc about 20 K).

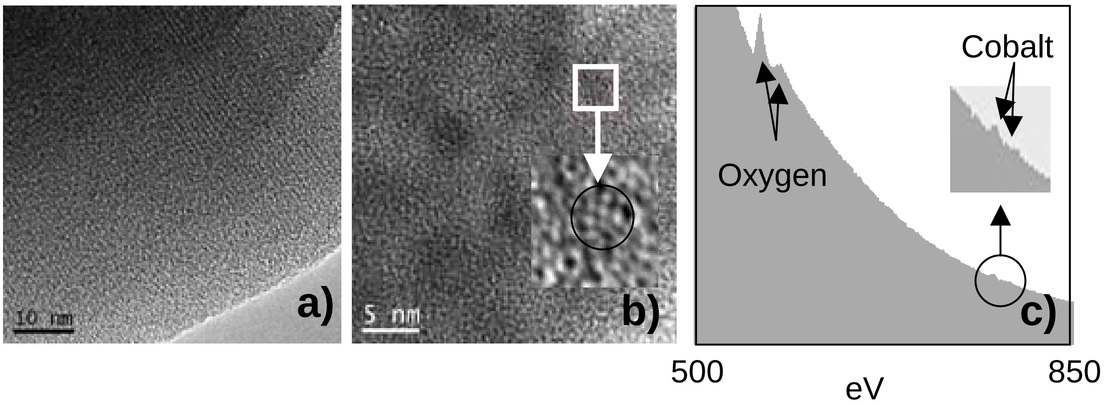

Fig.5 HRTEM of the BetaCo samples. *(a) Regular structure of the zeolite. (b) Co cluster in the SiO_2 matrix. The image was obtained at 10^6 magnifications. (c) EELS spectra of the same area where the tiny amount of Co is detected.*

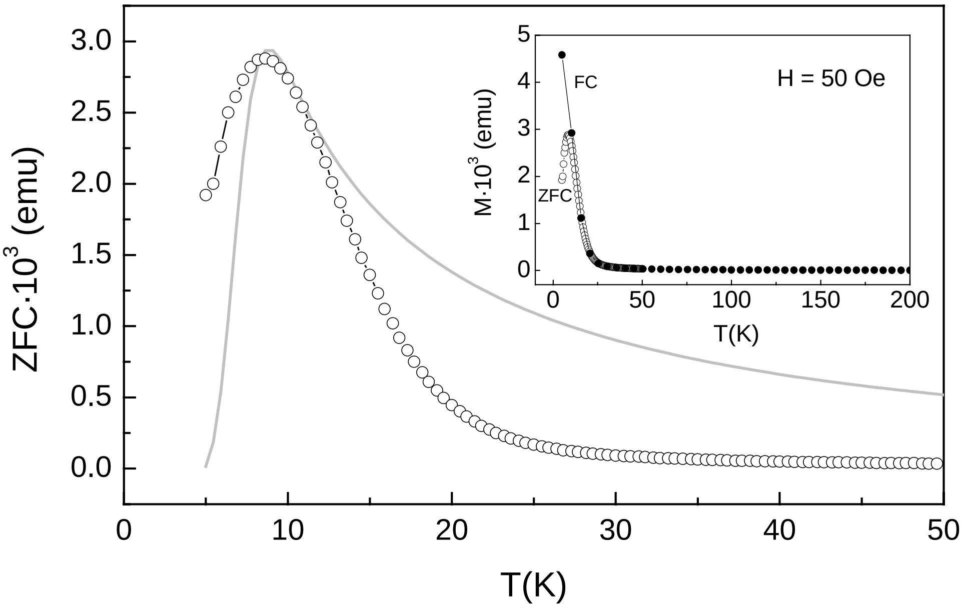

Fig.1. Magnetic susceptibility of BetaCo samples. *ZFC curve measured at 50 Oe for the sample BetaCo. The grey line correspond to the theoretical superparamagnetic relaxation of Co particles with the same magnetic moment and a monodisperse size distribution (σ = 0.05). Inset: The same curve plotted at temperatures up to 200 K.*

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MAGNETIC PROPERTIES OF METALLIC NANOPARTICLES

A. Hernando[1,2], J. de la Venta[1,2], B. Sampedro[1,2], E. F. Pinel[1,2], J. M. Merino[1,2], P. Crespo[1,2], M. L. Ruiz-González, M. A. García[1,2], J. M. González-Calbet[1,3]

[1]Instituto de Magnetismo Aplicado "Salvador Velayos". Universidad Complutense de Madrid, 28230, Madrid, Spain.
[2] Depto. Física de Materiales, UCM, 28040 Madrid, Spain.
[3]Depto. de Química Inorgánica I, Facultad de Química. UCM, 28040 Madrid, Spain.

Nanoparticles often exhibit different physical properties than bulk materials with the same composition, mainly because two reasons: (i) As the size of these system reaches the typical lengths of some phenomena, it is expected that the response of the system depends on the boundary conditions (which are no longer periodic, but determined by the particle size), and therefore, to be different from bulk material. (ii) Because of the large ratio of surface to volume atoms in nanoparticles, the surface energy becomes important when compared with volume energy and therefore the equilibrium situation can be different from that for bulk materials. Furthermore, surface atoms not only are different to volume atoms, but they can also be modified by interaction with other chemical species, that is, by capping the nanoparticles. This phenomenon opens the possibility to modify the physical properties of the nanoparticles by capping them with appropriate molecules. Actually, it should be possible that non ferromagnetic bulk materials exhibit ferromagnetic-like behaviour when prepared in NP. We have obtained magnetic nanoparticles from non magnetic bulk materials by different methods: Pd, Pt and the surprising case of Au (that is diamagnetic in bulk). In the case of Pt and Pd, the ferromagnetism arises from the structural changes associated with size effects. On the other size, gold nanoparticles become ferromagnetic when they are capped with appropriate molecules: the charge localised at the particle surface gives rise to ferromagnetic-like behaviour. The large spin-orbit coupling of those noble metals yields to a large anisotropy and therefore to high order temperatures.

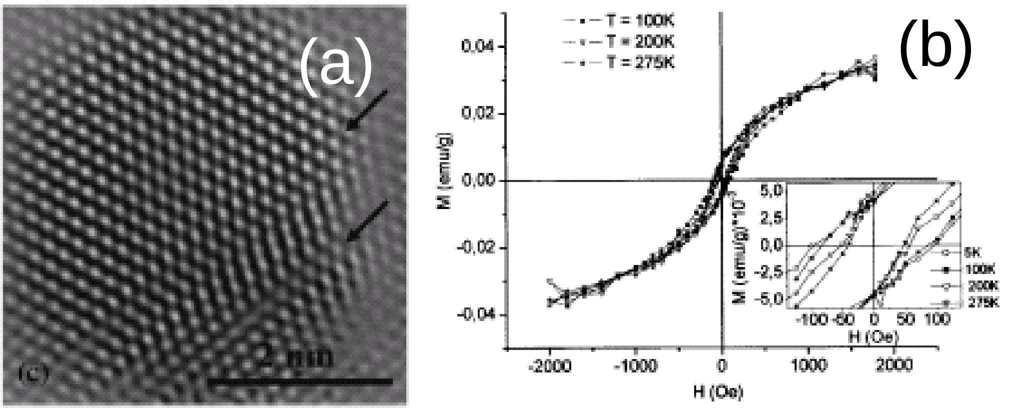

Figure 1. (a) Fourier filtered HRTEM image of a Pd nanocrystal (diameter 4.4 nm) showing two twin boundaries. (b) Hysteresis loops at different temperatures of Pd nanoparticles. Inset: a more detailed view of the thermal coercivity response of the same sample.

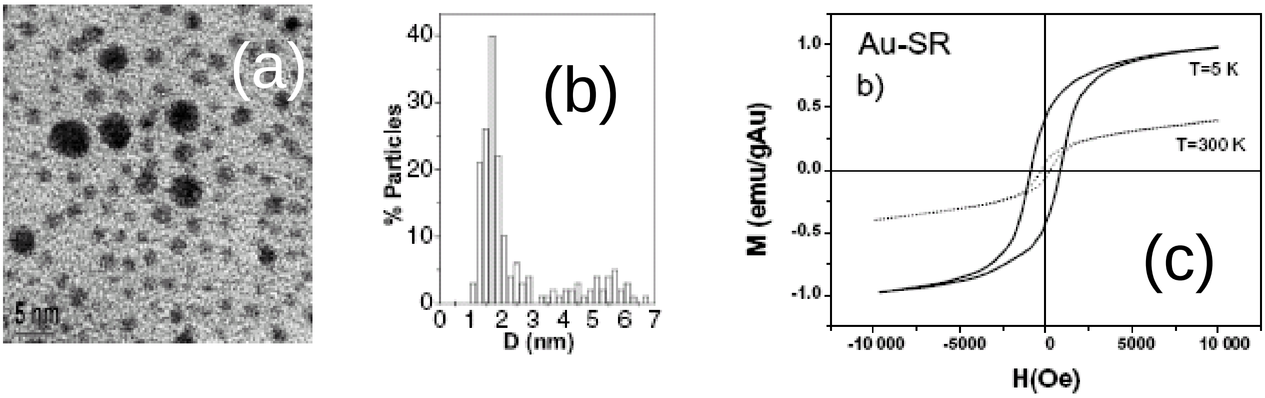

Figure 2. (a) Transmission electron micrographs, (b)the corresponding size histogram and (c) hysteresis loops from thiol-capped gold nanoparticles.

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MULTIPLE LENGTH SCALE PATTERNING OF SINGLE-MOLECULE MAGNETS

Jordi Gomez-Segura[a], Daniel Ruiz-Molina[a], Massimiliano Cavallini[b], Concepció Rovira[a], Fabio Biscarini[b] and Jaume Veciana[a]

[a]*Institut de Ciencia de Materials de Barcelona (CSIC), Campus Universitari de Bellaterra, 08193 Cerdanyola, Spain. E-mail: dani@icmab.es*
[b]*Istituto per lo Studio dei Materiali Nanostrutturati (CNR), Sez. di Bologna, Via P. Gobetti 101, I-40129 Bologna, Italy*

Single-molecule magnets (SMM) have a large-spin ground state with appreciable magnetic anisotropy, resulting in a barrier for the spin reversal. As a consequence, interesting magnetic properties such as out-of-phase ac magnetic susceptibility signals and stepwise magnetization hysteresis loops due to individual molecules rather than to long-range ordering are observed below the blocking temperature (T_B) where the magnetization relaxation rates are very slow. Such molecules may become materials with a potential impact in ultra-high-density magnetic storage and in quantum computing applications, provided their T_B values can be increased to reasonable values and the molecules can be organized into addressable domains.

The fabrication of ordered patterns of SMMs is a crucial step in the realization of memory elements based on these materials. New approaches that allow direct fabrication of ordered patterns of SMMs, either isolated or aggregated, onto surfaces where each molecule or molecular aggregate can be used as a bit of information are required. Because SMM is a paramagnetic material at room temperature, an ordered pattern of molecular aggregates is technologically more relevant than individually isolated molecules dispersed on a surface in view of developing new storage media. Arrays of domains with a characteristic size and position can indeed be addressed and read differentially by a magnetic head or by magnetic scanning probes.

Here we demonstrate the patterning of aggregates of SMMs with size and distance control on multiple length scales ranging from tens of nanometers to millimeters. For this to be achieved, different experimental techniques based on the use of polymeric thin films and/or stamp-assisted patterning of molecules together with dewetting phenomena, arising from competing interactions between the molecules and the substrate, have been used

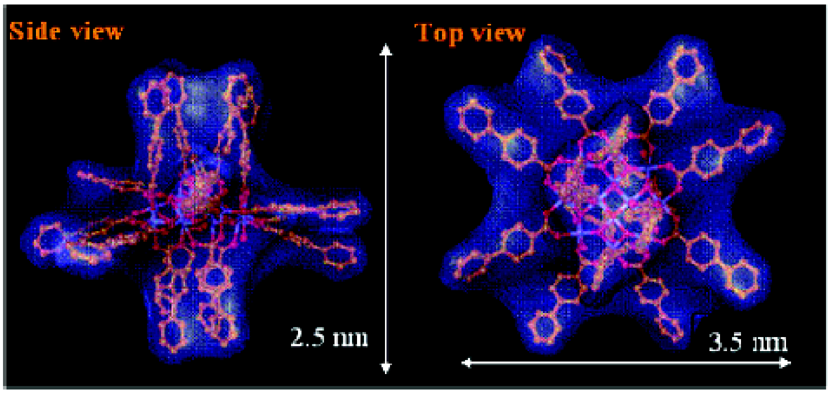

Figure 1. Molecular structure of the SMM complex used. Side and top views of the molecular structure of the Mn_{12} complex obtained by molecular modeling. Connolly surfaces around the molecule show the van der Waals shape and volume.

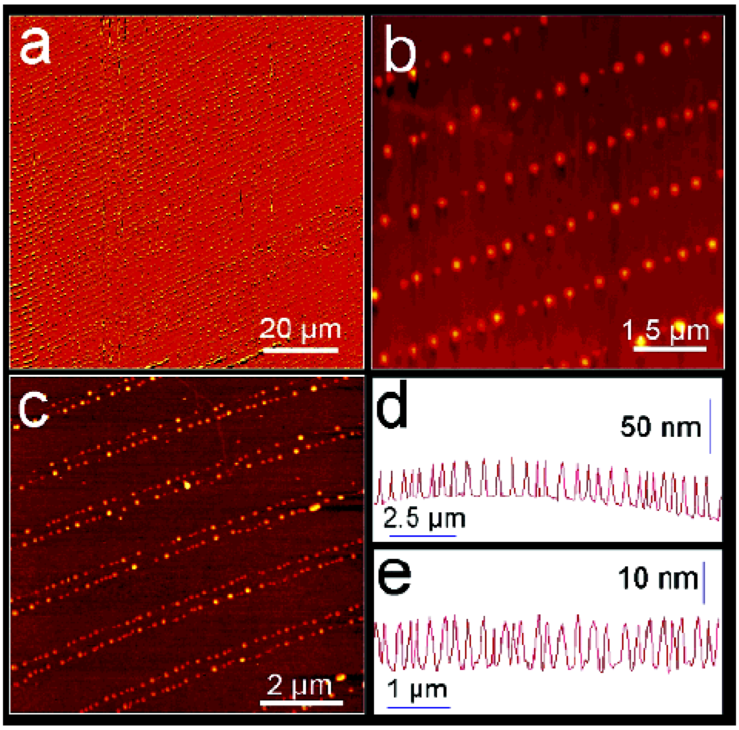

Figure 2. (a) AFM image (error signal) of patterns fabricated on a large area (100 x 100 μm^2). (b) Image of printed features using a dilute solution. (c) Image of printed features using a very dilute solution. Typical line profile along a line obtained using (d) a dilute solution (corresponding to b) and (e) a very dilute solution(corresponding to c).

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MAGNETIC DYNAMICS OF Co NANOSPHERES: ORIGIN OF THE ENHANCED ANISOTROPY.

J. Bartolomé, F. Bartolomé, L. M. García, F. Luis,
F. Petroff*, J.-L. Maurice*, V. Cros*, H. Jaffrès*, A.Vaurès*

Instituto de Ciencia de Materiales de Aragón, CSIC-Universidad de Zaragoza, Spain
*Unité mixte de Physique CNRS/Thales and Université Paris-Sud, Orsay, France

The present work deals with the observation of enhancement of the magnetic anisotropy of Co nanoparticles and its origin. The samples were granular multilayer samples prepared by sequential deposition, by sputtering, of amorphous Al_2O_3 and Co layers on a Si substrate. Co nanoparticles are self-organized in a quasi-regular spatial order of approximately hexagonal close-packed symmetry. The particles studied range in average diameter $\langle D \rangle$ between 0.7 nm and nearly 5 nm, with a narrow size distribution [1,2]. This well controlled morphology has enabled us to circumvent ambiguities in sample configuration and, by means of a simple model for fluctuating moments, explain the dynamics of the Co particle moments in terms of an activation energy with contributions from anisotropy K_{eff}, dipole-dipole interactions E_{dip}, and a bias magnetic field H. The anisotropy is enhanced by one to two orders of magnitude with respect to the bulk fcc Co due to strong pinning of the surface Co magnetic moments anisotropy, and increase as $1/D$ as the particle diameter decreases. The origin of this enhancement is related to an increase of the orbital magnetic moment at the surface atoms, as seen by XMCD spectroscopy [3]. Capping the Co nanospheres with a Cu film increases further the particle anisotropy and the orbital magnetic moment of the surface atoms Fig. [4].

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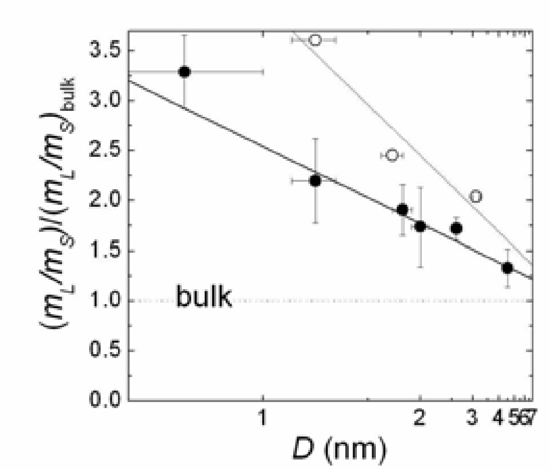

Figure 1. *Size dependence (shown in reciprocal scale of diameters) of the ratio* $\langle m_L \rangle / \langle m_S \rangle$ *scaled to the bulk (full dots) Co/Al_2O_3, (open dots) Co/Al_2O_3/Cu multilayers . Lines are guide to the eyes.*

HIGHLY CONCENTRATED EMULSIONS AS TEMPLATES FOR THE PREPARATION OF HIERARCHICALLY ORDERED MATERIALS

J. Esquena[1,*], H. Kunieda[2], C. Solans[1]

[1]Institut d'Investigacions Químiques i Ambientals de Barcelona (IIQAB)
Consejo Superior de Investigaciones Científicas (CSIC)
Jordi Girona, 18-26, 08034 Barcelona

[2]Graduate School of Environment and Information Sciences,
Yokohama National University
Tokiwadai 79-7, Hodogaya-ku, Yokohama 240-8501, Japan

Highly concentrated emulsions possess volume fractions of the dispersed phase higher than 0.74 [1-3], which is the maximum volume fraction of closed-packed monodispersed spherical droplets. These emulsions have a foam-like structure, consisting of deformed and/or polydispersed droplets, separated each other by a thin film of continuous phase [1,2]. The continuous external phase may possess a microstructure, such as microemulsion or cubic phases [3]. Therefore, these systems can be very appropriate for the templating of hierarchically ordered meso/macroporous materials, which possess high specific surface area easily accessible through the macropores [4]. The ordered homogeneous mesopores are very appropriate in processes requiring selective adsorption, e. g. in catalysis, purification, etc. [5]. In our previous research, meso/macroporous materials were obtained by a two-step process, polymerising in highly concentrated emulsions to obtain polystyrene solid foams [6], which were later used as frameworks to control the macropores [7]. The mesopores were obtained by impregnating the polystyrene foams with surfactant solutions, which contained the inorganic precursor. In the present work, hierarchically ordered meso/macroporous inorganic oxides have been prepared by a fast single-step method, consisting in carrying out the hydrolysis of alkoxysilanes in the continuous phase of highly concentrated emulsions. The highly concentrated emulsions remained stable, which allowed the control of the macropore size. Condensation of species was accelerated by removing alcohol by-products through evaporation. Figure 1 shows an example of a meso/macroporous silica material obtained by hydrolysis of TEOS.

* Corresponding author. E-mail: jemqci@iiqab.csic.es

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Figures

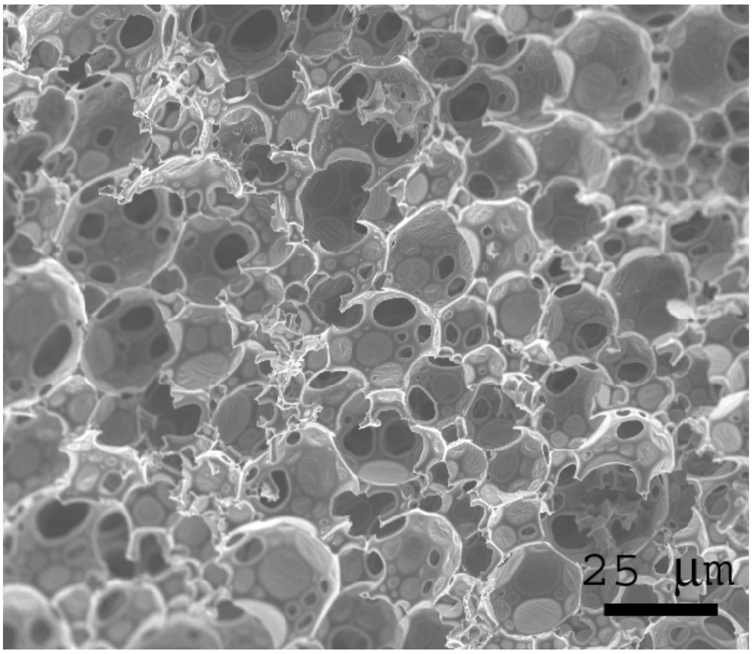

Fig. 1. Scanning electron microscopy image of a meso/macroporous silica.

MBE FABRICATION OF SELF-ASSEMBLED Si AND METAL NANOSTRUCTURES ON SI SURFACES.

N.Galiana, P.P. Martín, C. Munuera, C. Ocal, F. Soria, A. Ruiz and M. Alonso*
Instituto de Ciencia de Materiales de Madrid (CSIC), Madrid (Spain)
(* corresponding author: malonso@icmm.csic.es)

and M. Varela
Oak Ridge National Laboratory, Condensed Matter Division (USA)

Self-assembly and self-organization are highly attractive nanofabrication techniques because they provide means to precisely engineer nanostructures over large sample areas. For methods based on solid-phase epitaxy, numerous studies have demonstrated the importance of processes like steps rearrangement or strain relief in order to achieve ordered arrays of nanostructures [1]. We present here results showing quasi-ordered arrays of new types of Si-nanostructures that can been obtained on different types of Si substrates by exploiting self-assembly processes during Si-homoepitaxy. Moreover, we also show how these new types of Si nanostructures can be used as templates for further growth of metal nanostructures (see Figures 1-4), investigating different metals and growth conditions.

Samples have been grown by Molecular Beam Epitaxy (MBE) on Si(100)1x2 and Si(111)-7x7 surfaces, using low (<0.5º) and high (4º) miscut substrates, respectively [2]. As it can be seen (Figs.1,3), the Atomic Force Microscopy (AFM) images recorded after Si overgrowth display distributions of Si features which are different for each substrate type, but exhibit certain similarity in sizes and shapes within each sample .

For Si(100) substrates, a relatively regular distribution of 3D Si- islands is observed (Fig. 1), with well defined shapes (truncated pyramids with (100) facets on top) and polygonal bases with preferential edges along two orthogonal substrate directions The 2D-image of the Fast Fourier Transform (FFT) analysis shows certain order in islands arrangement and suggest a correlation with the process of ripples formation often reported for Si homoepitaxy on slightly vicinal Si(001) surfaces, which has been recently attributed to kinetic growth instabilities [3]. Although room temperature (RT) deposition of Co or Fe atoms at normal incidence [2] usually lead to metal layers homogeneously covering the whole Si substrate (see Scanning Electron Transmission Microscopy images in Fig 2, or ref. [4]), these Si-islands are nice candidates for fabricating metal nanostructures, simply by using thermal-activated processes or deposition at glancing incidence, for instance [1].

For vicinal Si(111) surfaces (4º miscut), the methodology developed in our group [2] allows to obtain a nanopatterning over the whole Si wafer, which consists of a triangular pattern with lateral dimensions about 300-500 nm and heights of 30 nm; see Fig. 3. Further experiments of Ag evaporation above RT (Fig. 4) show the viability of using these Si patterns as templates to obtain arrays of metallic nanocrystals with certain periodicity in sizes, shapes and spacing; a process that seems to be related to the diffusion barriers imposed by the substrate pattern.

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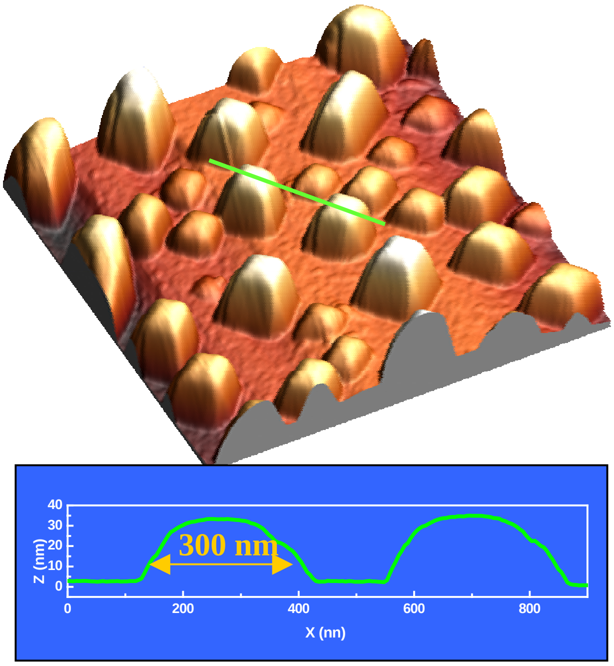
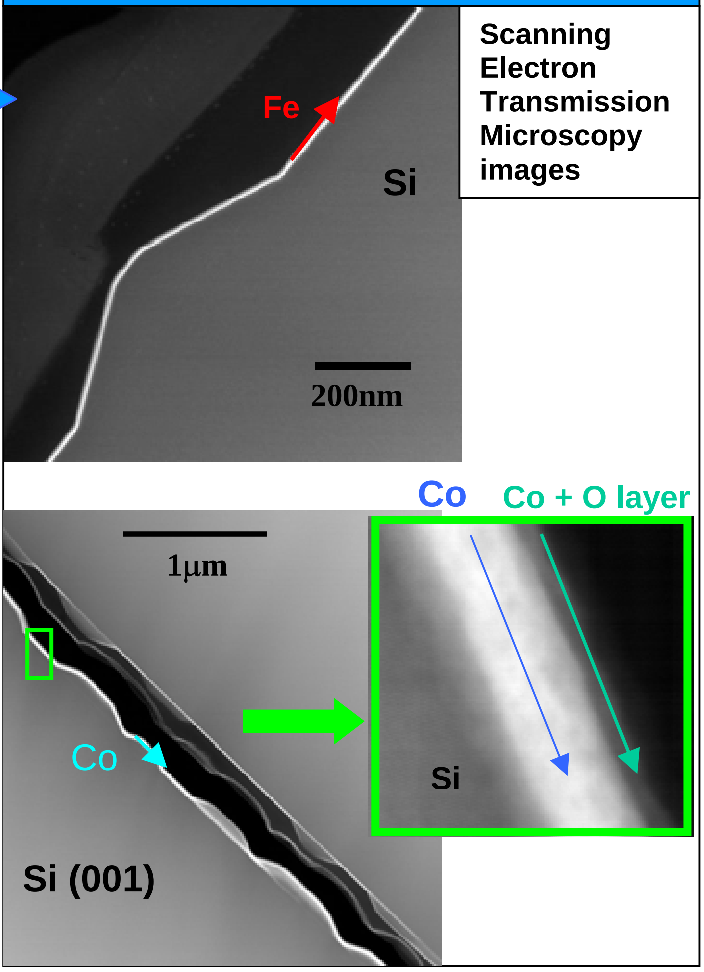
Figures 1-2:

AFM

Si 3D-islands
grown by MBE on Si (001)

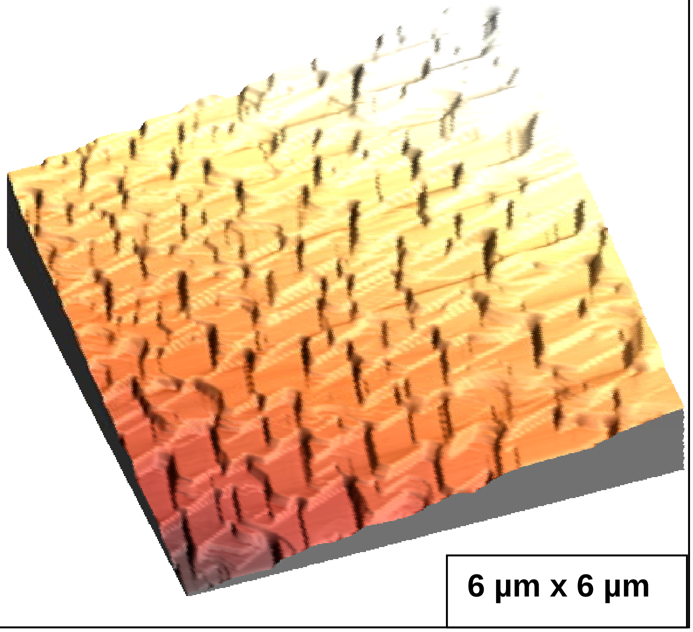


Scanning Electron Transmission Microscopy images



Figures 3-4:

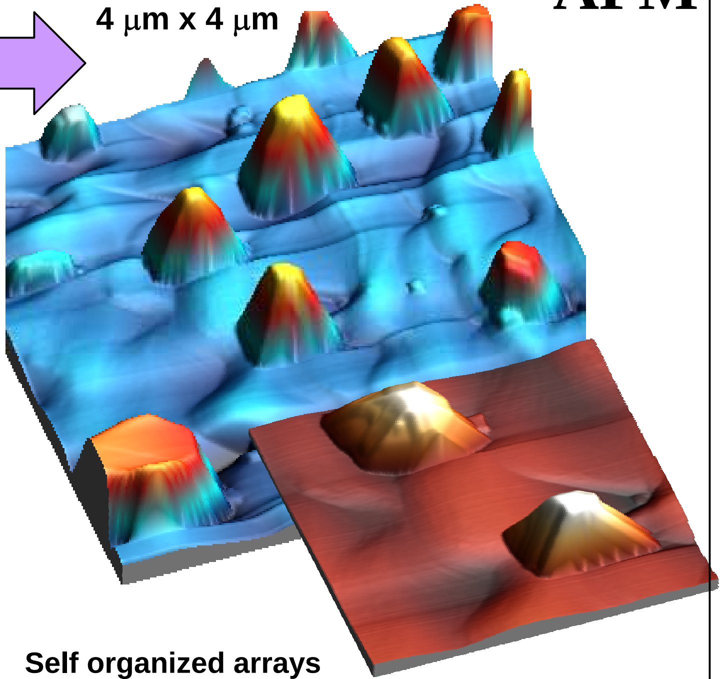
Nanopatterning achieved by self-organization during Si homoepitaxy on vicinal Si(111) surfaces (4º off).



6 µm x 6 µm

AFM

4 µm x 4 µm



Self organized arrays of Ag nanocrystals obtained by Metal deposition (4 nm) on these Si(111) nanopatterned substrates

Polyaniline-Carbon Nanotube Composites: From Wrapping and Self-Alignment to Solubility and Enhancement Effects

R. Sainz[1], A.M. Benito[1], M.T. Martínez[1], J.F. Galindo[1], J. Sotres[1], A.M. Baró[1],
B. Corraze[2], O. Chauvet[2], J.N Coleman[3], K. Ryan[3], W. J. Blau[3], W.K. Maser[1]

[1]Instituto de Carboquímica (C.S.I.C.), C/Miguel Luesma Castán 4, 50018 Zaragoza, Spain
[2]LPC, IMN, Univ. Nantes, rue de la Houssinière, F-44322 Nantes, France
[3]Physics Department, Trinity College, Dublin 2, Ireland

wmaser@carbon.icb.csic.es

Intrinsically conducting polymers [1] combine many advantages of plastics, e.g. flexibility and processing from solution, with the additional advantage of conductivity either in the metallic or semiconducting regimes. Easily processable into transparent films, this class of materials is of great interest for the development of thin film plastic opto-electronic devices [2]. On the other hand, carbon nanotubes (CNTs) have unique structural, mechanical, electronic and thermal properties [3] and are attractive building blocks for the development of novel polymer-nanocomposite materials with enhanced functionality, especially if it comes to enhanced conductivity, thermal stability, and reinforcement properties [4-6].
Starting conducting polymer as matrix material for our work is polyaniline (PANI) for the following reasons: the monomer is inexpensive, the polymerization is straightforward and it can be processed into films. Its electric and optical properties are reversibly controllable by both charge-transfer doping and protonation, and, additionally, it is environmentally stable [1,2]. First PANI-CNT composites with interesting enhancement characteristics have been fabricated in the last few years [7,8,9], however, solubility and processing, key points for device applications were not achieved yet.

Here, we report the formation of a soluble self-aligned PANI-CNT composite consisting of multi-wall carbon nanotubes (MWNTs) and the non-conducting but soluble emeraldine base (EB) form of PANI. Further processing of the composite into free-standing colored thin films was achieved. The characteristics of the composite in solution, in powder form and as film will be presented. The results provide evidence that polymerization in the presence of carbon nanotubes leads to a more planar conformation of PANI along MWNTs.

This is stabilized by strong π-π interactions between both components and accompanied by simultaneous self-alignment of MWNTs. A processable EB-MWNT composite with enhanced properties (increase of room-temperature electrical conductivity by 9 orders of magnitude and increase of thermal stability by 200ºC) has been obtained, thus opening many new possibilities for further technological applications. This work will be published soon in [10].

Figure 1: Polymerization of polyaniline in the presence of carbon nanotubes (left) results in a soluble carbon nanotube/polyaniline composite (middle). Polyaniline in the proximity of nanotubes grows in a more planar conformation due to strong π-π interactions simultaneously stabilized by self-organization of the nanotubes, thus forming aligned bundles of micrometer lengths (right).

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Acknowledgements: We thank J.M. Andrés and M. T. Bona (Inst. Carboquímica) as well as J. L. Serrano and L. Oriol (ICMA-Univ. Zaragoza) for research support and fruitful discussions. Work was financed by MCYT project NANOSIN (MAT 2002-04540-C05-04). Support through GDRE -"Science and Applications of Nanotubes – NANO-E" is acknowledged.

SELF–ORGANIZED CALIX[4]ARENES ON Au(110): FULLY RESOLVED STRUCTURE BY A COMBINED STM, LEED, AND GIXRD STUDY

V. Abad-Langlais, M. D Barò, S. Suriñach,
Departament de Física, Universitat Autònoma de Barcelona, 08193 Bellaterra (Barcelona), Spain;
Y. Gauthier, Maurizio De Santis,
Laboratoire de Cristallographie-CNRS, 38042 Grenoble, France;
O. Maresca,
Unitat de Química Física, Universitat Autònoma de Barcelona, 08193 Bellaterra (Barcelona), Spain
and Xavier Torrelles
Instituto de Ciencia de Materiales de Barcelona (ICMAB), Campus de Universitat Autònoma de Barcelona, 08193 Bellaterra (Barcelona), Spain

Large organic molecules doted of complex architectures have demonstrated long range self-organization when deposited on surfaces[1]. In order to understand the mechanism of 2D self-arrangement, we have carried out a study in ultra high vacuum (UHV) on calix[4]arenes combining structural information provided by Scanning Tunneling Microscopy (STM), Low Energy Electrons Diffraction (LEED) and Grazing Incidence X-Ray Diffraction (GIXRD) using synchrotron light.

A (1x2) reconstructed missing-row Au(110) has been used as substrate because the missing row reconstruction of this surface might be used as guide to arrange the molecules with a good matching between the metal lattice and the molecular dimensions. The molecule consists of four phenols linked by -CH_2- group in *ortho*–position (fig.1). This architecture offers a high flexibility and, as consequence, various conformational shapes exist for the same entity[2]. At room temperature, perfect self-organized overlayers are observed by STM (fig.2). Each molecular unit can be unambiguously identified by STM as well as the conformer and the relative position of each molecule with respect to the others. From the LEED pattern analysis and STM profiles, it was concluded that every other row of molecules is shifted with respect to the neighboring rows. In addition, in the shifted rows, the molecules are in a mirror position with respect to the surface plane. This 2D arrangement is probably steered by the hydrogen bonding interactions, which form a network between the alcohol groups of neighboring molecules. Clearly, in this system, the intermolecular interactions govern the orientation, conformation and the two-dimensional (2D) organization of these molecules at the metal surface while the gold rows of the underlying substrate acting as guide in the direction $[1\bar{1}0]$. On the other hand, as revealed by GIRXD, the missing row reconstruction undergoes a (1x2) to (1x3) phase transition (fig. 3). This change implies a collective motion of a large amount of gold atoms as observed by XRD. Other works[3,4] on induced Au(110)-(1x3) reconstruction report a charge transfer occurring between the metal and the adsorbate, especially when the metal surface is negatively charged. These results are of importance for interfacial supramolecular assemblies since such a charge transfer could either promote or forbid further interaction with other organic or inorganic species.

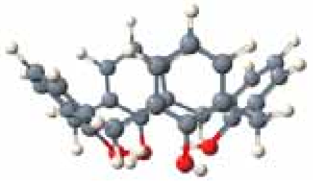

Figure1: The crown shape conformer of calix[4]arene.

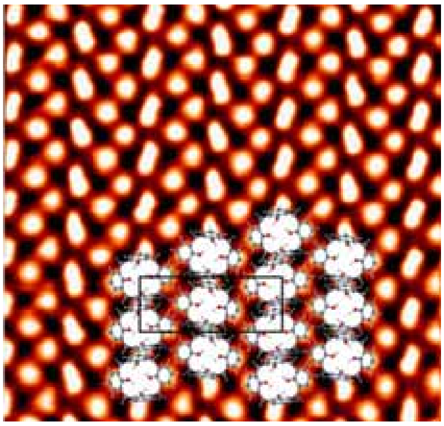

Figure 2: STM images of the fully covered surface. Each molecule can be perfectly identified as well as the unit cell of the molecular net which is (3.16x6) times larger than the Au(110)-(1x1) cell.

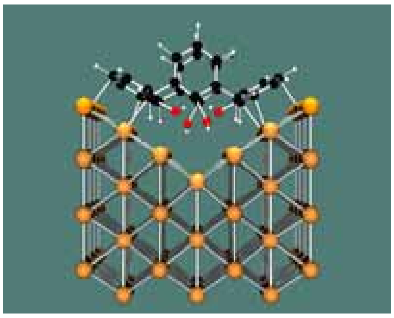

Figure 3: Fully resolved structure of the molecular overlayer and the underneath substrate from GIXRD measurements showing an expanded view of the Au(110)-(1x3) structure along the $[1\bar{1}0]$ direction in order to accommodate the calixarene molecule on top of the substrate.

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MARCH 17, 2004: SCIENTIFIC PROGRAMME

SCIENTIFIC PROGRAMME	
Thursday – March 17, 2005	
09h00-10h00	**Lars Montelius** (Lund University, Sweden): *Nanoimprint lithography: technology, prospects and some applications*
10h00-10h20	**Maria Villaroya** (UAB, Spain): *Patterning of nanometer-scale cantilevers integrated in CMOS circuit by e-beam lithography*
10h20-10h40	**Juan Carlos Martinez** (FIS-UCM, Spain): *Evanescent wave lithography. Towards the 3D nano-patterning of surfaces*
10h40-11h00	**Xavier Battle** (UB, Spain)*: Fabrication of magnetic nanodots over macroscopic area.*
11h00-11h30	***Coffee Break***
11h30-12h00	**Renzo Tomellini** (EU-NMP, Belgium): *Evolutions towards an European Strategy for Nanotechnology*
12h00-12h15	**Jose-Manuel Baez** (FECyT, Spain): *Survey on actual infrastructures and human resources in nano-sciences and nano-technologies in Spain*
12h15-12h30	**Marta Aymerich** (CIRIT, Spain)
12h30-12h45	To be defined
12h45-13h00	To be defined
13h00-14h00	**"2nd NanoSpain Workshop & WG" Conclusion Remarks** **Closing**

NANOIMPRINT LITHOGRAPHY : TECHNOLOGY. PROSPECTS AND SOME APPLICATIONS

L Montelius[1] , P Carlberg[1], F Johansson[1], T Mårtensson[1], R Bunk[1], M Beck[1,4], S.G. Nilsson[1], B Heidari[4], M Grazcyk[1], I Maximov[1], A Månsson[3], M. Kanje[2], W. Seifert[1], L Samuelson[1]

1 Dep. Solid State Physics & The Nanometer Consortium, Lund University, Sweden.
2 Dep. of Cell and Organism Biology, Lund University, Sweden.
3 Dep. of Chemistry and Biomedical Sciences, University of Kalmar, Sweden.
4 Obducat AB, Malmoe, Sweden
email: lars.montelius@ftf.lth.se
Internet: www.ftf.lth.se, www.nano.ftf.lth.seT

Recent years have seen a large interest in development of new lithographic techniques. One of these that have quickly reached a level of maturity that makes it useful for practical applications is nanoimprint lithography (NIL) (ref 1). This cost-efficient, high throughput method opens new avenues for nanoscale research in general and for nanobio in particular where often a need for many samples exists in order to probe the variability that characterizes biological systems (ref 2).

In this talk, I will address its use for the study of protein interactions by discussing three specific projects. In all projects we explore nanostructured surfaces interacting with biomolecules demanding a retained biological function of the assembled biomolecules, e.g. proteins. The first projects deals with the fabrication of neural devices enabling mind-controlled prosthesis to be made. In the second project we address the possibility to make a nano-traffic system and explore its potential for high-throughput drug screening systems, in the third project single molecular interactions are studied using nanomechanical transduction and finally in the fourth project we explore the use of interdigitated electrodes for probing cellular activity. Below, due to space limitations, I describe in some detail only three of these projects.

Project 1: The potential impact of neuro-electronic junctions are enormous since they can be used to compensate for both sensory and motor deficits in the nervous systems e.g they could be used to restore vision, hearing and motor impairments but also autonomic functions. Crucial issues for such junctions are spatial resolution, selective guidance of different types of nerve fibers to hot spots i.e. recording or stimulating sites on the interface surface. With NIL we fabricated sets of positive and negative patterns, and each set consisting of seventeen different patterns with variable distances between ridges and grooves in the resist material (fig 1). We then used sympathetic ganglia to study axonal outgrowth on the chip surfaces. By immunostaining the axons were found to align along the protruding faces of the patterns (fig 2).

Project 2: The muscle proteins myosin and actin are important for the muscle contraction in living systems. When actin molecules tagged with flourophores are added to a myosin coated surface in presence of ATP, the interaction between myosin and actin molecules can be followed employing fluorescence microscopy. In our project we are using nanostructured surfaces in order to fabricate test tracks for guiding the movements and to achieve a rectified movement along the tracks [3].

Project 3: A cantilever can be used as a universal platform for sensing applications, especially as a mass detector. By decreasing the dimensions of the cantilever the sensitivity can be increased to the point where it is possible to perform single molecule detection. By using NIL and metal lift-off cantilevers can be made in large numbers, in arbitrary dimensions and of a wide variety of materials.

Each application presents new and unique challenges for NIL. It is our experience that these usually relate to the ability to making good stamps [4]. Today we use a wide range of different materials, structuring techniques and etching methods.

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Acknowledgement: This work is partly performed within the Nanometer Consortium at Lund University supported by FP5 FET-NID projects Nanotech and Chanil and by the FP 6 projects NaPa and Nano2Life and by the Swedish Science Council, the Swedish Strategic Research Council and by the Swedish Agency for Innovation Systems in co-operation with Obducat AB, Malmo, Sweden.

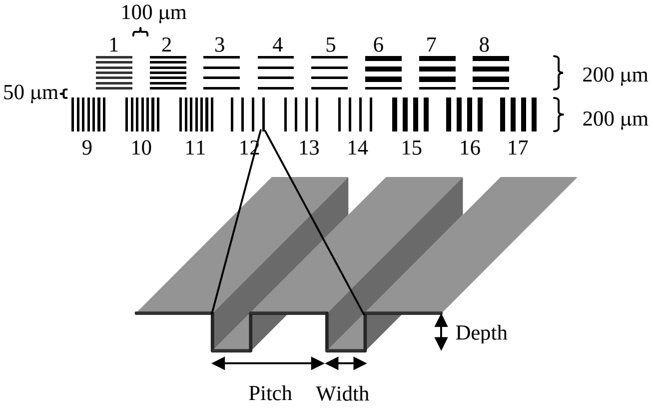

Figure. 1. *The features of the imprinted wafers on which the tests are performed. The wafers are ordinary 25 mm silicon wafer covered with PMMA 950. The pattern consists of 17 squares with grooves oriented horizontal and vertical and with different width and pitch.*

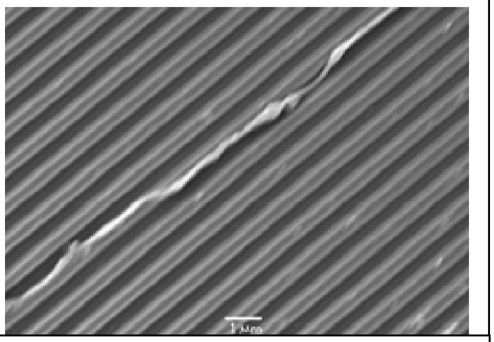

Figure 1. SEM pictures showing that the axons are growing on the ridge edges, and not in the grooves.

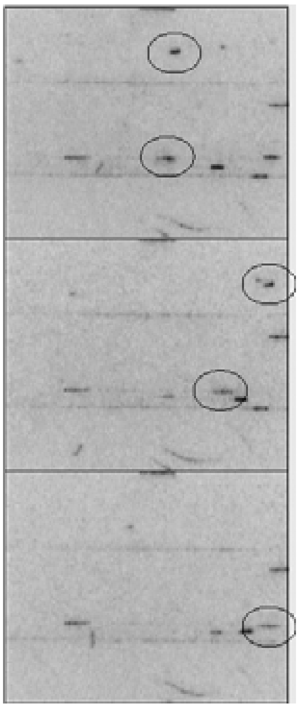

Figure 3. Left: Greyscale inverted image of optical micrograph showing fluorescently labeled actin moving approximately 30μm in polymer trenches.

Patterning of nanometer-scale cantilevers integrated in CMOS circuit by e-beam lithography

Gemma Rius[+], MaríaVillarroya, Jaume Verd, Jordi Teva, Gabriel Abadal, Eduard Figueras[+], , Jaume Esteve[+], Núria Barniol and Francesc Pérez-Murano[+]
[+] Institut de Microelectrònica de Barcelona (CNM-CSIC). Campus UAB. 08193 Bellaterra (Spain).
Departament d'Enginyeria Electrònica. Escola Tècnica Superior d'Enginyeria.Universitat Autónoma de Barcelona. 08193 Bellaterra (Spain).
Maria.Villarroya@uab.es, Gemma.Rius@cnm.es

Nano-electromechanical systems are based on the advantages of miniaturizing mechanical structures, such as cantilevers, for obtaining enhance functionality. NEMS represents an outcome of MEMS technology, scaled down to submicron dimensions. In this size regime, it is possible to attain extremely high fundamental frequencies while simultaneously preserving a very high mechanical response (small force constants). This powerful combination of attributes translates directly into high force sensitivity, operability at ultra-low power, and the ability to induce usable nonlinearity with quite modest control forces. Further development of NEMS requires surpassing several challenges which have to be addressed from a multidisciplinary framework that includes physicists, chemists, biochemists, and electrical and mechanical engineers. One of the aspects that offer more interest is the integration of NEMS with CMOS electronic circuits. Realization of nano/micro systems based on such combination offers an optimal path for interfacing the nanostructure to the external connections; it allows on-chip signal processing and permits the management of arrays of nanodevices.

In this work, we have evaluated the use of e-beam lithography (EBL) for the definition of silicon nanocantilevers in a pre-patterned CMOS substrate. The final objective is to develop a mass sensor with a sensitivity in the range10^{-17}-10^{-19} g [1, 2]. Deposition of mass onto the cantilever results in a decrease of its resonance frequency. The cantilever is driven at this resonance frequency by means of applying an oscillating voltage between the cantilever and an electrode located at a sub-micron separation. The detection of the oscillation of the cantilever is performed by amplifying the displacement current through the cantilever. As the equivalent capacitance of the cantilever/electrode system is extremely small (in the fF range), integration of the cantilever into a CMOS circuit reduces the contribution of the extra parasitic capacitance of pads and external wires that would hide the signal.

EBL allows higher resolution on the definition of the cantilever. When the dimensions of the cantilevers decrease, the mass sensitivity increases because the relative change of mass increases and the thermo-mechanical noise reduces [3]. The definition of the cantilever starts after completing the CMOS circuit fabrication. The cantilever is fabricated in a specific area (figure 1). The structural layer is the polysilicon bottom layer of the CMOS. Desirable characteristics of this layer are small surface roughness and a thickness of around 600 nm. For this, a protection layer (top polysilicon) is previously deposited for protection during the CMOS fabrication. Eventually, removal of the top polysilicon induces some damage that degrades surface roughness and thickness.

Other constraints that appear when EBL is performed on CMOS substrates are: i) It is necessary to use low energy electrons to reduce the damage on the circuit; ii) the alignment of the pattern in the pre-defined area has to be made without a previous SEM inspection; iii) The topography of the CMOS circuit presents steps of several microns which difficult the uniformity of the resist deposition, the focusing of the e-beam and the correct patterning near the edges of the steps. These constraints have been soften by defining pre-contacts by UV lithography as it is shown in figure 2. Preliminary examples of the cantilever definition are presented in figure 3.

Acknowledgments
This work has been partially funded by the project NANOSYS (MCYT-TIC2003-0723)

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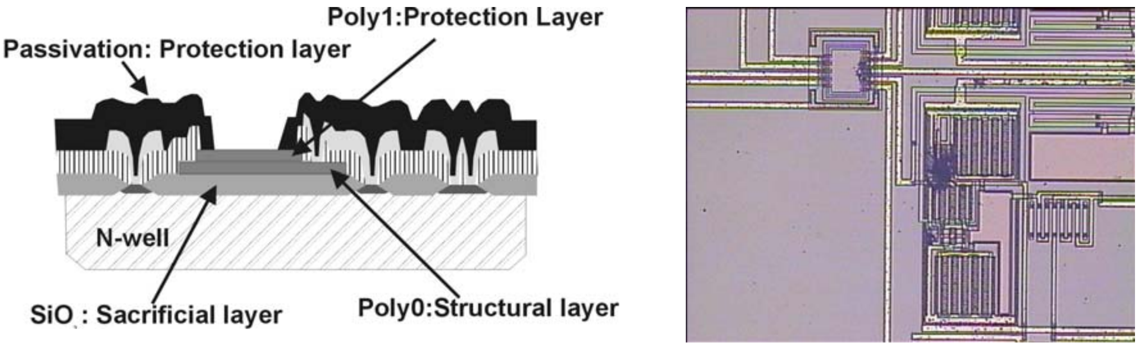

Figure 1. Left: Schematic cross section of the fabrication area after CMOS. The 2nd polysilicon layer (poly1) of the technology, is used during CMOS to protect the structural layer (poly0). It is removed by RIE, befor nanofabrication process. Right: Optical image fo one part of the chip showing the circuit and the area for fabrication

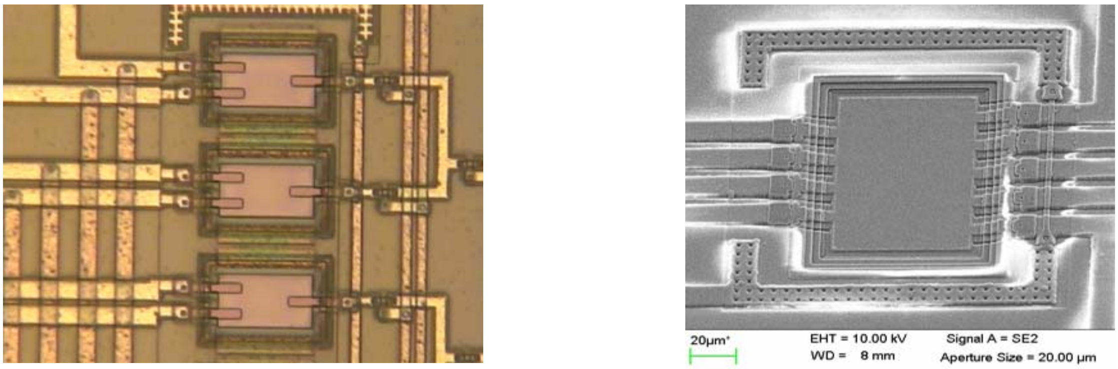

Figure 2. Left: optical image of a section of an array of areas in the CMOS circuit prepared for the fabrication of th enanocantilevers. Eelctrical contacts has been defined by UV lithography to make easy the alignemnt and the patterning of the edges. Right: SEM mage of another area prepared for fabricating a packed array of 4 cantilevers. It shows the topography of the area

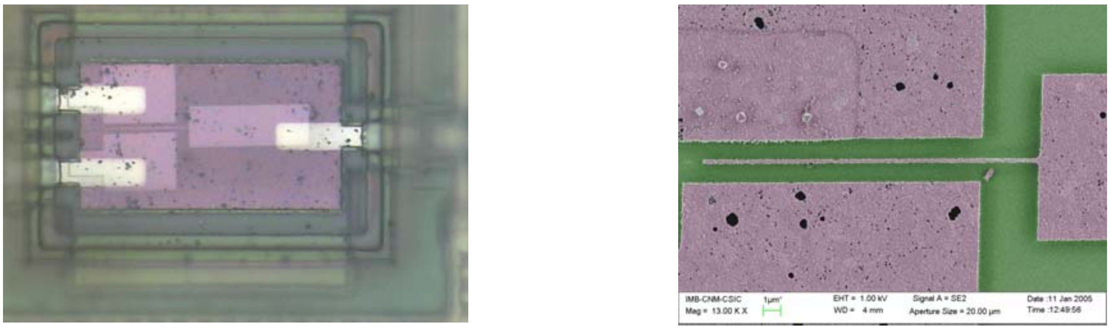

Figure 3. Left: Optical image after the e-beam exposure, development, deposition of 24 nm of aluminum and lift-off. Right: Colorful SEM image of a cantilever after the etching of silicon and under-etching of the silicon oxide to release the cantilever. The width of the cantilever is 200 nm.

Evanescent wave lithography. Towards the 3D nano-patterning of surfaces

Juan Carlos Martínez Antón
Departamento de Óptica, Escuela Universitaria de Óptica, Universidad Complutense
Madrid, 28037 Madrid, SPAIN. e-mail: jcmartin@fis.ucm.es

Abstract: Under total reflection, the evanescent wave generated permits the recording on photolithographic resins close to the interface. The control of the penetration depth by simple means enable the production of profiles and 3D surface structures in practically one step and to and extended field of view. In this contribution we present some first experimental results, the description of the technique and its expected capabilities to fabricate sub-wavelength structured surfaces (Λ~100nm) by means of interference or simply by projecting masks.

Currently, the author is working on a project financially supported by the Comuidad de Madrid entitled, "*Evanescent wave lithography. Generation of nano-structured surfaces*". The basic goal of this presentation is to describe the technique and the potential uses of the same.

It is well known that two coherent waves propagating in reverse directions, generate an interferential electromagnetic field with a periodicity of $\Lambda=\lambda/2n$ where n is the refractive index and λ the vacuum wavelength. Consider a refractive media of n = 1.775 and a λ of 355 nm, then we will have a grating of Λ~100 nm and a minimum detail of around 50 nm. Choosing the appropriate optics configuration, the interference structure can be transferred to the evanescent wave, which has a limited penetration depth. This clearly points out to the possibility of fabricating sub-wavelength patterned profiles, though conventional lithographic and optical materials and sources. Therefore, we do not need to resort to sophisticated vacuum etching techniques or VUV-EUV lithography to fabricate sub-wavelength systems in the order of 100 nm details. The potential is then very relevant and our interest is to validate this technique. There are previous results that support indirectly its viability. Sainov [1]-[2] uses the evanescent wave to generate a holographic grating of Λ=156.7 nm with a laser of emitting at 514.5 nm. Although our proposal keeps some similarities with the work of Sainov, it does not seem that the evanescent wave has been used before for nano-profile fabrication.

The techniques for nano-patterning the surfaces under design are based on ion-etching, electron-beam, etc… [3]; or based in other scanning technologies, like atomic force microscopy or scanning tunneling microscopy, which permit nano-patterning point by point with a nanometric probe by means of different physical mechanisms, for example, the anodization of differential oxidation of the surface. However, they are costly techniques in terms of time and inappropriate for extended areas. The evanescent wave promises a simple and rapid fabrication of several devices of large areas. Recently, A. Nesci y H. Tao *et al* [4]-[5] have measured the structure of the interferential evanescent wave encountered in the set-up of Fig.1. A similar set-up has been used by the author to register lithographically the interference of two laser beams and we obtained the satisfactory results of Fig.2, confirming the capability of the evanescent field to sculpt 3D profiles on the surface of a resin.

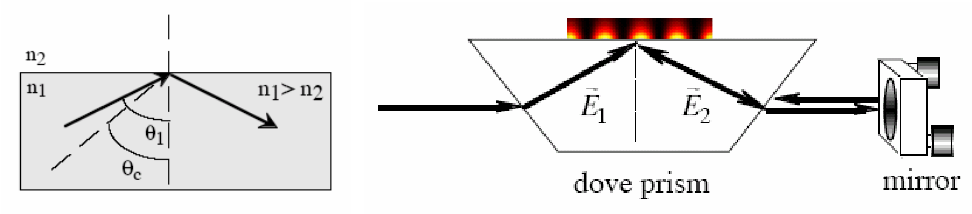

Fig. 1 Left: As is well known, to obtain a surface evanescent wave it is necessary that $n_1>n_2$ (refractive indices) and $\theta_1 > \theta_c$ (incidence angle above critical angle). Right: Field amplitude structure of the interference of two evanescent waves under a possible set-up.

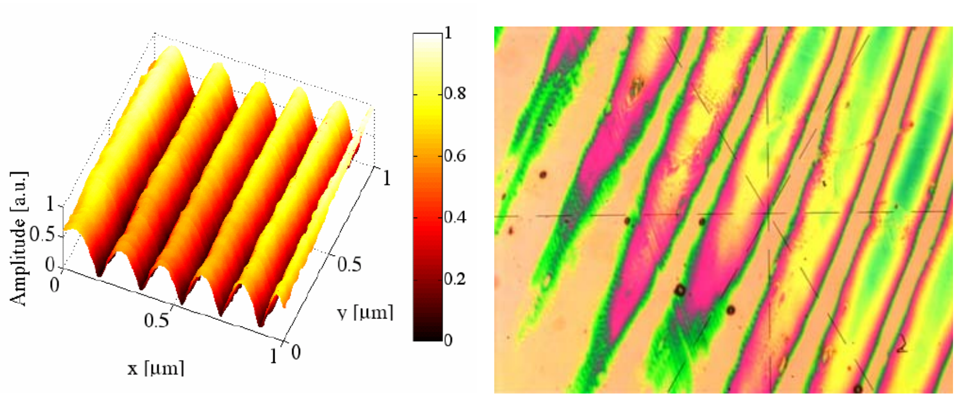

Fig. 2 Evanescent wave lithography. Left: Measured evanescent field near a surface under the interference set-up of Fig. 1 with a SNOM apparatus. Right: first experimental results obtained by the author showing the recording of an evanescent wave interference (like the one in the left) in a photolithographic resin. The image is obtained with a conventional optical microscope and every colour corresponds to an interference fringe, i.e. a certain thickness or penetration depth. The colour-depth map demonstrates the ability of the evanescent recording to generate 3D profiles on surfaces in one single step. Conventional lithography would need several steps to achieve an approximated binary profile and more limited in lateral resolution.

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FABRICATION OF MAGNETIC NANODOTS OVER MACROSCOPIC AREA. TOWARDS THE Terabit/in^2 RECORDING DENSITY?

Xavier Batlle[1, 2], Amílcar Labarta[1], Changpeng Li[2], Igor V. Roshchin[2] and Ivan K. Schuller[2]

[1] Departament Física Fonamental, U. Barcelona, Barcelona, Catalonia, Spain
xavier@ffn.ub.es, amilcar@ffn.ub.es

[2] Physics Department, U. California San Diego, La Jolla CA
igor@physics.ucsd.edu, changli@physics.ucsd.edu, ischuller@physics.ucsd.edu

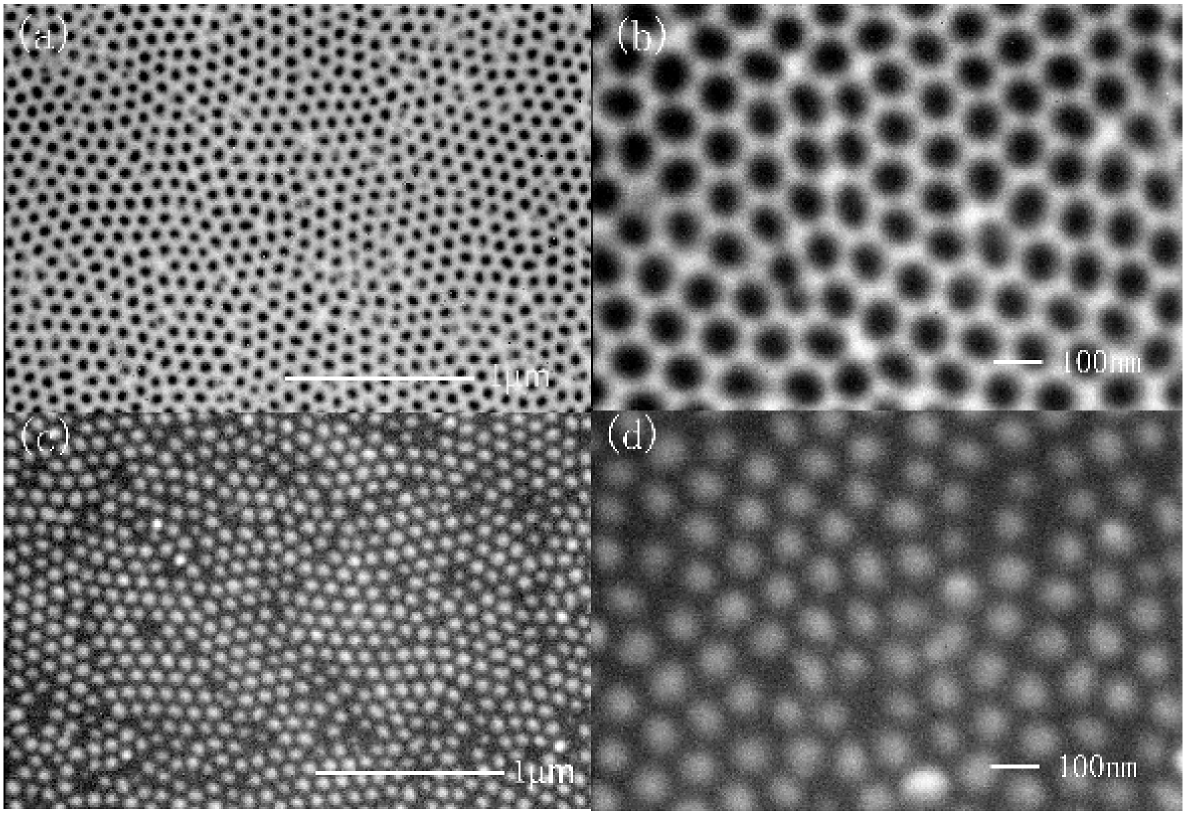
Nanostructured materials have attracted much research over the recent years, as they provide the critical building blocks for the booming of nanoscience and nanotechnology. Nanostructures have novel properties due to the interplay between the size confinement of electrons in small structures and proximity effects. This is relevant for example in device miniaturization towards the Tbit/in^2 recording density and in the thermal stability of the recorded bits. Nanofabrication by self-organized templates, in particular nanoporous alumina membranes, is being explored intensively due to the fact that it might enable mass production over large areas.

In this work, Al thin films of 1 to 10 microns in thickness were deposited onto Si substrates using electron-beam evaporation and sputtering. Highly ordered hexagonal arrays of alumina nanopores were obtained by anodic oxidation of the Al films (Fig. 1). Pore size and periodicity were controlled by the electrolyte used in the anodization process and by optimizing the parameters of the two-step anodization procedure. Single layer Fe and SiO_2 nanodots and bilayer Fe/FeF_2 exchange biased nanodots were deposited by electron-beam evaporation using the alumina nanopores as a template. The hexagonal arrays of nanodots show high degree of ordering over areas of ~ 1cm^2, while domain sizes are of ~ 0.5-1.0 μm^2 (Fig. 1). The average number of nearest neighbours is typically 6.0 ± 0.5, while the average angle between them is 60 º ± 10 º. Average dot size and periodicity range from 30 to 80 nm and from 60 to 100 nm, respectively, with a standard deviation of about 10%. Scanning electron microscopy (SEM) and atomic force microscopy (AFM) images yield a close agreement for those ordering parameters, while the latter show the homogeneity in the height of the nanodots (typically of ~ 25 nm). The highest dot density in the samples was about 0.4 Tbit/in^2, while the highest pore density was about 1.0 Tbit/in^2.

Magnetization hysteresis loops for the Fe dots suggest the key role of shape anisotropy and the transition from a vortex state to a single domain state as the dot size decreases. Quantitative analysis of the polarized neutron reflectometry in small angle geometry yield a vortex core size of ~ 14 nm, in good agreement with the 13 nm obtained from micromagnetic simulations. Exchange biased Fe/FeF_2 bilayer nanodots show an enhanced squareness in the magnetization loops with respect to the single layer Fe dots, thus suggesting that the exchange coupling with the antiferromagnet yields a magnetic stabilization in the ferromagnetic layer.

[1] Work supported by Spanish CICYT (MAT2003-01124) and MECD (Mobility of Researchers PR2003-0149), and Catalan DURSI (Joint Actions ACI2002-5)
[2] Work supported by US AFOSR

Figure 1. SEM images of porous alumina anodized at 40 V in 0.3 M oxalic acid (a-b), and corresponding Fe nanodots (c-d).



EVOLUTIONS TOWARDS AN EUROPEAN STRATEGY FOR NANOTECHNOLOGY

Renzo Tomellini and José Luis Viviente Solé
renzo.tomellini@cec.eu.int and jose-luis.viviente-sole@cec.eu.int
European Commission[1]

Advances across a wide range of sectors are being enabled through research and technological development (R&D) and innovation in nanosciences and nanotechnologies (N&N). These advances can address the needs of citizens and contribute to the Union's competitiveness and to many of its policies including public health, information society, energy, transport, security, space and sustainable development.

Products based on N&N are already in use and analysts expect markets to grow by hundreds of billions of euros during this decade. Europe must transform its world-class R&D in N&N into wealth-generating products in line with the actions for growth and jobs, as outlined in the "Lisbon Strategy" of the European Union[2].

On 12 May 2004 the Commission adopted the Communication *Towards a European Strategy for Nanotechnology*[3] in which an integrated and responsible strategy was proposed. This aims to reinforce the Union's leading position in N&N R&D and innovation while addressing any environmental, health, safety and societal concerns upfront. In this context, several needs were highlighted: increase investment and coordination of R&D; develop world-class competitive R&D infrastructure or "poles of excellence"; promote the interdisciplinary education and training of research personnel together with a stronger entrepreneurial mindset; provide favourable conditions for industrial innovation to ensure that R&D is translated into affordable and safe wealth-generating products and processes; respect ethical principles, integrate societal considerations into the R&D process at an early stage and encourage a dialogue with citizens; address public health, occupational health and safety, environmental and consumer risks of N&N-based products at the earliest possible stage; complement the above actions with appropriate cooperation and initiatives at the international level.

In its conclusions of 24 September 2004[4], the Competitiveness Council welcomed the proposed integrated and responsible approach and the Commission's intention to draw up an Action Plan for nanotechnology. The European Economic and Social Committee subsequently issued an opinion on the 15 November 2004 that supported the Commission's proposed approach[5].

All stakeholders were invited to provide their opinion on the Commission's proposal via an extensive open consultation that closed on 15 October 2004. Over 750 responses were received supporting the elements of the Commission's proposal. This survey has been the largest of its kind in Europe[6].

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[1] The present paper does not represent any commitment on behalf of the European Commission
[2] http://europa.eu.int/growthandjobs/index_en.htm
[3] http://www.cordis.lu/nanotechnology/src/communication.htm
[4] http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/intm/82067.pdf
[5] http://eescopinions.esc.eu.int
[6] http://www.nanoforum.org

Eventually, we should not forget that the world is one, human health is the same in all Countries and the markets are progressively integrated and globalised. There is therefore scope for doing much work within the framework of international cooperation and first of all to agree upon shared principles as the Commission highlighted in its Communication *Towards a European Strategy for Nanotechnology*[7] on May 2004 and it was echoed in June in a dedicated international informal meeting held in Alexandria (VA, USA)[8].

At policy level, the debate should be continued with all stakeholders. The ongoing informal exchange of views is precious in the present preparatory phase, before the debate is brought to a possible formal inter-governmental level. The participations in the nanotechnology session in the V World Social Forum (Porto Alegre, Brazil, January 2005)[9] and in the UNIDO symposium (Trieste, Italy, February 2005)[10] are examples.

At the level of R&D projects, the EU 6th Framework Programme for Research and Technological Development, which is open to virtually all Countries with -with few exceptions- financial contribution by the EU, offers dedicated funding. A call for proposals[11] is currently open.

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[7] http://www.cordis.lu/nanotechnology/src/communication.htm
[8] http://www.cordis.lu/nanotechnology/src/intldialogue.htm
[9] http://www.sociologos.org.br/materias_home/1001_nano.asp
[10] http://www.ics.trieste.it/NewDetails.aspx?new_id=194
[11] http://www.cordis.lu/nanotechnology/src/fp6_fund.htm

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SURVEY ON ACTUAL INFRASTRUCTURES AND HUMAN RESOURCES IN NANO-SCIENCES AND NANO-TECHNOLOGIES IN SPAIN

Presentation by J. M. Báez.
Director for Programmes & Studies (FECYT-Spanish Foundation for Science and Technology)

FECYT started in 2004 a pilot action on nano-science and nano-technology as a support activity to national authorities for the future implementation of public actions in this area.

In the framework of such action, FECYT developed a survey, in cooperation with the Phantoms Foundation and CSIC (coordinators of the Spanish Nanotechnology Network NanoSpain), to know the actual status of infrastructures in the nano-related areas and the needs in the area of technical human resources. The study is aimed to highlight potential needs for the future development of nano-activities in Spain.

The presentation will focus in the results of the survey and will highlight the most relevant findings in both the infrastructures and the technical human resources as an input or future public actions in this area.

LIST OF POSTERS
(Last update: 04/03/2005)

POSTERS – NANOBIOTECHNOLOGY (20)

Number	Name	Last Name	Title
POSTER 01	David	Alcantara	Magnetic glyconanoparticles: preparations, characterization and mri applications.
POSTER 02	Maria	Alonso Sande	PLGA-Mannosamine nanoparticles as new carriers for oral immunization
POSTER 03	María	Blanco	Controlled and prolonged parenteral delivery of vapreotide by using biodegradable particles
POSTER 04	Mª Luisa	Blazquez	Gold nanoparticle formation by seaweed biomass: influence of pH
POSTER 05	Ferhun	Caner	Microplane Model for Biological Soft Tissue
POSTER 06	Ignacio	Casuso	DC current-voltage characteristics of purple membrane obtained by conducting atomic force microscopy
POSTER 07	Jose M.	De la Fuente	Tat-peptide as an efficient molecule to translocate gold nanoparticles and cds quantum dots into cell nucleus.
POSTER 08	Maria	de la Fuente	Hyaluronate-Chitosan nanoparticles as new vehicles for ocular administration
POSTER 09	Ainara	Garcia	Funcionalization of carbon nanotubes for biomaterials applications
POSTER 10	Aleix	Güell	Preparation of atomically flat Au (111) surfaces for biological applications
POSTER 11	Ioanis	Katakis	Molecular biofuel cells as power supply in medical implants
POSTER 12	Mark	Kreuzer	Quantitative Detection of Doping Substances by a Localised Surface Plasmon Sensor
POSTER 13	Alicia	Larena	A new method for manufacturing nanostructured materials based on biopolymers
POSTER 14	Arben	Merkoçi	Carbon Nanotubes and Nanoparticles for applications in biosensors and DNA sensors
POSTER 15	Gerard	Oncins	Lateral force microscopy study of phospholipid bilayers in liquid environment
POSTER 16	Soledad	Penades	Glyconanotechnology: a new methodology to create biofunctional nanoparticles with application in biotechnology and nanomaterial science
POSTER 17	Cecilia	Prego	Chitosan nanocapsules as transmucosal carriers for oral peptide delivery
POSTER 18	Felix	Rico	Nanofabrication of cylindrical cantilever tips for probing mechanical properties of biopolymers by atomic force microscopy
POSTER 19	Jordi	Teva	Using second harmonic on cantilever based mass sensors to increase sensitivity to the pico-gram level
POSTER 20	Jose Luis	Toca	Recrystallization and Stability of Bacterial S-Layers on Flat Polyelectrolyte Surfaces and Hollow Polyelectrolyte Capsules

POSTERS – NANOCHEMISTRY (12)

Number	Name	Last	Title
POSTER 01	David	Amabilino	Chiral Expression and Transfer at the Nanoscale
POSTER 02	Pilar	Aranda	Glucose biosensor based on alumina membranes: influence of the membrane nanostructure
POSTER 03	Jose Carlos	Conesa	Behavior of catalytic cerium-containing mixed oxide nanoparticles upon high temperature treatments
POSTER 04	Concepción	Domingo	Improving the selectivity and sensitivity of molecular sensors based on nanoparticle enhanced (vibrational) spectroscopies (nes): raman-sers and infrared-seira
POSTER 05	Sergi	Garcia-Manyes	Force spectroscopy on lipid bilayers: a combined nanomechanical and Chemical Force Titration study
POSTER 06	Ricardo	Molina	Self-arrangement of surface chemical groups generated on air plasma treated wool
POSTER 07	Jordi	Nolla Anguera	Preparation of lipid nanoparticles from nano-emulsions by a low-energy method
POSTER 08	Jorge	Perez-Juste	Nanostructures with Tailored Optical Properties through doping with Gold Nanorods
POSTER 09	Jose	Ramos-Barrado	Influence of nanostructure of Nb2O obtained by chemical spray pyrolysis (CSP) in its electrochemical properties
POSTER 10	F.Xavier	Rius	Analytical sensors based on carbon nanotubes and molecular recognition
POSTER 11	Juan	Torrent-Burgués	Langmuir and Langmuir-Blodgett films of a copper ionophore
POSTER 12	Nora	Ventosa	Preparation of nanosuspensions of molecular materials from CO2 expanded solutions.

POSTERS – NANOELECTRONICS (10)

Number	Name	Last	Title
POSTER 01	Nuria	Barberan	Excitations of a “quantum dot” of rapidly rotating ultracold atoms
POSTER 02	Rosa María	de la Cruz	Confinement and polaron energies in truncated conical semiconductor quantum dots
POSTER 03	Luis	Froufe	Conductance quantization in surface disordered nanoscale systems
POSTER 04	Vega	Lloveras	Effect of the organic wires length in the Intramolecular Electron Transfer Phenomenon.
POSTER 05	Enrique	Miranda	Formation of nanocontacts in ultrathin SiO2 layers by the application of electrical stress
POSTER 06	Juanjo José	Palacios	Magnetic and orbital blocking in Ni nanocontacts
POSTER 07	Paolo	Pellegrino	Site of Er ions in Er-implanted silica containing Si nanoclusters
POSTER 08	Marc	Porti	A C-AFM investigation of MOS memory devices with Si-nanocrystals as storage nodes
POSTER 09	Miguel	Rey	Transports suppression in heterostructures driven by an ac gate voltage
POSTER 10	Rosana	Rodriguez	Dependence of the post-breakdown performance of MOS devices on the gate oxide BD spot electrical properties

POSTERS – ADVANCED NANOFABRICATION METHODS (21)

Number	Name	Last Name	Title
POSTER 01	Mª Angeles	Abellan	Nanoprofiled Si substrates for heteroepitaxy of strongly lattice-mismatched semiconductor compounds
POSTER 02	Pablo	Alonso	Fabrication of porous alumina monolithically integrated on GaAs (001).
POSTER 03	Joan	Bausells	Fabrication of electrodes with controllable sub-20 nm gap spacing
POSTER 04	Eusebio	Bernabeu	Optical considerations on dye-sio2 nanospheres in water solution
POSTER 05	Xavier	Borrise	Nanofabrication of Fresnel Zone Plate lenses for X-Ray Radiation
POSTER 06	Arturo	Dominguez-Rodriguez	Microwave sintering of nanotructured ceramic polycrystals.
POSTER 07	Jordi	Farjas	Patterning of active and passive nanometric regions on amorphous silicon thin films, by localized oxidation
POSTER 08	Ignacio	Gonzalez	Tailored Synthesis of Functional Polymers for Nanoimprinting Lithography
POSTER 09	Agustin R.	Gonzalez-Elipe	Control of the nanoporous structure of oxide thin films prepared by plasma enhanced chemical vapour deposition
POSTER 10	Francisco	Hernandez Ramiro	Contacts fabricated for nanometre-sized materials using electron- and Ion-assisted deposition in a focused ion beam machine
POSTER 11	Anna	Lagunas	Low-Temperature, Free- Radical Promoted Cobalt Oxide Nanoparticle Synthesis
POSTER 12	Ion	Lizuain Lilly	Development of Nanoimprimt Lithography technique:fabrication of an optical micro-encoder
POSTER 13	Mª José	López	Nanostructures fabricated by NanoImprint Lithography
POSTER 14	Marisol	Martin	Nanopatterning of perpendicular magnetic disk by nitrogen implantation.
POSTER 15	Chris	Mills	Poly(ethylene naphthalate) as a secondary master for imprint lithography
POSTER 16	Irene	Montequi	Synthesis of Ultra Fine Particles in Supercritical CO2: SPS Process
POSTER 17	Jose	Olivares	Fabrication of nano-structured optical media by swift heavy ion irradiation
POSTER 18	Francesc	Pérez Murano	Fabrication of Molds for Nanoimprint Lithography using AFM Nanolithography

POSTER 19	Gema	Rius Suñé	Combination of e-beam and UV lithography for the prototyping of nano-mechanical devices
POSTER 20	Pere	Roca-Cusachs	Stability of microfabricated gihg aspect ratio structures in poly (dimethylsiloxane)
POSTER 21	Romen	Rodriguez	A cost effective fabrication method for microfluidic polymeric structures

POSTER – NANOMATERIALS (53)

Number	Name	Last Name	Title
POSTER 01	Libertad	Abad	Contact resistance between a Manganese Perovskites and a Metal in LCMO epitaxial thin films
POSTER 02	Pablo	Alvarez	Magnetic behaviour and structural evolution of Fe70Cr10B20 metallic glass
POSTER 03	Jordi	Arbiol	HRTEM and EELS Analysis of non-Cassiterite SnO2 Nanowires for Nanosized Gas Sensors
POSTER 04	Oscar	Arroyo Sainz	Surface modification of polymers by plasma to improve the hydrophobic behaviour
POSTER 05	Belén	Ballesteros	Silver nanoparticles embedded in macro foams
POSTER 06	Ana	Benito	Bundles of Multi-Wall Carbon Nanotubes Produced by Chemical Vapor Deposition over Sol-Gel Catalysts
POSTER 07	Pablo Martin	Botta	Dielectric behavior associated to nano-scale electronic phase separation in La0.5Ca0.5MnO3
POSTER 08	Lluis	Cabedo Mas	Influence of the clay type and modification on the final properties of amorphous pla nanocomposites
POSTER 09	Jose	Calderon-Moreno	Aurivilius and fluorite-type SrBi2Nb2O9 nanocrystallites obtained using an ‘amorphous citrate’ route.
POSTER 10	Carles	Corbella	Structure and morphology of diamond-like carbon films with metal contents
POSTER 11	Luis	Díaz Sol	IR Laser Induced Gas-Phase Deposition Of Iron Nanoparticles Embedded In A Polymeric Matrix.
POSTER 12	Eduardo	Elizalde	rf-Magnetron plasma deposition of vertically well-aligned carbon nanotubes
POSTER 13	Reyes	Elizalde	Nanostructure formation during deposition of TiN/Si3N4 nanomultilayer films by reactive dual magnetron sputtering
POSTER 14	Paloma	Fernandez	Luminescence of elongated nanostructures of oxide semiconductors
POSTER 15	Laura	Fernández	Induced magnetic anisotropies in Co and Fe-rich Finemet-type amorphous and nanocrystalline alloys.
POSTER 16	Jordi	Garcia Cespedes	Structural study of carbon nanotubes produced by chemical vapour deposition from ammonia and acetylene.
POSTER 17	María	García del Muro	Magnetic properties of granular Co-ZrO2 films

POSTER 18	Pedro	Gomez Romero	Hybrid nanomaterials for energy production ans storage devices
POSTER 19	F. Javier	Gutierrez	Preparation and characterization of carbon nanotube suspensions for epoxy nanocomposite manufacturig
POSTER 20	Cristina	Hoppe	Dielectric Response of Dispersions of Magnetite Nanoparticles in an Oleic Acid Modified Epoxy Network
POSTER 21	Nuria	Iturriza	Nanocrystalline particles induced by thermal annealing in finemet amorphous alloy
POSTER 22	Maria Jesús	Jurado	The influence of the recycling on PA nanocomposites
POSTER 23	Zorica	Konstantinovic	Structural properties of granular Ag-ZrO2 and Au-ZrO2 thin films
POSTER 24	Jose María	Lagaron	Barrier properties of nanocomposites and nanobiocomposites of interest in high and ultrahigh barrier food packaging applications and controlled release
POSTER 25	Monica	Lira	Nanomaterials for SOFC applications
POSTER 26	Juan	Lopez Valentín	Rubber/layered silicate nanocomposites
POSTER 27	Elena	López-Camacho	Helical and straight carbon nanotubes growth on silicon substrates with different surface roughness
POSTER 28	Enrique	López Ponce	On the origin of ferromagnetism in the Mn:Zn:O system
POSTER 29	Jorge	Macanás	Polymeric membranes as nanoreactors for sinthesis of stabilised metal nano-clusters for electrochemical applications
POSTER 30	Elena	Martines	Characterization of Nanotopographies: Water Contact Angles and SEI Modelling
POSTER 31	Maria Teresa	Martinez	Influence of the catalyst on the diameter of thermal CVD grown carbon nanotubes
POSTER 32	Judit	Molera	Silver nanoclusters composite glasses obtained by the Lustre technique.
POSTER 33	Carmen	Munuera Lopez	Molecular ordering and nanopatterning in self-assembled monolayers
POSTER 34	Dimitri	Muraviev	Novel routes for inter-matrix synthesis of polymer-stabilized metal nanopaticles for sensor applications
POSTER 35	Olatz	Murua	Manufacturing of ceramic foams for tissue regeneration
POSTER 36	Fernando	Palacio	Iron oxide nanocomposites from n-base polymers

POSTER 37	Francesca	Peiro	Final configuration of magnetic Co nanoparticles depending on the nature of the capping layer from high resolution transmission electron microscopy
POSTER 38	Fernando	Pigazo	Experimental and computational analysis of the angular dependence of the hysteresis processes in an antidots array
POSTER 39	Maria Pilar	Pina	Exchanged zeolites for optical sensor applications: a preliminar study
POSTER 40	Carlos	Pina	Surface nanostructures formation during crystal growth from aqueous solution
POSTER 41	Cinta	Punjol	Synthesis of Nanocrystals of KRE(WO4)2 (RE=Gd,Yb) by modified Pechini method
POSTER 42	Mathias	Reufer	Amorphous photonic materials
POSTER 43	Josep	Roque	Lustre surface characterization: Comparison between ancient and modern productions.
POSTER 44	Emma	Rossinyol	Nanostructured mesoporous tungsten oxide for gas sensor applications
POSTER 45	Pablo	Sanchís	Experimental implementation of an adiabatic coupling technique for SOI photonic crystal coupled-cavity waveguides
POSTER 46	Jacobo	Santamaría	Giant Magnetoresistance in Ferromagnet / Superconductor Structures
POSTER 47	Jesús Daniel	Santos	Magnetic sensors based in amorphous and nanocrystalline alloys with different geometries
POSTER 48	Rosalía	Serna	Controlling the structure at the nanoscale to improve the response of Optical systems
POSTER 49	Leonardo	Soriano	Electronic Structure of TiO2 Nanoparticles as Observed by X-ray Absorption Spectroscopy (XAS)
POSTER 50	Jordi	Sort	Exchange biased vortices
POSTER 51	Juan José	Suñol	Fe-Ni soft magnetic nanocrystalline materials developed by mechanical alloying
POSTER 52	Leticia	Zárate	Observation of antiferromagnetic coupling in amorphous CoxSi1-x / Si multilayers with low switching fields.
POSTER 53	Arcady	Zhukov	Magnetoresistance in thin wires with granular structure

POSTERS – SCANNING PROBE MICROSCOPIES (13)

Number	Name	Last Name	Title
POSTER 01	Lidia	Aguilera	CAFM Enhanced electrical performance: application to the characterization of high-k dielectrics in MOS devices.
POSTER 02	Ismael	Diez-Perez	Electrochemical formation of a semiconducting metal oxide observed by in situ tunneling spectroscopy
POSTER 03	Maria José	Esplandiú	Single-Walled Carbon Nanotubes as nanotools for Scanning Probe Microscopies
POSTER 04	Natalia	Galiana	Ultrasonic force microscopy at si-based nanostructures grown by molecular beam epitaxy
POSTER 05	Ricardo	Garcia	Multipurpose Force Tool for Quantitative nano-scale analysis and Manipulation of Biomolecular and Polymeric surfaces
POSTER 06	Gabriel	Gomila	Nano-scale Impedance Spectroscopy
POSTER 07	Mónica	Luna	Combination of non-contact Scanning Force Microscopy modes for the simultaneous study of topographic and electrostatic properties
POSTER 08	Javier	Mendez	Direct observation of reactants structures during catalytic reaction by means of stm and video-stm
POSTER 09	Elisa	Palacios	Determination and separation of Electrostatic and Van der Waals contributions to tip sample interacion in Non-Contact Scanning Force Microscopy
POSTER 10	Romain	Quidant	Subwavelength patterning of the optical near-field for manipulation at the nanometre scale
POSTER 11	Felix	Ritort	Condensation transition in DNA-PAMAM dendrimer fibers studied using optical tweezers
POSTER 12	Xavier	Sisquella	Development of single molecule nanobiosensors for the search of antibiotic and antimalarial compounds
POSTER 13	Maria	Torres	Magnetic Force Microscopy images of Patterned Media.

POSTERS – SIMULATION AT THE NANOSCALE (11)

Number	Name	Last Name	Title
POSTER 01	Marino	Arroyo	Anomalous elasticity of thick multiwalled carbon nanotubes through multiscale simulations
POSTER 02	Iván	Cabría	Effect of Lithium doping on the adsorption of molecular hydrogen on graphene layers and carbon nanotubes
POSTER 03	Agusti	Emperador	Isospin Transitions in Integer Filling Factor Phases of Weakly Coupled Vertical Diatomic Quantum Dot Molecules
POSTER 04	Felipe	Garcia	A micromagnetic study of the hysteretic behaviour of antidot lithographed Fe films
POSTER 05	Jose V.	Garcia Ramos	Surface Plasmon photonics on nanostructured metal surfaces
POSTER 06	Javier	Gil-Sevillano	Atomistic Simulation of the Mechanical behviour of craked nanowires
POSTER 07	Sacha	Gomez-Moñivas	Effective tip radius in electrostatic force microscopy
POSTER 08	Oscar	Iglesias	Exchange bias and surface anisotropy effects in the hysteresis loops of nanoparticles
POSTER 09	Xavier	Oriols	Quantum shot noise in mesoscopic systems: A de Broglie-Bohm wave-particle description
POSTER 10	Alfredo	Sánchez	Applications of Cholesky decomposition based methods in the nano-scale
POSTER 11	Francisco	Torrens	Calculations on co?solvents of single-wall carbon nanotubes

LIST OF POSTERS - FLASH
(Last update: 04/03/2005)

Tuesday session - POSTERS - FLASH (12)

Last Name	Name	Title	Topic
Arbiol	Jordi	HRTEM and EELS Analysis of non-Cassiterite SnO2 Nanowires for Nanosized Gas Sensors	Nanomaterials
Garcia	Jordi	Structural study of carbon nanotubes produced by chemical vapour deposition from ammonia and acetylene.	Nanomaterials
Garcia del Muro	Maria	Magnetic properties of granular Co-ZrO2 films	Nanomaterials
Jurado	Mª Jesus	The influence of the recycling on PA nanocomposites	Nanomaterials
Konstantinovic	Zorica	Structural properties of granular Ag-ZrO2 and Au-ZrO2 thin films	Nanomaterials
Murua	Olatz	Manufacturing of ceramic foams for tissue regeneration	Nanomaterials
Serna	Rosalia	Controlling the structure at the nanoscale to improve the response of Optical systems	Nanomaterials
Soriano	Leonardo	Electronic Structure of TiO2 Nanoparticles as Observed by X-ray Absorption Spectroscopy (XAS)	Nanomaterials
Bausells	Joan	Fabrication of electrodes with controllable sub-20 nm gap spacing	Nanofabrication
Bernabeu	Eusebio	Optical considerations on dye-SiO2 nanospheres in water solution	Nanofabrication
Lizuain	Ion	Development of Nanoimprimt Lithography technique:fabrication of an optical micro-encoder	Nanofabrication
Riús	Gema	Combination of e-beam and UV lithography for the prototyping of nano-mechanical devices	Nanofabrication

Wednesday session - POSTERS - FLASH (11)

Last Name	Name	Title	Topic
Alonso	Maria	PLGA-Mannosamine nanoparticles as new carriers for oral immunization	Nanobiotechnology
Casuso	Ignacio	DC current-voltage characteristics of purple membrane obtained by conducting atomic force microscopy	Nanobiotechnology
De la Fuente	Maria	Hyaluronate-Chitosan nanoparticles as new vehicles for ocular administration	Nanobiotechnology
Prego	Cecilia	Chitosan nanocapsules as transmucosal carriers for oral peptide delivery	Nanobiotechnology
Conesa	Juan Carlos	Behavior of catalytic cerium-containing mixed oxide nanoparticles upon high temperature treatments	Nanochemistry
Molina	Ricardo	Self-arrangement of surface chemical groups generated on air plasma treated wool	Nanochemistry
De la Cruz	Rosa Mª	Confinement and polaron energies in truncated conical semiconductor quantum dots	Nanoelectronics
Esplandiu	Mª Jose	Single-Walled Carbon Nanotubes as nanotools for Scanning Probe Microscopies	SPM
Garcia	Ricardo	Multipurpose Force Tool for Quantitative nano-scale analysis and Manipulation of Biomolecular and Polymeric surfaces	SPM
Ritort	Felix	Condensation transition in DNA-PAMAM dendrimer fibers studied using Optical tweezers	SPM
Iglesias	Oscar	Exchange bias and surface anisotropy effects in the hysteresis loops of nanoparticles	Simulation at the nanoscale

LIST OF PARTICIPANTS
(Last update: 04/03/2005)

ALPHABETICAL ORDER

Participants (222)

Last Name	Name	Country	Contribution	Topic
Abad	Veronique	Spain	Oral	Nanomaterials
Abad	Libertad	Spain	Poster	Nanomaterials
Abadal	Gabriel	Spain	Attendee	-
Abellan	Mª Angeles	Spain	Poster	Advanced Nanofabrication Methods
Aguilera	Lidia	Spain	Poster	Scanning Probe Microscopies
Albaladejo	Silvia	Spain	Attendee	-
Alcantara	David	Spain	Poster	Nanobiotechnology
Alonso	Mª Jose	Spain	Oral	Nanobiotechnology
Alonso	María	Spain	Poster	Nanobiotechnology
Alonso	Pablo	Spain	Poster	Advanced Nanofabrication Methods
Alvarez	Pablo	Spain	Poster	Nanomaterials
Amabilino	David	Spain	Poster	Nanochemistry
Antonietti	Markus	Germany	Invited Speaker	-
Aranda	Pilar	Spain	Poster	Nanochemistry
Arbiol	Jordi	Spain	Poster	Nanomaterials
Ares	Pablo	Spain	Attendee	-
Arroyo	Oscar	Spain	Poster	Nanomaterials
Arroyo	Marino	Spain	Poster	Simulation at the nanoscale
Astilleros	Jose Manuel	Spain	Attendee	-
Aymerich	Marta	Spain	Oral	Scientific Policy and Infrastructure
Badenes	Goncal	Spain	Attendee	-
Baez	Jose Manuel	Spain	Oral	Scientific Policy and Infrastructure
Ballesteros	Belen	Spain	Poster	Nanomaterials
Barberan	Nuria	Spain	Poster	Nanoelectronics
Baro	Mª Dolors	Spain	Attendee	-
Bartolome	Juan	Spain	Oral	Nanomaterials
Batlle	Xavier	Spain	Oral	Advanced Nanofabrication Methods
Bausells	Joan	Spain	Poster	Advanced Nanofabrication Methods
Benito	Ana	Spain	Poster	Nanomaterials
Bennink	Martin	Netherlands	Invited Speaker	-
Bernabeu	Eusebio	Spain	Poster	Advanced Nanofabrication Methods
Bertran	Enric	Spain	Attendee	-
Blanco	Maria	Spain	Poster	Nanobiotechnology
Blazquez	Mª Luisa	Spain	Poster	Nanobiotechnology
Borrise	Xavier	Spain	Poster	Advanced Nanofabrication Methods
Cabria	Ivan	Spain	Poster	Scanning Probe Microscopies
Calderon Moreno	Jose	Spain	Poster	Nanomaterials
Caner	Fehur	Spain	Poster	Nanobiotechnology
Cartoixa	Xavier	Spain	Oral	Nanoelectronics
Casuso	Ignacio	Spain	Poster	Nanobiotechnology
Cebollada	Federico	Spain	Attendee	-
Cid Salavert	Cristina	Spain	Attendee	-
Cirera	Albert	Spain	Attendee	-
Colchero	Jaime	Spain	Attendee	-

Conesa	Jose C.	Spain	Poster	Nanochemistry
Corbella	Carles	Spain	Poster	Nanomaterials
Correia	Antonio	Spain	Organising Committee	-
De la Cruz	Rosa Mª	Spain	Poster	Nanoelectronics
De la Fuente	Jesus M.	United Kingdom	Poster	Nanobiotechnology
De la Fuente	María	Spain	Poster	Nanobiotechnology
Devesa	François	Spain	Technical Organising Committee	-
Diaz Sol	Luis	Spain	Poster	Nanomaterials
Domingo	Concepcion	Spain	Poster	Nanochemistry
Dominguez	Arturo	Spain	Poster	Advanced Nanofabrication Methods
Elizalde	Reyes	Spain	Poster	Nanomaterials
Emperador	Agusti	Spain	Poster	Simulation at the nanoscale
Eritja	Ramon	Spain	Attendee	-
Esplandiu	Maria Jose	Spain	Poster	Scanning Probe Microscopies
Esquena	Jordi	Spain	Oral	Nanomaterials
Esteve	Jaume	Spain	Attendee	-
Farjas	Jordi	Spain	Poster	Advanced Nanofabrication Methods
Fernandez	Rafael	Spain	Attendee	-
Fernandez	Laura	Spain	Attendee	-
Paloma	Fernandez	Spain	Poster	Nanomaterials
Fernandez-Barquín	Luis	Spain	Oral	Nanoelectronics
Fernandez-Busquets	Xavier	Spain	Oral	Nanobiotechnology
Fesenko	Oksana	Spain	Attendee	-
Figueras	Albert	Spain	Attendee	-
Franco	Victor	Spain	Oral	Nanomaterials
Froufe	Luis	Spain	Poster	Nanoelectronics
Galiana	Natalia	Spain	Oral	Nanomaterials
Garcia	Ainara	Spain	Poster	Nanobiotechnology
Garcia	Rebeca	Spain	Attendee	-
García	Jordi	Spain	Poster	Nanomaterials
Garcia	Ricardo	Spain	Oral	Advanced Nanofabrication Methods
García Gil	Sandra	Spain	Attendee	-
Garcia Güell	Aleix	Spain	Poster	Nanobiotechnology
Garcia del Muro	Montserrat	Spain	Poster	Nanomaterials
Garcia Martinez	Yamila	Spain	Oral	Nanoelectronics
Garcia Ramos	Jose Vicente	Spain	Poster	Simulation at the nanoscale
Garcia Sanchez	Felipe	Spain	Poster	Simulation at the nanoscale
Garrido	Blas	Spain	Attendee	-
Gil	Adriana	Spain	Attendee	-
Gil Sevillano	Javier	Spain	Poster	Simulation at the nanoscale
Goikolea	Eider	Spain	Attendee	-
Gomez	Jose Mª	Spain	Attendee	-

Gomez	Diego	Spain	Attendee	-
Gomez Bastus	Neus	Spain	Oral	Nanobiotechnology
Gomez Fernandez	Javier	Spain	Attendee	-
Gomez Moñivas	Sacha	Spain	Poster	-
Gomez de Salazar	Jose Mª	Spain	Attendee	-
Gomila	Gabriel	Spain	Poster	Scanning Probe Microscopies
Gonzalez	Julian	Spain	Poster	Nanomaterials
Gonzalez	Mª Teresa	Spain	Oral	Nanoelectronics
Gonzalez	Ignacio	Spain	Poster	-
Gutierrez	Francisco	Spain	Attendee	-
Gutierrez	Fº Javier	Spain	Poster	Nanomaterials
Hernandez	Fernando	Spain	Technical Organising Committee	-
Hernandez Ramirez	Francisco	Spain	Poster	Advanced Nanofabrication Methods
Hernando	Antonio	Spain	Oral	Nanomaterials
Hofmann	Heinrich	Switzerland	Invited Speaker	-
Hueso	Luis Eduardo	Spain	Oral	Nanoelectronics
Ibañez	Mª Teresa	Spain	Technical Organising Committee	-
Insausti	Maite	Spain	Attendee	-
Iturriza	Nuria	Spain	Poster	Nanomaterials
Jansat	Susanna	Spain	Attendee	-
Jurado	Mª Jesus	Spain	Poster	Nanomaterials
Katakis	Ioanis	Spain	Attendee	-
Konstantinovic	Zorica	Spain	Poster	Nanomaterials
Kreuzer	Mark	Spain	Attendee	-
Labarta	Amilcar	Spain	Attendee	-
Lagunas	Anna	Spain	Poster	-
Ledesma	Javier	Spain	Attendee	-
Lira-Cantu	Monica	Spain	Poster	Nanomaterials
Lizuain	Ion	Spain	Poster	Advanced Nanofabrication Methods
Lopez	Mª Jose	Spain	Poster	Advanced Nanofabrication Methods
Lopez Camacho	Elena	Spain	Poster	Nanomaterials
Lopez Corral	Ignacio	Spain	Attendee	-
Lopez Ponce	Enrique	Spain	Attendee	-
Lopez Valentin	Juan	Spain	Poster	Nanomaterials
Lloveras	Vega	Spain	Poster	Nanoelectronics
Macanas	Jorge	Spain	Poster	Nanomaterials
Machado	Eduardo	Spain	Oral	Simulation at the nanoscale
Macho Aparicio	Santiago	Spain	Attendee	-
Maestre	David	Spain	Attendee	-
Mairata i Payeras	Antoni	Spain	Attendee	-

Marin	Jose R.	Spain	Attendee	-
Martin-Gonzalez	Marisol	Spain	Poster	Advanced Nanofabrication Methods
Martines	Elena	Spain	Poster	Nanomaterials
Martinez	Juan Carlos	Spain	Oral	Advanced Nanofabrication Methods
Martinez	Javier	Spain	Oral	Scanning Probe Microscopies
Martinez	Ramses V.	Spain	Attendee	-
Maser	Wolfgang	Spain	Oral	Nanomaterials
Mendez	Javier	Spain	Oral	Scanning Probe Microscopies
Merkoçi	Arben	Spain	Poster	Nanobiotechnology
Miranda	Enrique	Spain	Poster	Nanoelectronics
Molera	Judit	Spain	Poster	Nanomaterials
Molina	Ricardo	Spain	Poster	Nanochemistry
Montelius	Lars	Sweden	Invited Speaker	-
Montequi	Irene	Spain	Poster	Advanced Nanofabrication Methods
Morales	Daniel	Spain	Attendee	-
Morante	Juan Ramon	Spain	Attendee	-
Munuera	Carmen	Spain	Poster	Nanomaterials
Muñoz	Maria	Spain	Attendee	-
Muraviev	Dmitri	Spain	Poster	Nanomaterials
Murua	Olatz	Spain	Poster	Nanomaterials
Navajas	Daniel	Spain	Attendee	-
Nolla	Jordi	Spain	Poster	Nanochemistry
Oliva	Antoni	Spain	Attendee	-
Olivares	Jose	Spain	Poster	Advanced Nanofabrication Methods
Oncins	Gerard	Spain	Poster	Nanobiotechnology
Ordejon	Pablo	Spain	Attendee	-
Oriols	Xavier	Spain	Poster	Simulation at the nanoscale
O´Sullivan	Clara	Spain	Attendee	-
Pacheco	Luis	France	Attendee	-
Palacio	Fernando	Spain	Attendee	-
Palacios	Elisa	Spain	Poster	Scanning Probe Microscopies
Palacios	Juan	Spain	Attendee	-
Pastoriza	Isabel	Spain	Oral	Nanochemistry
Peiró	Francesca	Spain	Poster	Nanomaterials
Pellegrino	Paolo	Spain	Poster	Nanoelectronic
Penades	Soledad	Spain	Poster	Nanobiotechnology
Perez Conde	Jesus	Spain	Attendee	-
Perez Juste	Jorge	Spain	Poster	Nanochemistry
Perez Murano	Francesc	Spain	Attendee	-
Pi	Marti	Spain	Attendee	-
Pigazo López	Fernando	Spain	Poster	Nanomaterials
Pina	Carlos	Spain	Poster	Nanomaterials
Porti	Marc	Spain	Poster	Nanoelectronic
Prego	Cecilia	Spain	Poster	Nanobiotechnology
Puig	Jorge	Spain	Attendee	-
Pujol	Maria	Spain	Poster	Nanomaterials
Quidant	Romain	Spain	Poster	Scanning Probe Microscopies
Reufer	Mathias	Switzerland	Poster	Nanomaterials

Rey	Miguel	Spain	Poster	Nanoelectronic
Rico	Felix	Spain	Poster	Nanobiotechnology
Rius	Gemma	Spain	Poster	Advanced Nanofabrication Methods
Rius Ferrus	Xavier	Spain	Poster	Nanochemistry
Riu Rusell	Jordi	Spain	Attendee	-
Roca-Cusachs	Pere	Spain	Poster	Advanced Nanofabrication Methods
Rodriguez	Rosana	Spain	Poster	Nanoelectronic
Rodriguez	Jordi	Spain	Attendee	-
Rodriguez-Trujillo	Romen	Spain	Poster	Advanced Nanofabrication Methods
Roldan	Jose Luis	Spain	Technical Organising Committee	-
Roque	Josep	Spain	Poster	Nanomaterials
Rossinyol	Emma	Spain	Poster	Nanomaterials
Ruiz	Daniel	Spain	Poster	Nanomaterials
Ruiz-Hitzky	Eduardo	Spain	Oral	Nanochemistry
Rurali	Riccardo	Spain	Oral	Simulation at the nanoscale
Saenz	Juan Jose	Spain	Organising Committee	-
Sahagún	Enrique	Spain	Attendee	-
Salmeron	Miquel	USA	Invited Speaker	-
Samitier	Josep	Spain	Organising Committee	-
Sanchez Acevedo	Zayda	Spain	Attendee	-
Sanchez de Meras	Alfredo	Spain	Poster	Simulation at the nanoscale
Sanchez Moreno	Jose Manuel	Spain	Attendee	-
Sanchis	Pablo	Spain	Poster	Nanomaterials
Santamaria	Jacobo	Spain	Poster	Nanomaterials
Santos	Jesus Daniel	Spain	Poster	Nanomaterials
Scheffold	Frank	Switzerland	Invited Speaker	-
Serna	Rosalia	Spain	Poster	Nanomaterials
Sisquella	Xavier	Spain	Poster	Scanning Probe Microscopies
Solans	Conxita	Spain	Attendee	-
Soria	Silvia	Spain	Attendee	-
Soriano	Leonardo	Spain	Poster-Flash	Nanomaterials
Sort	Jordi	Spain	Poster	Nanomaterials
Suñe	Jordi	Spain	Attendee	-
Suñol	Juan José	Spain	Poster	Nanomaterials
Teva	Jordi	Spain	Poster	Nanobiotechnology
Thayil	Anisha	Spain	Oral	Nanobiotechnology
Toca	Jose Luis	Spain	Poster	Nanobiotechnology
Tomellini	Renzo	Belgium	Invited Speaker	Scientific Policy and Infrastructure
Torrent-Burgues	Juan	Spain	Poster	Nanochemistry
Torres	Francesc	Spain	Attendee	-
Veciana	Jaume	Spain	Attendee	-
Ventosa	Nora	Spain	Poster	Nanochemistry

Ventosa	Carles	Spain	Attendee	-
Viguier	Claude	France	Attendee	-
Vila	Anna	Spain	Attendee	-
Vilas	Jose Luis	Spain	Attendee	-
Villanueva	Luis G.	Spain	Attendee	-
Villarroya	María	Spain	Oral	Advanced Nanofabrication Methods
Zarate	Leticia	Spain	Poster	Nanomaterials

NanoSpain

Spanish Nanotechnology Network
Red Española de Nanotecnologia

http://www.nanospain.org

Phantoms
Foundation
Parque Cientifico de Madrid - Pabellon C - 1ºPlanta
Ctra Colmenar Viejo Km 15
Campus de Cantoblanco - Universidad Autónoma de Madrid
28049 Madrid, Spain
Fax: +34 91 4973471
E-mail: antonio@phantomsnet.net
WEB: http://www.phantomsnet.net

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Parc Científic de Barcelona
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UAM UNIVERSIDAD AUTONOMA DE MADRID
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