TNT 2009

Trends in NanoTechnology

Barcelona (Spain)
September 07-11, 2009

PHANTOMS foundation

Universidad de Oviedo

UAM Universidad Autonoma de Madrid

UAB Universitat Autònoma de Barcelona

CSIC Consejo Superior de Investigaciones Científicas

Universitat de Barcelona

CIC nanoGUNE nanoscience cooperative research center

Georgia Tech

NIMS Nanomaterials Laboratory

Purdue University

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MANA

On behalf of the International, Local and Technical Committees, we take great pleasure in welcoming you to Barcelona (Spain) for the 10th "Trends in NanoTechnology" (TNT2009) International Conference.

2009 marks the 10th anniversary of this conference series and TNT2009 is being held in large part due to the overwhelming success of earlier TNT Nanotechnology Conferences and will be organised in a similar way to the prior events.

This high-level scientific meeting series aims to present a broad range of current research in Nanoscience and Nanotechnology worldwide, as well as initiatives such as iNANO, EU/ICT/FET, GDR-I/Nano-I, MANA, CIC nanoGUNE Consolider, Synergys, etc. TNT events have demonstrated that they are particularly effective in transmitting information and promoting interaction and new contacts among workers in this field. Furthermore, this event offers visitors and sponsors an ideal opportunity to interact with each other.

One of the main objectives of the Trends in Nanotechnology conference is to provide a platform where young researchers can present their latest work and also interact with high-level scientists. For this purpose, the Organising Committee provides every year around 80 travel grants for students. In addition, this year, 19 awards (4800 Euros in total) will be given to young PhD students for their contributions presented at TNT. More than 60 senior scientists are involved in the selection process. Grants and awards are funded by the TNT Organisation in collaboration with several governmental and research institutions.

TNT is now one of the premier European conferences devoted to nanoscale science and technology with around 350-400 participants worldwide.

We are indebted to the following Scientific Institutions, Companies, Individuals and Government Agencies for their help and financial support: Phantoms Foundation, Universidad de Oviedo, Donostia International Physics Center (DIPC), CIC nanoGUNE Consolider, Consejo Superior de Investigaciones Científicas, Universidad Autónoma de Madrid, Universidad Complutense de Madrid, University of Purdue, Georgia Institute of Technology, CEA/LETI, MINATEC, Universidad de Barcelona, Universidad Autónoma de Barcelona, 22@Barcelona, Knowledge innovation market bcn (Kimbcn), nanoaracat, Instituto Catalán de Nanotecnología, Instituto Universitario de Investigación en Nanociencia de Aragón, Instituto Español de Comercio Exterior (ICEX) & "españa-technology for life" program, NIMS (Nanomaterials Laboratory) and MANA (International Center for Materials and Nanoarchitectonics), NanoBasque, University of Fribourg and frimat, Adolphe Merkle Institute, Air Force Office of Scientific Research, NSERC/CRSNG (Nano Innovation Platform), GDR-I/Nano-I, International

Iberian Nanotechnology Laboratory (INL), Institute for Bioengineering of Catalonia (IBEC), Centro de Investigación en Nanomateriales y Nanotecnología (CINN), IE Universidad, Ayuntamiento de Barcelona, Fundación Itma, Ministerio de Ciencia e Innovación, ONCE, Parque Científico de Madrid (PCM), P. Van Hove (private donation), FEI Company, IJ Cambria Scientific, Ambassade de France en Espagne, C'Nano Ile-de-France and Wiley-VCH & PSS.

We would also like to thank the following companies and Institutions for their participation: Nanotec Electronica, Fischer, Orsay Physics, Raith, Wiley-VCH, Scientec, Omicron Nanotechnology, Phantoms Foundation, ICEX, LOT, Photon Lines, nano tech 2010, SMA, nanoaracat, Institut Català d'investigació Química (ICIQ), Parc Científic de Barcelona (PCB), Institute for Bioengineering of Catalonia (IBEC), Barcelona Nanotechnology Cluster Bellaterra (BCN-b), Institut de Nanociencia i Nanotecnología (IN2UB), Institut de Ciències Fotòniques (ICFO), Center for Research in NanoEngineering (CRNE), EMaS Research Center and LEITAT Technological Center.

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

The Organising Committee

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TNT2009 POSTER AWARDS

Funded by		Award
NIMS MANA	NIMS/MANA	300 Euros
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nanoBasque	nanoBasque	250 Euros
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Private Donation	-	David Prize: 300 US Dollars
Private Donation	-	Keren Prize: 300 US Dollars
TNT 2009 Trends in NanoTechnology Barcelona (Spain) September 07-11, 2009	TNT2009 Organisation	Free registration to the 2010 Conference

in collaboration with

PHANTOMS foundation

presents

"PASSPORT TO PRIZES" PROGRAM

At this new edition of the Trends in Nanotechnology conference we are pleased to organise the TNT2009 "Passport to Prizes" program.

How does the "Passport to Prizes" program work?

Each TNT2009 conference attendee will find a passport card inside his TNT2009 conference bag. You will take your card around the exhibit hall on Monday, Tuesday and Wednesday. Take this opportunity to visit the stands that the exhibitors have prepared, and to learn about the companies and their new products. Each exhibiting company has received a stamp with a number. Attendees will be responsible for collecting stamps from the participating exhibitors that are listed on their passport.

Once you have completed your passport card with a minimum of 20 stamps, **fill in your personal data** and take the card to the ticket tumbler located in the Registration Area. Please, do not forget to complete the passport card with your name and institution before you put it into the box.

All completed entries will be eligible for a prize drawing that will be conducted on the evening of Wednesday (09/09/2009) during the Poster Award Ceremony.

Do not miss this opportunity to win one of our **two Digital Cameras** (donated by Phantoms Foundation).

And remember that winners need to be present to win. So… see you at the conference dinner and the poster award ceremony!

TNT2009 PLATINUM SPONSORS

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Universidad de Oviedo

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Ajuntament de Barcelona

22Barcelona El districte de la innovació

ICN Institut Català de Nanotecnologia

INSTITUTO UNIVERSITARIO DE INVESTIGACIÓN EN NANOCIENCIA DE ARAGÓN

cinn Centro de Investigación en Nanomateriales y Nanotecnología

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International Nanotechnology Exhibition & Conference nano tech 2010

SMA

CATALONIA MACRO-STAND EXHIBITORS

ICFO Institut de Ciències Fotòniques

ICIQ Institut Català d'Investigació Química

UB Parc Científic de Barcelona

ibec Institute for Bioengineering of Catalonia

bnc-b BARCELONA NANOTECHNOLOGY CLUSTER BELLATERRA

nanoaracat

IN2UB INSTITUT DE NANOCIÈNCIA I NANOTECNOLOGIA

UPC CRNE Centre for Research in NanoEngineering

EMaS CENTRE DE RECERCA RESEARCH CENTER

LEITAT Technological Center managing your technologies

TNT2009 EXHIBITORS

Nanotec Electronica is one of the leading companies in the Nanotechnology Industry. In only ten years Nanotec Electronica has established itself as one of the strongest companies that design, manufacture and supply Scanning Probe Microscopes (SPM). Our highly qualified team uses cutting-edge technology in order to provide a cost-effective tool to gain access to the nanometer scale for both scientific and industrial communities. With its headquarters based in Spain and distributors located around the world, Nanotec ensures global presence and guarantees total customer satisfaction.
Nanotec´s Cervantes FullMode Atomic Force Microscope (AFM) in its several configurations allows not only imaging samples with atomic precision but also the study of magnetic, electronic and mechanical properties at the nanoscale, making it a powerful tool for physicists, chemists, biologists and engineers willing to characterize their samples at the nanometer scale. Its robust design provides strong mechanical stability to ensure high imaging resolution, and its semi-automated and open design allows scientists to exploit the capability of SPM to its maximum for both research and academic purposes. Nanotec Electronica also provides Dulcinea Control Systems, with an open and modular design that facilitates interfacing with any other standard AFM/SNOM/STM system available in the market. Highly versatile, it allows different modes of operation from Contact Mode to Frequency Modulation Mode and lithography ensuring a reliable and accurate performance of all SPM systems. Nanotec has also developed and freely distributes SPM software WSxM. Its user-friendly interface ensures easy operation of SPM microscopes and data processing. WSxM is available for its free download at www.nanotec.es

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For more than two decades **Raith GmbH** has been developing and selling high-tech systems in the domain of nanotechnology worldwide.
Main areas of operations are designing and manufacturing of systems enabling fabrication of superfine surface structures down to the range of less than 10 nanometers (electron and ion beam lithography) and semiconductor inspection tools for industry (defect review).
Renowned customers such as Infineon Technologies or the Massachusetts Institute of Technology in Boston avail themselves of the know-how Raith has acquired since its early being in business.
With its highly educated staff of physicists, engineers and technicians Raith offers optimum service and support for answers to technical and application related questions.
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Since 1985 Raith has pioneered the way for SEM lithography. Today complete turnkey lithography system solutions complement Raith product portfolio. These systems are used in state-of-the-art research in Physics, Electrical Engineering and other R&D related fields.

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The Spanish Institute for Foreign Trade (**ICEX**) ("Instituto Español de Comercio Exterior") is the Spanish Government agency serving Spanish companies to promote their exports and facilitate their international expansion, assisted by the network of Spanish Embassy's Economic and Commercial Offices and, within Spain, by the Regional and Territorial Offices.
It is part of the Spanish Ministry of Industry, Tourism and Trade ("Ministerio de Industria, Turismo y Comercio").

Web: www.icex.es
España, Technology for life: www.spainbussiness.com

The Phantoms Foundation (non-profit organisation) was established on November 26, 2002 (in Madrid, Spain) to provide high level Management profile to National and European scientific projects.
The Phantoms Foundation works in close collaboration with Spanish and European Governmental Institutions such as MEC (Spanish Ministry of Science) and ICEX (Spanish Institute for Foreign Trade), or the European Commission to provide focused reports on Nanoscience & Nanotechnology related research areas (infrastructure needs, emerging research, etc.) and develop activities to stimulate commercial nanotechnology applications (Spanish Pavilion at nanotech2008, nanotech2009 and NSTI).

Web: www.phantomsnet.net

Orsay Physics was founded in 1989 by researchers, engineers and specialists in charged particle optics from Paris-Orsay University and started to develop Focused Ion Beam (FIB) columns and systems.
After eight years of experience in developing innovative FIB concepts, Orsay Physics moved into new facilities dedicated to high quality FIB production in Provence.
Our growing success, which comes from our ability to customize our products for dedicated uses, has required a huge investment in new resources. In 2004, our production capacity and R&D activities were increased by the addition of a new building and new equipment. At the same time, we have an ongoing programme of recruiting qualified staff and optimizing product quality and reliability in accordance with ISO 9001: version 2000.

Orsay Physics is now a world leader in the field of customized Focused Ion and Electron Beam columns and related equipment such as Gas Injection Systems. Our key strength is that we manage the whole process internally from the conception through to commercial manufacture passing via design, development and prototype production.

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Measuring the world of atoms in an industrial style

Cost-effective coating analysis and micro hardness measuring instruments enables economic quality testing in industrial nanotechnology.
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Until now the cost of the instruments used for characterization of the properties of this nano-coats has been uneconomically high. Such instruments are almost exclusively suitable for laboratory applications.
Now, quality testers in the field of nanotechnology can work much more cost-efficient using the FISCHERSCOPE® X-RAY XDV® for the analysis and thickness measurement of nano-coatings and the and the PICODENTOR® HM500 for nano-hardness measuring.
The cost of acquiring these instruments is less than half the typical cost of current comparable instruments. This is possible through the well thought-out design of these measuring instruments in combination with sophisticated evaluation electronics and software. Moreover, with the automated measurements processes that last only a few seconds, depending on the specifications, it is not only suitable for laboratory measurements but can be used advantageously for quality assurance in manufacturing. In combination with a personal computer, the instruments provide all typical statistical evaluations, print forms and documentations. In this manner, it provides a qualified quality test in the field of industrial nanotechnology.
Through the development of a cost-effective coatings analysis and micro-hardness measuring instruments suitable for use in industrial manufacturing, Helmut Fischer GmbH + Co. KG of Sindelfingen, Germany proves again its great competency and innovative power.
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Since 1992 **Suministro de Materiales y Asistencia** has been founded with the finality to dedicate it to the microelectronics.
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LOT-Oriel is a high-tech distribution company, established successfully more than 30 years in research and development in university as well as industrial surroundings. Besides the headquarters in Darmstadt we serve the needs of our customers all around Europe either through our subsidiaries or cooperation partners. Our main activities cover fields like:

- Optical spectroscopy, microscopy
- Laser, laser optics
- Material research
- Surface science
- Bio-/nanotechnolgy

One of our key areas is the rapidly expanding field of bio-/nanotechnolgy focusing on different products/technologies:

- Life Science Scanning Probe Microscopy (SPM) for high-end applications under controlled environmental conditions
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- Bottom-up nanofabrication via Dip Pen Nanolitography
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- Quartz Crystal Microbalance with Dissipation Monitoring (QCM-D) for rapid characterisation of biointerfaces

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Nanotechnology has been our everyday business since long before the term ever existed.
Founded in 1984 by Norbert Nold, Omicron started business by introducing the SPECTALEED and the legendary Ultra High Vacuum STM 1 as their first and highly successful products. The STM 1, which still delivers state-of-the-art performance even by today's standards in nearly 200 laboratories worldwide, firmly established Omicron's present position as the world market leader in UHV scanning probe microscopy.

Today, our products like, for example, the new NanoESCA or the UHV Gemini Column are right at the forefront of research. We are used to redefining the limits of the technically feasible again and again. More than 500 articles demonstrate this to the full. Many of them were published in leading journals such as Nature, Science, Physical Review Letters or Chemical Review Letters.

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Photon Lines Óptica is a distribution company selling value added solutions into the Spain and Potugal optics markets.

The focus of the company is two-fold: We supply a range of cameras (including CCD cameras, CMOS cameras, infrared cameras, intensified cameras) into low light level, high speed vision and imaging applications as well as high technology lasers, optical components and optical detectors (photomultipliers, photodiodes, streak tubes, image intensifiers, etc...) into the fields of industrial applications, life sciences, military, semiconductor and scientific research. Additionally, we have a branch of modulators for optical telecommunications.
With sister offices in the UK, France and Spain, Photon Lines Óptica is able to call upon a pool of expertise in the field of photonics to the benefit of customers and suppliers alike.

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nano tech 2010 (International Nanotechnology Exhibition & Conference) will be covering the entire nano marketplace and creating a variety of business opportunities at Tokyo Big Sight by concurrently holding; nano tech 2010: the world's largest nanotechnology exhibition, Nano Bio Expo 2010: exhibition uniting biotechnology, nanotechnology and business, ASTEC2010 & METEC'10: Specialized exhibition for surface technology, treatment and processing, nano & neo functional material 2010: exhibition for electronics and printing materials, and our new exhibition named InterAqua 2010, which focuses on water processing techniques and circulation systems. Exhibitors will enjoy a powerful synergy effect with visitors to all concurrently held exhibitions.

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TNT2009 "CATALONIA MACRO-STAND" EXHIBITORS

EMaS: a Centre for research of new materials and in micro/nanotechnology
The Research Centre on Materials and micro/nanoSystems Engineering, EMaS, is a research centre from the Rovira i Virgili University in Tarragona which investigates in the field of science and engineering of new materials and its microstructuration to use them in the design and development of micro and nanosystems.

The EMaS Research Centre is made up of 89 expert researchers in various disciplines as physics, chemistry, chemical engineering, optics, photonics, electronics and environmental engineering. EMaS, as a multidisciplinary centre, has to increase its chances in front of the European R+D scene. Although it is a young centre, established in September 2008, the first results obtained proved the suitability of this centre.

EMaS
Campus Sescelades
Marcel·li Domingo, s/n
43007 Tarragona (SPAIN)
Web: www.urv.cat/centres_recerca/emas/

CRNE
Centre for Research in NanoEngineering

The Technical University of Catalonia (UPC) has recently joined the global Catalan effort in the development of nanotechnology-related research infrastructures with the creation of the Center for Research in Nanoengineering (CRnE). This new initiative has been launched with the aim to provide a technological development base for applications of nanotechnology, with a special focus on computing, materials and electronics

The objectives of the CRnE have been designed with three main cornerstones: people, excellence in research and service to society. The center aims to attract worldwide young, clever and motivated PhD students and post-doctoral researchers, to offer to these young people the best conditions to achieve significant scientific contributions with the highest impact, and then to facilitate their incorporation to industry, as highly-qualified employees and/or managers of their own entrepreneurial activities. On the other hand, the activities of the center will help the nucleation of current research efforts at UPC, with a clear focus on nanoscale engineering. Nanolithography and nanoelectronics, advanced analytical devices for aerospace applications, nanoparticles and colloids in building materials, molecular dynamics of self-assembling systems, more efficient and environmentally-friendly catalytic methods, and high-performance coatings for metals and ceramics are among the current research activities that will benefit directly from such an initiative. And finally, in the best of UPC's tradition of technological service to society, an ambitious plan of diffusion of capabilities and results will be conceived to provide expertise through interaction with industrial partners.

CRnE
Universitat Politècnica de Catalunya
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08034 Barcelona (SPAIN)
Web: www.upc.edu/crne/index.php/home

Leitat is a Technological centre specialized in production Technologies, performing R&D activities in the areas of material sciences, environment, surface treatments, biotechnologies and renewable energies, with deep knowledge and experience on technological transfer to several industrial sectors.
The main research lines on the application of nanotechnology in LEITAT are focused on material science with a special interest in developing new materials from organically-modified nanoparticles.

These research lines include the development of:

- **Chemical modification and production of nanoparticles:** Funcionalization of carbon nanotube, organic modification of nanoclays, synthesis of magnetite nanoparticle (Fe_3O_4)
- **New nanocomposite:** Fibres for fabric manufacturing (Extrusion of nanoparticle and carbon nanotube in polymeric blends).
- **Functionalization of textiles:** Through innovative surface treatments (Plasma polymerization, grafting of chemically modified nanoparticles).
- **Multifuncional and smart materials:** Thermochromic and phosphorescent polymer blend, nanofibre by electrospinning, nanocapsule...etc.
- **Human Performance Enhancement:** Improvement of personal equipments in terms of comfort and protection (mechanical, thermal).

LEITAT also owns a pilot plant with semi-industrial scale machinery for nanocomposite fiber extrusion and fabric manufacturing like knitting and weaving, and a fully equipped laboratory for characterization of all fabric properties. In addition, our Testing Department can offer service of certification (ISO, UNE...) and more that 800 determinations of physical and chemical parameters.
Every year, LEITAT takes part in several R&D projects funded by industrial partners and offers customized services attending their needs, to reach the highly specialized levels required for today's market demands.
LEITAT has signed a collaboration agreement with the ICN, the Catalan Institute of Nanotechnology, focused on research of excellence in Nanoscience and Nanotechnology, for boosting the effective industrialization of innovative products based on nanotechnology.

Leitat
Passeig 22 de Juliol, 218
08221 Terrassa Barcelona (SPAIN)
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Nanoaracat is a collaboration agreement between the governments of the Autonomous Communities of Aragon and Catalonia, to initiate joint activities in the fields of Nanoscience and Nanotechnology.

Since 2006, Nanoaracat organises conferences on nanoscience and the applications of nanotecnology in the industrial sector, as well as training courses. It also funds short term visits and exchanges of research personnel between the different centres linked to the agreement in the two communities.

These initiatives promote research in nanoscience and naotechnology, collaboration and the transfer of knowledge in this field between the academic and industrial sectors in Aragon and Catalonia.

Web: www.nanoaracat.com

The **Institute of Chemical Research of Catalonia (ICIQ)** is a non-profit organisation that has been created by the Department d'Innovació, Universitats i Empresa (DIUE) of the Catalan government, with the aim of becoming a centre of reference in Chemistry within the European scientific and technological community. ICIQ is supported by both scientific and industrial advisory committees, composed of internationally renowned scientists and leading chemical companies.

Our mission is to lead, from the vantage point of molecular science, cross strategies for solving major social and economic problems, thereby contributing to the establishment of a knowledge-based economy and improving citizen's quality of life.

ICIQ
Avgda. Països Catalans 16
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Web: www.iciq.es

The **Parc Científic de Barcelona (PCB)** is a meeting point where university, business and society come together. Its objective is to promote innovation, particularly in the life sciences. Founded by the University of Barcelona in 1997, it was the first science park in Spain and is an international point of reference today in the promotion of innovation, with more than 2,200 employees. The goals of the PCB are:

- To potentiate quality research with the support of a wide range of technologies
- To revitalize the relation between university and business
- To promote the creation of new companies and institutions
- To further the science-society dialogue and encourage careers in science

At present the park is home to 4 research institutes, more than 50 companies, an incubator for biotechnology companies, more than 70 research groups and a wide range of research support technology.

The Nanotechnology Platform is part of the PCB technological offer and includes highly trained personnel, technological "know how", and state-of-the-art facilities dedicated to facilitate the use of nanotechnology in a variety of research areas such as nanobioengineering, BioMEMS, materials science, magnetism, optics, biomaterials, and tissue engineering. The Platform provides users with a wide range of high-resolution characterization and fabrication equipment. The highly skilled Platform staff composed by seven professionals, among them four PhDs, offers scientific and technological advice that expands from the design of devices or processes to fabrication and analysis of results.

Parc Científic de Barcelona
Baldiri Reixac 10, 08028 Barcelona (SPAIN)
Web: www.pcb.ub.es

Research institutes are nowadays amongst the most significant organisational units of research within the University of Barcelona. They were created to encourage research and to promote its outcome within society. Many public administrations and other official bodies worldwide organise research and development activities in the field of Nanotechnology by creating specialised research institutes. With a will of following the same organisational pattern, the University of Barcelona created in 2006 the Institute of Nanoscience and Nanotechnology (IN2UB), which has as an aim to coordinate multidisciplinary research activities carried out by several research groups of this institution. The (IN2UB) wants to contribute to the progress of science, while spurring, at the same time, industrial excellence. researchers who are members of the (IN2UB) come from different scientific disciplines, such as Physics, Chemistry, Pharmacy Science, Biochemistry, and Medicine. In this framework, the (IN2UB) aims at promoting, both internally and internationally, the collaboration among different groups and research centers by strengthening interdisciplinary activities which integrate both basic and applied research.
The main and most challenging objectives of the IN^2UB are to encourage the most suitable synergies among researchers, in order to favour the interdisciplinary work patterns necessary to take on frontier research project development, as well as to promote interaction among researchers and those companies interested in nanotechnologies and their different uses by bringing the two fronts to collaborate in project development that shall meet the technological requirements of the business world.

Universitat de Barcelona; IN2UB
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ICFO-The Institute of Photonic Sciences (www.icfo.es) is a leading institution in the European Union in the field of Photonics. It conducts world-class, wide-scope research centre in the Science and Technologies of Light. ICFO research aims at providing new understanding, new solutions and new tools to tackle major challenges in information, health, environmental management, safety and energy. ICFO hosts more than 250 employees, 45 cutting-edge research laboratories, and one nanophotonics facility, in a 9000 sq.m dedicated building based at the Mediterranean Technology Park, in the metropolitan Barcelona area.
ICFO welcomes partnerships with all types of institutions. One of our main goals is to act as a key ally of the optics and photonics community, by being a resource for science, technology and talented people, and a trusted partner to undertake ambitious common projects. We enthusiastically invite selected institutions to set a long-lasting relationship with us, through common research projects, services or alliances. The ultimate aim is to build mutual knowledge and trust, and in thus boosting mutual benefits.

ICFO – The Institute of Photonic Sciences
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Web: www.icfo.es

The Institute for Bioengineering of Catalonia (IBEC) is an interdisciplinary research centre focused on Bioengineering and Nanomedicine. Based in Barcelona, the patrons and founders of IBEC are the Government of Catalonia (Generalitat de Catalunya), the University of Barcelona (UB) and the Technical University of Catalonia (UPC).

While creating knowledge, IBEC aims to contribute to making a better quality of life, improving health and generating wealth. Current programmes and research lines at IBEC are:

- **Cellular biotechnology**
  Microbial biotechnology and host-pathogen interaction
  Molecular and cellular neurobiotechnology
- **Biomechanics and cellular biophysics**
  Cellular and respiratory biomechanics
  Nanoprobes and nanoswitches
- N**anobiotechnology**
  Nanobioengineering
  Single molecule bionanophotonics
  Nanoscale bioelectrical characterization
- **Biomaterials, implants and tissue engineering**
  Bio/non-bio interactions for regenerative medicine
  Molecular dynamics at cell-biomaterial interface
  Biomechanics and mechanobiology
- **Medical signals and instrumentation**
  Biomedical signal processing and interpretation
  Artificial olfaction
  Neuroengineering
- **Robotics and biomedical imaging**
  Robotics

Institut de Bioenginyeria de Catalunya
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Integrated in the framework of the UAB Research Park, BNC-b is a scientific and industrially oriented virtual entity, grouping the capabilities and expertises in nanoscience and technology, of the following research centres, owned by CSIC (Spanish National Council of Research), ICN (Catalonian Institute of Nanotechnology-Foundation) and UAB (Autonomous University of Barcelona, Bellaterra).

BNC-b
Web: www.bnc-b.net

TNT 2009
Trends in NanoTechnology
Barcelona (Spain)
September 07-11, 2009

Welcome Reception (Monday) and Conference Dinner (Wednesday)

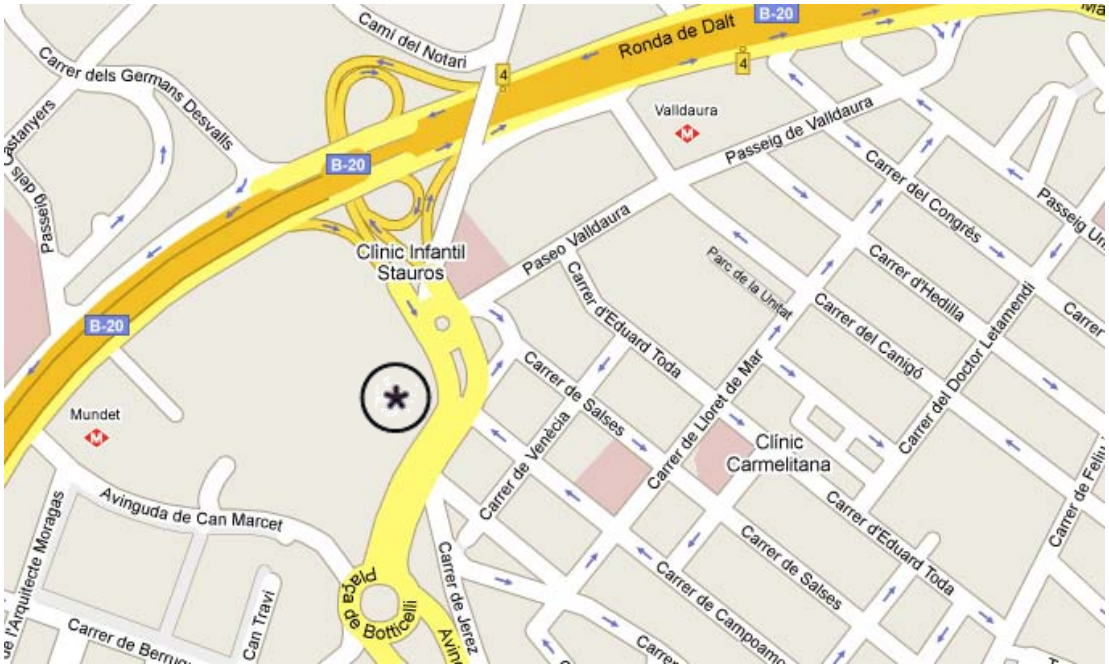
Restaurant Can Cortada

Avinguda de l'Estatut de Catalunya, 55
08035, Barcelona (Spain)
Underground: Valldaura (Line 3) – From 05:00 to 24:00

Can Cortada, a former castle of the 11th century, is located in the Avenue Estatut de Catalunya. In 1994, the family Soler i Ribatallada reformed it to turn it into a restaurant.

With more than a thousand years of history, this ancestral farmhouse forms part of the Art heritage of the Count city and the interior shelters a former tower of defence to anticipate possible feudal assaults.

During the Middle Age, the tower was growing with attached wings, supporting always its military character, and in 1711 the property was acquired by Joan Cortada, who gave the name to the current house.



SCIENTIFIC PROGRAM

TNT2009 - POSTER PRESENTATION DETAILS

Poster size: A0 format (width: 841 mm x Height: 1189 mm) (Portrait)

Session A (PA) - students: From Monday morning to Tuesday evening.
Session B (PB) - seniors: From Wednesday morning to Thursday evening.

Posters from Session A (PA) should be installed on Monday morning and removed on Tuesday between 18h00 and 19h30.

Posters from Session B (PB) should be installed on Wednesday before 10h00 and removed on Thursday between 19h30 and 20h00.

I: Invited Lecture (40 min. including discussion time)
K: Keynote Lecture (30 min. including discussion time)
O: Oral Presentation (15 min. including discussion time)
PS: Poster Session

SCIENTIFIC PROGRAM - TNT2009
Monday – September 07, 2009

08h00-09h00	**REGISTRATION**	
09h00-09h10	**TNT2009 Opening Ceremony - Welcome and Introduction**	
"Nanomagnetism" Session I – Sponsored by CIC nanoGUNE (Spain)  ***Chairman: Andreas Berger (CIC nanoGUNE, Spain)***		
09h10-09h50 **p. 15**	**Stuart Parkin** (IBM, USA) *"Racetrack Memory: a storage class memory based on current controlled magnetic domain wall motion"*	**I**
09h50-10h20 **p. 67**	**Tom Thomson** (University of Manchester, UK) *"The Search for Tbits/in2: Understanding the Fundamentals of Nanomagnetism"*	**K**
10h20-10h50 **-**	**Paulo Freitas** (IST, Portugal) *"Spintronic devices for biomolecular and biomedical applications"*	**K**
10h50-11h20	**Coffee Break - Poster Session A - Instrument Exhibition**	**PS**
Chairman: Robert Baptist (CEA/DRT/LETI, France)		
11h20-12h00 **p. 5**	**Masakazu Aono** (MANA/NIMS, Japan) *"Single-molecule-level control of local chemical reactions for molecular nanowiring and ultradense data storage"*	**I**
12h00-12h30 **p. 47**	**Tsuyoshi Hasegawa** (MANA/NIMS, Japan) *"New functions achieved by an atomic switch"*	**K**
12h30-12h45 **p. 111**	**Micha Polak (University of the Negev, Israel)** *"A Remarkable Nano-Confinement Effect on Chemical Equilibrium: From Nucleotide Dimer Formation in Molecular Cages to Deuterium Exchange Reactions on Interstellar Dust Grain Surfaces"*	**O**
12h45-13h15 **p. 53**	**Christian Joachim** (CEMES-CNRS, France) *"From Hybrid to Mono-molecular logic gates"*	**K**
13h15-15h15	**Lunch**	
"Nanobiotechnology" Session – Sponsored by IBEC/UB (Spain)  ***Chairman: Josep Samitier (IBEC/UB, Spain)***		
15h15-15h45 **p. 65**	**Francois Rossi** (JRC, Italy) *"Protein interaction with nanostructured surfaces"*	**K**
15h45-16h15 **p. 73**	**Christophe Vieu** (LAAS, France) *"Assembling a biological nanomotor on a nano-engineered surface"*	**K**
16h15-16h45 **p. 79**	**Tomaso Zambelli** (ETH Zurich, Switzerland) *"FluidFM: combining AFM and nanofluidics in a novel tool for single-cell experiments and beyond"*	**K**
16h45-17h00 **p. 89**	**Laura Fumagalli** (IBEC/UB, Spain) *"Quantitative nanoscale dielectric microscopy of thin films and biomembranes at low frequencies"*	**O**
17h00-17h15 **p. 97**	**Alekber Kasumov** (Université Paris-Sud, France) *"Defects and Conductivity of DNAs"*	**O**
17h15-17h30 **p. 119**	**Dominique Vuillaume** (IEMN-CNRS, France) *"A nanoparticle organic memory field-effect transistor behaving as a programmable spiking synapse"*	**O**
17h30-20h00	**Coffee Break - Poster Session A - Instrument Exhibition**	**PS**

21h30	**WELCOME RECEPTION (Can Cortada Restaurant)**

SCIENTIFIC PROGRAM - TNT2009
Tuesday – September 08, 2009

Chairman: Roberto Otero (UAM, Spain)		
08h30-09h00 -	**Masahiko Hara** (RIKEN Advanced Science Institute and Tokyo Institute of Technology, Japan) *"AFM Studies of Single Molecular Detection and Molecular Recognition"*	**K**
09h00-09h30 **p. 45**	**Peter Grutter** (McGill University, Canada) *"Filling of Few Electron Quantum Dots Imaged and Characterized By Scanning Force Microscopy"*	**K**
09h30-10h00 **p. 59**	**Rubén Pérez** (Universidad Autónoma de Madrid, Spain) *"Imaging, Manipulation and Chemical Identification of Individual Atoms with dynamic Force Microscopy: A theoretical perspective"*	**K**
10h00-10h15 **p. 113**	**Alain Rochefort** (Ecole Polytechnique de Montreal, Canada) *"SPAGS-STM, a true high performance tool for in-silico imaging"*	**O**
10h15-11h00	**Coffee Break - Poster Session A - Instrument Exhibition**	**PS**
"Nanomagnetism" Session II – Sponsored by CIC nanoGUNE (Spain) ***Chairman: Stuart Parkin (IBM, USA)***		
11h00-11h30 **p. 51**	**Luis Hueso** (CIC nanoGUNE, Spain) *"Spintronics with organic semiconductors"*	**K**
11h30-12h00 **p. 41**	**E. E. Fullerton** (UCSD, USA) *"Spin transfer torques in high anisotropy magnetic nanostructures"*	**K**
12h00-12h30 **p. 49**	**Burkard Hillebrands** (University of Kaiserslautern, Germany) *"Nanomagnetism - a perspective from the dynamic side"*	**K**
12h30-13h00 **p. 27**	**Claude Chappert** (IEF-CNRS, France) *"Non volatility and GHz magnetization dynamics in magneto-electronic devices, from memory to logic"*	**K**
13h00-13h15 **p. 83**	**Xavier Batlle** (Universitat de Barcelona, Spain) *"Exchange bias in core/shell magnetic nanoparticles: experimental results and numerical simulations"*	**O**
13h15-15h00	**Lunch**	
15h00-17h00	**Parallel Session: "PhD"**	
	Parallel Session: Industry Tech Transfer (SynergyS)	
17h00-18h00	**Coffee Break - Poster Session A - Instrument Exhibition**	**PS**
18h00-19h30	**Parallel Session: Catalonia Research I**	
	Parallel Session: Catalonia Research II	

Parallel Sessions Programs

SCIENTIFIC PROGRAM - TNT2009
Tuesday – September 08, 2009

"PhD" Parallel Session *Chairman: Manuel Marqués (UAM, Spain)*		
15h00-15h15 **p. 161**	**Iñigo Martin-Fernandez** (IMB-CNM-CSIC, Spain) *"Massive fabrication of Single-Walled Carbon Nanotube Field Effect Transistors"*	**O**
15h15-15h30 **p. 153**	**Amelia Barreiro** (CIN2 (CSIC-ICN), Spain) *"Nanotube based thermal motors: sub-nanometer motion of cargoes driven by thermal gradients"*	**O**
15h30-15h45 **p. 155**	**Giulio Biddau** (Universidad Autónoma de Madrid, Spain) *"Adsorption and cyclo-dehydrogenation of polycyclic aromatic hidrocarbons on Pt surfaces: Towards the synthesis of heterofullerenes"*	**O**
15h45-16h00 **p. 157**	**Oscar Castillo-Fernández** (IBEC, Spain) *"Study of DNA mobility in 20 nm channels using AC and DC electric fields"*	**O**
16h00-16h15 **p. 159**	**Hender López** (Universitat Autonoma de Barcelona, Spain) *"High Frequency Behavior of the Datta-Das and Resonant Spin Lifetime Transistors"*	**O**
16h15-16h30 **p. 163**	**Johannes Stiegler** (CIC nanoGUNE, Spain) *"Nanoscale infrared near-field mapping of free-carrier concentration in single semiconductor nanowires"*	**O**
16h30-16h45 **p. 165**	**Saranyan Vijayaraghavan** (University of Basel, Switzerland) *"Conformational-controlled networking of H-bonded assemblies on surfaces"*	**O**
16h45-17h00 **p. 151**	**Enrique Abad** (Universidad Autónoma de Madrid, Spain) *"A case study of a metal/organic interface at the molecular level: a tip/C60 contact"*	**O**

SCIENTIFIC PROGRAM - TNT2009
Tuesday – September 08, 2009

Parallel Session: Industry Tech Transfer (SynergyS)

SynergyS22@Barcelona

The principal aim of SynergyS22@Barcelona is to offer to the participants of the TNT2009 conference the opportunity to approach their research results to the companies of the local enterprise network related to the fields of nanoscience and nanotechnology.

14h30-15h00	Registration (companies)
15h00-15h05	**Welcome to SynergyS22@Barcelona**
15h05-15h35	Invited speaker **Mike Hendrickson** (Boeing Research and Technology, USA) - to be confirmed
15h35-15h45	Nanotech2010 presentation
15h45-15h50	Synergys Presentation
15h50-16h20	Companies' challenge presentations
15h50-15h55	**SEAT** challenge
15h55-16h00	**Endor Nanotechnologies** challenge
16h00-16h05	**Chemetall** challenge
16h05–16h10	**Grupo DAMM** challenge
16h10-16h15	To be defined
16h15-16h20	To be defined
16h20-18h00	**Networking cocktail**
18h00	Closing

SCIENTIFIC PROGRAM - TNT2009
Tuesday – September 08, 2009

Parallel Session: Catalonia Research I *Chairman: David Jiménez (Universidad Autónoma de Barcelona, Spain)*		
18h00-18h15 **p. 129**	**Sonia Conesa-Boj** (Universitat de Barcelona, Spain) *"Hexagonal and Twinned-cubic Phase Domains in Silicon Nanowires"*	**O**
18h15-18h30 **p. 127**	**Sergi Claramunt** (Universitat de Barcelona, Spain) *"Synthesis of ZnO nanowires using gold colloids and optical spectroscopy"*	**O**
18h30-18h45 **p. 143**	**Riccardo Rurali** (Universitat Autònoma de Barcelona, Spain) *"Theory of Doping in Silicon Nanowires"*	**O**
18h45-19h00 **p. 141**	**Nicolás Pérez** (Universidad de Barcelona, Spain) *"Magnetism and biodistribution of high quality iron oxide nanoparticles"*	**O**
19h00-19h15 **p. 139**	**Jordi Llorca** (Universitat Politècnica de Catalunya-CRnE-INTE, Spain) *"Control of the metal-oxide interface in pre-formed gold nanoparticles anchored to inorganic oxides. Implications for catalysis"*	**O**
19h15-19h30 **p. 147**	**Gerard Tobias** (ICMAB-CSIC, Spain) *"Carbon Nanocapsules: Blocking Materials Inside Carbon Nanotubes"*	**O**

SCIENTIFIC PROGRAM - TNT2009
Tuesday – September 08, 2009

Parallel Session: Catalonia Research II *Chairman: Xavier Cartoixa (Universidad Autónoma de Barcelona, Spain)*		
18h00-18h15 **p. 133**	**Sonia Estrade** (Universitat de Barcelona, Spain) *"EELS assessment of cation migration IN (001) and (110) LCMO layers as a function of layer thickness"*	**O**
18h15-18h30 **p. 131**	**Cesar Diez-Gil** (ICMAB-CSIC, Spain) *"Detection at ppt Level of Mercury Ions in Water Based in New NanoStructured Solid-Supported Systems"*	**O**
18h30-18h45 **p. 145**	**Florencio Sánchez** (ICMAB-CSIC, Spain) *"Tailoring growth mechanisms in heteroepitaxy of complex oxides"*	**O**
18h45-19h00 **p. 137**	**Oscar Iglesias** (Universitat de Barcelona, Spain) *"Phenomenology and models of exchange bias in core/shell nanoparticles"*	**O**
19h00-19h15 **p. 135**	**Alex Fragoso** (Universitat Rovira i Virgili, Spain) *"Supramolecular Interfacial Engineering based on Cyclodextrin-Modified Surfaces for Biosensor Applications"*	**O**

SCIENTIFIC PROGRAM - TNT2009
Wednesday – September 09, 2009

Chairman: Xavier Cartoixa (Universidad Autónoma de Barcelona, Spain)		
08h30-09h00 **p. 57**	**Roberto Otero** (Universidad Autónoma de Madrid, Spain) *"Nanoscale Structure of Organic/Metal Interfaces"*	**K**
09h00-09h15 **p. 99**	**Zorica Konstantinovic** (ICMAB-CSIC, Spain) *"Nanostructuration and self-assembly in complex oxide thin films"*	**O**
09h15-09h30 **p. 107**	**Narcís Mestres** (ICMAB-CSIC, Spain) *"Self organization of chemical solution synthesised oxide nanostructures"*	**O**
09h30-09h45 **p. 85**	**Alessandro Coati** (Synchrotron Soleil, France) *"Early stages of growth in the Ag/Ni(111) system"*	**O**
09h45-10h00 **p. 103**	**Jorge Lobo Checa** (CIN2, Spain) *"Electronic confinement and band formation originating from a supramolecular porous network"*	**O**
10h00-11h00	**Coffee Break - Poster Session B - Instrument Exhibition**	**PS**
Chairman: Juan Jose Saenz (UAM, Spain)		
11h00-11h40 **p. 9**	**Pedro Echenique** (DIPC, Spain) *"Acoustic surface plasmon on a metal surface with adlayers"*	**I**
11h40-12h10 **p. 43**	**Antonio García-Martín** (IMM-CNM-CSIC, Spain) *"Intertwined effects in nanostructures with simultaneous plasmonic and magneto-optic properties"*	**K**
12h10-12h40 **p. 63**	**Vincent Reboud** (Catalan Institute of Nanotechnology, Spain) *"Two-dimensional nanoimprinted photonic crystals for laser applications"*	**K**
12h40-12h55 **p. 101**	**Geoffroy Lerosey** (LOA - Institut Langevin, France) *"Controlling the phase and amplitude of plasmon sources at a subwavelength scale"*	**O**
13h00-15h00	**Lunch**	
Chairman: Antonio García-Martín (IMM-CNM-CSIC, Spain)		
15h00-15h30 **p. 25**	**Yia-Chung Chang** (Academia Sinica, Taiwan) *"Optical metrology and Nanophotonics"*	**K**
15h30-16h00 **p. 19**	**Javier Aizpurua** (CFM-CSIC / DIPC, Spain) *"Interactions in optical nanoantennas for field-enhanced spectroscopy and microscopy"*	**K**
16h00-16h30 **p. 71**	**Niek van Hulst** (ICFO - Institute of Photonic Sciences, Spain) *"Nanoscale Control of Single Photon Emitters by Optical Nano-Antennas and Tailored fs Pulses"*	**K**
16h30-16h45 **p. 121**	**Yutaka Wakayama** (National Institute for Materials Science, Japan) *"Molecular nanowire with pi-stacking structure for opto-electronic applications"*	**O**
16h45-17h00 **p. 109**	**Vincenzo Palermo** (ISOF, Italy) *"Solar cells and thin film transistors based on perylene-functionalized polymers"*	**O**
17h00-17h40 **p. 7**	**Federico Capasso** (Harvard University, USA) *"Wave front engineering using metamaterials"*	**I**
17h40-18h30	**Coffee Break - Poster Session B - Instrument Exhibition**	**PS**
Chairman: David Jiménez (Universidad Autónoma de Barcelona, Spain)		
18h30-19h00 **p. 39**	**Akira Fujiwara** (NTT Basic Research Laboratories, Japan) *"Si-based single-electron devices"*	**K**
19h00-19h15 **p. 117**	**Álvaro San Paulo** (Instituto de Microelectrónica de Barcelona, Spain) *"Si nanowires for ultra-high performance nanoelectromechanical systems"*	**O**
19h15-19h30 **p. 115**	**Albert Romano-Rodríguez** (Universitat de Barcelona, Spain) *"Nanodevices based on individual nanowires: fabrication strategy, device properties, device integration and guidelines for future work"*	**O**

21h00	**CONFERENCE DINNER (Can Cortada Restaurant)**
00h00	**POSTER AWARDS CEREMONY**

SCIENTIFIC PROGRAM - TNT2009
Thursday – September 10, 2009

Chairman: Stephan Roche (CIN2, Spain & CEA-INAC, France)		
13h00-13h40 **p. 11**	**Sumio Iijima** (Meijo University, Japan) *"Nanoscience and nanotechnology of nano-carbon materials"*	**I**
13h40-14h10 **p. 29**	**Jean-Christophe Charlier** (University of Louvain, Belgium) *"Ab initio Quantum Transport in Carbon Nanostructures"*	**K**
14h10-14h40 **-**	**Marc Bockrath** (CalTech, USA) *"Carbon nanotubes, from correlated electron phenomena to devices and sensors"*	**K**
14h40-15h10	**Coffee Break - Poster Session B - Instrument Exhibition**	**PS**
Chairman: José-Luis Costa-Krämer (IMM-CSIC, Spain)		
15h10-15h50 **p. 13**	**Uzi Landman** (Georgia Institute of Technology, USA) *"Small is different: emergent physics and chemistry at surfaces and interfaces"*	**I**
15h50-16h20 **p. 23**	**Michael R. Berman** (Air Force Office of Scientific Research, USA) *"Toward an Understanding of the Reactivity and Properties of Nanoparticles"*	**K**
16h20-16h50 **p. 33**	**Herve Dietsch** (University of Fribourg, Switzerland) *"Synthesis and Characterization of Functionalized Nanoparticles and their Use in Nanocomposites with Tailored Properties"*	**K**
16h50-17h20 **p. 75**	**Christoph Weder** (Case Western Reserve University, USA) *"Mechanically adaptive polymer nanocomposites"*	**K**
17h20-17h50 **p. 77**	**Constantine Yannouleas** (Georgia Inst. of Tech, USA) *"Artificial few-electron single and molecular quantum dot in low magnetic fields: Electronic spectra, spin configurations, and Heisenberg cluster"*	**K**
17h50-18h05 **p. 87**	**Ben Erné** (Utrecht University, Netherlands) *"Quantifying Colloidal Nanoparticle Interactions in Liquid Environment by Cryogenic Electron Microscopy"*	**O**
18h05-19h30	**Coffee Break - Poster Session B - Instrument Exhibition**	**PS**

SCIENTIFIC PROGRAM - TNT2009
Friday – September 11, 2009

"Nanotubes & Graphene" Session I– Sponsored by GDRI (France) ***Chairman*: *Jean-Christophe Charlier (University of Louvain, Belgium)***		
08h30-09h00 **p. 31**	**Vincent Derycke** (CEA Saclay, France) *"Dynamic Performances of Carbon Nanotube Transistors and Programmable Devices for Adaptive Architectures"*	**K**
09h00-09h30 **p. 55**	**Annick Loiseau** (LEM - ONERA, France) *"Optical properties of individual Boron Nitride Nanotubes"*	**K**
09h30-09h45 **p. 93**	**Cristina Gómez-Navarro** (Universidad Autónoma de Madrid, Spain) *"Chemically derived graphene: electronic and mechanical properties"*	**O**
09h45-10h00 **p. 95**	**Ernesto Joselevich** (Weizmann Institute of Science, Israel) *"Self-Organization of Complex Carbon Nanotube Patterns Directed by Crystal Surfaces"*	**O**
10h00-10h15 **p. 123**	**Zhao Wang** (EMPA, Switzerland) *"Deformation of nanotubes/graphene by a transverse electric field"*	**O**
10h15-10h30 **p. 91**	**Douglas Galvao** (State University of Campinas, Brazil) *"The Discovery of the Smallest Metal Nanotube with a Square Cross-Section"*	**O**
10h30-11h00	**Coffee Break**	
"Nanotubes & Graphene" Session II– Sponsored by GDRI (France) ***Chairman*: *Annick Loiseau (LEM - ONERA, France)***		
11h00-11h15 **p. 105**	**Francesco Mercuri** (University of Perugia, Italy) *"Modeling of low-dimensional carbon nanostructures: an efficient approach based on chemical criteria"*	**O**
11h15-11h45 **p. 61**	**Stephen Purcell** (Université Claude Bernard Lyon1, France) *"Growing a Carbon Nanotube Atom by Atom: "And Yet it Does Turn"*	**K**
11h45-12h15 **p. 35**	**Toshiaki Enoki** (Tokyo Institute of Technology, Japan) *"Unconventional electronic and magnetic structures of edge states in nanographene"*	**K**
12h15-12h45 **p. 69**	**Kazuhito Tsukagoshi** (NIMS, Japan) *"Band-gap modulation in gated bilayer graphene"*	**K**
12h45-13h15 **p. 21**	**Adrian Bachtold** (CIN2(CSIC-ICN), Spain) *"Nanotube and Graphene ElectroMechanics"*	**K**
13h15-13h45 **p. 37**	**Andrea C. Ferrari** (University of Cambridge, UK) *"Nanotube and Graphene-Based Polymer Optoelectronics"*	**K**
13h45-14h00	**CLOSING REMARKS & TNT2010 ANNOUNCEMENT**	

ABSTRACTS

(Only those abstracts received before August 25, 2009 are included in the abstracts´ booklet)

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ABSTRACTS

INVITED CONTRIBUTIONS

Single-molecule-level control of local chemical reactions for molecular nanowiring and ultradense data storage*

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Two novel methods of single-molecule-level control of local chemical reactions are reported. Both methods are of importance not only for the basis of nanochemistry but also for the realization of molecular nanoelectronic devices.

1) *Electrical wiring of a single functional molecule using conductive linear polymer chains through firm chemical bonding*

   In the development of molecular electronics using functional molecules, the most important problem to be solved is the electrical wiring of the functional molecules. Numerous studies have been reported concerning the use of microfabricated metal wires for this purpose. However, functional molecules that can make firm chemical bonding with a metal wire are limited and the use of microfabricated metal wires limits the density of integration of created nanoscale molecular devices. We have developed a method to wire a single functional molecule with conductive linear polymer chains through firm chemical bonding. For this purpose, the polymer chains are grown by chain polymerization with its direction pointed to the functional molecule. The front end of the chain polymerization is in a radical state inherently, so that when it encounters the functional molecule, it makes firm chemical bonding with the molecule, as confirmed by the first principles theoretical calculation.

2) *Reversible control of the chemically unbound and bound states of a few adjacent C60 molecules at designated positions*

   It has been found that the reversible switchover between the chemically unbound and bound states of adjacent two or three C_{60} molecules can be controlled at any designated position in a thin film of C_{60} molecules at room temperature by simply changing the polarity of electric field applied to the position using the tip of a scanning tunneling microscope. By using this method, we have succeeded to create single-molecule-level, nonvolatile, rewritable, ultradense memory bit array with a bit density of 190 Tbit/in^2, which is about 10^2-10^3 times greater than that of today's conventional data storage. It has also been demonstrated that three-state multistate bit operation is also possible.

*This work has been made in collaboration with Y. Okawa, Y. Tateyama, T. Hasegawa, M. Nakaya, T. Nakayama, International Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS).

Wave front engineering using metamaterials

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Sub-wavelength photonics is emerging as one the most exciting and potentially useful areas of physical optics. I will highlight recent research in my group aimed at inventing and investigating laser sources and optical fibers with unique near field and far-field properties [1]. Using surface plasmons interacting with metallic nanostructures and metamaterials built on the facets of semiconductor lasers with focused ion beam (FIB) processing, we have demonstrated new infrared light sources in the range from 0.8 to 10 microns that can create extremely intense (> 100 MW/cm^2) nanoscale size light-spots of dimensions much smaller than the wavelength. [2,4] These sources have revolutionary applications in areas such high density DVD's (1 Tb disks) and high resolution chem/bio imaging, for example to peer into the interior of cells.

Monolithically integrated metallic nanostructures have also been used to achieve beam shaping of quantum cascade lasers and in particular to dramatically reduce (by a ~ factor of 30) their divergence down to a few degrees in orthogonal directions, opening up exciting new applications in laser ranging, chemical sensing and optical wireless.[5,7] Lasers with built-in polarization control have also been demonstrated. [8]

To take full advantage of the potential of nanophotonics for beam engineering new soft-lithography techniques (*nanoskiving* [9] *and decal transfer* [10]) have been developed by us and the group of George Whitesides at Harvard, which allow fabrication of arrays of sub-wavelength features on non conventional templates such as the facets of optical fibers and curved surfaces such as those of micro resonators. These arrays include frequency selective surfaces for filtering, Surface Enhanced Raman Scattering (SERS) surfaces, new optoisolators, hyperlenses for below diffraction focusing in the far-field, etc.. Fiber based SERS sensors have been demonstrated. [11]

The talks will conclude with a discussion of exciting new directions.

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Acoustic surface plasmon on a metal surface with adlayers

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A variety of metal surfaces such as (111) surfaces of noble metals Cu, Ag, and Au, and Be(0001) are known to support a partially occupied electron bands of the Shockley surface state at the center of the Brillouin zone. This state has a parabolic-like dispersion with two-dimensional (2D) momentum parallel to the surface and their wave functions are strongly localized at the nanometer scales near the surface. Therefore they are considered to form a quasi two-dimensional surface-state band with a 2D Fermi energy ε_F^{2D} equal to the surface-state binding energy at the $\overline{\Gamma}$ point. Indeed the surface states are immersed in the sea of bulk electrons and the charge corresponding to surface states constitutes only a small fraction of total electronic charge at metal surfaces. However, due to its 2D character this surface state can strongly modify the dielectric properties of surfaces. Recently it has been demonstrated that due to the coexistence of carries near the surface in bulk and surface bands there is a possibility for existence of a novel kind of collective electronic excitations – acoustic surface plasmon (ASP).

An interesting property of the ASP is its quasi-linear dispersion with momentum parallel to the surface, q, for small values of q. The slope of the dispersion is determined by the Fermi velocity of the surface state, which could be changed by altering the filling of the surface state band. Thus the ASP dispersion can be tailored in a wide range. One way to alter the Fermi velocity is to adsorb species on the surface. For instance, many alkali atoms covered metal surfaces are known to induce a partly occupied nearly free electron-like band, a quantum well band. In this contribution we demonstrate how this quantum well band generates ASP excitations taking as examples, the Na/Cu(111) and K/Be(0001) systems.

We present results of a self-consistent calculation of the surface loss function for these systems with the inclusion of realistic surface band structures. In the case of the Na/Cu(111) system we investigated how the results depend on the Na coverage, whereas for the K/Be(0001) comparison between the model and ab initio calculations will be made.

Nanoscience and nanotechnology of nano-carbon materials

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Nanoscience is largely dependent on controlling the nanometer-sized structures of materials. A typical example is carbon nanotubes whose unique properties have been investigated in details theoretically and experimentally. Some of carbon nanotubes have been demonstrated to become semiconducting and others are metallic, depending on whether the nanotubes have chiral structure or achiral one. Controlling the structures of carbon nanotubes is also practically important in term of industrial application since we make thin film transistors of single walled carbon nanotubes.

Another important issue for Nanoscience of nano-carbon materials is to know exact atomic structures of such basically non-periodic structures, and for this purpose a powerful electron microscope comes in. We thank for the recent advanced technology of electron microscopes which are equipped with spherical aberration corrected objective lenses that allow us to observe individual atoms of even light element such as carbon and boron. Furthermore dynamic behaviors of such light element material objects have brought us a new sight of nanostructures that are induced by heating as well as electron beam irradiation.

As examples mentioned above we demonstrate some latest results on structural characterization of carbon nanotubes[1-5], grapheme [6], and boron nitride thin films [7], including "monatomic carbon strings (ultimate quantum wire!)" that have been successfully made and observed in our laboratory [8].

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Small is different: emergent physics and chemistry at surfaces and interfaces

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When the scale of materials structures is reduced to the nanoscale, emergent physical and chemical behavior often occurs, that is not commonly expected, or deduced, from knowledge learned at larger sizes. Such new behavior may be found when the size of the interrogated physical system becomes comparable to a phenomena-dependent characteristic length-scale; for example, the width of a quantum wire approaches the Fermi wave-length of the conducting electrons, or the dimensions of a liquid bridge, or a nanojet, approach the wave-length of a hydrodynamical instability underlying collapse or droplet ejection. Using computer-based simulations we highlight and discuss such emergent phenomena, focusing on interfacial nanostructures. Systems that we discuss include: electrons in 2D semiconductor quantum dots, nano-scale junctions, liquid bridges and jets, hole formation and self-repair mechanisms in lipid bilayer membranes, and interfacial control of the chemical catalytic properties of surface supported clusters.

Racetrack Memory: a storage class memory based on current controlled magnetic domain wall motion

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Racetrack Memory promises a novel storage-class memory with the low cost per bit of magnetic disk drives but the high performance and reliability of conventional solid state memories [1]. Unlike conventional memories, the fundamental concept of Racetrack Memory (RM) is to store multiple data bits - as many as 10 to 100 bits- per access point, rather than the typical single bit per transistor. This is accomplished in Racetrack Memory by storing data bits in the form of domain walls in magnetic nanowires which are oriented either parallel to the surface or perpendicular to the surface of a silicon wafer (see Figure 1). These distinct structures form "horizontal" and "vertical" Racetrack Memories. Conventional CMOS devices and circuits are used to provide for the creation and manipulation of the domain walls in the magnetic nanowires or "racetracks". The domain walls are shifted along the nanowires using nano-second long current pulses via the transfer of spin angular momentum from the spin polarized current generated in the magnetic nanowire racetracks [2].

In this talk we discuss progress towards building a Racetrack Memory and the fundamental physics underlying it. In particular, we discuss the current and field controlled dynamical motion of magnetic domain walls in magnetic nanowires formed from permalloy and related materials.

The structure of domain walls in sufficiently narrow permalloy nanowires are either of transverse or vortex types. These walls display two chiralities, clockwise and anti-clockwise, which have equal energies in smooth nanowires. In addition, the vortex walls have a tiny core region with an out-of-plane magnetization which consequently has a polarity (up or down). The transverse and vortex wall structure and the number of domain walls can be determined from the anisotropic magnetoresistance displayed by permalloy [3]. By introducing pinning sites in the nanowire the chirality can also be determined [3]. The polarity of the core of the vortex domain walls can be inferred from the resonant ac current excitation of a trapped domain wall [4].

The current and field induced motion of domain walls along permalloy nanowires is distinctly different in smooth nanowires versus those which have intrinsic or extrinsic pinning sites. We discuss the resonant excitation of pinned domain walls by using a succession of current pulses whose temporal length and separation are tuned to the fundamental harmonic frequency of the domain wall arising from its being trapped in a local pinning potential [5-6].
The field driven dynamical motion of domain walls is complex. In small magnetic fields the structure of the domain walls is unchanged during their motion but, above a certain threshold field, which is distinct for transverse and vortex walls, the domain wall structure oscillates periodically between transverse wall structures of different chiralities and vortex and anti-vortex wall states [7-8]. By using spin-valve nanowire structures the stochastic dynamical behavior of the current and field driven motion of the domain walls can be observed. The stochasticity has a complex field dependence and is greatest for intermediate field values [9].

Finally, we discuss the development and demonstration of a current-controlled domain wall shift register [10]. We discuss recent studies in which up to six domain walls can be injected and moved with the same current pulse along permalloy nanowires.

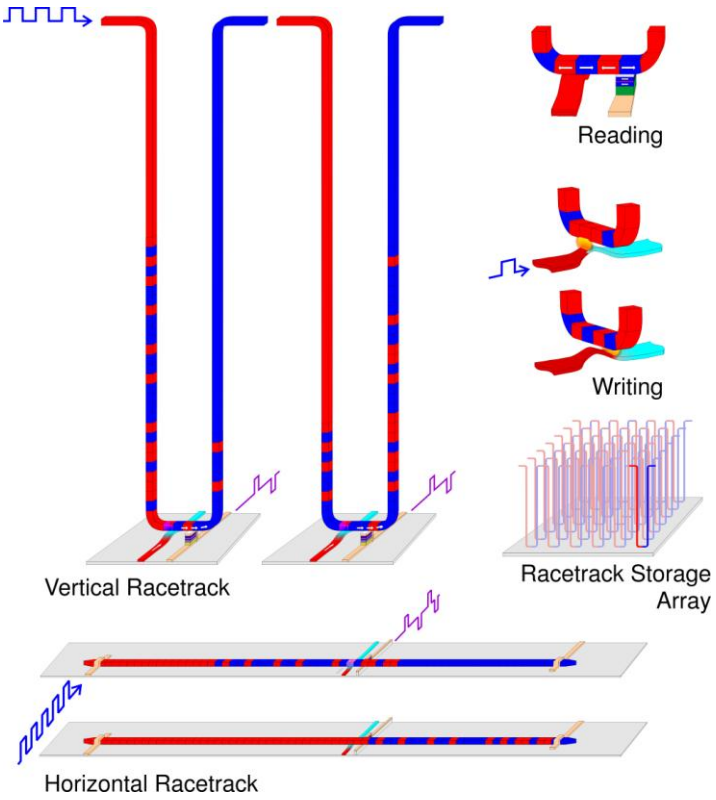

Figure 1: *The Racetrack Memory is a novel innately three-dimensional memory device in which many data bits are stored per access element. In the vertical racetrack tall columns of magnetic material are arranged above the surface of a silicon wafer. Conventional silicon based microcircuits are fabricated within the silicon wafer to provide the electronic devices needed to operate the memory. The data is stored in the Racetrack in the form of magnetic domain walls. These domain walls separate magnetic regions which are magnetized in opposite directions (which can be parallel or perpendicular to the nanowire's direction). The domain walls are written into the Racetrack using one writing device per Racetrack. As illustrated a possible writing element is formed by moving a single domain wall along a neighboring wire. The magnetic fringing fields from the domain wall writing element can be used to write domain walls into the Racetrack. All the domain walls in the Racetrack are shifted along the Racetrack in lockstep by short pulses of spin-polarized current. The domain walls are read by moving them to a reading device - one per racetrack. The reading device can be formed from a magnetic tunnel junction magnetoresistive sensing element. By arranging many vertical Racetracks per unit area very high storage densities are possible, comparable to those of magnetic hard disk drives. However, the Racetrack Memory has no wear-out mechanism and is thus highly reliable. A second form of Racetrack Memory is one in which the Racetracks are placed horizontally on the surface of the silicon wafer. This type of memory is much easier to fabricate. The density of the nanowires is reduced, however, so that the storage capacity will be less than a hard disk drive but rather comparable to FLASH memory. This Racetrack Memory has much higher performance than FLASH, has no wear-out mechanism and uses much less energy.*

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KEYNOTE CONTRIBUTIONS

Interactions in optical nanoantennas for field-enhanced spectroscopy and microscopy

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Optical antennas are nanoscale metallic structures which act as effective receivers, transmitters and receivers of visible light. These nanoatennas show the ability to focus electromagnetic radiation into tiny spots of nanometer-scale dimensions allowing for more effective field-enhanced visible spectroscopies such as in surface-enhanced Raman spectroscopy (SERS). A brief review on the basics of the optical response of these optical nanoantennas will be presented, with examples of the optical response in different canonical nanostructures such as metallic nanorings [1], nanorods [2], nanowires [3], dimers [4] or nanoshells [5] which are commonly used as optical nanoantennas.

We will address the use of optical nanoantennas in a variety of spectroscopy and microscopy techniques. In particular, the use of λ/2 nanorod-like gold nanoantennas will be described in detail. By engineering the length of the rod-like nanoantennas, it is possible to extend the field enhancement capability into the infrared range of the spectrum (as shown in Fig. 1 (a) for a micron-sized nanoantenna) to perform direct surface-enhanced infrared absorption (SEIRA) [6]. With use of this concept, we show that it is possible to obtain direct IR spectral information of a few thousand molecules deposited on the antenna (see Fig. 1(b)). Another option to engineer the optical response of a nanoantenna relies on the manipulation of the antenna gap. We show theoretically and experimentally the modification of the optical response of nanoatennas as a function of the thickness of the antenna gap, bridging together concepts of optics and circuit theory [7].

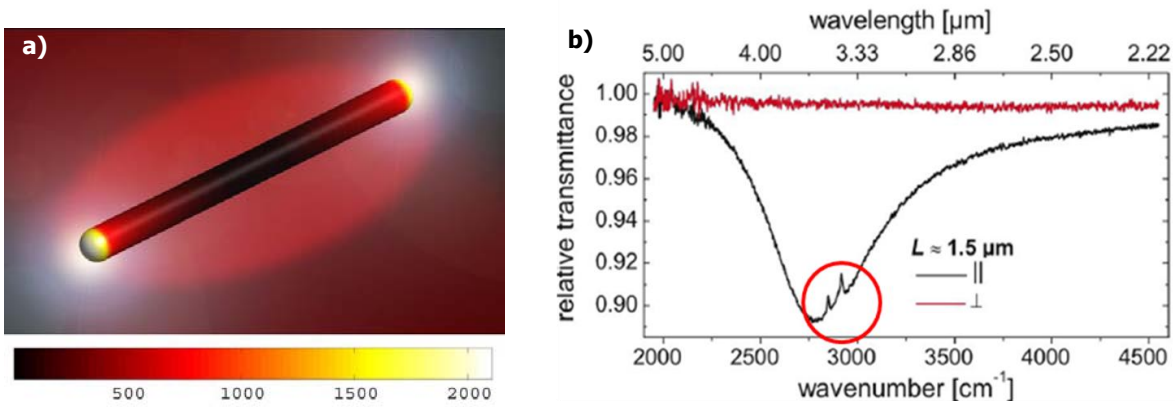

Figure 1: *(a) Near-field around an infrared nanoantenna of length L=1.3 μm when illuminated resonantly with wavelength λ=3.41 μm. (b) Transmission spectroscopy of two molecular fingerprints (marked as a red circle), when the molecules are deposited on top of an antenna similar to that in (a).*

The interaction between tip and sample in scattering-type near field optical microscopy (s-SNOM) can also be understood as an antenna effect due to the interaction of tip and sample. This near-field interaction allows for direct mapping of near-field patterns with nanoscale resolution with use of radiation from the visible to the Terahertz [8]. Examples of nanoscopy for each range of the spectrum will be presented. Another spectroscopy where the role of plasmonic resonances plays an important role is Raman-Brillouin scattering of single metallic nano-objects. The interaction between the vibrations of a metallic nano-object and the plasmons induced on it determine the activation and deactivation of certain vibrational modes

in the Raman scattering. We analyse in detail how the presence of geometrical indentations and cavities in optical nanoantennas localizes the electromagnetic fields at the indentations (see Fig. 2 (a)). Following the variations of the near-field for a particular vibrational mode (Fig. 2(b)), we can address the modulation of the near-field (Fig. 2(c)), and determine how strongly the field in the cavities and in the indentations is modulated. For certain vibrational modes such as the breathing-like mode in silver nanocolumns, these "acousto-plasmonic hot spots" produce breaking of Raman selection rules with activation of anomalous vibrational modes in Raman spectroscopy.

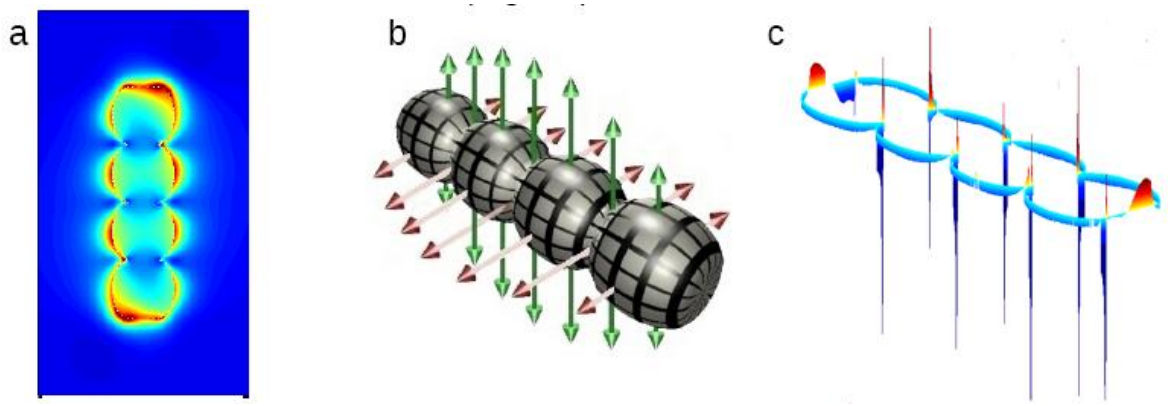

Figure 2: *(a) Near-field map around a silver nanocolumn presenting indentations. (b) Breathing-like vibrational mode of the same nanocolumn, and (c) Modulation of the near-field around the nanocolumn surface for the breathing-like vibrational mode in (b). Strong "acousto-plasmonic hot spots" can be observed at the indentations, producing Raman selection rules breaking. The nanocolumn is 10 nm long, 2 nm wide and the wavelength of the incident light is λ=413nm.*

To illustrate the wide range of applications of plasmonic interactions in totally different systems, we will conclude by analysing the forces originated from the excitation of plasmons by the fast electron beam in Scanning Transmission Electron Microscopy (STEM). Our model calculations show that metallic nanoparticles experience attractive or repulsive forces as a function of the position of the electron beam. This ability to manipulate the forces on the particles can be used in gold nanoparticles for example to produce coalescence.

From the overview and the examples shown here, it is straightforward to conclude that an understanding of the interactions occurring at the optical nanoantennas in such a variety of systems, and the knowledge on the electromagnetic response occurring in the different spectroscopy and microscopy configurations are crucial to engineer and design plasmonic devices for improved detection and controlled optical response.

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Nanotube and graphene electromechanics

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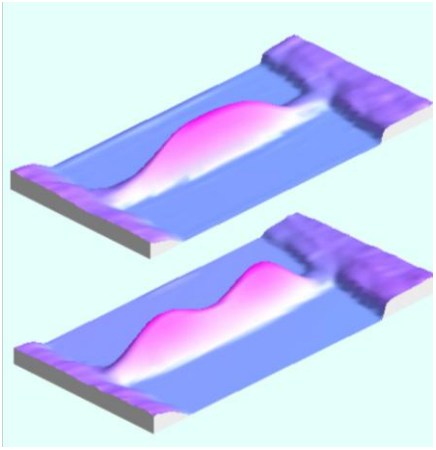

Mechanical resonators based on carbon nanotube or graphene hold promise for many scientific and technological applications. Nanotube resonator devices are outstanding inertial mass sensors with a sensitivity that enables the detection of the mass of individual atoms [1]. In addition, nanotubes are an excellent system to study quantum electromechanics, since the mutual interaction between the charge transport through the nanotube and its mechanical degree of freedom are remarkably strong. A proposal for ground-state cooling of the mechanical oscillations using back-action with constant electron current will be discussed [2].

A novel detection method of the vibrations of nanotubes [3] and graphene [4], based on atomic force microscopy, will be presented. This method enables the detection of the resonances up to 3.1 GHz with subnanometer resolution in vibration amplitude. Importantly, it allows the imaging of the mode-shape for the first eigenmodes.

I will also report on a new artificial nanofabricated motor in which one short nanotube moves relative to another coaxial nanotube [5]. The motion is shown to be controlled by how the atoms are arranged within the two nanotubes. The motion is actuated by imposing a thermal gradient along the device, allowing for sub-nanometer displacements. This is, to our knowledge, the first experimental demonstration of displacive actuation at the nanoscale by means of a thermal gradient.

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Toward an understanding of the reactivity and properties of nanoparticles

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The chemical and reactive properties of nanoparticles span an interesting middle ground between the properties of individual atoms and molecules on one hand and bulk materials on the other. Unique properties compared to atoms or bulk systems can arise in nanoparticles for several reasons. For example, the fact that a high percentage of atoms in small nanoparticles are at or near the surface affects their reactivity. The fact that atoms and molecules are confined in structures of dimensions smaller that the characteristic length scale of some properties also leads to novel behaviors. Yet, many fundamental questions remain unanswered regarding what controls reactivity and processes on the nanoscale. In this talk, I will discuss emerging results demonstrate that the reactivity and properties of nanostructures can be affected by many factors including composition, geometry, electronic structure, spin, substrate interactions, fluxionality, defects, and interactions with neighbors. It will be seen that a small number of key active sites can dominate the observed properties and behaviors. Examples will be given of the unique reactivity and catalytic properties of size-selected nanosized metal clusters, plasmonic properties of nanoparticles, and of the flexibility available to control these properties.

Optical metrology and Nanophotonics

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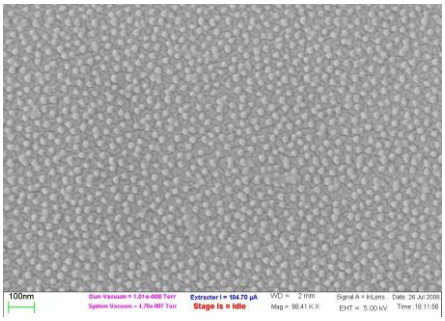

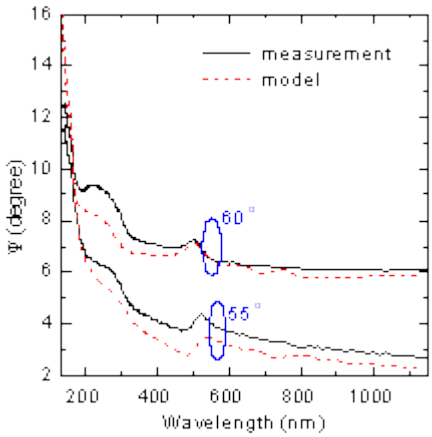

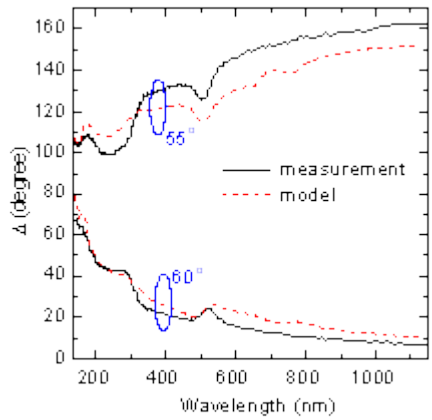

Optical metrology allows optical inspection of the geometry of nanostructures down to 10nm scale. It uses a best fit to the measured ellipsometric spectra via theoretical simulation to determine the critical dimension of an assumed shape. If done correctly, one can reconstruct images of nm resolution by using an optical instrument (with wavelength longer than 100nm). It is noninvasive and capable of probing buried structures. Reflectivity analyses of nanoscale gratings (1D to 3D) and random distribution of metallic nanoparticles on a substrate are reported. Efficient modeling softwares based on rigorous couple waves analysis (RCWA) and Green's function approach have been developed and used in optical metrology of 2D/3D gratings and isolated features on a substrate. Samples with different sizes of Gold nanoparticles immobilized on a glass substrate were investigated by variable-angle spectroscopic ellipsometry in the UV to near IR region. (SEM picture shown in figure) Both the GF method and RCWA were used to model the ellipsometric spectra. It is found that the GF method is 10 ~ 100 times more efficient than RCWA in most cases. Our model calculations show good agreement with the ellipsometric measurements. (see figure) This demonstrates that the spectroscopic ellipsometry could be a useful tool to provide information about the size and density of nanoparticles deposited on insulating substrate. The technique can be extended to inspect buried nanostructures and biological systems.

Non volatility and GHz magnetization dynamics in magneto-electronic devices, from memory to logic

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In the last ten years since its first product (the spin valve read head for hard disk recording by IBM in 1997), the applications of spin electronics have undergone a spectacular acceleration towards nano-integration of magnetic devices into solid state electronics. Among the latest examples are the Spin-RAM demos recently proposed by Sony [1] and Hitachi [2], which promise dense, scalable [3, 4], magnetic non volatile memories (MRAM) using spin angular momentum transfer switching (Spin-RAM). This incursion has been made possible by a chain of scientific breakthroughs that illustrate how Nanosciences can impact electronics. For instance, giant magnetoresistance of multilayers (Nobel Prize 2007) or the magnetic tunnel junction (MTJ) have made reading of smaller and smaller magnetic bits possible for today's record areal densities in hard disk recording.

One crucial aspect of magnetic storage, however, is the exceptional time span over which magnetization dynamics has to be controlled, from 10 years for non volatile storage to ~1 nanosecond for the writing speed [5]. The issue could even be worse for solid state applications, where writing power is expected to be limited. Furthermore, the potential to achieve writing speeds above one GHz through precessional dynamics [6-8] may be the best advantage of MRAM compared to other non volatile memory technologies, allowing, for instance, the use a single memory technology in microcontrollers and SoC. Furthermore, low power, error free GHz operation would open the way to the development of non volatile, programmable logic chips mixing MTJs and CMOS [9-16]. Application to RF sources is also actively pursued.

Our group has been exploring such issues on many different systems from MTJ nanopillars to current induced domain wall propagation, and the talk will give an overview of our understanding of the route towards achieving ultrafast non volatile spin electronics devices, on the road to magnetic logic chip.

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Ab initio quantum transport in carbon nanostructures

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Their unusual electronic and structural properties promote carbon nanostructures as promising candidates for a wide range of nanoscience and nanotechnology applications. Not only can carbon nanotubes be metallic, but they are mechanically very stable and strong, and their carrier mobility is equivalent to that of good metals, suggesting that they would make ideal interconnects in nanosized devices. Further, the intrinsic semiconducting character of other tubes and graphene nanoribbons, as controlled by their topology, allows us to build logic devices at the nanometer scale, as already demonstrated in many laboratories.

The tremendous importance of the transport properties of nanotubes [1], both from a fundamental and technological point of view, justifies wealth of work and theories developed to deal with 1D systems involving a confined electron gas. The purpose of the present talk consists in defining the electronic and quantum transport properties of both nanotubes and nanoribbons in relation with their atomic structures. Since quantum effects are prominent in carbon nanostructure physics, the electronic quantum transport has been investigated using both the Landauer-Buttiker and the Kubo-Greenwood formalisms, allowing to extract generic properties such as quantum conductance, conduction mechanisms, mean-free-paths... Within both frameworks, the well-known ballistic properties of armchair metallic nanotubes have been reproduced.

However, like in most materials, the presence of defects in carbon nanotube and graphene has been demonstrated experimentally. These defects may take different forms: vacancy, bivacancy, "Stone-Wales" defect, 5/7 pair, atom in substitution, ... and are known to modify the electronic properties of the host graphene material [2]. It is crucial to understand the properties of these defects in order to conquer their detrimental effects, but also because controlled defect introduction may be used to tune carbon-nanostructure properties in a desired direction. Consequently, the modifications induced by those defects in the electronic properties of the carbon hexagonal network have been investigated using first-principles calculations. Computed constant-current STM images of these defects have been calculated within a tight-binding approach in order to facilitate the interpretation of STM images of defected carbon nanostructures. As these defects should also play a key role in the chemical reactivity of carbon nanotubes, the study of the modulation of the conductance due to specific molecules adsorbed at the defected nanotube surface will also be presented [3].

In contrast to carbon nanotubes, graphene nanoribbons (GNRs) exhibit a high degree of edge chemical reactivity, which, for instance, prevents the existence of truly metallic nanostructures. Additionally, the discrepancy between the theoretical electronic confinement gap and the experimentally measured transport gap has been attributed to localized states induced by edge disorder. To date, most of the transport studies of edge disordered GNRs have assumed simplified defect topologies, although recent ab initio calculations have proposed and edge chemistry, with evidence of the stability of certain types of geometries such as the Stone-Wales reconstruction. Several experimental studies have also reported the characterization of individual edge defects either by means of Raman, scanning tunneling or transmission electronic microscopy. Consequently, it is presently mandatory to investigate and illustrate the impact of realistic edge defect topology on the electronic transport properties of long and disordered GNRs [4].

In addition, the ground state of zigzag graphene nanoribbons (zGNRs) with hydrogen passivated zigzag edges presents finite magnetic moments on each edge with negligible change in atomic structure, thus suggesting these carbon nanostructures to be attractive for spintronics. Indeed, zGNRs are predicted to exhibit a magnetic insulating ground state with ferromagnetic ordering at each zigzag edge and antiparallel spin orientation between the two edges. However, ideal zigzag GNRs are not efficient spin injectors due to the symmetry between the edges with opposite magnetization. In order to obtain net spin injection, this symmetry must be broken. Incorporating defects (such as vacancies or adatoms) in the GNR or imperfections at the edge which usually cannot be avoided experimentally, break the symmetry between the edges and could thus influence the spin conductance of the GNR. Finally, the introduction of magnetic point defects in zGNRs favors a specific spin configuration of the edges [5]. Consequently, magnetic point defects are also expected to play a key role on the transport properties of graphene nanoribbons.

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Dynamic Performances of Carbon Nanotube Transistors and Programmable Devices for Adaptive Architectures

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Carbon nanotubes (CNTs) are known to have exceptional electronic properties. Still, the future integration of carbon nanotube transistors into conventional/mainstream integrated circuits remains unlikely. Indeed, the improvement in performances may not be sufficient to justify the immense efforts necessary to tackle the serious issues of precise placement of individual CNTs and device performance variability. However, CNTs benefit from decisive advantages that can open new perspectives in *unconventional* type of circuits. Among the intrinsic properties of CNTs two are of particular importance in this context: *(i)* their exceptional transport properties (carrier mobility >10^5 cm^2/V.s, ballistic transport over several hundreds of nm...) allow developing electronic devices operating at very high frequencies and *(ii)* these properties are preserved to a large extend when CNTs are integrated in various types of environments among which one finds: above-IC and unconventional substrates (such as plastic ones).

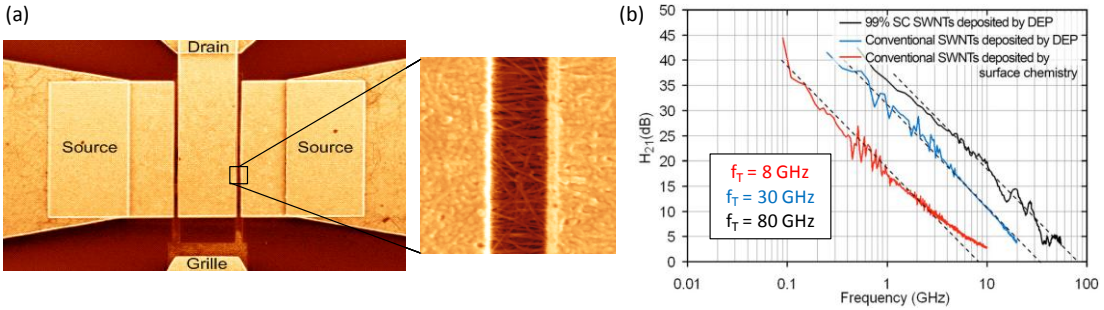

Figure 1: *(a) SEM image of an HF transistor, the channel of which is a network of dense and aligned CNTs deposited by DEP [1]. (b) Current gain as a function of frequency for three types of CNT networks and the corresponding cut-off frequencies. The use of purely semiconducting CNTs allows reaching 80 GHz [3].*

In this presentation, I will first present our most recent results on high frequency CNT transistors. We showed earlier that the use of dense and well aligned CNT networks allows reaching operating frequencies as high as 30 GHz [1] and that the proposed process flow is compatible with flexible substrates [2]. In 2009, we demonstrated that the use of high purity CNTs containing 99% of semiconducting chiralities allows improving f_T up to the record value of 80 GHz, without the need for CNT alignment [3]. CNTs networks thus prove to be very serious candidates for high-speed 'macro'-electronic applications in range of frequencies out of reach for other organic materials.

But even if nano-objects with well defined structures and original electronic properties, such as CNTs, are of great interest for the development of new generation of circuits (especially when co-integrated with silicon-based electronics), it is expected that conventional circuit architectures developed so far for the CMOS technology will not be ideally suited for these new objects, in particular because these architectures can barely cope with any significant variability among as-built devices, which is an inherent particularity of nano-devices. Conversely, adaptive circuits, such as neural networks, represent a challenging approach which intends to take advantage of the rich functionality of nano-size building blocks and at

the same time to manage variability by means of a learning (or a training) step. In this context, carbon nanotube field effect transistors (CNTFETs) functionalized with a thin film of photoconductive polymer are of special relevance as they combine exceptional electrical performances with additional functionalities such as light sensing and memory capabilities.

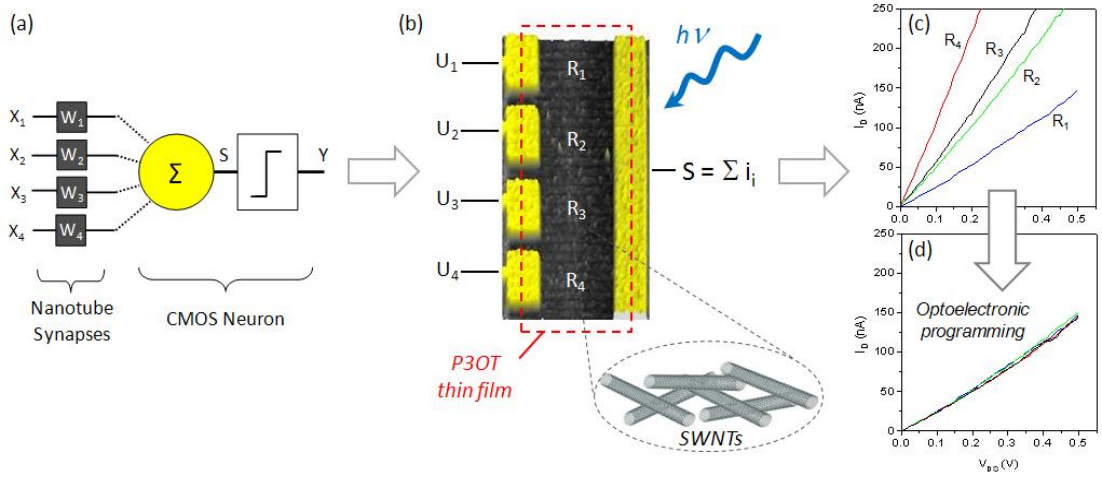

Figure 2: *(a) Principle of a simple perceptron, the basic building block of neural network circuits. Input signals (x_i) are weighted using the synaptic weights (w_i). The neuron computes the sum $\Sigma(x_i.w_i)$ and compares it to a threshold value to trigger an output signal. (b) AFM image of a prototype implementation of such perceptron using CNT programmable devices to store the synaptic weights. (c) Example of programming. The initially dispersed resistivity values of the 4 devices (R_1 to R_4) can be adjusted to arbitrary values with high precision.*

In a second part of my presentation, I will show that these optically-gated CNTFETs (so called OG-CNTFETs) [4,5] have all the required characteristics of artificial synapses, the basic building blocks of adaptive circuits. In particular, they can be operated as 2-terminal devices with a non-volatile memory effect, efficient programmability, large dynamics and remarkable tolerance to variability [6]. The capability to program independently multiple devices is also established and a way to implement these nano-synapses into circuits is proposed. Using thin silicon wires as gate electrodes with a scaled-down oxide layer, we show that the programming steps can be performed using sub-µs electrical pulses, thus allowing high speed training.

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Synthesis and characterization of functionalized nanoparticles and their use in nanocomposites with tailored properties

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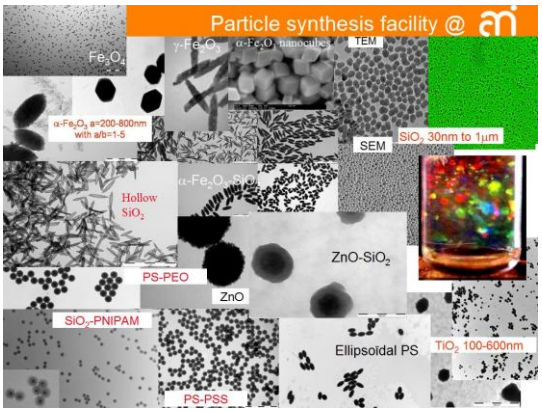

Figures: *Overview of the particle synthesis facility within the Adolphe Merkle Institute*

Nanostructured organic–inorganic hybrid systems represent an exciting class of materials. Polymers reinforced with nanoscale particles should show vastly improved properties. Yet, experimental evidence suggests that a simple extrapolation of the design paradigms of conventional composites cannot be used to predict the behavior of nanocomposites. A major problem arises from the fact that the control of the mixing between the two dissimilar phases remains a challenging task, and there still is a lack of data on structure–property relationships at a nanoscale level. We have thus started a systematic study in which we combine synthetic activities for the production of nanoparticles with functionalized surfaces and tailored properties with the application of state-of-the-art characterization methods such as time-resolved neutron and X-ray scattering experiments in order to understand and improve the formation mechanism of polymer-colloid nanocomposites [1].

In this presentation, I will give an overview of the different types of particles and particle architectures such as composite core/shell particles, particles with tuneable optical and magnetic properties and specific surface functionalities that can be obtained using a wet chemistry approach [2-3].

I will show how we can control the particle morphology (poly- versus monocrystalline), their size and shape as well as their size distribution and their stability against aggregation and phase separation if we possess knowledge about the growth mechanisms and the interparticle interactions. As an example, I will present how particles can be transferred from aqueous to organic media (or vice-versa) through appropriate surface functionalization without having to go through a drying step, and demonstrate how this can be used to integrate them into a polymer matrix in order to make new nanocomposite materials. Some strategies to modify the surface chemistry of colloidal particles will be also presented.

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Unconventional electronic and magnetic structures of edge states in nanographene

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The electronic structure of nanographene depends crucially on its edge shape. The periphery of an arbitrary shaped nanographene sheet is described in terms of a combination of zigzag and armchair edges. In zigzag edges, nonbonding π-electron state (edge state) is created in spite of the absence of such state in armchair edges according to theoretical and experimental works [1-3]. Therefore, the zigzag edges are chemically active due to the presence of edge state located at the Fermi level. Furthermore, the localized spins of edge state contribute to make nanographene magnetic. We investigated the magnetic properties of nanographene and nanographite, the latter of which is stacked nanographene sheets, and their guest adsorption effect using nanographene-based nanoporous carbon (activated carbon fibers (ACF)) [4,5].

ACFs consist of a 3D disordered network of nanographite domains, each of which is a stack of 3-4 nanographene sheets with a mean intra-sheet size of ca.2 nm. The magnetism of an individual nanographene sheet is described as ferrimagnetic structure with a net non-zero magnetic moment created by the cooperation of strong ferromagnetic intra-zigzag-edge ($\mathcal{J}_0$) and less strong ferromagnetic/antiferromagnetic ($\mathcal{J}_1$) inter-zigzag-edge interactions acting between the edge-state spins. Then an individual nanographite domain, in which the edge-state spins of constituent nanographene sheets are coupled with each other by antiferromagnetic inter-nanographene-sheet interaction ($\mathcal{J}_2$ ($<\mathcal{J}_1$)), behaves as a superparamagnetic particle which is weakly interacting with adjacent domains through inter-domain antiferromagnetic interaction $\mathcal{J}_3$ having a mean strength of -2- -3 K.

The electron transport between nanographite domains is subjected to Coulomb-gap variable range hoppings. According to ESR observations, the spin relaxation is governed by the Korringa mechanism in which the interaction between the edge-state spins and conduction π-carriers plays an important role. At high temperatures, frequent electron hoppings taking place between the domains create a homogeneous magnetic state of the edge-state spins in the nanographite network. The lowering of the temperature slows down the inter-domain electron hopping process, resulting in the development of a nonequilibrium magnetic state at low temperatures with a crossover from the equilibrium state to the nonequilibrium one at ca.20K. The heat-treatment enhances the inter-domain interaction, bringing about a transition from insulator to metal at a heat-treatment temperature of 1200 °C. In the vicinity of the transition, a spin glass state of the edge-state spins appears, for which a random distribution of exchange interactions $\left|\sqrt{\langle \Delta J^2 \rangle}/\langle J \rangle\right| \sim 0.8$ is responsible.

Chemically inert guest molecules such as water, organic molecules, rare gas, etc., which are condensed in the nanopores, compress the nanographite domains, resulting in the reduction in the inter-nanographene-sheet distance. The increase in inter-nanographite-domain antiferromagnetic interaction $\mathcal{J}_3$ induced by this mechanical compression works to switch the magnetic state from high spin state to low spin state, as $\mathcal{J}_2$ is sensitive to the change in the inter-nanographene-sheet distance. Charge transfer interaction modifies the magnetism when guest molecules having electron accepting activities such as HNO_3 are adsorbed.

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Nanotube and Graphene-Based Polymer Optoelectronics

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Carbon nanotubes (CNTs) exhibit strong saturable absorption, i.e. they become transparent under sufficiently intense light. This has great potential for applications in photonics. By tuning the nanotube diameter it is easy to tune the saturable absorption in a broad optical range of interest in spectroscopy, photochemistry, biomedical research and telecommunications. The performance of CNT-based saturable absorbers strongly depends on the CNT concentration, bundle size, and transparency of the matrix where CNTs are dispersed.

Here, we review the fabrication and characterization of saturable absorber based on CNT-polymer composites [1,2]. We use ultrasonication to obtain CNT solutions. These are then studied by photoluminescence excitation spectroscopy [3]. We find that exciton energy transfer between semiconducting CNTs is an efficient carrier relaxation channel in the bundles [3]. This fingerprints and quantifies the presence of bundles and allows us to optimize the solutions [1-3]. The composites are successfully used to mode-lock lasers in a broad spectral range [4-6]. We focus on two recent advances. The first is the realisation of a mode-locked tuneable fiber laser [6]. This is achieved through the control of amplification at the transitions of an Er^{3+} gain medium by placing a band pass filter in the cavity. The laser generates 2.4 ps pulses continuously tuneable between 1518 and 1558 nm, the widest to date [6]. The second is a stretched-pulse fibre laser generating ~120 fs pulses. This allows us to realise a laser with high power (0.63W) [7], orders of magnitude higher than previous nanotube-based fibre lasers.

We then consider graphene. Single and few layer graphene have as well strong nonlinear optical properties with ultrafast response over a broad spectral range. Here, we report the linear and nonlinear optical characterization of graphene-polymer composites prepared using wet chemistry techniques [8, 9]. The composites are then integrated in a fiber laser cavity, to generate ultrafast pulses. We obtain pulse duration of ~800fs [3, 4] at 1557nm with a 3.2nm spectral bandwidth [10, 11]. The time-bandwidth product is 0.317, close to the theoretical value of 0.314 for Fourier-transform limited $sech^2$ pulses, indicating that the pulse is as short as allowed by the spectral bandwidth. These composites are expected to mode-lock from visible to IR due to the broad absorption range of graphene, with the potential to overcome the wide tenability offered by nanotubes [6]

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Single-electron devices based on silicon nanowire MOSFETs

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Silicon nanowire MOSFETs are expected to be key components for future nanoelectronics. Based on the top-down approach using MOSFET technology, we have shown that their ultimately scaled channel and excellent gate control provide us with the opportunity to realize single-electron manipulation/detection devices, in which individual electrons can be transferred, manipulated, and detected in a well controlled manner. Such an ultimate charge control is promisingly applicable to metrological current standards, high-sensitivity sensors as well as low-power devices and circuits.

In this presentation our recent work on single-electron devices is described. One is the fast single-electron transfer utilizing single-electron ratchet [1] composed of the nanowire MOSFETs with fine gates. The simple operation with a single clock signal applied to one of the gates realized GHz-clocked single-electron transfer via a charge island formed in the nanowire channel between the gates (Fig. 1). Moreover, it was found that the nonadiabatic single-electron dynamics and their dependence on the electron number in the island play a significant role and make the transfer accuracy better than the thermal-equilibrium limit determined by temperature and the island size [2, 3]. The other topic is the single-electron random-number generator and its application to stochastic information processing circuit operating at room temperature [4, 5] (Fig. 2). In contrast to the first topic we do not regulate the time interval of single-electron transfer and rather let them randomly pass through a nanowire MOSFET. We monitor them in real time by an electrometer that is capacitively coupled to the drain of the nanowire MOSFET, which is terminated at the tip and thereby acts as a small charge node. This is actually the real-time detection of the shot noise in the MOSFET. We then utilized the shot noise as high-quality random numbers and demonstrated data processing which stochastically extracts the most preferable pattern among various ones. Thus, we demonstrate that silicon nanowire MOSFETs are quite promising for the precise control of single electrons as well as new circuit applications based on charge discreetness.

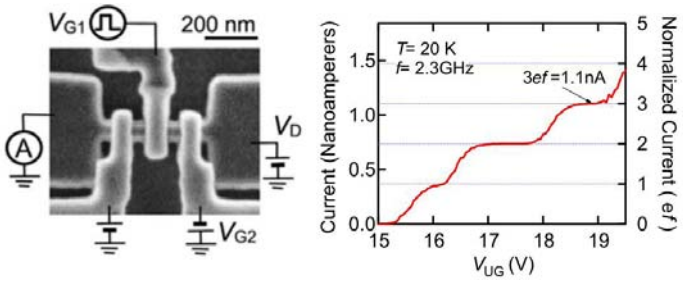

Figure 1: *GHz single-electron transfer by single-electron ratchet.*

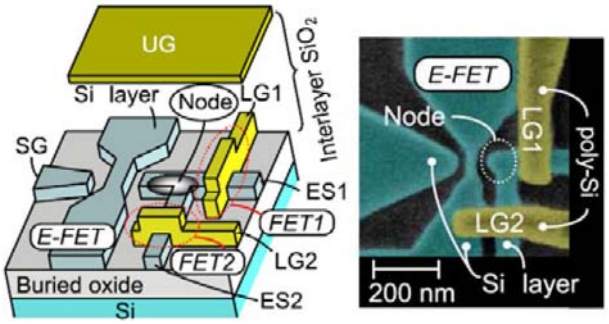

Figure 2: *Room-temperature operating single-electron counting device.*

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Spin transfer torques in high anisotropy magnetic nanostructures

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In most magnetic applications the orientations of the magnetic elements within devices are controlled by external magnetic fields. However, it has recently been appreciated that the relative orientations of nano-magnets can be controlled directly by the injection of spin polarized currents known as spin transfer effects [1]. The ability of a spin-polarized current to reverse the magnetization orientation of a nanomagnets should enable a range of magnetic devices such as high performance random-access magnetic memories and spin-oscillators [2].

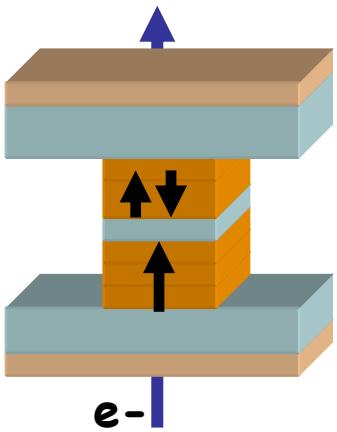

Figure 1: *Schematic of a simple perpendicular anisotropy spin-torque device.*

In this presentation we highlight recent research on using spin-transfer torques to manipulate nano-elements having strong perpendicular magnetic anisotropy (as shown schematically in Fig. 1 [3-7]. The use of perpendicular anisotropy materials has a number of advantages. The magnetic response is more strongly determined by the intrinsic properties of the materials rather than by the shape of the device. The resulting device performance is less sensitive to lithography variations and is controllable by judicious engineering of materials properties. Other advantages of high anisotropy materials include: higher stability against thermal activation, more efficient coupling of the spin-current to magnetic excitations [3], and higher magnetic resonance frequencies. Finally, the study of spin-transfer reversal of perpendicular anisotropy elements provides insight into the magnetic reversal of patterned media elements.

To take advantage of the perpendicular geometry one needs materials systems with perpendicular anisotropy while maintaining a high spin polarization p and low damping α. One materials set that has proven effective is Co/Ni multilayers [3]. In the structure in Fig. 1 the reference high-coercivity reference layer is a $[Co/Pt]_4/[Co/Ni]_2$ multilayer and the free layer that reverses under the action of either current or field is a [Co/Ni] multilayers. Using such structures we have demonstrated current-induced reversal in perpendicular anisotropy nanopillars and explored the current-field phase diagram shown in Fig. 2 and described in detail in Ref. 3. We find regions of hysteretic switching and regions of reversible behavior. For perpendicular anisotropy devices the switching current is expected to be proportional to the effective field acting on the free layer and therefore should be linear with the applied field. While the linear trends are observed in the data there are several discrepancies between theoretical and experimental results and will be discussed. In addition we have also observed current induced domain-wall formation in the free layer [4] and current-induced telegraph noise between the uniform and domain state of the free layer [6].

The better understand the reversal behavior we studied the angular dependence of the applied field on the device [7]. The switching field in the absence of current is well described by the Stoner-Wohlfarth asteroid for a uniaxial system. With the addition of current we find

that spin-torque reversal is most efficient when the applied field is parallel to the anisotropy axis. Surprisingly, for fields applied at an angle to the anisotropy axis the switching fields are current independent for currents lower than a critical value and the critical current increases with increasing field angle.

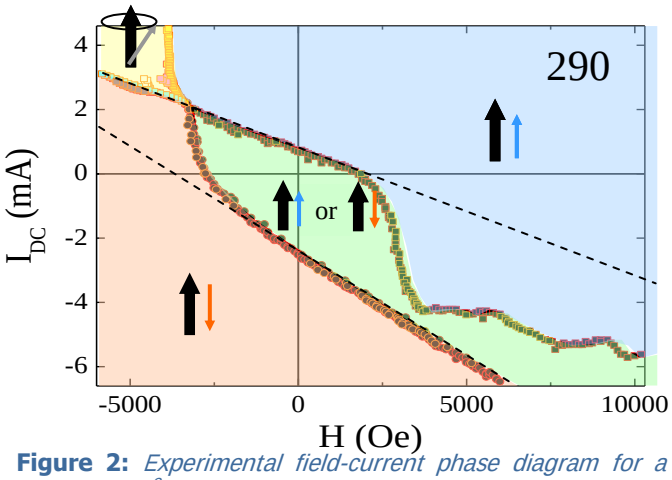

Figure 2: *Experimental field-current phase diagram for a 50 x 100 nm^2 hexagonal nanopillar at 290 K. The data points indicate changes in the magnetic configurations with current and field*

Finally, several advances are still needed to realize a practical device [2]. One key point is the reduction of the currents required to switch magnetization while maintaining the thermal stability of the free layer. To address this issue we adjusted the perpendicular anisotropy and volume of the free element. We observe that the critical current scales with the height of the anisotropy energy barrier and we achieve critical currents as low as 120 µA in quasi-static room-temperature measurements of a 45-nm diameter device [5]. We have also explored anti-parallel coupled reference layers to limit the dipolar interactions between the free and reference layer and we will present results for coupled reversal of the free and reference layer.

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Intertwined effects in nanostructures with simultaneous plasmonic and magneto-optic properties

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Subwavelength composite materials constitute an interesting path towards the development of materials with "on demand" optical properties. We will present our latest results on systems composed of both noble and ferromagnetic metals, which we denote as magnetoplasmonic systems. While noble metals have intense and narrow plasmon resonances they lack magneto-optical (MO) activity at reasonable magnetic field intensities. On the other hand, ferromagnetic metals are MO active but their plasmon resonances are weak and broad. By combining both kinds of materials in smart structures we intend to obtain systems which simultaneously exhibit plasmon resonances and MO activity. Even more, we will show that in such systems it is possible both to enhance the magneto-optical activity of the system via surface plasmon excitation, and to modulate the plasmon properties via application of a magnetic field [1].

First we will concentrate on the effects of plasmon excitation on the MO response, starting from the analysis of Au/Co/Au nanodiscs [2] where it will be shown how the excitation of a localized surface plasmon (LSP) leads to an enhancement of the electromagnetic field within the MO active layer, which in turns produces an enhancement of the system MO activity (a factor of two at specific wavelengths). This latter effect has also been observed in pure Ni nanowires and membranes, characterized though by a much broader plasmon resonance [3]. The same influence of the LSP on the magneto-optical properties can be observed in systems where the constituents responsible for plasmon excitation and MO activity are spatially separated. This has been shown in structures formed by Au nanodiscs and Au/Co/Au continuous trilayers separated by layers of SiO_2 [4]. Here the LSP excitation on the nanodiscs induces a redistribution of the electromagnetic field at the Co layer, and an enhanced magneto-optical activity occurs at those energies where the electromagnetic field in the magnetic layer is increased.

The same system will allow the analysis of the effect of the MO activity on the plasmon properties. In this case the application of a magnetic field in the transverse configuration affects the LSP and the surface plasmon polariton (SPP) excitation differently [5]. We will show that the wavevector of the SPP is the physical magnitude which is modified upon application of a magnetic field in the transverse configuration. That modification can be used in a wide variety of scenarios. Here we will discuss its application in active nanointerferometry and biosensing.

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Filling of few electron quantum dots imaged and characterized by scanning force microscopy

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The ability of quantum dots to confine single charges at discrete energy levels makes them a promising platform for quantum computation where the intrinsic properties of single electrons, such as spin, act as the conventional 1 and 0 bit in a classical computer. In order to control initialization and to scale up the number of bits, an understanding of both the energy levels of single quantum dots and the variation between dots need to be characterized.

Self-assembled quantum dots are of considerable interest in this field because their size, shape, and material can be controlled during the growth process. Controlling these properties is important as these influence the confinement potential, thereby controlling the energy levels of the dot. However, the method of growth does not allow for positioning of the quantum dots which end up randomly distributed over the sample surface. This makes it difficult for lithography techniques to access the quantum dots to perform either charge transport or charge sensing measurements so that the dot properties can be measured.

An atomic force microscope can be used to spatially access the dots, and by applying a voltage between cantilever tip and back-electrode (beneath the dot), the energy levels of individual dots can be probed (see figure 1). At low temperatures the dots are in the Coulomb blockade regime and individual electrons can be controllably added by applying a sufficient bias voltage to overcome this electrostatic repulsive energy. The oscillating cantilever in these experiments is responsible for both loading/emptying the dots through electrical gating and also detecting tunneling events through a change in resonant frequency and/or the amount of energy required to maintain a constant oscillation amplitude. Electrical leads are not required in this experiment which not only leaves the surface electrostatically intact but also gives us the freedom to investigate any dot on the surface.

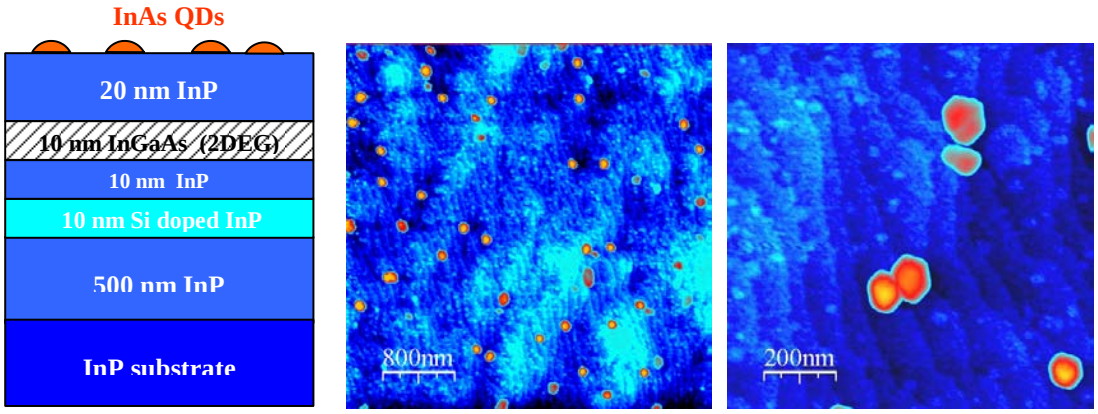

Figure 1: *Schematic of sample and its topography imaged by nc-AFM at 4.5K*

Using an atomic force microscope we demonstrate the ability to probe the electron levels in few electron self-assembled InAs quantum dots. The charging energy, level spacing, and shell structure of single dots are extracted and supported theoretically (see figure 2). In this contribution, we present the mechanism of the dissipative electrostatic interaction due to the tunneling single-electrons in detail. In essence, this dissipative interaction arises from the delayed response of a single tunneling electron to the oscillating chemical potential induced by the oscillating tip. The delay is due to the finite tunneling rate which is determined by the tunnel barrier. We developed a theoretical model for this dissipation process and obtained a

very good agreement between the theoretical dissipation versus Vbias curve and the experimental one (Fig. 2). Multi-dot complexes are also investigated and pairs of dots which are either capacitively or tunnel coupled are observed (figure 3). Finally, we show how by increasing the oscillation amplitude of the cantilever we can probe the excited states of the dot similar to excited state spectroscopy.

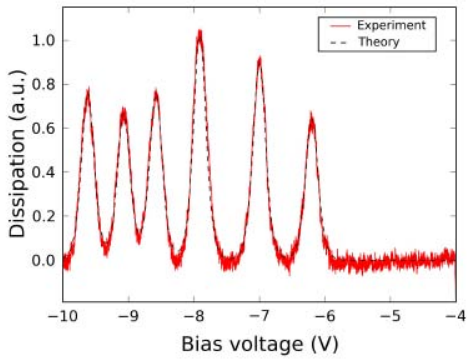

Figure 2: *Theoretical (solid) and experimental (dashed) dissipation versus bias voltage curves. (T = 30 K, A=0.5 nm, Tip-QD distance = 15 nm)*

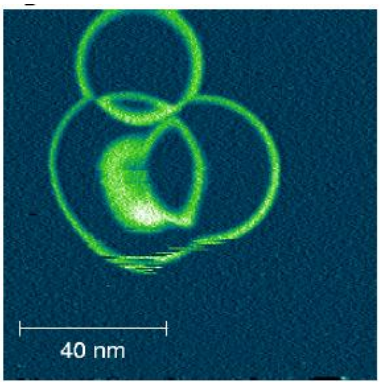

Figure 3: *Multiple qdots interacting. 4.5 K nc-AFM dissipation image*

This work was performed in collaboration with Lynda Cockins, Yoichi Miyahara, Steven Bennett, Aashish Clerk, Sergei Studenikin, Philip Poole and Andy Sachrajda.

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New functions achieved by an atomic switch

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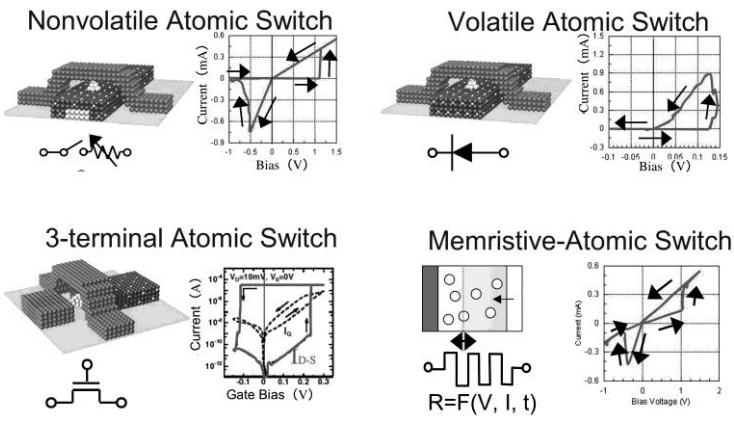

Figure 1: *Variety kinds of functions achieved by atomic switch*

Atomic switch is one of the nanodevices, which is based on the different operating mechanism from the conventional semiconductor transistors. It has been developed as a two-terminal device, where the formation and annihilation of a metal filament is controlled in a nanogap between two electrodes using a solid-electrochemical reaction [1]. The formation and annihilation can be also controlled in an ionic conductive material [2]. The atomic switches show noble characteristics such as small size, low power comsumptiuin, low on-resisitance, and nonvolatility. These characterisitics are useful for developing new types of electronic devices. For instance, it has been used to develop a new type of programmble logic deveices 'programable cell based integrated circuits' which can achieve many functions by a single chip [3]. Because of the unique mechanism, atomic switch can achieve many functions. For instance, 'volatile' atomic switch can be made by controlling materials and device structures. The formation and annihilation of a metal filament can be controlled by the third electrode, namely three-terminal type atomic switch can be made. Recently, 'memristive operation' has been demonstrated using TiO_2-based resistive switch by controlling oxygen vacancies [4]. Similar operation can be achieved by an atomic switch, where cations are controlled. These functions of atomic switches are shown in the figure. Since the atomic switches are made by metals and metal oxides, they can be formed in metal layers of CMOS devices to configure three-dimensional circuits. Thus, the many functions are useful to make high-performance crossbar circuits [5]. Atomic switch also has learning abilities. The functions of atomic switches will be introduced with their applications.

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Nanomagnetism - a perspective from the dynamic side

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The fundamental dynamic excitations of a magnetically ordered solid state material are spin waves. In small magnetic structures these spin waves have unusual dispersion and propagation properties given by finite size effects, the spatially varying direction of magnetization and interactions. While propagation of spin waves has been intensively studied in the model system Yttrium-Iron-Garnet (YIG), which exhibits very low magnetic damping but allows only for millimeter-scale object sizes, experimental investigations on the sub-micron scale are still rare.

I will give an introduction into the diverse field of spin-wave propagation phenomena in nanomagnets. The experimental technique is time- and phase resolved Brillouin light scattering microscopy, a powerful and versatile tool to investigate the properties of spin waves on the sub-micrometer length scale.

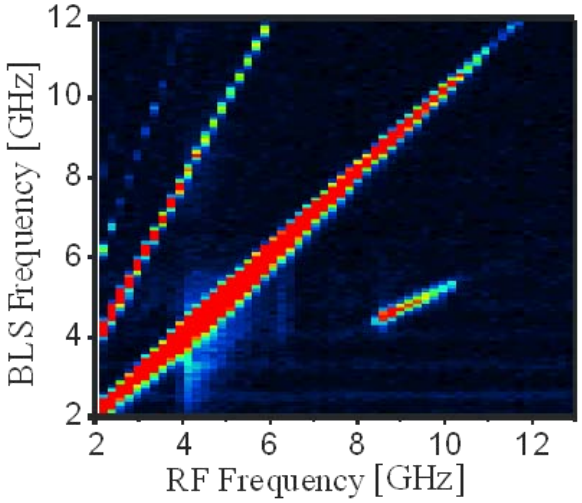

Figure 1: *Investigation of the spin-wave dynamics in a nano-contact subject to a microwave current. Shown is the BLS spectral intensity as a function of the microwave excitation frequency for an externally applied in-plane field of 245 Oe. The diagonal indicates the directly excited magnetic resonances whereas the signals above and below the diagonal show the intensities of spin waves created by nonlinear processes*

I will present two scenarios of spin-wave dynamics in magnetic nanostructures. First, I will briefly discuss spin-wave propagation in small magnetic ring structures. Modes can be identified which exist due to quantization along the ring perimeter, due do quantization because of the ring width, and due to localization effects in regions of large inhomogeneity of the internal field. These modes can be driven into the nonlinear regime, and nonlinear mode coupling is observed.

A ferromagnetic nano-structure may emit spin waves if subject to an electric current flowing through the structure. We have investigated the dynamics of the magnetization in the Py free layer of one spin-valve structure with a point contact with 80 nm in diameter subject to a combined microwave and dc current. The magnetic resonance frequencies are determined for different externally applied magnetic fields. The spin-waves radiation from the contact are studied for several applied microwave frequencies and under the influence of the applied dc current, as well as a function of the applied power from the microwave source. The results reveal strong nonlinear effects namely the generation of eigenmodes with higher frequency ($2f$, $3f$) but also modes with a non-integer factor ($0.5f$, $1.5\ f$) with respect to the excitation microwave frequency f, see Fig. 1. These non-integer factor modes are assumed to be associated with three-magnon-scattering processes. In order to localize the eigenmodes around the nanocontact we have performed 2D scans with high spatial resolution of 250 nm.

The obtained patterns show that half and second harmonic modes are localized within the point contact area.

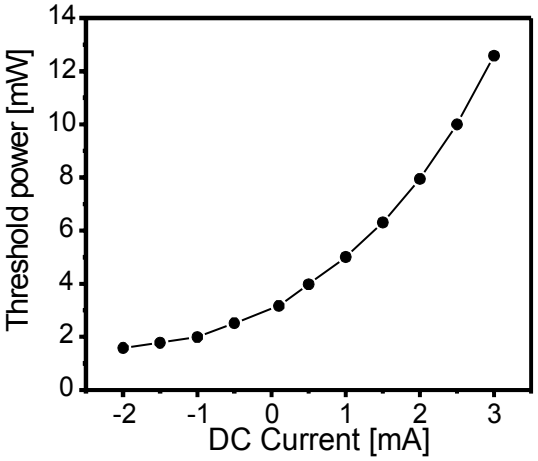

Figure 2: *Threshold power of the spin waves with half the excitation frequency as a function of the applied dc current. The applied field is 245 Oe.*

For obtaining more information about the effect of the dc current on these nonlinear processes we studied the power dependence of the emitted spin waves as a function of the applied microwave power and the dc current. An interesting result is that the appearance of spin waves with half the excitation frequency shows clearly a threshold behaviour as a function of the applied microwave power. The threshold shows an exponentially increasing dependence on the dc current, see Fig. 2, independent on the scan position. This can be understood as an effect of the spin torque and not due to the Oersted field created by the current.

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Spintronics with organic semiconductors

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Organic semiconductors (OSC) research over the past decades has made continuous and impressive progress [1]. The greatest success has been undoubtedly achieved in the optoelectronics field, where display products based on hybrid light emitting diodes with organic emitter (OLEDs) have become available to consumers, and organic photovoltaic devices are challenging existing commercial applications. These accomplishments generate a strong demand for other mainstream products based on new hybrid organic-inorganic devices. Considerable improvements have already been achieved in organic field effect transistors (OFETs), while organic electric memories for data storage applications are nowadays attracting both fundamental research and applications.

Organic semiconductors have recently caught the attention of spintronics, and significant efforts are being made towards their integration in this field [2, 3]. Spintronics is a branch of electronics that takes full advantage of, not only the charge, but also the spin of the electron. It encompasses different topics, related mainly to the generation of a nonequilibrium spin polarization in various materials and devices, together with its manipulation and detection [4-7].

The most attractive aspect for spintronic applications is the weakness of the spin scattering mechanisms in OSC, implying that the spin polarization of the carriers can be maintained for a very long time in these materials. This property is due to the very low spin orbit coupling in OSC: carbon has a low atomic number (Z), and the strength of the spin orbit interaction is generally proportional to Z^4. Noticeably, spin relaxation times in excess of 10 microseconds were reported by different resonance techniques years before the first organic spintronic experiments [8, 9], values exceeding by orders of magnitude the characteristic times detected in inorganic materials [10].

Organic spintronics can currently be seen as a fascinating puzzle in which many pieces are still lacking. For example, the electronic properties of OSC are radically different from those of such band semiconductors as Si or GaAs. Consequently, their spin properties are also different. The most challenging and exciting aspect of organic spintronics is therefore the need to face a conceptually new physical behaviour and to unveil both its fundamentals and possible application issues. In addition to this stimulating fundamental interest, the results so far obtained in this novel field are very encouraging. It cannot be excluded that OSC will compete with other materials for the leadership in the spintronics field or at least in some selected niche applications.

In this talk I shall focus on the major achievements and questions arising from spin injection and transport in organic semiconductor materials. I will begin by presenting and discussing the concepts and facts which are widely accepted by the community and will conclude by addressing the most controversial issues and open questions [11].

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From Hybrid to Mono-molecular logic gates

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In Molecular electronics [1], one molecule can be: (a) a simple device mimicking the electrical behaviour of a rectifier (1974), a switch (1986) or an amplifier (1997), (b) a complete classical electronic circuit embedded in a large molecule (1984) or (c) a full logic gate using intramolecular quantum behaviour with no resemblance to an electronic circuit [2]. After discussing how to control intramolecular time dependent quantum dynamics to get a Boolean algebra [3], a current drive single molecule NOR-AND logic gate is presented based on a simple dinitro-anthracene molecule [4]. Supporting this design, experimental of single molecule - molecular orbitals imaging are presented [5] together with a new multi-electrode atomic scale planar technology to interconnect this molecule logic gate to a large number of metallic nanopads on a passivated semi-conductor surface [6].

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Optical properties of individual boron nitride nanotubes

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Stability of boron nitride nanotubes has been theoretically predicted in 1994 whereas first syntheses of multiwall and of singlewall nanotubes have been achieved in 1995 and 1996 respectively. Similarly to carbon nanotubes, they are composed of rolled up hexagonal boron nitride (hBN) sheets. According to calculations, BN nanotubes are all wide band gap semiconductors and their band gap value should not depend much on their diameters and chirality. They are also expected to emit strongly in the UV range because of excitonic recombinations. Preliminary optical absorption experiments performed on BN-SWNT synthesized by a laser vaporization technique [1] have confirmed the existence of a large gap close to 6 eV [2, 3].

As it has been experimentally demonstrated for the related bulk material hBN, stronger excitonic effects than in carbon nanotubes should occur in BN nanotubes. The excitons involved in these materials are expected to be localized excitons of very large binding energy (quasi-Frenkel excitons). Such effects have not been experimentally demonstrated yet for BN nanotubes especially because of a lack of pure samples.

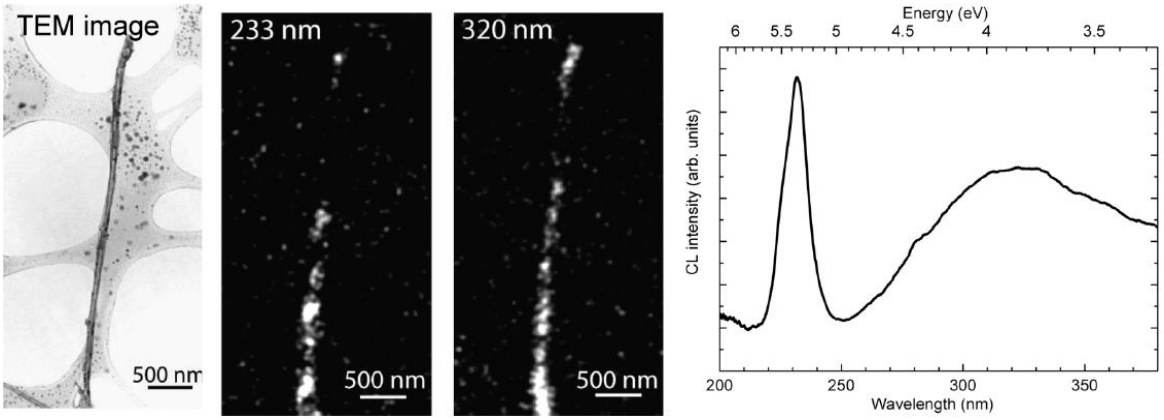

Figure 1: *from left to right: TEM image of a BN-MWNT, cathodoluminescence images of the same tube recordd at 233 and 320 nm respectively and cathodoluminescence spectrum of the same tube exhibiting two emission bands, one centred on 320 nm and related to impurities and vacancies and the second one at 230 nm related to gap and dominated by excitons [4].*

In our study, optical properties of multi-wall BN nanotubes are investigated with luminescence and excitation spectroscopies. Cathodoluminescence spectroscopy and imaging of individual BN nanotubes of diameters ranging from 30 nm to 110 nm have been undertaken. The results are compared with photoluminescence experiments at various temperatures (from 5 K to 300 K) on the same macroscopic sample. These experiments show that BN nanotubes are strong UV emitters at about 230 nm (Figure 1). Photoluminescence excitation experiments on the same sample further confirm the interpretation of the UV emission as due to excitonic recombinations. The precise nature of the luminescence bands are interpreted in comparison

with hBN (Figure 2). This study gives experimental evidences that the optical properties of BN nanotubes are dominated by large binding energy excitons.
The nature of the excitons will be discussed comparatively in hBn and in the nanotubes.

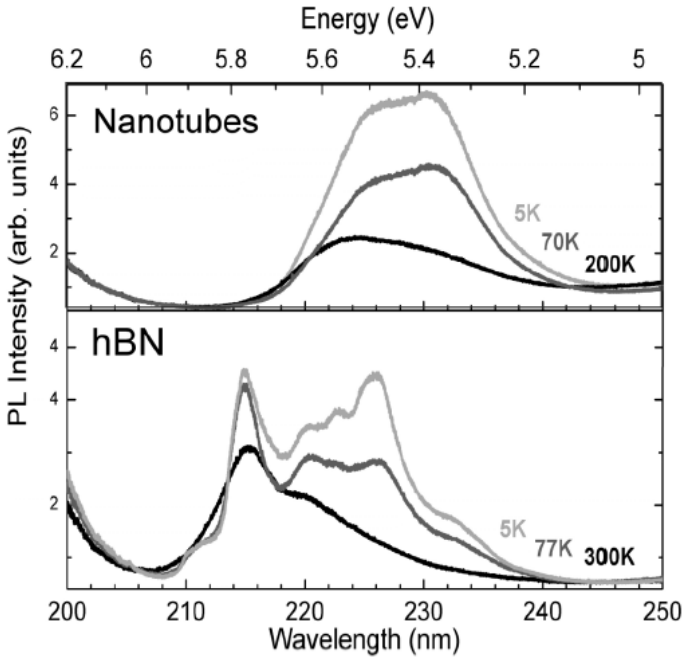

Figure 2: *Photoluminescence spectra recorded on BN-MWNT (top) and on hBN crystallites (bottom) for varaible temperatures, showing the excitonic band associated with the gap. In hBN, the band displays free and bound excitons, the latter being trapped on structure defects of the crystallite [5, 6] . In the nanotube sample, the band is red-shifted. This red-shift has been shown to be due to non radiative free excitons [7].*

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Nanoscale structure of organic/metal interfaces

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Organic heterostructures based on blends of molecules with electron-accepting (large electronaffinity) and electron-donating (small ionization potential) character display interesting electrical and optical properties with promising technological applications. For example, they show electroluminiscence for Organic Light Emission Diodes (OLEDs) [1], photovoltaic response for solar cell devices [2,3] and one-dimensional conduction for low molecular-weight metallic films [4]. These blends of molecules are deposited onto or contacted with metallic layers and their performance depends crucially on the alignment of energy levels, the molecular nanostructure and crystalline perfection. Interfaces between organic species with either donor or acceptor character and metal surfaces are, thus, of paramount importance for the performance of the devices described above.
In this contribution we will describe our recent efforts in order to understand, control and engineer molecular nanostructures on solid surfaces, especially those made out of organic donors and acceptors. In particular we will focus on three different topics:

- We will describe the subtle ways in which charge-transfer across organicacceptors/ metal interfaces can affect not only energy level alignment but also molecular self-assembly and atomic structure during thin film growth. Using a battery of experimental techniques (Scanning Tunnelling Microscopy, Low Energy Electron Diffraction and X-Ray Photoemission Spectroscopy, Near-Edge X-ray Absorption Fine Structure) and Density Functional Theory calculations, here we show that electrontransfer at the interfaces between a metal surface and the organic acceptor tetracyano-pquinodimethane (TCNQ) leads to substantial structural rearrangements both on the organic and metallic sides of the interface.
- We will show how surface templates can help in organizing donor/acceptor blends at the nanoscale, opening new means of growing bulk-heterojunction devices for photovoltaic applications. In particular we demonstrated that Due to differences in bonding strength with the substrate and different interactions of the donating (a TTF derivative) and the accepting (a functionalized fullerene) species with the Au(111) herringbone surface reconstruction, mixed thin films spontaneously segregate into a lateral superlattice of interdigitated nanoscale stripes with a characteristic width of about 10-20 nm, a morphology that has been predicted to optimize the efficiency of organic solar cells [5,6].
- Organic nanoparticles show size-dependent absorption and fluorescence bands or single photon emission. Although these size effects in organic nanoparticles might have been expected on the basis of the optical properties of their inorganic counterparts, the detailed understanding of these effects is hindered by the difficulty in the synthesis of organic nanocrystals, i.e. organic nanoparticles with an ordered molecular arrangement, is the synthesis of such nanocrystals on solid surfaces. In the same way in which crystalline inorganic nanodots can be epitaxially grown on suitable substrates under conditions in which 3D Volmer-Weber growth takes place, an organic system could in principle be devised such that the growth of crystalline 3D islands sets in

before the completion of the first monolayer. In practice, however, for organic adsorbates deposited on inorganic substrates intermolecular interactions are usually much weaker than molecule-substrate interactions thus promoting a layer-by-layer growth mode, and preventing the fabrication of isolated 3D nanocrystals with regular shapes. Here we show that, upon deposition of cone-shaped subphthalocyanine molecules on Cu(111), isolated triangular nanocrystallites up to 3 ML high appear on the surface before the completion of the first monolayer. The different molecular layers show an alternating or antiferroelectric (AF) stacking of the molecular dipole moments.

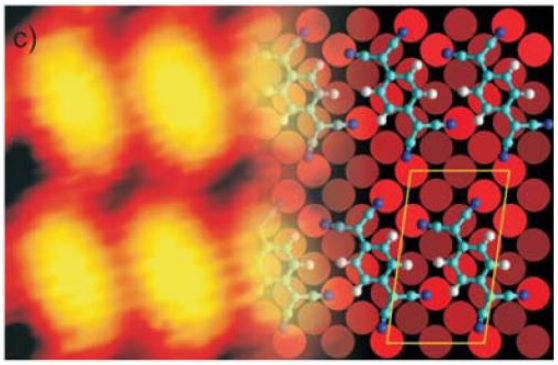

Figure 1: *Charge transfer triggered, substrate mediated interactions between TCNQ molecules adsorbed on Cu(100)*

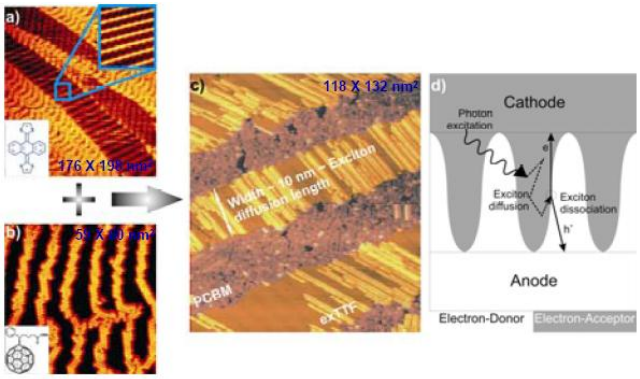

Figure 2: *Lateral superlattice at the nanoscale due to different interactions of the donating and accepting species with the surface reconstruction.*

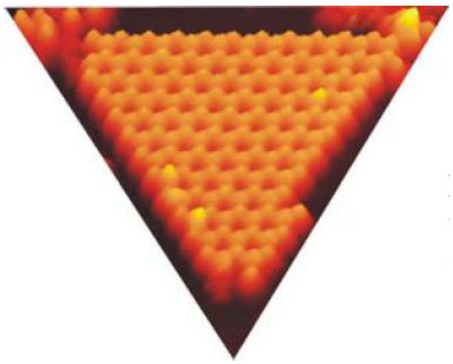

Figure 3: *2MLthick molecular crystal of SubPc on Cu(111)*

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Imaging, manipulation and chemical identification of individual atoms with dynamic force microscopy: a theoretical perspective.

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

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

Finally, we extend this collaboration between theory and experiment in the analysis of force curves measured in a technologically relevant oxide surface: the rutile TiO_2(110) surface. We have characterized the interaction between clean and contaminated Si-based tips in order to understand the rich variety of atomic contrasts observed on this surface. Our calculations show that the relative contribution of the weak short-range electrostatic interaction and the onset of chemical bonding between the closest tip and surface atoms is very sensitive to the tip-sample distance, defining different interaction regimes along the tip-sample distance. In particular, we show the short-range electrostatic interaction in weak interaction regime can provide a complex atomic contrast such as the experimentally reported neutral and all-inclusive [7] contrast modes.

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Growing a carbon nanotube atom by atom: "and yet it does turn"

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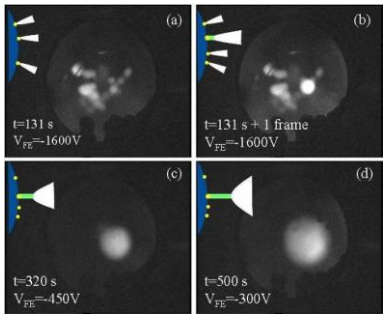

Figure 1: *Evolution of the FEM pattern with time during CNT growth in acetylene at 800°C. (A) FEM pattern from Ni particles before acetylene. (B) FEM pattern showing a bright circular spot one frame after the CNT nucleation. (C)(D) Enlarging CNT-FEM pattern as the CNT lengthens.*

The key issue for realizing the potential of CNTs has always been, and still remains, a better control of CNT growth. Measurement techniques, models and control are needed at the atomic scale as this is the size of the critical growth zone. Though important progress is now being made by growing CNTs in transmission electron microscopes [1], this does not yet show how individual atoms integrate into a growing CNT. Ding, et al. [2] have recently proposed that atoms may simply repetitively stick to the edges of growing single wall nanotubes (SWNTs) by a 'screw-dislocation-like' (SDL) mechanism. Such a mechanism is attractive because it points towards controlled growth by a sort of epitaxy, as for bulk single crystals, and connects the growth speed to helicity. However to test this theory and find the experimental conditions over which it is applicable, an experimental method that can measure growth with an atomic resolution is needed. Here we show that field emission (FE) permits such "atomic" resolution by observing the growths of individual carbon nanotubes (CNTs); from the nucleation stage, directly in a field emission microscope (FEM) [3]. As we explain below, our results lend direct support to the SDL model.

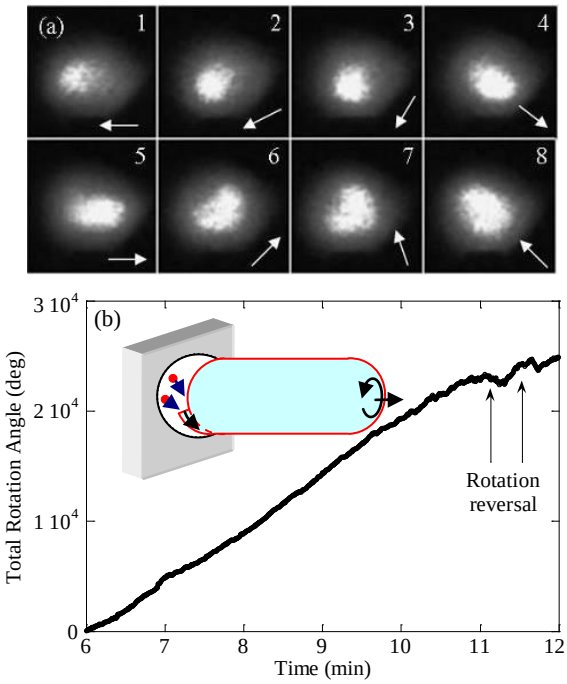

Figure 2: *(a) Sequence of FEM patterns from a growing CNT that follows a single revolution as the CNT lengthens (in order 1 to 8). (b) Angle of the pattern as a function of time during a large part of the growth. Inset: schema of the rotating CNT growth.*

Ni was first deposited on a sharp W tip in an ultrahigh vacuum FE system and formed into nano-particle catalysts by de-wetting. The CNTs were then grown by chemical vapour deposition (CVD) in 10^{-7} Torr acetylene at 800°C, during FEM imaging. Electrons emitted from the caps of individual, growing CNTs formed circular FEM patterns on a phosphor viewing screen. A series of typical FEM images during the growth of a CNT are shown in Fig. 1. The voltage necessary for FE progressively decreased and the pattern increased in diameter which by FE principles means that a CNT grew radially from the W support tip.

A more interesting type of growth was when in addition to strengthening and widening, the FE pattern rotated axially during growth. In one case the CNT rotated ~180 times during its 11 min growth cycle (see Fig. 2). This immediately suggests growth by the SDL mechanism where

the integrating atoms don't simply extrude the CNT, but force it to simultaneously rotate about the catalyst particle.
More striking and in-depth information was obtained by a frame by frame analysis of the video. This showed that the rotation proceeded by discrete steps with about ~24 per rotation, half the number of atoms on the circumferences of common SWNTs (see Fig. 3). We conclude that each step is the direct observation of the SDL growth of a SWNT, one carbon dimer at a time.

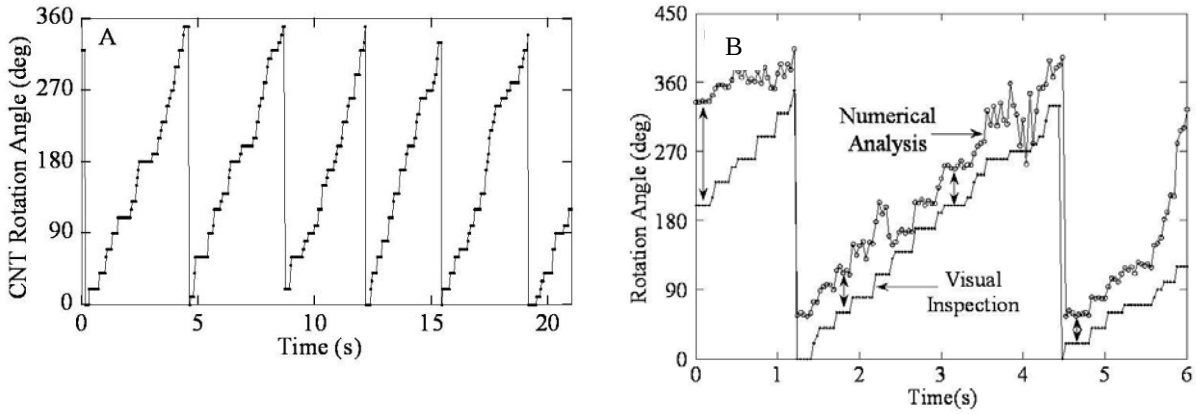

Figure 3: *(A) Frame by frame measurement of the rotation angle of the FE pattern showing that it proceeded by discrete steps. The number of the steps for the 5 cycles were {25, 25, 21, 21, 25}, varying because steps of one or less frames are difficult to tabulate. (B) Detail of the fourth cycle. Two types of analysis have been made which are displaced by 60° for clarity.*

This work brings new insights to the three elements needed for advancing controlled CNT growth: measurement, model and control. The striking observation by FEM of the fabrication atomic brick by atomic brick of a molecular system is a new measurement technique at the atomic scale.

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Two-dimensional nanoimprinted photonic crystals for laser applications

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Polymer photonic devices generate a great interest to serve as new platforms for planar photonic integrated circuits (PICs). However the fabrication of PhCs often requires elaborate and expensive techniques, such as electron-beam lithography and reactive ion etching. For the last ten years, nanoimprint lithography (NIL) has become an alternative cost-efficient technology to replicate features with a sub-10 nm resolution. We show here the fabrication and optical characterization of polymer PhC band edge lasers and polymer PhC with photonic band gaps fabricated by NIL in a polymer layer doped with rhodamine 6G on glass substrates. Silicon PhCs stamps with different lattice constants were fabricated and successfully imprinted by standard NIL process. Figure 1 shows a scanning electron microscope (SEM) image of a stamp structure and the corresponding two-dimensional PhC imprinted in the active polymer. The pattern is well reproduced, with a surface roughness comparable to the one on the stamp. These polymer lasers were pumped optically using a frequency-doubled Q-switched Nd:YAG laser (532 nm, 0.7 ns, 10Hz). The beam was focused to a ~20 mm radius spot. The emission from the PhCs was analyzed with a CCD spectrometer.

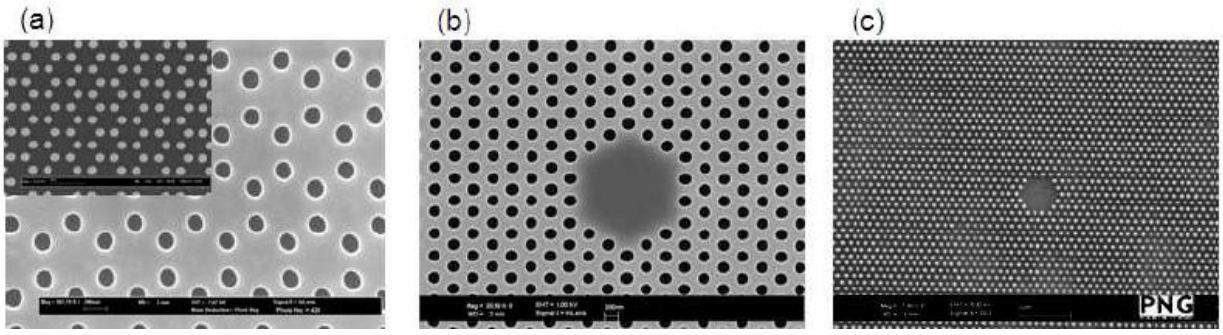

Figure 1: *(a) SEM micrographs of nanoimprinted photonic crystals in mr-NIL 6000, in which rhodamine 6G have been incorporated (concentration: $5 \cdot 10^{-3}$mol·L^{-1}), Inset: SEM micrographs of a silicon stamp containing two-dimensional honeycomb array of pillars, (b) SEM micrographs of a silicon microlaser stamp containing two-dimensional triangular array of pillars, (c) SEM micrographs of nanoimprinted photonic crystals in the dye doped polymer.*

Figure 2a shows the measured spectra of 460 nm lattice constant honeycomb PhCs made in polymer, excited above the lasing threshold. By scaling the lattice constant of the PhC, the emission wavelength can be tuned. Insets in Figure 2a shows the light input-output relation of these lasers, exhibiting a sharp turn-on at the laser threshold. At much higher excitation levels, multimode laser oscillations were observed. The lasing mode has been matched with a very good agreement to the expected band edge lasing modes calculated with a plane-wavebasis frequency-domain method. Furthermore, microcavities have the potential to exhibit an ideal cavity for the control of the spontaneous emission. A simulated example by 2D FDTD of the transmission of a plane wave along the GM direction of the microcavity is presented

Figure 2b. It shows a sharp resonance inside the bandgap. The light is expected to be strongly localized in the defect induced by the PhCs exhibiting a photonic band gap (inset). Experimental validation is under progress.

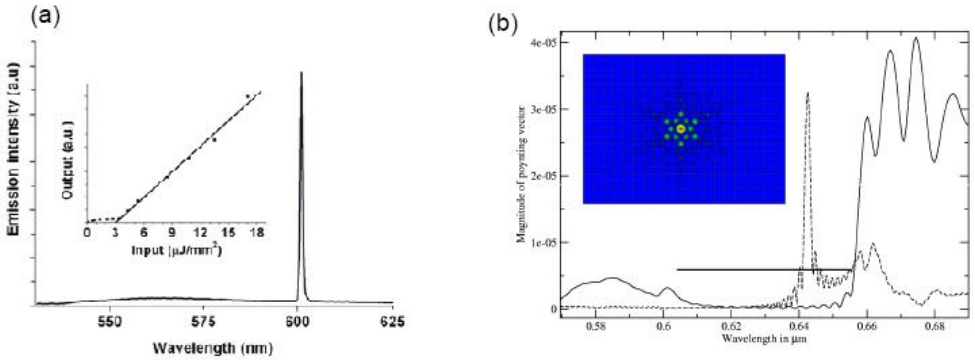

Figure 2: *(a) Emission spectra of a band edge laser (lattice constant: 460 nm). Inset: Radiated power as a function of the excitation energy, (b) Results of the FDTD simulation of transmission of a plane wave through a PhC with a defect (in dotted lines) and without defect (solid line). The bandgap wavelength range is marked with a horizontal bold line. Inset: Electric field in the out-of-plane direction for the PhC at the resonant wavelength of the microcavity.*

In conclusion, we fabricated polymer photonic crystal band-edge lasers using nanoimprint lithography. The laser emission wavelength can be tuned by controlling the lattice constant of the PhCs, covering a wavelength range of 30 nm around 550 nm. Nanoimprinted microcavities with two-dimensional photonic crystals have been successfully fabricated opening the way on the realization of ultrasmall laser cavity. Unlike the electron-beam lithography commonly used for patterning nanophotonic structures, NIL offers a cost-efficient, rapid and large area processing capability. The direct transfer of the PhC pattern in an active layer reduces the number of process steps for the fabrication of this type of lasers.

We gratefully acknowledge Mads Brøkner Christiansen and Anders Kristensen for the dye-doped polymer. The support of the EC-funded of the EC-funded project NaPaNIL is gratefully acknowledged. The content of this work is the sole responsibility of the authors.

Protein interaction with nanostructured surfaces

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One of the major challenges for the development of analytical devices for biological analysis relies on the ability to design advanced surfaces with controlled interaction with the biological entities [1,2]. Surface functionalization techniques provide those bio-interfaces: appropriate surface physico-chemical properties are able to control the conformation and activity of the immobilized biomolecules. The subsequent technological step is the combination of different bio-functions in micro- and nano-patterns on the surfaces. For instance, structuring the surface in adhesive and non adhesive zone in order to preferentially guide the cell growth is one of the most promising tools for the development of cell chips and for tissue engineering [3]. The requirement of further integration scales and the study of the special behaviour of the biomolecules interacting with nanostructured materials have been the two main motivations for the development of submicron patterning techniques [4]. For instance a strong increase of magnitude of sensitivity in biosensing devices together with lower detection limits have been demonstrated [5,6].

Plasma assisted deposition and etching techniques are interesting methods to produce functionalized surfaces with controlled micro- and nano-patterns: they provide high-level functionality with good stability on different substrates and are compatible with different micro- and nano-patterning techniques.

In this work we show some examples of micro- and nano-functional surfaces provided by plasma processes and self assembled monolayers in combination with Electron Beam Lithography and Colloidal lithography, and their application as platforms for molecular detection. In particular, micropatterned surfaces were produced by a spatial arrangement of different functional domains by a combination of plasma polymerisation and electron beam lithography: non-fouling patterns were made of poly(ethylene oxide) (PEO)-like polymers obtained by pulsed plasma polymerization of diethylene glycol dimethyl ether while fouling surfaces were composed of Poly-acrylic acid (PAA) from acrylic acid monomer obtained by plasma polymerization, and stabilised by electron beam. PAA nanopillars of 150nm diameter can be obtained in a PEO non-fouling background. Adsorption of IgG on those surfaces show that the protein adsorbs on the pillars, which results in a higher detection sensitivity in an immunoreaction with anti-IgG. On the other hand, nano-patterns of fouling-antifouling areas have been produced by combining Colloidal Lithography techniques with plasma deposited thin films and SAM's: in particular carboxylic functionalized nano-spots in a PEO-like anti-fouling matrix have been produced. We show that these chemical nano-patterns are able to immobilize proteins selectively in the carboxylic functional nano-domains, leaving the anti-fouling matrix clear. Moreover Enzyme-Linked Immunosorbent Assay and SPR imaging experiments were set-up showing that nano-patterned surface constrains the immobilization of the antibodies in a biological reactive configuration, thus significantly improving the device performances as compared to more conventional non-patterned or disordered patterned surfaces. We show with different methods (SPR, QCM, ELISA) that the detection sensitivity improvement increases as the size of the patterns decreases and that this effect is associated to the immobilisation of proteins at the boundaries of the patterns.

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The search for Tbits/in^2: understanding the fundamentals of nanomagnetism

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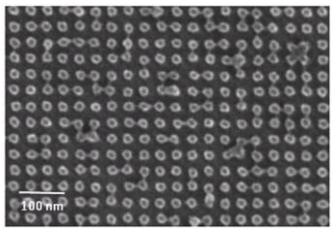

Figure 1: *Patterned array of Co/Pd islands with 28 nm period (820 Gbit/in^2) produced by Extreme Ultraviolet Interference Lithography (EUV-IL) at PSI, Switzerland [3-4].*

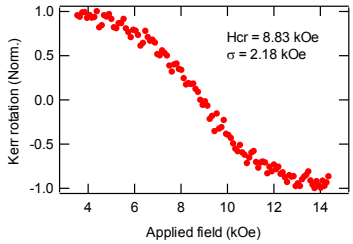

Figure 2: *Kerr rotation remanence curve for 32 nm period Co/Pd magnetic island array. In this sample the SFD (σ/H_{cr} = 0.25) which is much greater than could be used in a particular device.*

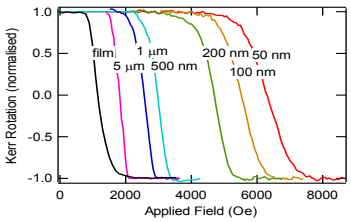

Figure 3: *Remanence curves as a function of island size of a series of Co/Pd nanomagnetic island arrays.*

Control of switching in magnetic nanostructures is critical for device applications from MRAM cells to patterned recording media [1]. Typically, we desire that very large numbers of these nanoscale magnets switch in an identical way when subject to same external conditions e.g. applied field and temperature. In the case of bit patterned media created from arrays of nanomagnetic islands [2], such as those shown in fig.1, each element should switch when subject to a particular head field. In practice, identical switching of magnetic elements is not observed and this leads to a finite switching field distribution (SFD), fig.2. The SFD has two components; an intrinsic component due to physical variations of material properties and a component due to magnetostatic fields from neighbouring islands. The magnetostatic component can be determined both by measurement and by simulation [5] and becomes increasingly significant as the period of the patterned magnetic arrays is reduced.

The intrinsic component of the SFD results from a distribution of anisotropy that occurs at length scales set by the exchange (nucleation) length. The intrinsic distribution of anisotropy can be probed by varying the number of nucleation sites and measuring the field needed to reverse the element; provided that domain wall pinning energies are much less than the nucleation energy. In the case of Co/Pd multilayer islands with large perpendicular anisotropy and high exchange coupling where this condition is met, we show that by measuring the reversal properties as a function of island size, fig.3, the intrinsic distribution of anisotropy can be quantified. Knowledge of the anisotropy distribution allows possible physical mechanisms for these material variations to be studied.

The current status of patterned media as a future data storage technology will also be discussed briefly in the context of some recent results on quasi-static recording of patterned nanostructures.

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Band-gap modulation in gated bilayer graphene

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We present fundamental researches on thin graphite film, with the goal of realizing future nanometer scale electronic applications. The graphite films are expected to be an important element in nano-carbon electronics. For a control of the conduction of the thin graphite channel, gating effect must be fully clarified. Here, we introduce our original gate-structure to efficiently apply gate-voltage to the graphene channel, and discuss energy-gap modulation in gate-electric field.

Our starting materials are thin graphite film (thickness < 10 nm) or bilayer graphene pealed off from bulk graphite on SiO_2/doped-Si substrate. The thin film is connected to two or multiple metallic electrodes. In general, conduction of the graphite can be changed in gate voltage applied to the doped-Si substrate. In this configuration, the gate electric field can be applied from the substrate side (back-gate configuration). Observed resistance in the gate-voltage change shows ambipolar behavior based on clear carrier polarity change.

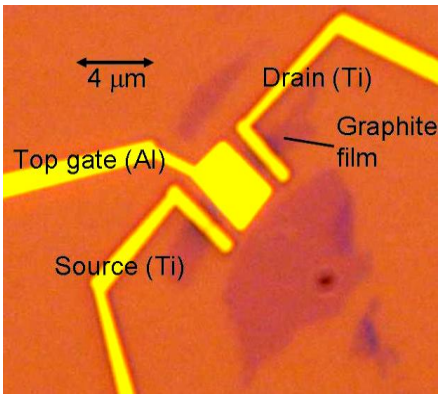

Figure 1: *Optical microscope image of a thin graphite film with source-drain electrodes and a Al top gate on SiO_2/Si substrate.*

We also attached a front gate, which was directly formed on the surface of the graphite film. We deposit an Al electrode on the graphite film (Fig.1). The graphite channel and the Al electrode are naturally insulated in air. Then the Al electrode can be used as a front gate. The front gate also changes the conduction of the thin graphite film. A scan of the top gate voltage generates a resistance peak in the ambipolar response. The back gate voltage shifts the ambipolar peak depending on the graphite thickness. The shift is larger in thinner film. The peak shift depending on the thickness is clarified in terms of the inter-layer screening length λ to the electric field in the dual-gated graphite film. We assume that the gate-induced carriers decay exponentially from both surfaces, and that the conductivity in each layer increases proportionally to the induced carrier density. Then the condition for the ambipolar resistance peak in top-gate voltage scan is obtained as a function of back-gate voltage, λ, and the graphite film thickness. Applying this model to the thickness-dependence, we succeeded in estimating a screening length to be 1.2 nm in the thin graphite device.

Based on the screening length obtained in the above experiment, a bilayer film was electrically gated in dual-gate configuration. The effective electric field successfully generated the band-gap depending on the gate-electric field. The observed band-gap depends on the applied electric field, and opens up to 200 meV at 1 V/nm. The existence of the band-gap was confirmed in a conductance measurement depending on the temperature.

Nanoscale control of single photon emitters by optical nano-antennas and tailored fs pulses

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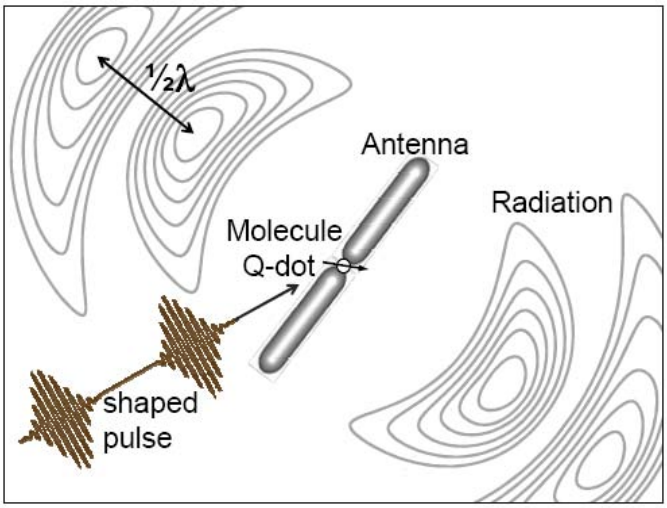
Current trends in nanoscience now allow the exploration of light in and around nanostructures, single molecules, molecular complexes, etc. Indeed by proper control on the nm-scale subwavelength strong light fields are being created and detected. In the nanoworld single molecules or nanoparticles are the ultimate detectors of both local optical fields and interaction with the local environment. Here we focus on the control of single molecules using resonant nano-antenna and phase shaped fs pulses.



Figure, the concept: *A single molecule or quantum dot interacts with free optical radiation via a nanooptical antenna. In close proximity to the resonant nano-antenna the emitter exhibits enhanced excitation and decay rates and redirected emission [2]. Excitation by phase shaped fs pulses allows to control the excitation path.*

We show how both excitation and emission of individual molecules is controlled by coupling to resonant optical nano-antennas. The molecule probes the local antenna field and here we show optical fields of a resonant monopole antenna, spatially localized within 25 nm [1]. Next the enhancement of the radiative and excitation rates is treated, particularly how the angular emission of the coupled system is highly directed, as the dominant antenna mode determines the angular emission. Thus arbitrary control over the main direction of emission is obtained, regardless of the orientation of the emitter [2]. A nano-Yagi-Uda antenna is discussed affording enhanced rates, strong unidirectional emission and, in reciprocity, efficient nano-focusing, making such antennas a promising candidate for compact easy-to-address planar sensors at the single molecule level [3].

Next we address the femtosecond dynamics of single molecules at room temperature employing double pulse excitation scheme. By controlling both delay time and relative phase between the electric fields of the pulses we are able to manipulate the excited state population probabilities of single molecules. An analysis of these data based on the optical Bloch equations for two- and three level systems allows retrieving the dephasing time and Rabi frequencies of single molecules directly in the time domain.

The combined spatio-temporal control is promising for controlled single photon sources, light harvesting systems, efficient bio-sensors and optical imaging with 10 nm resolution.

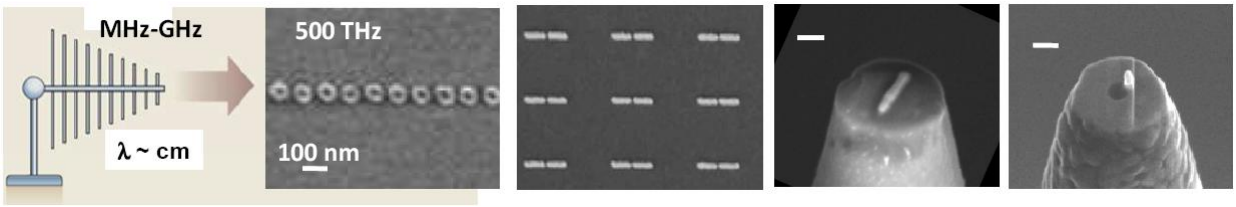


Figure: *From radio to optical frequency, some characteristic nano-optical antennas. Scale bars 100 nm.*

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Assembling a biological nanomotor on a nano-engineered surface

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Nature offers today thousands of machine at the nano-scale, working in symphony within any living organism on Earth. This basic analysis shows that biology can be seen as a nanoscale phenomenon [1]. Molecular biology, genetics and biochemical methods have been extensively used for studying the structure and principle of these bio-machines from their in vivo observations to their in vitro extraction and purification. These methods have revealed extraordinary capacities, such as for example the F1F0-ATPase [2]. This nano-motor, presents mechanical and biochemical properties, which are for the moment, out of reach to any nano-scale artificial machine produced by silicon technologies. Since the pioneering work of C. Montemagno [3] a new paradigm has thus been proposed; we call it "Nanotechnologies from biology". The idea is to integrate natural nanoscale bio-machines on devices in order to exploit their exceptional efficiencies. This methodology can be seen as a rupture with respect to the conventional "top-down" and "bottom-up" approaches, because here, the engineering of the active part of the device is devoted to nature rather than to human conception.

In this paper we describe the initial technological steps dedicated to the assembly of the flagellar nanomotor of bacteria on an artificial engineered surface using nanotechnologies. We will address both questions of the elucidation of the structure and mechanism of this mesoscopic nanomotor and its integration in 2 or 3 dimensions on a solid support. This work is a fundamental research which would serve as a base for the future development of the new area of integrated hybrid bio-inspired devices.

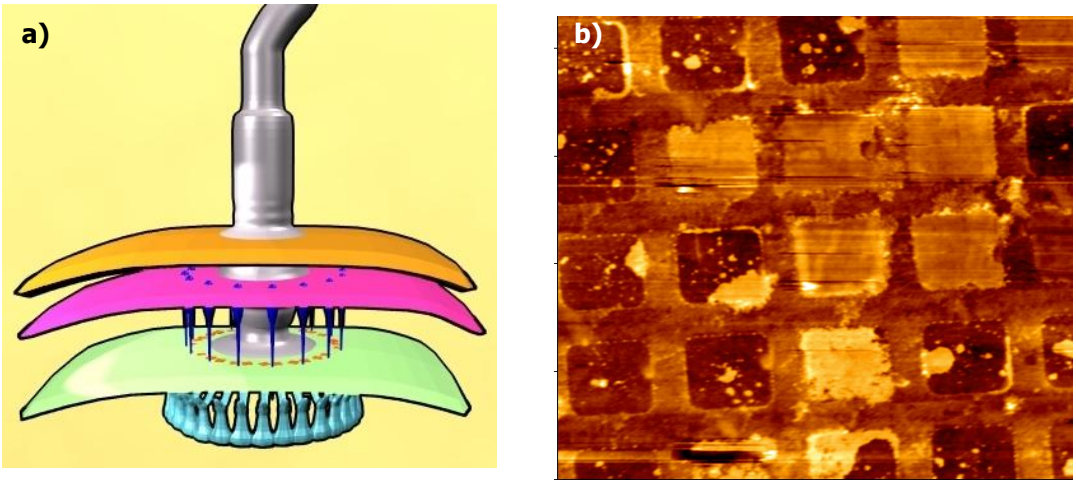

Figure 1: *a) Schematic of the flagellar nanomotor of bacteria. The largest ring at the basis (C-Ring) measures 45 nm in diameter; b) AFM image in liquid medium of patterned phospholipidic membranes of E. Coli obtained by Micro-Contact printing and selective liposome fusion. Scale bar 5 µm.*

Through the combination of soft-lithography and self-assembly and using liquid Atomic Force Microscopy for imaging the assembly, we have been able to observe the assembly of one piece of this bionanomachine on a supported phospholipidic bilayer membrane. The structure, the investigation of the interactions between the constitutive proteins of this machine using Quartz Crystal Microbalance technology (QCM) will be reported together with the possible routes until the complete assembly of this biological nanomachine.

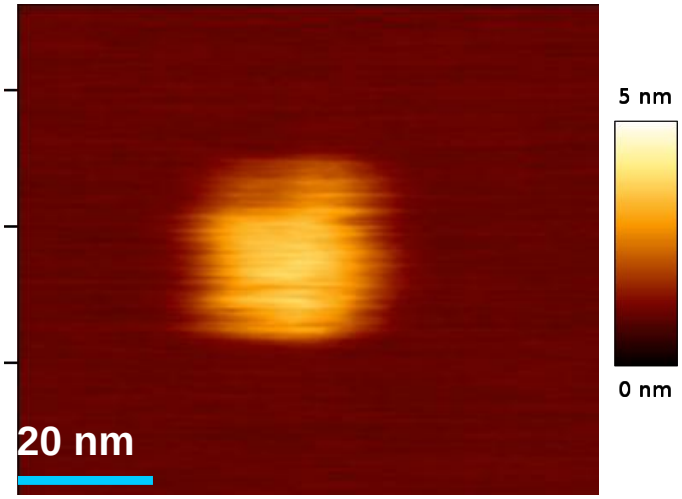

Figure 2: *AFM image in liquid medium of FliG proteins (MS ring) assembled on a supported phospholipidic membranes of E. Coli.*

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Mechanically adaptive polymer nanocomposites

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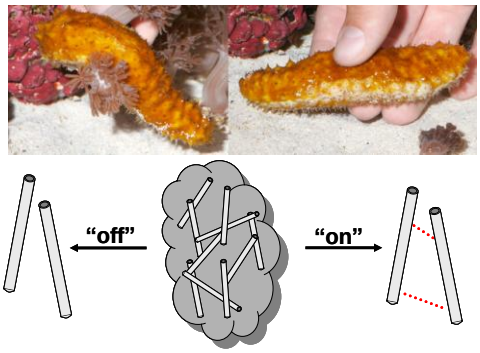

Figure 1: *Pictures of a sea cucumber in soft and stiff state and schematic of the switching mechanism in this biological model and the proposed biomimetic nanocomposites. The stress transfer among rigid, percolating nanofibers, and therewith the overall stiffness of the material, is controlled by a stimulus.*

Polymers which change their mechanical properties "on command", i.e. upon exposure to a pre-defined stimulus in a highly selective and reversible manner, are attractive for countless technologically relevant applications. Examples of technologically useful "smart" materials that exhibit such morphing mechanical behavior are, however, limited. [1]
We recently introduced a new family of stimuli-responsive nanocomposites that mimic the defense mechanism at play in the skin of sea cucumbers. [2] Like other echinoderms, these creatures have the fascinating ability to rapidly and reversibly alter the stiffness of their skin when threatened. [3] This dynamic mechanical behavior is achieved through a nanocomposite architecture, in which rigid, high-aspect-ratio collagen fibrils reinforce a viscoelastic matrix. The stiffness of the tissue is regulated by controlling the molecular interactions, and therewith the stress transfer, among adjacent collagen fibrils by locally secreted proteins. [3]
Intrigued by this capability and with the initial goal of creating new adaptive materials for biomedical applications, which change their mechanical properties upon exposure to physiological conditions, we recently began to investigate whether nanocomposites can be created that exhibit similar architecture and morphing mechanical properties. A first series of such adaptive nanocomposites was created from a rubbery ethylene oxide-epichlorohydrin copolymer (EO-EPI) into which a rigid network of high-stiffness, high-aspect ratio cellulose nanofibers was incorporated (Fig. 1). [2] The EO-EPI matrix displays a low modulus (~1 MPa) and can accommodate the uptake of several chemical stimuli. Cellulose nanofibers, isolated from the mantles of sessile sea creatures known as tunicates, were used as the reinforcing filler. [4] These "whiskers" exhibit high stiffness (tensile modulus ~130 GPa) and dimensions at the nanometer scale (26 nm x 2.2 µm). Similar nanofibers can be isolated from a range of renewable bio-sources, including wood and cotton. [4] On account of the high density of strongly interacting surface hydroxyl groups, cellulose whiskers have a strong tendency for aggregation. [5-6] As a result the fabrication of polymer/cellulose-whisker nanocomposites in which the nanofibers assemble into a percolating network can be intricate. Good dispersion during processing is achieved when whisker self-interactions are "switched off" by competitive binding with a hydrogen-bond-forming solvent. [5-7] Upon solvent evaporation the

interactions among the whiskers are "switched on" and they assemble into a percolating network. This architecture and strong interactions among the whiskers maximize stress transfer and therewith the overall modulus of the material. Indeed, E′ increased with increasing whisker content from ~4 MPa (neat polymer) to ~800 MPa (upon introduction of 19% v/v whiskers). [5] The non-covalent interactions between the percolating cellulose fibers in the nanocomposites can be mediated by chemical stimuli. Through modest aqueous swelling (20%), the reinforcing cellulose network can be disrupted, resulting in a dramatic modulus reduction from 800 to 20 MPa for a composite comprising 19% v/v whiskers (Fig. 2). [2] The original stiffness is restored when the composites are dried. Control experiments and analyses using mechanical models (Fig. 2) support the conclusion that the stiffness change is due to the designed mechanism of altered whisker–whisker interactions, rather than alternative effects such as plasticization of the matrix. [2]

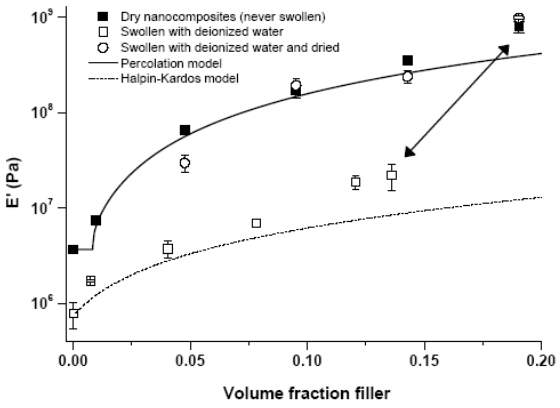

Figure 2: *Tensile storage moduli E′ of EO-EPI/cellulose whisker nanocomposites. The materials were conditioned as indicated. Lines represent values pre-dic¬ted by the percolation and Halpin-Kardos models. The arrow indicates changes in modulus and volume fraction of whiskers resulting from aqueous swellling of one selected sample (19% v/v whiskers).*

Developing a second generation of such adaptive materials based on poly (vinyl acetate) (PVAc) and cellulose whiskers we have shown that the combination of this effect with a chemically influenced thermal transition allows for amplification of the mechanical contrast. Mechanical switching over several orders of magnitude (5 GPa to 12 MPa) has now been achieved. [2,8]

These chemo-responsive mechanically-dynamic nanocomposites are potentially useful for a plethora of applications. For example, the chemo-responsive materials discussed here are currently being investigated for their potential to serve as 'smart' materials for biomedical applications. This presentation will highlight our recent efforts to develop adaptive substrates for intra-cortical microelectrodes.

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Artificial few-electron single and molecular quantum dots in low magnetic fields: electronic spectra, spin configurations, and heisenberg clusters

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Exact-diagonalization (EXD) studies for few-electron (N) anisotropic quantum dots and quantum-dot molecules - covering a broad range of strength of inter-electron repulsion, confinement anisotropies (for single dots), and interdot separation (double dots) - will be presented for zero and low magnetic fields [1-3]. As a function of the magnetic field, the energy spectra exhibit a low-energy band consisting of a group of M states, with the number M being a consequence of the conservation of the total spin and the ensuing spin degeneracies for N electrons. The energies of the M states cross at a single value of the magnetic field, and with increasing Coulomb repulsion they tend to become degenerate, with a well defined energy gap separating them from the higher-in-energy excited states. The appearance of the low-energy band is a consequence of electron localization and formation of a Wigner molecule [4]. Using spin-resolved pair-correlation distributions, a method for mapping the complicated EXD many-body wave functions onto simpler spin functions associated with a system of N localized spins is introduced. Detailed interpretation of the EXD spin functions and EXD spectra associated with the low-energy band via an N-site Heisenberg cluster (with B-dependent exchange integrals) is demonstrated. Such analogies to Heisenberg clusters are promising for enabling future spintronics applications of artificial dots. Aspects of spin entanglement, referring to the well known N-qubit Dicke states, will also be discussed.

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FluidFM: combining AFM and nanofluidics in a novel tool for single-cell experiments and beyond

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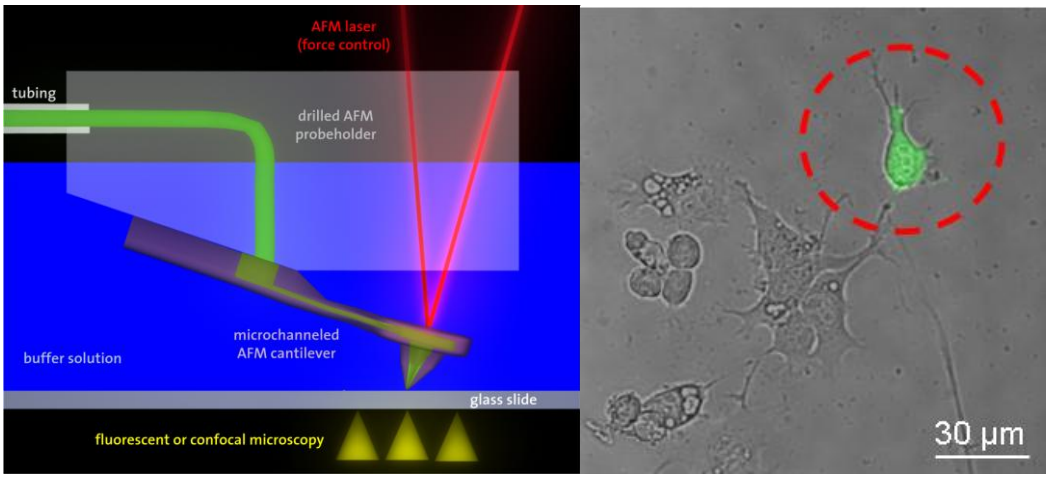
In this lecture, we describe the invention of a new type of atomic force microscope (AFM) including a nanofluidic circuit. This system is the result of a collaboration with **CSEM SA** (Neuchâtel, Switzerland). We call it the "fluidFM" [1] and can be used to dispense ultra small quantities of a solution from the AFM tip onto a sample in liquid or gaseous environment. A standard optical-beam detection and feedback system allows the forces between AFM tip and sample to be controlled to within a picoNewton resolution.

The instrument is composed of custom made AFM cantilevers encompassing an integrated microfluidics channel which are fabricated at CSEM [2]. The micro-channel ends at a well defined aperture located at or in the vicinity of the apex of the AFM probe tip while the other end is connected to a reservoir etched in the upper face of the cantilever chip. The cantilever chip is then fixed against an AFM probe holder so that the reservoir coincides with a macroscopic channel drilled in the AFM probeholder and terminating with a tube connector. In this way, a continuous and "closed" fluidic channel is thus created from the tube to the tip aperture that can be filled with whatever solution and the can be immersed in whatever liquid environment.



We show that biological molecules can be dispensed in their native aqueous environment highly locally, thanks to a gentle but close contact between the dispensing tip and a surface.
To date, AFM-based methods of transporting material have been of limited use in biomedical applications: dip-pen and similar methods allow liquid and water-soluble molecules to be patterned at high resolution but only in air; transport of molecules grafted to the AFM tip only allows the delivery of small quantities of a limited range of molecules.

In contrast, the fluidFM is flexible and versatile: an almost unlimited range of liquids and soluble molecules can be delivered either in air or in a physiological buffer, while force feed-back allows precise work with delicate samples in a variety of different experimental configurations.

As proof of principle, we also demonstrate the use of the fluidFM by injecting arbitrary substances into individual living cells or subcellular structures of living cells. In this model experiment we used a simple fluorescent dye to demonstrate the capabilities of our technique.

Thanks to the precise AFM force feedback, we could reliably discriminate between staining by gentle contact on the membrane or by injection upon cell perforation.
We strongly believe that the fluidFM will have an important impact in bionanotechnology both opening a new chapter of biological experiments towards precise single-cell infection with time resolution and, on the other hand, enabling a new generation of analytical methods involving in situ femtoliter sampling and analysis. Moreover, its versatility will surely stimulate innovative experiments from physics to materials science, chemistry and molecular electronics.

We would like to thank the Swiss innovation promotion agency (KTI/CTI) for supporting our feasibility studies and Stephen Wheeler from the ETH-LBB Workshop for technical help.

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ORAL CONTRIBUTIONS

(Plenary Session)

Exchange bias in core / shell magnetic nanoparticles: experimental results and numerical simulations

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In this talk, we will review some of the main experimental observations related to the occurrence of exchange bias in magnetic systems, focusing the attention on the phenomenology associated to nanoparticles with core/shell structure as compared to thin film bilayers [1]. The main open questions posed by the experimental observations will be discussed and contrasted to existing theories and models for exchange bias [1]. We will also present some recent numerical simulations [2-4] based on a simple model of a core/shell nanoparticle, showing evidence that the magnetic order of interfacial spins accounts for most of the experimental observations. Finally, we will discuss the occurrence of exchange bias on laser-ablated granular thin films composed of Co nanoparticles embedded in amorphous zirconia matrix [5]. The deposition method allows controlling the degree of oxidation of the Co particles by tuning the oxygen pressure at the vacuum chamber. The nature of the nanoparticles embedded in the nonmagnetic matrix may be monitored from metallic, ferromagnetic (FM) Co to antiferromagnetic (AFM) CoO_x, with a FM/AFM intermediate regime for which the percentage of the AFM phase can be increased at the expense of the FM phase, leading to the occurrence of exchange bias in particles of about 2 nm in size. This is a model system to study some of the features of exchange bias in nanoparticles, such as particle size dependence, induced exchange anisotropy on the FM leading to high irreversible hysteresis loops, and blocking of the AFM clusters due to proximity to the FM phase. The funding from the Spanish MEC through a FPU grant, Spanish CICYT project MAT2006-03999 and from the Catalan DURSI (2005SGR00969) are acknowledged.

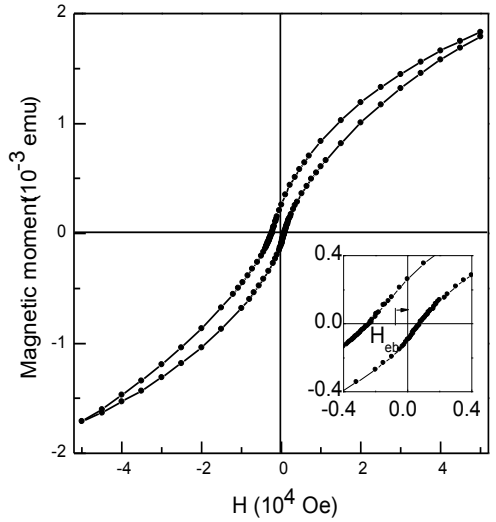

Figure 1: *Hysteresis loop at 1.8 K for an oxygen pressure at the deposition chamber $Po_2=10^{-3}$ mbar, recorded after field cooling the sample under 50 kOe. The inset shows a detail of the low field region where the shift of the hysteresis loop due to the EB is clearly observable. The Heb shift is indicated in the inset by a small arrow.*

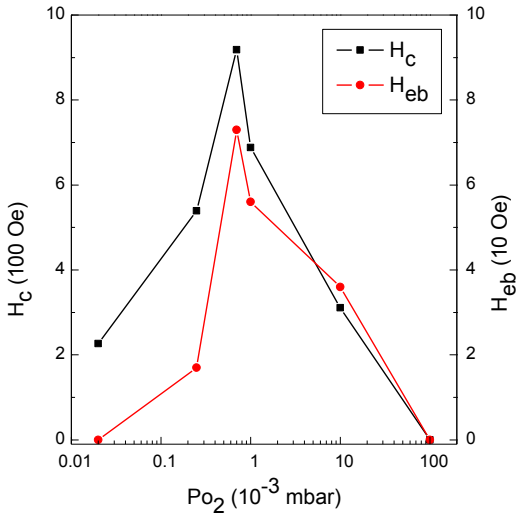

Figure 2: *Exchange bias (H_{eb}) and coercive field (H_c) dependence on oxygen pressure (Po_2) at the deposition chamber.*

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Early stages of growth in the Ag/Ni(111) system

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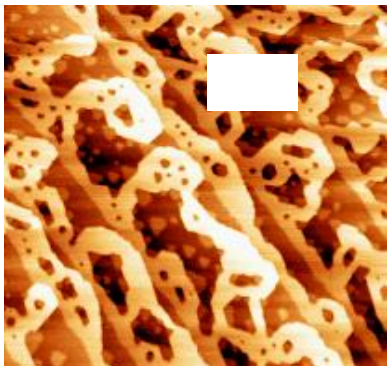

Figure 1: *STM image (250x250) nm² of Ni(111) surface after 1.2 ML of silver deposit and annealing at 525 K.*

Metal on metal growth mechanism is a complex issue involving a large set of thermodynamic parameters. A good understanding of this process is of primary importance to interpret for instance the selective efficiency of bi-metal catalysts towards a given reaction [1]. The Ag/Ni couple, where both metals are immiscible in the bulk phase, has been the subject of a number of theoretical and experimental works.

The first stage of silver growth on Ni(111) up to 2 monolayer (ML) have been investigated by a combination of several experimental and theoretical tools. A detailed study by Scanning Tunnelling Microscopy (STM) [2] of the Ag growth process on Ni(111) as a function of coverage and annealing scheme has lead to the conclusion that Ag grows from the very beginning mainly as bilayer islands, without wetting layer (fig.1). Low energy electron diffraction (LEED) results have shown the occurrence of collinear or rotated registry of the silver plane on the Ni(111) surface depending on thermal treatment (fig.2). In order to determine the geometry of these tilted but still commensurate reconstructions, the adsorption energies have been calculated by quenched molecular dynamics (QMD) simulations for a large number of configurations [3]. Three of those tilted reconstructions, corresponding, respectively, to rotation angles equal to 1°, 2.2°, and 3.5°, have been found energetically more stable than the collinear one. These results support not only our data but also the tilted superstructures observed by various authors using LEED or STM.

In addition, soft X-ray photoelectron diffraction (XPD) in the forward scattering regime has been used to confirm the presence of bilayer Ag islands in the very early stages. Full photoelectron diffraction patterns collected on the clean substrate and on several deposits from about 1ML to 5ML thicknesses have shown twinning and asymmetric rotational effects

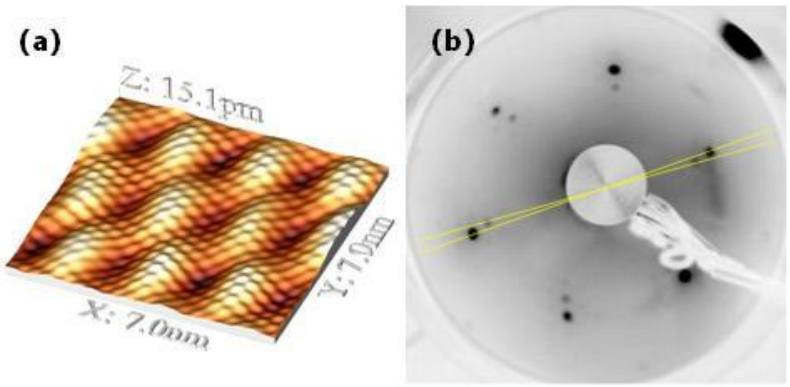

Figure 2: *(a) 3D atomic resolution STM image of "tilted" reconstruction moiré induced by silver layer on Ni(111) after annealing at 675 K, (b) corresponding LEED pattern.*

of the order of magnitude mentioned above. Quantitative structural data have been extracted from hard X-ray reflectivity (XRR) and grazing incidence X-ray diffraction (GIXD) with the help of QMD simulations. These combined measurements have been performed on the ALOISA beamline at ELETTRA (Italy).

This study shows how the coupling between STM, synchrotron radiation techniques and atomistic simulations is fruitful as well as necessary to understand such phenomena.

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Quantifying colloidal nanoparticle interactions in liquid environment by cryogenic electron microscopy

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The self-assembly process of nanoparticles in liquid environment depends crucially on the colloidal interactions between the nanoparticles.[1] Whereas most research has examined the physical properties of the eventually obtained colloidal assembly structures, we focus in our experiments on the interactions between nanoparticles while dispersed in the liquid. An approach that we have introduced to study the interactions between magnetic and semiconducting nanoparticles is cryogenic electron microscopy.[2-6] The presentation will visualize in which ways dispersive, magnetic dipolar, electric dipolar, and coulombic interactions affect the nanoparticle positions, leading to different local structures in the liquid. For example, magnetic nanoparticles self-assemble into living polymer structures that grow in an external magnetic field. In zero field, quantum dots exhibit similar linear structures, which we ascribe to the presence of a permanent electric dipole moment. Currently, we are investigating the effects of coulombic screening on dipolar structure formation. In all cases, not only do the interactions lead to a rich variety of nanostructures in the liquid dispersion, but conversely, quantitative analysis of the visualized structures constitutes a powerful characterization of the colloidal interactions between the nanoparticles. These are the same interactions that affect self-assembly into novel nanostructured meta-materials of interest for applications.

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Quantitative nanoscale dielectric microscopy of thin films and biomembranes at low frequencies

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The dielectric constant of insulating materials plays a key role in many electrical, optical and biological phenomena. With scaling of technological applications toward submicro or even nanoscale lengths, the accurate measurement of this property with high spatial resolution has become increasingly important and difficult. The standard thin film characterization techniques require large-area test structures and are not capable of addressing the dielectric constant at the nanoscale. For this reason new techniques are being investigated. Some progress in this direction has been made using scanning probe techniques at microwave frequencies. However, the quantification of the dielectric constant in the low-frequency domain (<1 MHz) have not been achieved yet despite the variety of studies based on electrostatic force microscopy.

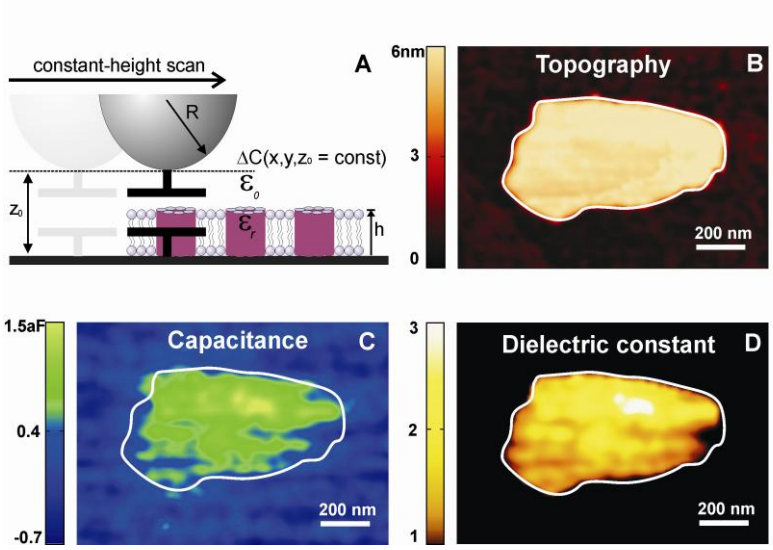

Figure 1: *(a) Schematic representation of low-frequency Nanoscale Dielectric Microscopy (NDM). (b) Topography, (c) local capacitance image and (d) dielectric constant image reconstructed from (b) and (c) of a Purple Membrane fragment [1].*

Here we will present a novel methodology implemented in our group, referred to as nanoscale dielectric microscopy (NDM) [1], which allows performing quantitative maps of the dielectric constant of ultrathin films with high precision and nanoscale spatial resolution. In NDM the dielectric constant images are reconstructed with the use of a precise analytical theoretical model [2] from local capacitance variations and thickness images. The capacitance variations in the sub-attoFarad range are probed either by *alternating current (ac) sensing* or by *force sensing* approach. The obtained dielectric constant is independent from the experimental set-up (probe radius, scan height, etc.) and represent an intrinsic property of the thin film investigated. Examples of application of NDM to thin oxide films [3] and single-layer biomembranes (Figure 1) will be provided, together with a discussion on the ultimate limits of the technique.

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The discovery of the smallest metal nanotube with a square cross-section

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The study of the mechanical properties of nanostructures presents new theoretical and experimental challenges. The arrangements of atoms in nanostructures and macroscopic matter can be quite different, principally due to the role of surface energy. The interplay between atomic and electronic structure in association with applied mechanical stress can also lead to surprising differences.
Of particular interest are the structures that can not exist at macroscale but that can be stabilized (at least as metastable ones) at nanoscale, especially when stress/strain is present. Examples of these cases are atomic suspended chains and helical nanowires [1].
We present here results showing the spontaneous formation of the smallest possible (onelattice- parameter-wide) square metal nanotube during silver nanowire stretching [2] (Figure 1).

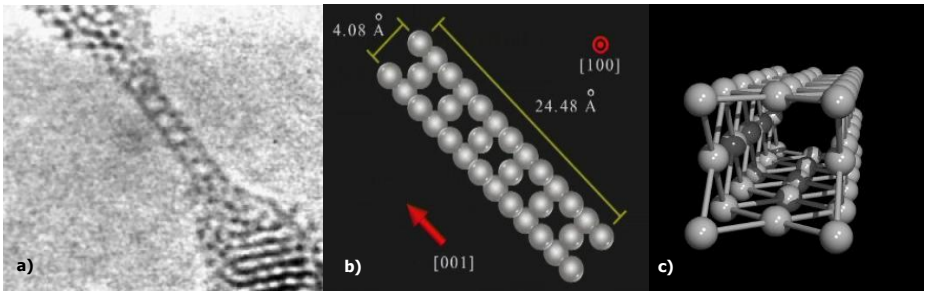

Figure 1: *(a) High Resolution Transmission Electron Microscopy image showing the observed spontaneous formed square cross section Ag nanotube; (b) Estimated dimensions; (c) frontal view.*

These results were obtained from a suitable combination of time-resolved atomic resolution experiments and ab initio (SIESTA code) theoretical modeling, The quantum ballistic conductance of these tubular nanowires should be 3.6G0 (G0 conductance quantum). This signature could make the structure possible of identification from electronic transport experiments.
The theoretical analysis suggests that the formation of these hollow structures requires a combination of minimum basis size and high-gradient stress, which could explain why these structures have not been reported before, even from theoretical simulations, where low-stress regimes and small structures have been the usual approach. Our results demonstrate that a proper understanding of the mechanical deformation of nanoscale systems requires the analysis of high-symmetry metastable atomic arrangements. The possibility of the existence of other 'exotic' structures is also addressed.
Work supported in part by the Brazilian Agencies FAPESP, CAPES and CNPq.

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Chemically derived grapheme: electronic and mechanical properties

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The promising electronic, mechanical and thermal properties of graphene for high demanding applications call for the need of approaches that provide access to large amounts of graphene monolayers.
Here we report on the electronic and mechanical properties of single graphene sheets obtained via chemical reduction of graphite oxide, a promising route for the large scale production of graphene layers that offers the possibility to assemble them on insulating technological relevant substrates.
Chemically reduced single graphene oxide layers exhibit moderate conductivities due to the presence of defects or residual functional groups remaining after reduction1. This moderate electrical performance can be extraordinarily improved by a CVD process to heal defects contained within the monolayers. In this manner, sheets with two orders of magnitude conductivity enhancement can be obtained2, reaching mobilities that exceed those of the molecular semiconductors currently used in organic electronics.
From the mechanical point of view, AFM indentation experiments on suspended chemically derived layers reveal a Young modulus closely approaching that of pristine graphene3, with their electrical conductivity scaling inversely with the elastic modulus.

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Self-organization of complex carbon nanotube patterns directed by crystal surfaces

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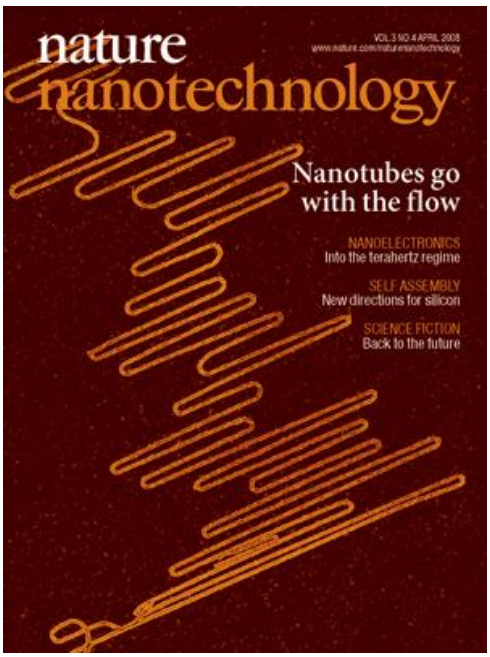

The organization of carbon nanotubes into well-defined horizontal geometries and arrays on surfaces is a critical prerequisite for their large-scale integration into nanocircuits. We have elaborated a series of surface-directed mechanisms of carbon nanotube growth, which can be classified as different modes of orientational epitaxy: Lattice-directed epitaxy (by atomic rows), ledge-directed epitaxy (by atomic steps) [1], and graphoepitaxy (by nanofacets) [2]. Some of these modes of "nanotube epitaxy" can be simultaneously combined with electric field-directed growth [3] for the orthogonal self-assembly of carbon nanotube crossbar architectures [4], and with gas flow for the self-organization of nanotube serpentines [5]. Nanotube epitaxy on different crystal surfaces can thus controllably yield a wide range of unprecedented geometries [6], including highly straight [1,2], kinked [1], wavy [2], crossbar [4], serpentine [5], coiled [5], and more.

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Defects and conductivity of DNAs

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Conductor or insulator? The debate about the conductivity of DNA have been recently revived due to contradictory results of transport measurements on a small number of molecules deposited on a substrate and connected to metallic electrodes, and an answer to this question is important for DNA based molecular electronics. In several works it was observed that double-stranded DNA molecules are conducing (semiconducting, metallic or even superconducting due to proximity induced superconductivity) [1-3]. However in other works DNA was found to be insulating [4], even when the molecules had perfectly ordered base pairs.

In this report we argue the conductivity of DNAs depends on defects in the molecules. At first we consider the global defect of the DNAs structure due to the interaction of the molecules with the underlying substrate. For most commonly used substrates like mica or silicon oxide the interaction between the molecule and the surface is very strong and induces a very large compression deformation of deposited DNAs. The thickness of such compressed DNAs is 2–4 times less than the diameter (about 2 nm) of native Watson-Crick B-DNA [4]. Here we confirm the insulating character of DNA on such substrates. On the other hand when the substrate is treated (functionalized) so that deposited molecules keep their original thickness, we find that they are conductors, both from conducting AFM (fig.1) and transport measurements on molecules connected to platinum electrodes. This conductivity persists down to very low temperature (0.1 K) where it exhibits a non-ohmic behavior with a power law singularity in the bias dependence of the differential resistance typical of one-dimensional conductors with Coulomb interactions between electrical carriers [2].

The local defects of DNAs like "bubbles" can also influence the conductivity of the molecules. The existence of "bubbles" has been confirmed experimentally [5], and the biological aspects of these local denaturations were discussed in a number of studies. Local deformations should cause breaking of a long-range order in the DNA structure (i.e., interruption of the parallel base-pair (bp) stackings) similar to an order breaking in solid bodies due to the dislocation introduction. However, their influence on conductivity has not been properly addressed until now. In this report, we present the temperature-dependent conductivity (fig.2) and structural evolution monitored through Raman spectroscopy measured on the DNA-lipid cast film between physiological and denaturation temperatures. We observed a substantial reduction in

the DNA conductivity due to premelting effects starting at temperature as low as 40◦C, lending support to the theoretical inference on the importance of the long-range parallel bp stacking in DNA for the electrical conduction [6].

We acknowledge the financial support by ANR Quantadn.

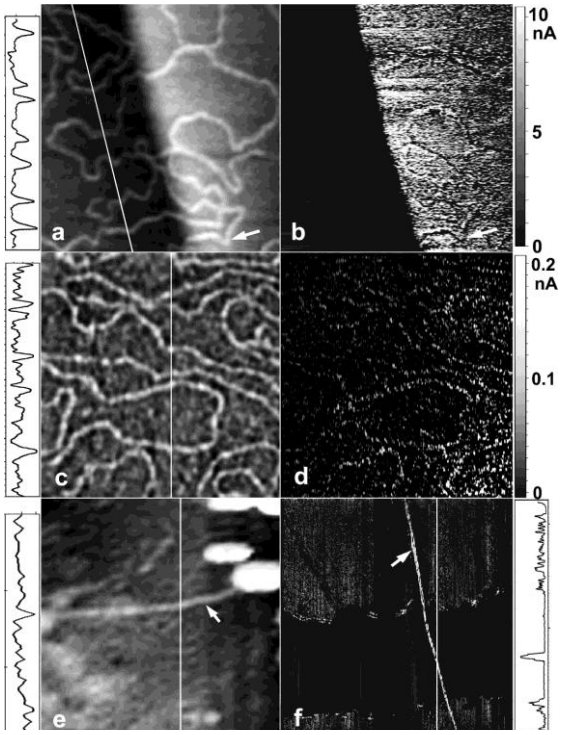

Figure 1: *AFM (left) and SRM (right) images of DNAs: (a) AFM image of DNAs on the clean substrate without penthylamine; (b) SRM image of the same molecules (right bright part of a and b images is Pt); (c) AFM picture of DNAs on the substrate treated by penthylamine; (d) SRM image of the same molecules, Pt electrode is outside of the image; (e) AFM image of a DNA combed across the slit between Re/C electrodes on mica; (f) SRM image of a rope of DNAs combed between Pt electrodes on mica. On the left- and right-hand sides of the image there are profiles of DNAs and current scales of SRM (voltage was up to 0.23 V) images, respectively. Note that when (b) is plotted on the same current scale as (d), the DNA molecules on the mica still appear as black as the mica substrate.*

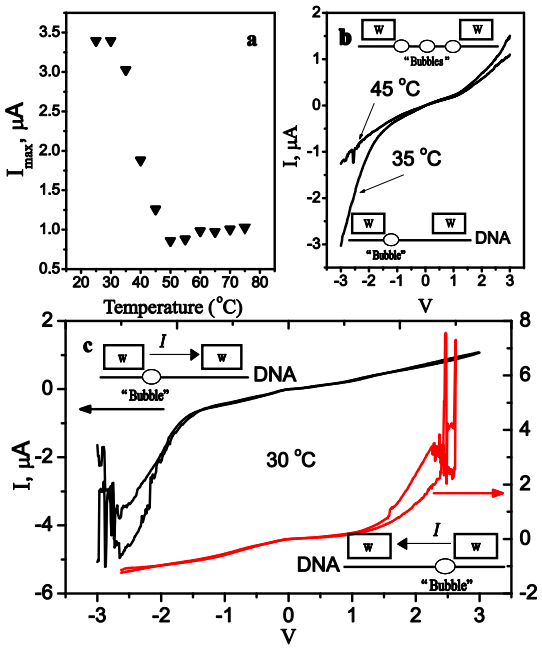

Figure 2: *Temperature-dependent conductivity measurements under luminosity: (a) temperature dependence of Imax, (b) I-V characteristics of the DNA film at 35 and 45◦C. The insets show the increasing number of bubbles with a temperature, (c) irreversible I-V characteristics (at 30◦C) of the DNA film which had been subjected to a high bias voltage at 80◦C with opposing polarities. The insets show the assumed schematics of the bubble type defect movements inside the DNA molecules at 80◦C.*

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Nanostructuration and self-assembly in complex oxide thin films

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Oxide thin films often exhibit a tendency toward self-organized growth forming regular arrays of three dimensional nanostructures. This behaviour offers enormous potential for the implementation of new nanodevices, while at the same time attracts great attention due to their rich physics. Among them, manganese perovskites showing colossal magnetoresistance and half metallic characteristics have emerged as promising candidates for miniature spintronic devices.

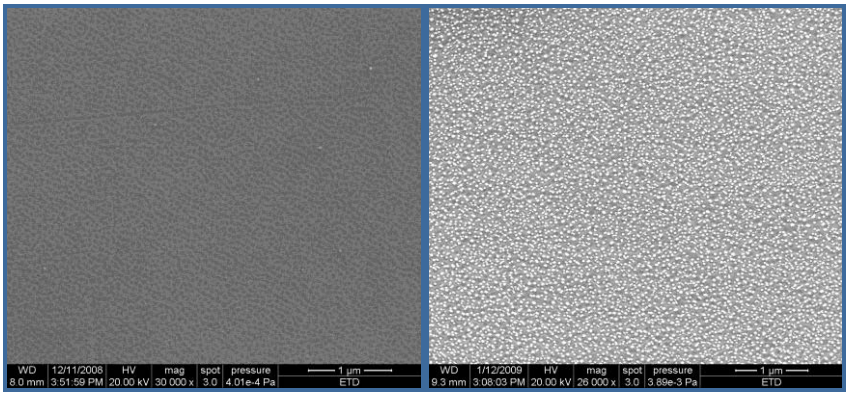

Figure 1: *Scanning electron microscopy images of bare LSMO film (left) and LSMO film with Au particles (right).*

Complex oxide thin films are often elastically strained, due to film-substrate lattice mismatch, and this lattice strain can, in some cases, select preferential growth modes leading to the appearance of different self-organized morphologies. In this work we report on the controlled fabrication of self-assembled nanostructures in highly epitaxial $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) thin films [1, 2]. By carefully controlling growth rate dramatic changes of the surface morphology of LSMO films grown on top of $SrTiO_3$ substrate can be induced: from very flat surface, through nanometric mounds and antidots (Figure 1. left) to hatches [1]. All nano-objects form long-range ordered arrays running in the steps direction defined by the miscut angle of underlying substrate [2]. Therefore, it is manifested that self-organization process is directly promoted by the topological features of the substrate and indicate the importance of kinetic effects (adatom diffusion process on surface terrace, over substrate steps, along edges,...). On the other hand, the influence of the lattice strain on antidots formation is studied using different substrates ($LaAlO_3$, $NdGaO_3$, $La_{0.3}Sr_{0.7}Al_{0.35}Ta_{0.35}O_9$) and analyzed within an energetic model proposed by J. Tersoff and F.K. LeGoues [3]. The implementation of self-assembled gold nanoparticles on the top of the nanostructured antidots is explored.

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Controlling the phase and amplitude of plasmon sources at a subwavelength scale

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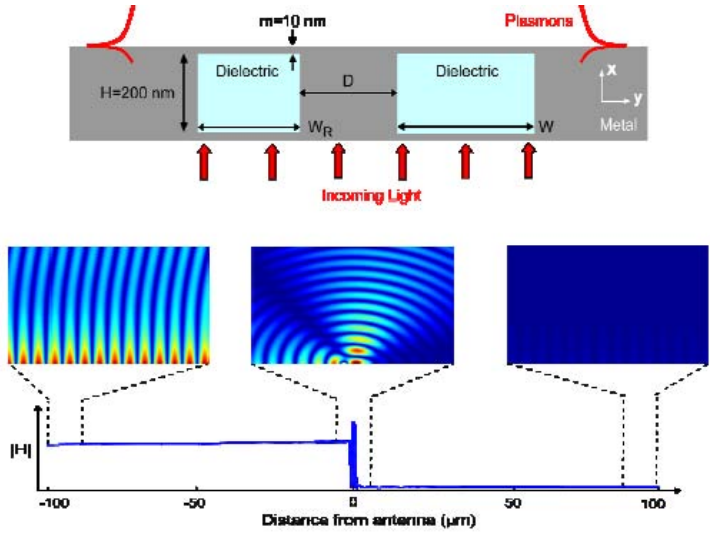

Figure 1: *Scheme of the unidirectional plasmonic coupler and field by the antenna. The field at the antenna's position has been devided by 10 to fit the same colorbar.*

Surface plasmons polaritons (SPPs) are collective excitations of electrons coupled to an electromagnetic field at the interface between a dielectric and a metal [1]. Their evanescent nature along the normal to the metal/dielectric interface allows a subwavelength confinement that can be significantly smaller than diffraction limited optical waves in bulk media. SPPs, therefore, are ideal candidates for the construction of subwavelength optical devices. In the past few years, SPPs have also been identified to be the major physical mechanism involved in the extraordinary transmission of light (ETL) through metal films with subwavelength holes which was first reported by Ebbesen et al [2]. Subsequent studies have been made on uniform periodic arrays of holes, slits, and more complex shapes fabricated in metallic films. Those studies demonstrate that one can take advantage of the interferences between plasmons generated on metal films by uniform periodic sources (e.g., slits or holes in metal films) to, for instance, focus or disperse light, or realize ETL. Naturally, for flexible control and manipulation of light by such metal films, it is necessary to evolve beyond the uniform periodic sources and introduce the rich possibilities afforded by non-uniform source.films.

When light enters a subwavelength dielectric structure in a metallic film, a significant fraction, if not all, of the light propagates through the film as surface plasmons that are confined at the metal/dielectric interfaces. For example, transverse magnetic (TM) polarized light impinging on a silver film containing air gaps gives rise to waves known as gap plasmons (GPs), whose properties are closely related to the dimensions of the gaps: the smaller the gap width, the larger the wavenumber of the GP. This way, one can design sources of plasmons with tuned phase by adjusting the width of the gap. Similarly, one can fill the air gaps with different dielectrics hence inducing an optical path length between the generated plasmons. Those two approaches are quite inflexible and practically hard to fabricate.

In order to realize surface plasmon sources with tunable phase and amplitude, our approach utilizes the gap plasmon dispersion relation along with Fabry-Perot (FP) resonances in a cavity. Air gaps in metal films typically display low-efficiency FP resonance that, as we will show, can be increased by introducing highly reflective "mirrors" on both sides of the metal film. Sharper resonance results in longer propagation of the GPs in the gaps due to constructive interference and multiple reflections in the cavity. Hence, the relative phase

accumulation at the output side for slits of varying widths is increased regardless of the metal film thickness. Our cavity design corresponds to a forced mechanical oscillator: when driven below, at, and above the resonance frequency, the response lags, matches, or leads in phase. Namely, tuning the width of the gap, or equivalently the GP wavenumber, allows a control of the phase and amplitude of the generated SP.

To illustrate this new mechanism, we present a simple design consisting of only two parallel cavities of different widths (see figure 1). We show that such a system realizes a unidirectional plasmonic antenna similar to the one that was studied very recently by F. López-Tejeira et al. [3]. In our unidirectional antenna, however, the lateral size can be reduced to half a plasmon wavelength (compared to a minimum size of several wavelengths in [3]). Additionally, the top surface of our antenna is flat, which may prove useful for many applications such as sensing. Furthermore, using both the gap plasmons dispersion relation and the metal mirrors allows us to provide a design that does not use unrealistic slit width, nor very difficult fabrication procedures such as filling different slits with different dielectrics.

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Electronic confinement and band formation originating from a supramolecular porous network

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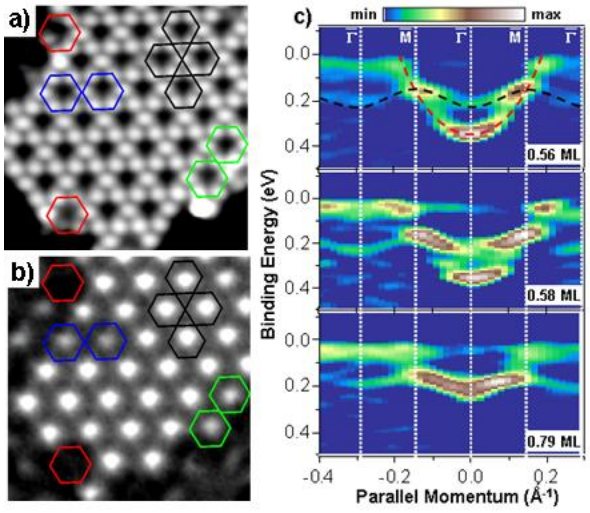

Figure 1: *Study of the electronic confinement of the surface state within a porous molecular network. (a) STM image of the porous network (13.6x13.6 nm², -0.20 V, 70 pA) and (b) simultaneously recorded dI/dV map (LockIn: Vrms = 8 mV, f = 513 Hz). (c) Band dispersion resulting from the periodic influence of the porous network on the surface state studied with ARPES at different molecular coverages. The color scale represents the 2nd derivative of the photoemission intensity*

The properties of crystalline solids can to a large extent be derived from the scale and dimensionality of periodic arrays of coupled quantum systems like atoms and molecules. Periodic quantum confinement in two dimensions has been elusive on surfaces mainly because of the challenge to produce regular nanopatterned structures capable of trapping electronic states.

We report on the practical implementation of *periodic* zero-dimensional confinement by demonstrating that the two dimensional free electron gas of the Cu(111) surface state can be trapped within the pores of an organic nanoporous network [1]. Thus, these pores can be regarded as a regular array of quantum dots, as observed in Fig 1 a) and b). Moreover, the periodic influence which the molecular network imposes on the confined electronic states originates new electronic subbands, as shown in Fig. 1 c). The shallow dispersive character of the lowest subband is indicative of electronic coupling between neighbouring pore states [2]

A consequence of our work is the perspective to engineer these artificially created electronic structures by modification of the dimensions of the molecular network periodicities together with the appropriate choice of the substrate. This will allow the fabrication of related systems with different band structures resulting in '2D electronic metamaterials' in analogy to the well-established optical metamaterials [3, 4].

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Modeling of low-dimensional carbon nanostructures: an efficient approach based on chemical criteria

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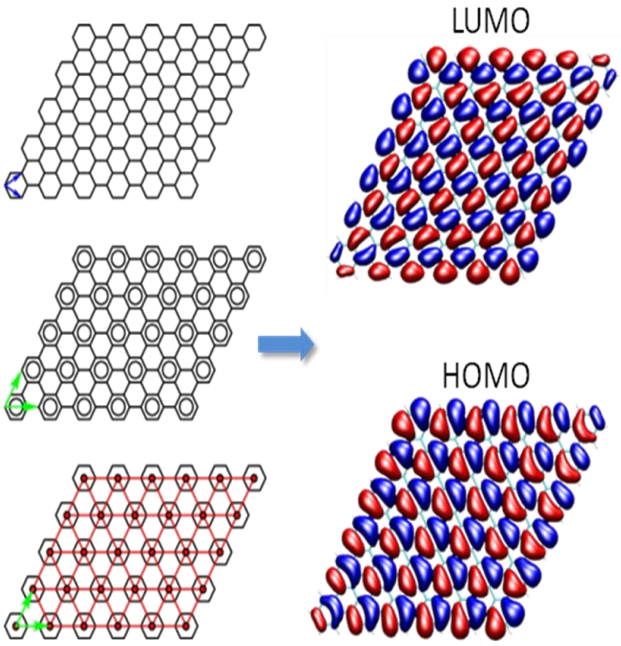

Recently, the properties of nanostructured carbon materials, like carbon nanotubes (CNTs) and graphene, have been the subject of in-depth investigations in view of their potential use in nanotechnology. Most of the interest concerning nanostructured carbon materials is related to the peculiarities of their electronic structure, which is constituted mainly by a complex network of pi-conjugated bonds. Details of the electronic structure play a crucial role in the application of such materials as nanostructured building-blocks for molecular electronics and in functionalization processes, where the CNTs and graphenes undergo chemical reactions [1]. However, the particular structural and electronic features of nanostructured carbon poses significant problems to computational modeling. Recent work indicated the extension of classical organic chemistry concepts to the case of low-dimensional nanostructured carbon materials as a successful approach to obtain an accurate and consistent description of the electronic structure of the hexagonal carbon atom network [2-4]. In this work we apply state-of-the-art numerical techniques to investigations on the stability and on electronic and chemical properties of nanotubes and graphenes and related compounds [4-6]. Our approach is based on the definition of suitable models of the system under study starting from chemical considerations. Results indicate unprecedented accuracy in the prediction of properties for a large variety of systems, obtained at a relatively cheap computational cost.

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Self organization of chemical solution synthesised oxide nanostructures

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Applying nanoscale design and fabrication strategies to functional oxides is potentially promising because they posses high environmental stability and extraordinarily useful properties that expand from photocatalysis to ferroelectricity and ferromagnetism, which are highly attractive for applications in electronic, optoelectronic or biological devices. An alternative approach to the fabrications of nanostructured media by nanolithography is the formation of nanostructures by self-organization, where spontaneously ordered, large-area patterns of nanometric objects appear. In this context and although much less studied, chemical solution deposition (CSD) offers a high throughput and cost-efficient route for the generation of complex oxides capable of competing with vapour deposition techniques [1, 2].

In this work we combine ultradiluted metalorganic precursor solutions of $Ce_{0.9}Gd_{0.1}O_{2-y}$ (CGO) and $La_{0.7}Sr_{0.3}MnO_3$ (LSMO), spin coated on top of different single crystalline substrates ($LaAlO_3$, $SrTiO_3$, Yttria-stabilized ZrO_2 (YSZ), MgO, and CeO_2 buffers deposited on YSZ), to generate 0D and 1D self-assembled strained oxide nanostructures, as a consequence of the interplay among lattice mismatch, crystallographic structure and interface and surface energies.
In particular, the fluorite $Ce_{0.9}Gd_{0.1}O_{2-y}$ over $LaAlO_3$ (perovskite) heteroepitaxy results in the formation of single crystalline nanometer size nanowires, displaying two possible orthogonal orientations [3].

Different nanofabrication methods to induce self-organization of the grown nanostructures are demonstrated.

- The use of a nanoindenter at extremely low loads produces nanometer-depth indentation lines on the substrates before the growth of epitaxial CGO nanowires. A drastic change occurs due to the strain field induced by nanoindentation and the degeneracy in nanowires orientation is lifted suppressing one of the two possible orientations at the indented areas. The balance between the two orientations is restored where no deformation is present, (see Figure 1).

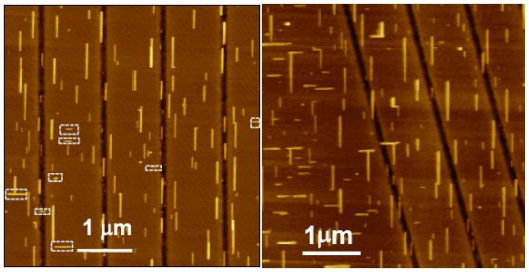

Figure 1: *(a) AFM topography image of single oriented CGO nanowires grown on a nanoindented LAO substrate; (b) outside the nanoindented area, the homogeneous distribution on both orientations is recovered*

- Track etched polymers directly buffering low lattice mismatch single crystalline substrates have been successfully used as a novel methodology to generate assemblies of vertical LSMO nanostructures using solution methods, (see Figure 2).

- When the same methodology is used on fluorite (Gd doped-CeO_2) buffered substrates, self-assembled epitaxial horizontal and orthogonally oriented LSMO nanowires exhibiting a monoclinic crystallographic structure recently discovered for high aspect ratio manganite nanowires [4] are obtained. Self-organization and coarsening of the

nanowires up to 40 µm in length is achieved through kinetic evolution at high temperatures, (see Figure 3).

This work has been supported by Nanoselect CSD200700041, Hiperchem NMP4-CT2005-516858, Xermae, Nanosuperenergy MAT2008-01022, and the MICINN. Nanoindentation was performed at the Nanotechnology Laboratory of MATGAS 2000 A.I.E.

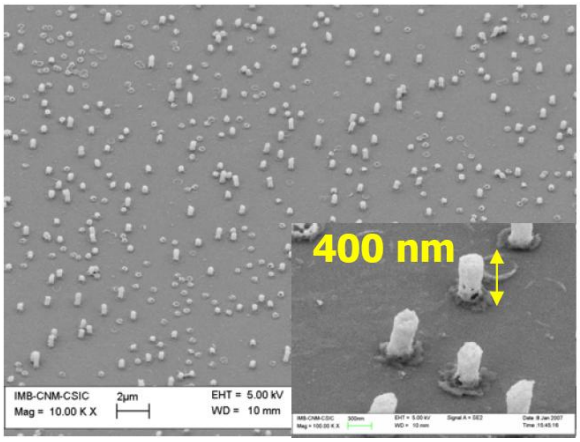

Figure 2: *FE-SEM images of vertically oriented LSMO Nanorods grown from CSD on top of a (001) STO substrate previously buffered with a track-etched polymer template*

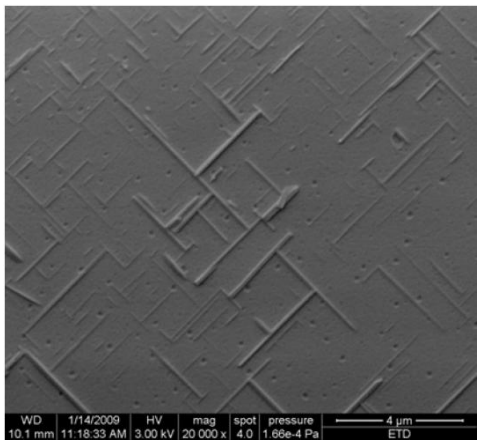

Figure 3: *FE-SEM images of self organized horizontal LSMO nanowires grown from CSD on top of a CeO2/YSZ substrate previously buffered with a track-etched polymer template*

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Solar cells and thin film transistors based on perylene-functionalized polymers

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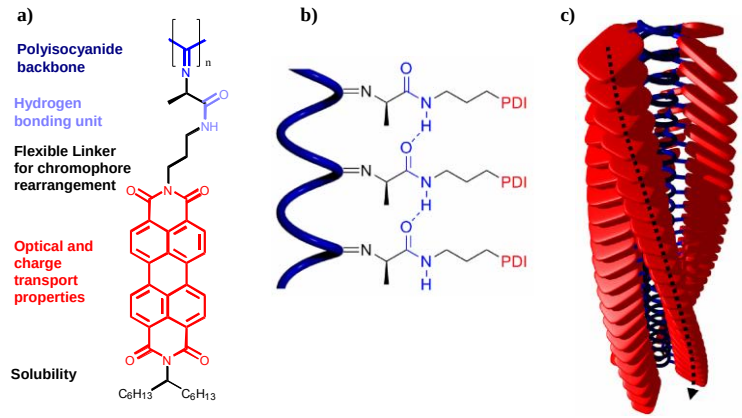

Figure 1: *Chemical structures. a) Chemical structure of PIC-PDI; The relevant parts of the molecule and their role in the macromolecular properties are shown in different colours. b) Illustration of the hydrogen-bonding between the n^{th} and $(n+4)^{th}$ monomeric units within the polymer; the blue helix represents the carbon backbone. c) Cartoon showing the complete helical structure of PIC-PDI. The dashed arrow indicates a stack of PDI units running along the central polyisocyanide*

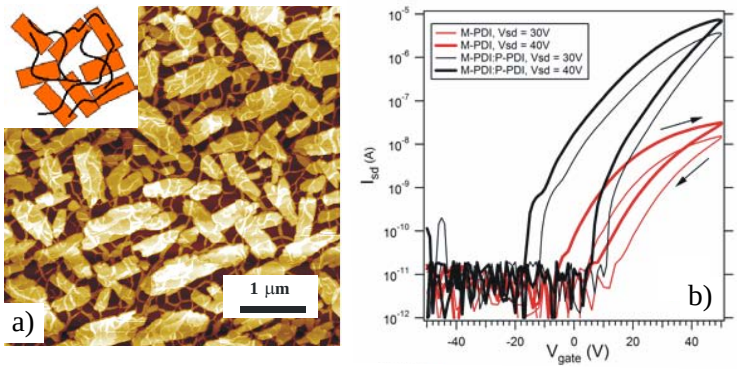

Figure 2: *a) AFM image of nanocrystals of monomeric PDI bridged by PIC-PDI fibers. Inset: a cartoon of blend structure. b) Transfer curves of FETs based on a blend of polymeric and monomeric PDI vs. monomeric PDI .*

Two main classes of semiconducting molecules are commonly used for opto-electronic applications: polymers, featuring an easy solution-processability in thin and uniform yet poorly ordered films, and small poly-aromatic molecules, forming highly defined (liquid)-crystalline architectures with excellent charge mobility. Herein, we combine the two material types by employing structurally well-defined polyisocyanopeptide polymers (PIC) as scaffolds to precisely arrange thousands of electron accepting molecules, i.e. perylene-bis(dicarboximides) (PDIs), in hundreds of nanometer long, well-defined chromophoric wires (fig. 1).[1] The PIC polymer backbone enforces high control over the spatial location of PDI dyes favoring both enhanced exciton and charge transfer.

By adding to a monomeric PDI polycrystalline film just 17% of the PIC-PDI polymer, acting as percolation pathways for charge transfer between the different crystals, we obtained a two orders of magnitude increase in charge carrier mobility within the film, as measured in thin film transistor (TFT) devices (fig. 2).[2,3] Furthermore, the photovoltaic activity of this polymeric PIC-PDI shows a significant improvement,

respect to monomeric PDI, when blended with regio-regular poly(3-hexylthiophene) (P3HT) in solar cells.[4] For the first time we visualized by Kelvin Probe Force Microscopy (KPFM) the photovoltaic activity occurring in such a blend, thus allowing to gain quantitative insight into the correlation between architecture and function with a nanoscale resolution.[5]

These multi-chromophoric wires represent a new class of versatile building blocks for nanoelectronics.

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A remarkable nano-confinement effect on chemical equilibrium: from nucleotide dimer formation in molecular cages to deuterium exchange reactions on interstellar dust grain surfaces

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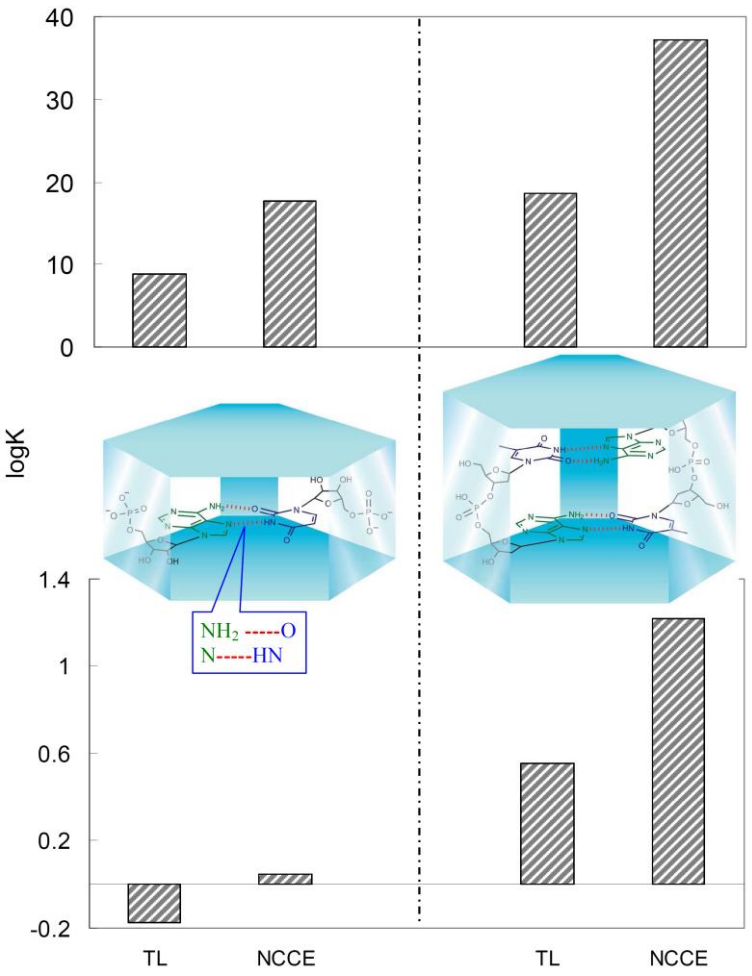

Figure 1: *Nano-confinement effects relative to the thermodynamic limit: Equilibrium constants of mononucleotide (left) and dinucleotides (right) base pair formation computed (300 K) using estimated high (upper panel) and the low (lower panel) values of the reaction energy for each of the two reactions. Inset: Schematics of the mono- and dinucleotide base pairs encapsulated in self-assembled molecular cages and the hydrogen bonds formed (box).*

With current developments in nanoscience and nanotechnology, experimental studies of reactions in confined nanospaces have been emerged. Thus, a variety of tailor-made "nanoreactors" have been fabricated: (i) molecular capsules, held together either by covalent bonding or by self-assembly via weaker interactions such as metal coordination and hydrogen bonds, for organic and metal catalyzed synthesis; (ii) carbon nanotubes for the synthesis of nanowires, nanobeads, or polymeric chains, and more. In a related field, considerable research has been devoted to explain and/or reproduce observations of deuterium fractionation in interstellar molecules originally adsorbed on surfaces of tiny dust grains. Yet, while focusing mainly on reaction kinetics, the possible role of equilibration has not been explored in these studies. Since classical thermodynamics of macroscopically large systems is not fully applicable under such conditions, we recently developed a pertinent statistical-mechanical formulation for chemical equilibria, based on the canonical-ensemble and the ideal lattice gas model [1]. As shown, unique properties characterize a closed small system of reaction mixture molecules at equilibrium, including significant extra stabilization of exothermic reaction products, namely, the enhancement of the reaction extent or equilibrium constant. The origin of this remarkable deviation from the macroscopic thermodynamic limit (TL), which we name "The nano-confinement effect on chemical equilibrium" (NCCE), is elucidated. In a first implementation of the theory, the work focuses on experimentally explored artificial and natural confined reaction systems, representing widely divergent branches of chemistry.

First, the NCCE effect is studied for a most recently reported original experiment regarding nucleotide dimerization in molecular cages [2]. In particular, the predicted remarkable

enhancement of equilibrium constants as compared to the TL, can contribute to the experimentally observed stabilization of hydrogen-bonded base pairs of mono- and dinucleotides in the cages (Fig.1).

Secondly, we treat H-D exchange reactions driven by zero-point energy differences as a model for equilibration on interstellar dust grain surfaces. In particular, the computations reveal that the equilibrium constants of the $H_2CO+D=HDCO+H$, $HDCO+D=D_2CO+H$ and $H_2+D=HD+H$ exothermic surface reactions are significantly enhanced (Fig.2), mainly due to doubling of the lnK vs. 1/T slope, and the overall effect of product stabilization increases for smaller numbers of reacting molecules. We suggest that the herein predicted astrochemical NCCE effect can be an amplifying source for the commonly observed enrichment of interstellar media in deuterated molecules. The universality of the new effect can have important implications in other situations when chemical equilibration is reached in a confined nanospace.

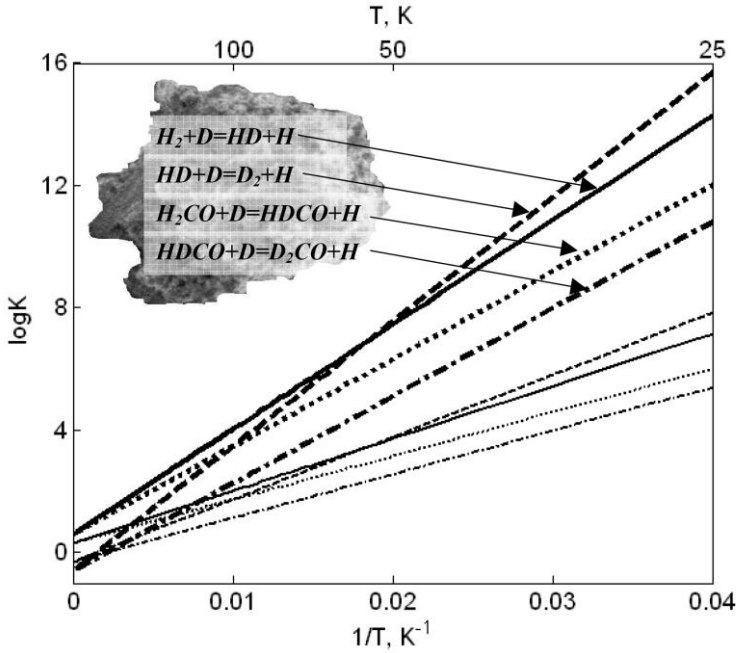

Figure 2: *Equilibrium constants of H-D exchange reactions on the surface of an interstellar grain computed for the smallest reaction mixture (2 molecules, thick lines) compared to the TL values (thin lines).*

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SPAGS-STM, a true high performance tool for in-silico imaging

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The production of numerical STM images of large-scale molecular systems is often limited to the use of low-level theory such as the Tersoff-Hamann (TH) approach [1]. A significant amount of STM features are revealed by such a representation of surface states that are obtained from electronic structure calculations, except that the influence of the tip is totally excluded. Electron scattering approach such as the Laudauer-Buttiker formula (LBF) [2] considers the influence of the tip, but can also considers electron-electron, electron-phonon, and several other inelastic scattering events [3]. Due to all these features, the LBF approach represents one of the most accurate models for generating STM images.

Despite the high accuracy of such scattering approach, the associated computational complexity and effort needed to obtain STM images still constitute the major drawbacks of the LBF technique. Nevertheless, our recent development in parallel computing [4] and space discretization [5] in STM simulations open a route toward a next generation of real-time STM imaging. In addition, we are presently developing new software features where chemical and physical intrusions within the model framework can be performed. Following this chemical intrusion scheme, the composition of the molecular specie studied by STM can be modified, and the resulting STM image be rapidly computed and visualized. For example, it costs nearly 16 sec to evaluate a STM image of a (5,5) nanotube model containing 250 carbon atoms within TH limits, while around 1 sec is needed to evaluate a new STM image in which a carbon atom has been replaced by a nitrogen atom (see Figure 1) in the original model [6]. This improvement in rate of producing STM images was possible through a judicious use of matrix refreshment and iterative techniques for matrix diagonalization. This intrusive mode opens an efficient route for exploring the role of functional groups or heteroatoms on the origin of STM contrasts of adsorbed molecules.

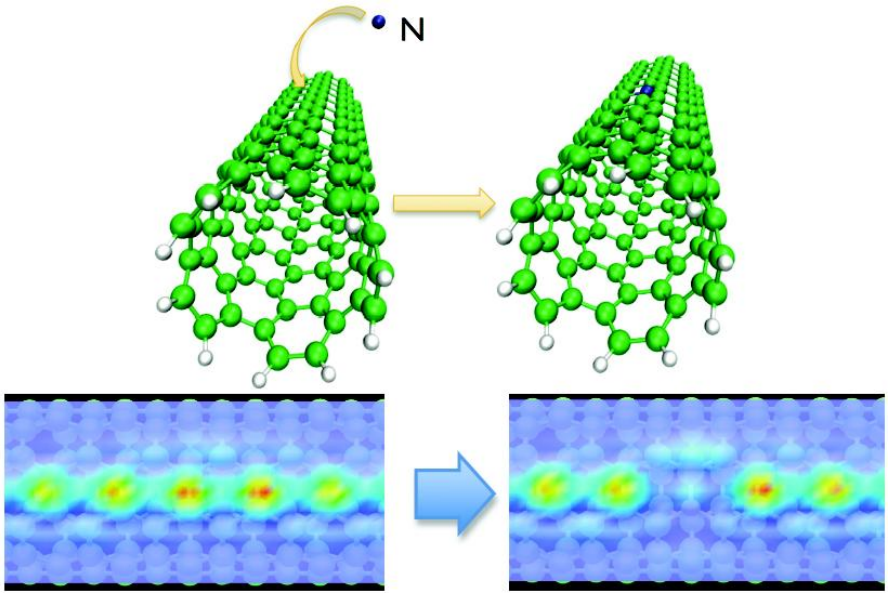

Figure 1: *Representation of the chemical intrusion (top) in the evaluation of STM images (bottom) of a (5,5) carbon nanotube (left side) in which a carbon atom is replaced by a nitrogen atom (right side).*

In this presentation, a brief overview of our most recent contributions in the rapid production of accurate STM images will be given. In addition, several convincing examples related to electron confinement nearby nanostructures, to surface reshaping induced by adsorbates, and to more subtle molecular interactions such as π - π interactions will be discussed. Finally, I will show that quantitative analysis of STM contrasts can be used to understand, and in some cases to discriminate between possible surface mechanisms.

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Nanodevices based on individual nanowires: fabrication strategy, device properties, device integration and guidelines for future work

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In the last 15 years, nanomaterials (nanowires, nanotubes, nanobelts, ...) have emerged as potential active elements in new devices and circuit architectures thanks to their unique characteristics, consequence of their large surface-to-volume ratio, the possibility to accurately control their composition, dimensions and chemical and physical properties [1]. A large number of papers have been published dealing with the optimisation of the synthesis and fabrication procedures of these nanomaterials, several works have reported on their electrical characterisation, some of them being able to characterise individual nanomaterials. However, the number of reports on the nanodevice fabrication based on these individual nanomaterials is quite reduced, as their manipulation or the contact fabrication to them remains a process which is difficult to control.

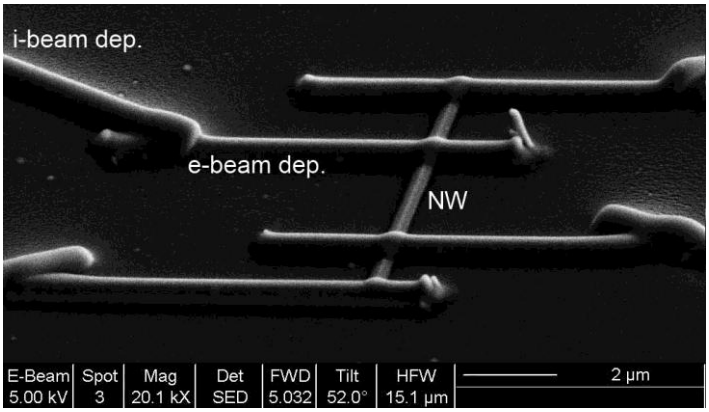

Figure 1: *SEM image (tilted by 52 degrees) of a SnO_2 single-crystalline nanowire contacted using electron- and ion-assisted deposition in 4-probe configuration.*

The work which will be presented here will be the review of the research activity which we have carried out on the fabrication of nanodevices based on individual nanowires and, more concretely, monocrystalline metal-oxide nanowires. For this purpose, dual-beam focused-ion beam technology has been extensively used for the deposition of a Pt-containing material, which in this work has been employed for contact fabrication to the nanomaterials. A specific contact methodology based on the use of both electron- and ion-assisted Pt deposition on prepatterned isolated semiconducting substrates has been developed, which prevents structural damage to the nanomaterials while assuring a reasonable conductivity of the metal nanostripe and a controlled nanowire-nanostripe interface [2]. The electrical characterisation of such ensemble at different temperatures has allowe its modelling according to different mechanisms and the critical parameters for device operation have been identified [3,4].

After their characterisation, these metal-oxide-based nanostructures have been tested as nanodevice prototypes. Two different applications have been addressed: gas sensing and photodetection. The gas response of such nanodevices has demonstrated that the sensitivity to the gas atmosphere is comparable to that of their thin- or thick-film counterparts, while the response time and recovery after exposure to gas are much better, both parameters being a direct consequence of the large surface-to-volume ratio [5]. Furthermore, the use of

suspended microhotplates instead of bulk substrates allows the fabrication of very low power consumption nanodevices, which are suited for their integration into portable gas alarms.
Due to the large-bandgap and photoresponse of the metal-oxide nanowires, UV photodetectors have been fabricated and tested using the same methodology as for the gas sensors. Their optical characteristics will be reviewed and critically compared to equivalent microdevices based on bulk or thin-film metal-oxide materials [6].
The design of such a system will also be addressed.
This contribution attempts to critically discuss the fabrication strategy, its impact on the electrical behaviour of the fabricated nanostructures, the fabrication of operative nanodevices, the limitations of the methodology, the design of integrated electronic systems involving such nanodevices, as well as give guidelines for future work.

Financial support from the Spanish Ministry of Science and Innovation and from the EU is acknowledged.

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Si nanowires for ultra-high performance nanoelectromechanical systems

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The catalytic growth of semiconductor nanowires offers the possibility of achieving otherwise unfeasible structural conformations and material combinations at the nanoscale that result in unique physical properties [1]. In consequence, nanowire devices based upon such bottom-up nanofabrication approach, in which functional quasi-1D nanostructures are assembled from chemically synthesized building blocks, have the potential to go beyond not only the size reduction limits, but also the device functionality constraints of top-down lithography based technologies. This is particularly significant for nanoelectromechanical systems (NEMS) because their basic properties are greatly influenced by scaling-laws, thus resulting in completely extreme or different behaviour at the nanoscale.

Among the wide variety of semiconductor materials and growth methods explored so far for bottom-up nanowire device research, Silicon nanowires obtained via the so called vapour-liquid-solid (VLS) mechanism remain as a central issue due to both their unique properties and their dominant relevancy in the electronics industry. In particular, VLS Si nanowires offer exceptional perspectives for applications in NEMS. Their structural quality (low defect density, low surface roughness) and unique electromechanical properties (high stiffness and resonance frequencies, giant piezoresistance) together with recent advances in growth control, promise to allow unprecedented performance of wide variety of systems, ranging from ultra sensitive force or mass sensors to low power, multifunctional RF signal processing components.

In this presentation we will describe several results concerning the fabrication, characterization and performance optimization of several Si NW based NEMS. By combination with top-down micro/nano fabrication methods, the VLS synthesis can be used to produce horizontally suspended nanowires between the sidewalls of prefabricated Si microstructures [2]. This approach can be applied to obtain single nanowire or nanowire array based beam-

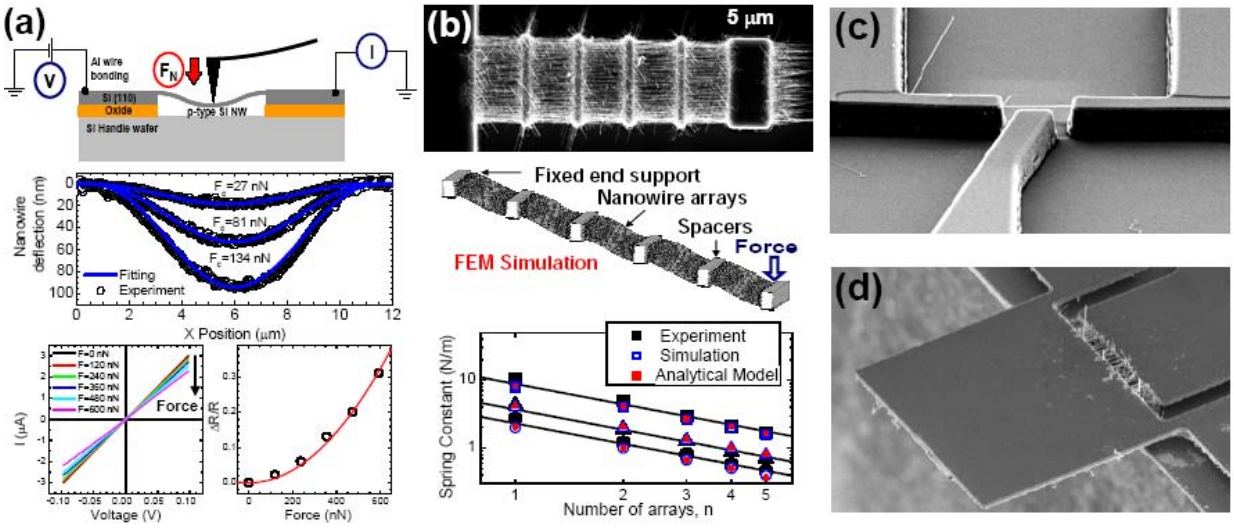

Figure 1: *Mechanical elasticity and piezoresistance measurements on horizontally grown Si nanowires (a); Spring constant measurements and finite element simulations of cantilever-like structures composed of several horizontal nanowire arrays (b); Single nanowire nanomechanical resonator (c) and piezoresisitive cantilever sensor based on a Si nanowire array strain gauge (d).*

like structures [3], which serve as basic building blocks for nanomechanical devices. The characterization of the elasticity [4], mechanical resonances [5] and piezoresistance [6] of such structures [fig.1 (a) and (b)] has lead us to propose the development of nanomechanical resonators and piezoresistive transducers as devices that would directly benefit from the extraordinary properties of Si nanowires. It will be discussed how nanomechanical resonators based on individual, extremely small nanowires can provide a detection limit for inertial mass sensing close to that required for atom resolution mass spectrometry [fig.1 (c)], whereas piezoresistive strain gauges based on highly dense nanowire arrays can be applied to obtain cantilevers [fig.1 (d)] with a detection limit for displacement sensing up to ten times better than that provided by conventional Si thin film piezoresistive cantilevers.

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A nanoparticle organic memory field-effect transistor behaving as a programmable spiking synapse

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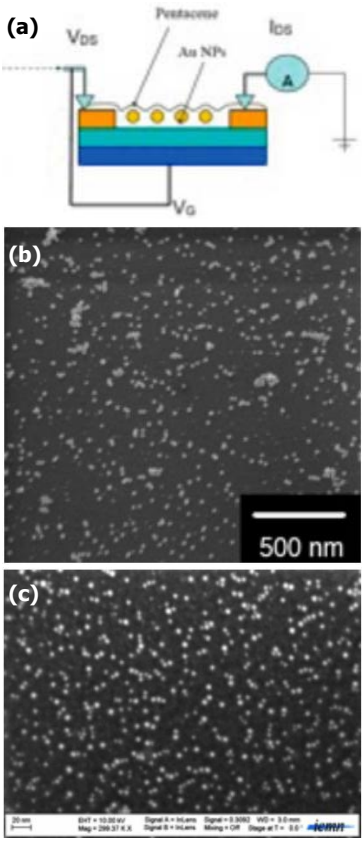

Figure 1: *Schematic view (a) of the NOMFET, and SEM of the 20 nm NP (b) and 5 nm NP (c) network on the gate dielectric surface.*

Molecule-based devices are envisioned to complement silicon devices by providing new functions or already existing functions at a simpler process level and at a lower cost by virtue of their self-organization capabilities, moreover, they are not bound to von Neuman architecture and this may open the way to other architectural paradigms. Neuromorphic electronics is one of them. Here we demonstrate a device made of conjugated molecules and metal nanoparticles which behaves as a biological spiking synapse. We have built a nanoparticle organic memory filed-effect transistor (NOMFET) and we demonstrate that this device exhibits the main behavior of a biological spiking synapse. Facilitating and depressing synaptic behaviors can be reproduced by the NOMEFT and can be programmed. The NOMFET exhibits short term plasticity, as a biological synapse, and can be shrunk to nanometric size. These results open the way to rate coding utilization of the NOMFET in neuromorphic computing circuits. We can also envision the NOMFET as a building block of neuroelectronics for interfacing neurones or neuronal logic devices made from patterned neuronal cultures with solid-state devices and circuits.

The device (Fig. 1) consists of a bottom-gate, bottom source-drain contact organic transistor configuration. The gold NPs (20 and 5 nm in diameter) were immobilized into the source-drain channel using surface chemistry (self-assembled monolayers) and they were subsequently covered by a thin film (35 nm thick) of pentacene. Scanning electron microscope (SEM) images, Fig. 1, show a random distribution of the 20 nm NPs, with the formation of some aggregates. From an image analysis, we deduce an average density of ~ 2-5x10^{10} NP/cm^2. For the 5 nm NPs, we obtain a rather uniform distribution of NPs (no NP aggregation) with a density of ~ 6.5x10^{11} NP/cm^2.

The synaptic behavior is obtained by virtue of the combination of two properties of the NOMFET: the transconductance gain of the transistor and the memory effect due to charges stored in the NP. We previously demonstrated that this type of device works as a non-volatile memory [1] but with a "leaky" behavior. The retention time was in the range of few 10 s to few 1000 s, and this behavior is used here to implement the synapic weight w_{ij} with a possible dynamic working in this range, a mandatory condition to obtain the training/learning of a spiking neural network [2]. A transistor is basically a multiplier, thus it is used to realize the basic function of the synapse described as $S_j=w_{ij}S_i$, where S_i and S_j are the pre- and postsynaptic signals (here the source/drain current and voltage of the NOMFET). We demonstrate that we can tailor the dynamic behavior of the NOMFET in the frequency/time domain (0.01-10 Hz) by adjusting the size of both the NPs (5-20 nm in diameter) and the

NOMFET (50 nm to 12 µm). In a biological synapse, short term plasticity induces a dynamical processing of pulses pattern that depend on the timing between pulses and on the past history of the synapse [3]. This behavior is exactly what we demonstrated for the NOMFET (figure 2). We also demonstrate that models developed to explain and simulate the behavior of biological synapse [4] can be successfully adapted to the NOMFET behavior. These results open the way to rate coding utilization [5] of the NOMFET in neuromorphic computing circuits [6].

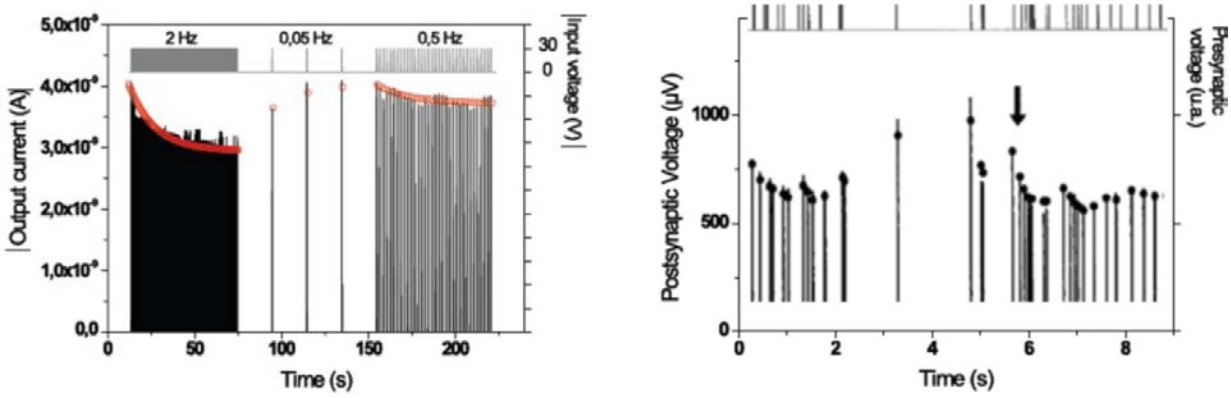

Figure 2: *Typical synaptic behaviour of the NOMFET (left) and comparison with the response of a biological synapse (right). The open circles and dots correspond to the modelling of the NOMFET and of a biological synapse, respectively.*

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Molecular nanowire with pi-stacking structure for opto-electronic applications

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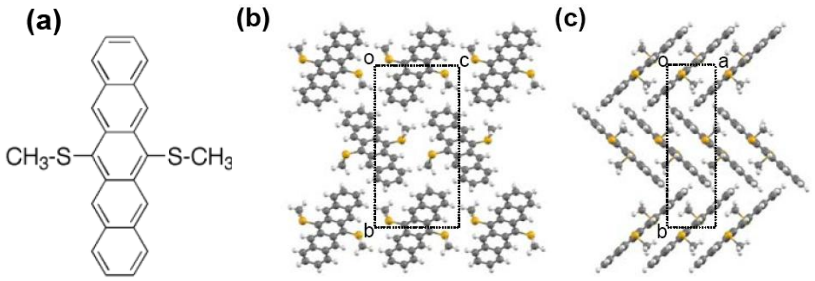

Figure 1: *(a) molecular structure of 6,13-bis(methylthio)pentacene (BMTP). Crystal structure of BMTP (b) along the <100> direction and (c) along the <001> direction. The molecules form pi-stacking structure along <100> direction.*

We demonstrate a comprehensive study of self-assembled molecular nanowires, including molecular design, one-dimensional wire growth, resistivity measurement of individual wire and photoconductivity. Additionally, particular emphasis will be put on a multi-level switching of a multi-channel field-effect transistor. 6,13-bis(methylthio)pentacene (BMTP) was synthesized, where the methylthio substituents (SCH_3) were attached on both sides of pentacene. These substituents are effective to modify intermolecular interaction, resulting in a highly pi-stacking structure in crystal [1] (Fig.1). The molecules deposited in vacuum showed anisotropic crystal growth to form one-dimensional wires on nanometer scale. X-ray diffractometry revealed that the long-axis of the wires coincides with that of the pi-stacking (Fig.2), so that high conductivity in this direction is expected. Resistivity of the individual wire was measured by a so-called nanostenciling technique [2], which enabled AFM observation, electrode deposition and electrical measurement in vacuum. The resistivity was determined to be $5x10^6$ Ωcm, which is relatively lower than those of other organic semiconductors. This is a result of highly pi-stacking and single-crystalline structure of the wire. The nanowires were found to have high photoconductivity. As a result, optical switching with a ratio of 100:1 was achieved (Fig.3). Next, double wires were connected in parallel with common source/drain electrodes and electrical current through each wire were controlled by respective gate electrodes. Each gate electrode can apply the bias voltage independently and the current through each channel (wire) can be modulated respectively, achieving multi-value operation (four values: on/on, on/off, off/on and off/off) (Fig.4) [3]. These results demonstrate a potential of molecular nanowires for opto-electronic devices.

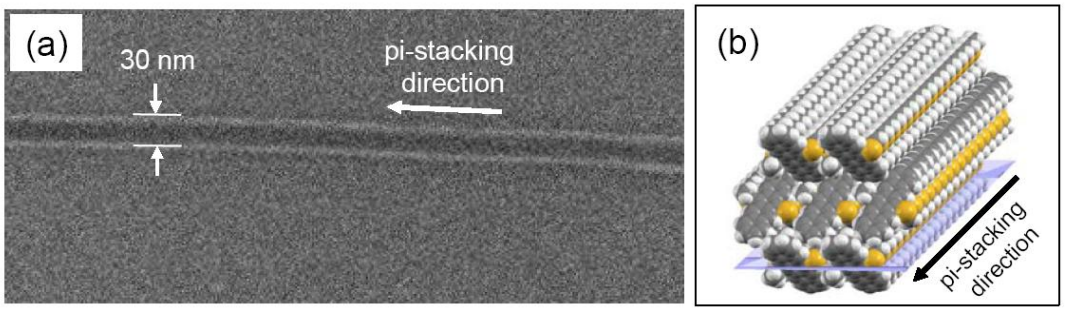

Figure 2: *(a) SEM image of BMTP wire on OTS-treated SiO_2 surface. (b) Illustration of BMTP wire with pi-stacking structure. The direction of pi-stacking along the <100> direction coincides with the long axis of the wire in (a).*

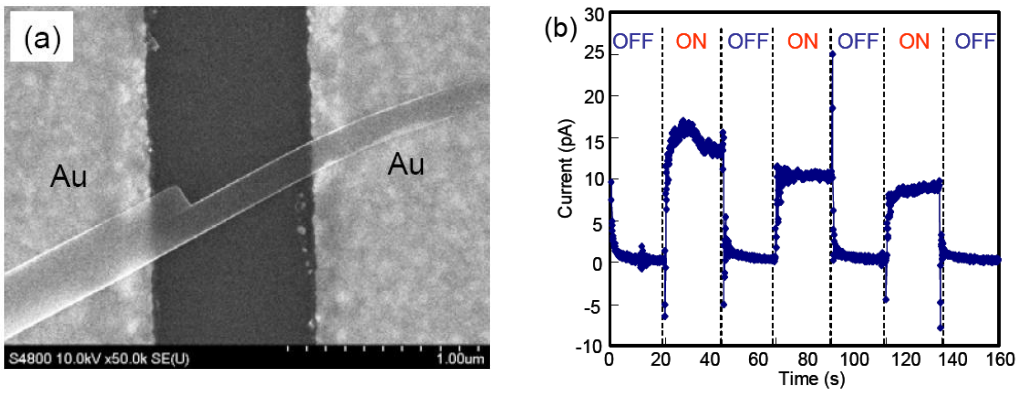

Figure 3: *(a) SEM image of BMTP wire with Au electrodes on both sides. (b) Optical switching of electrical current. Electrical current was increased by visible light irradiation.*

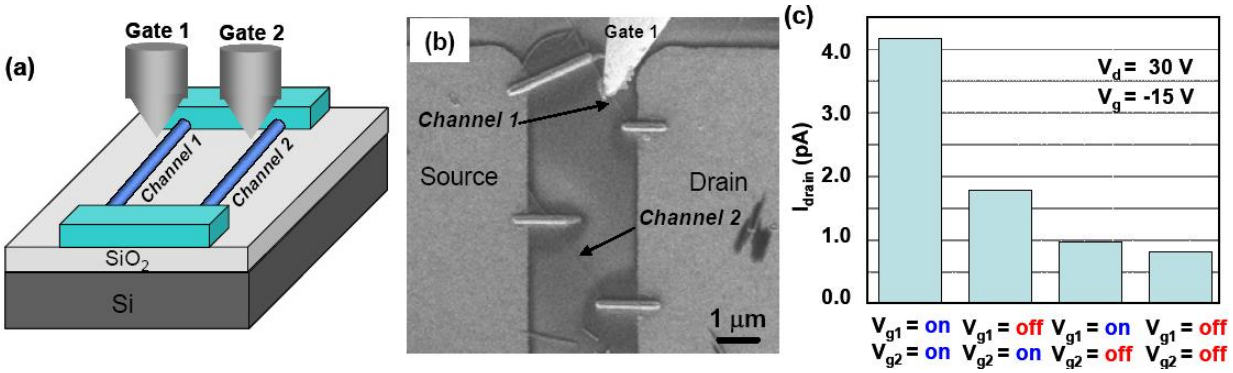

Figure 4: *(a) Illustration of a double-channel transistor with top-gate configuration. (b) SEM image of the double-channel transistor. (c) Four-level switching achieved by applying bias voltage from respective gate electrodes at a constant drain bias voltage.*

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Deformation of nanotubes/graphene by a transverse electric field

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If we bring a glass rod electrically charged by rubbing with silk, near a hair, the hair will be attracted to the rod. Here we demonstrate an approach to predict similar electrostatic phenomena occurring in nanoscale. This approach expands the applications of carbon nanotubes and graphene nanoribbons in nanoelectromechanical systems (NEMS), which allow direct conversion from electrical energy to nanoscale mechanical energy. The nanostructures are deflected in response to transverse gate voltages as a consequence of electric polarization. We demonstrate a strong dependence of the electrostatic deformation on both the field strength and the geometry of nano-objects. This field-induced deflection allows the nanostructures to oscillate at a frequency in a gigahertz range.

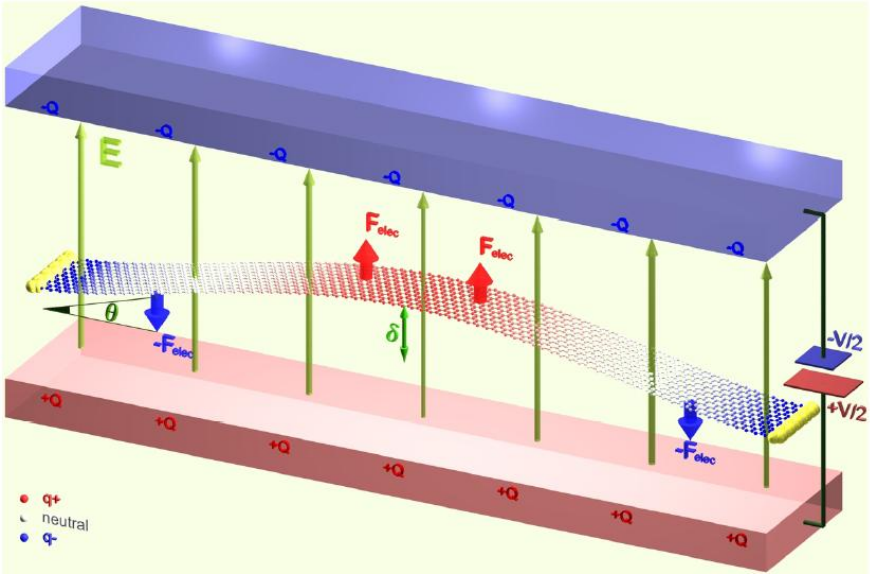

Figure 1: *Deformation of a graphene nanoribbon under a transverse gate voltage.*

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ORAL CONTRIBUTIONS

(Catalonia Parallel Sessions)

Synthesis of ZnO nanowires using gold colloids and optical spectroscopy

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ZnO is a direct wide band-gap (3.37 eV) semiconductor material with a large exciton binding energy of 60 meV, and is a good candidate to create promising devices due to its unique properties [1]. In particular, ZnO nanowires (NWs) offers novel properties, such as a surface to volume ratio almost infinite that gives an increased sensitivity and a band-gap dependence as a function of the NW diameter. Usually ZnO NWs are grown by the vapour-liquid-solid (VLS) method using Au as catalyst [2].
In this work, we reported the synthesis of ZnO NWs using Au colloids as catalyst by the VLS growth process on SiO2/Si, alumina and quartz substrates. The Au colloidal solution was deposited over the substrate using three different methods: drop casting, immersion and spin coating. We chose the drop-casting method as the standard deposition process, as we obtained the most homogeneous distribution and the best quality ZnO NWs. Then, several test involving different solvents (toluene, hexane and water) and different colloidal concentrations (1:1, 1:10 and 1:50) were performed. The morphology and the crystallinity of the ZnO NWs have been characterised using field-emission scanning electron microscopy (FESEM) and high-resolution transmission electron microscopy (HRTEM). Using toluene as a solvent for 5 nm Au colloids over SiO2/Si substrates we obtained ZnO NWs with diameters and lengths ranging from 30 nm to 360 nm and 0.3 µm to 9.3 µm, respectively. Over alumina substrates and with a 1:1 colloidal concentration we obtained ZnO NWs with a more uniformal distribution of the dimensional parameters with average values of 60 nm in diameter and 1.4 µm in length. The same procedure was done for 5 nm Au colloids dissolved into hexane over SiO2/Si substrates, obtaining ZnO NWs with diameters and lengths ranging from 40 nm to 400 nm and 0.4 µm to 11 µm, respectively. In the case of alumina we obtained ZnO NWs with average values of 80 nm in diameter and 1.7 µm in length. Finally, in the case of water as a solvent, a drop with a 1:1 concentration was deposited over SiO2/Si obtaining ZnO NWs with diameters and lengths ranging from 40 nm to 270 nm and 0.5 µm to 6.8 µm, respectively; and using the alumina substrate we obtained ZnO NWs with average values of 60 nm in diameter and 0.8 µm in length. Different morphologies of the ZnO NWs were obtained, as shown in figure 1. HRTEM analysis reveals the high crystal quality of the ZnO NWs, see figure 2.
Raman spectra corroborate the well known ZnO phonon characteristics [3], see figure 3 and table 1. Photoluminescence spectra shows two emission peaks: one around 380 nm, associated to an exciton and a broader peak, from 450 nm to 720 nm, associated to the defects such as oxygen vacancies [4], see figure 4. The relative emission intensity of both peaks changes depending on the solvent used for the Au colloids.

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Figures:

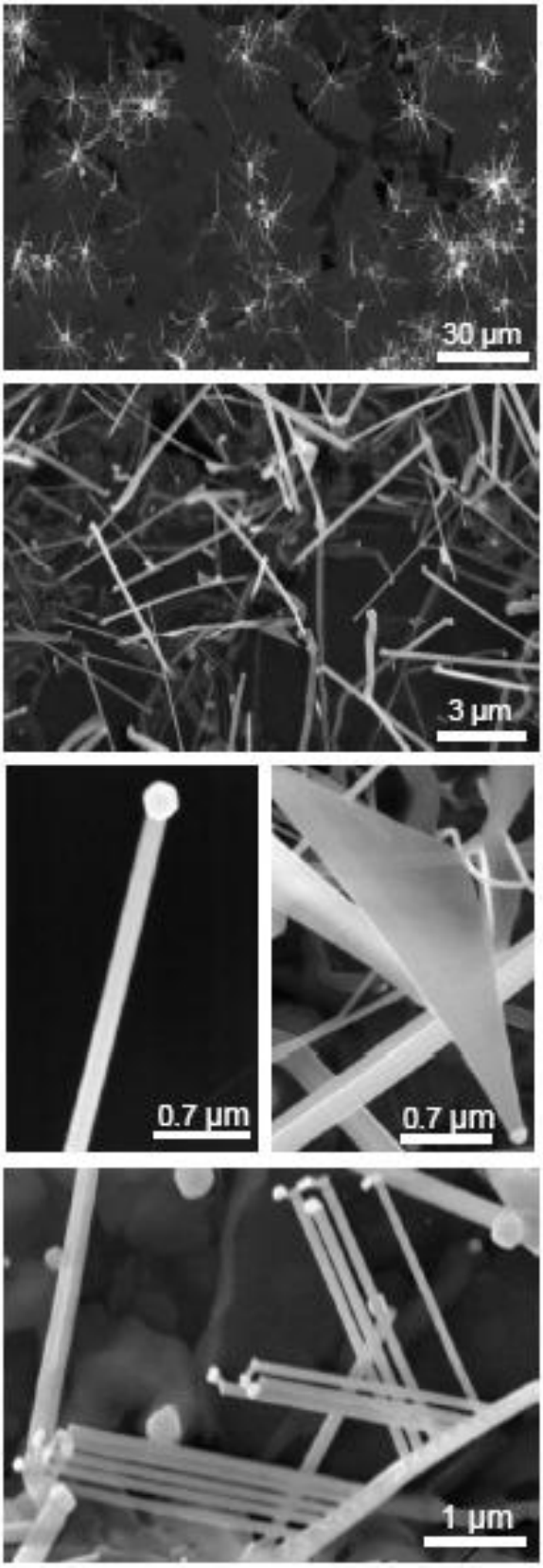

Figure 1: *FESEM images of ZnO NWs with different morphologies obtained grown by the VLS process.*

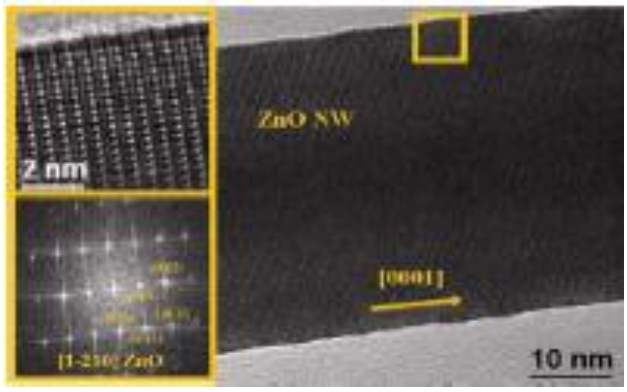

Figure 2: *HRTEM images of a single crystal ZnO NW.*

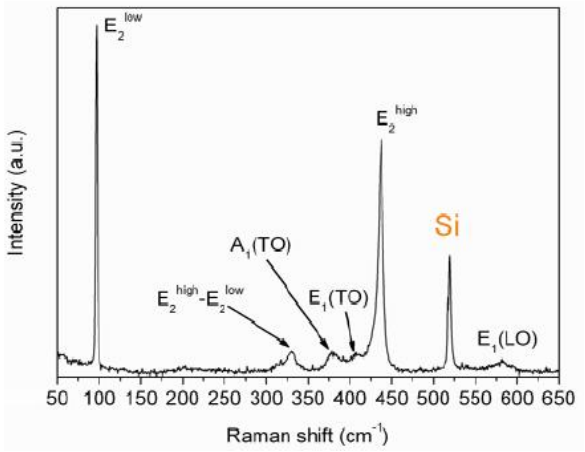

Figure 3: *Raman scattering spectrum of the ZnO NWs.*

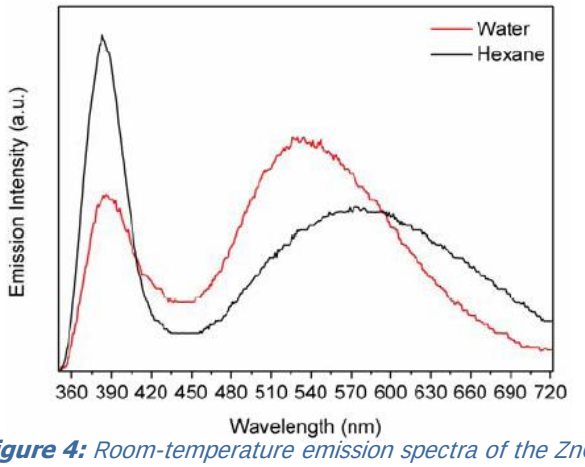

Figure 4: *Room-temperature emission spectra of the ZnO NWs with UV excitation at 325 nm.*

	E_2^{low}	E_2^{high} -E_2^{low}	A_1(TO)	E_1(TO)	E_2^{high}	E_1(LO)
Our data	97	332	380	407	437	582
Bulk [3]	99	333	378	410	438	590

Table 1: *Raman-active phonon-mode frequencies (in cm^{-1}) for ZnO.*

Hexagonal and twinned-cubic phase domains in silicon nanowires

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Formation of hexagonal domains in group IV and III-V nanowires has been a point of intensive study in the last few years due to the dramatic influence of these domains on the electronic and optoelectronic properties of these nanostructures [1,2]. Wurtzite/Zinc-blende heterostructures have been found to influence the optical properties in III-V nanowires [3]. It is also expected that the presence of these heterostructures will change the transport properties [2].

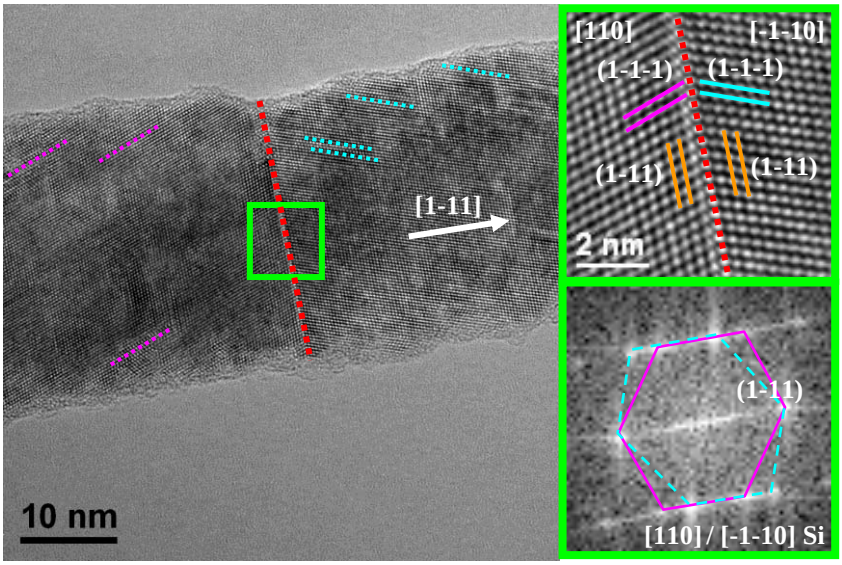

Figure 1: *(a) HRTEM micrograph of a Ga-seeded Si NW with presence of several twinned-cubic domains. (b) Magnified detail of the squared region in (a) showing the structure at both sides of the twin. (c) Power spectrum obtained in (b).*

The nanowires were grown by the Vapor-Liquid-Solid method, in which a metallic nanoparticle is used to catalyze the nucleation and growth of the nanowires. Gold is the most widely used metal, because of its ease of implementation for the growth. Gold is an undesired metal for Si-based technology. As a consequence, the uses of other catalysts such as Cu, In, Al or even catalyst-free nanowires growth have been studied [4]. Recently, after successful use of Ga as catalyst for III-V NWs [5], the use of Ga as an alternative catalyst for Si NWs growth has been also implemented [6]. The main benefit of using Ga is to avoid harmful contamination of the nanowires. Interestingly, in this case the Si nanowire morphology, growth direction and crystallization are affected. In particular, the appearance of rotationally twins and stacking-faults in the NW structure is a problem that must be studied in detail, as this phenomenon can have dramatic consequences for the physical properties of the grown nanowires.

Twin planes and, more generally, planar stacking faults are commonly found in group IV and III-V nanowires grown in the [111] direction. The formation and resulting morphology of randomly distributed stacking faults and twins in nanowires has been investigated by several authors. A rotationally twin plane in a zinc-blende (ZB) nanowire changes the atomic stacking locally and can be considered as a monolayer of the Wurtzite (WZ) phase. Formation of hexagonal domains in group IV and III-V nanowires has been the subject of intensive study in

the last few years due to the dramatic influence of these domains on the electronic, optoelectronic and thermal conductivity properties of these nanostructures as elements for electronic device.

In the present work, we will present a detailed study of the formation of hexagonal domains in Si NWs when using different catalytic seeds (such as Ga, In, Cu and Au). Growth conditions (temperatures, pressures, etc.), as well as the material used as a catalyst and its deposited amount induce important changes in the NW crystallization, sometimes leading to the formation of twins and stacking-fault defects on the cubic structure. Periodicity of these faults, mainly twin defects, will be shown to create local areas of hexagonal structure. A detailed high-resolution transmission electron microscopy study of the different defect arrangements found in our nanowires will be shown. Several 3D atomic models and corresponding electron microscopy simulations will be also used for the understanding of the different structural configurations.

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Detection at ppt Level of Mercury Ions in Water Based in New NanoStructured Solid-Supported Systems

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Heavy metal ions are highly toxic elements, which contamination, due to both natural and anthropogenic reasons, has become severe in some parts of the world, resulting in health damage to their inhabitants [1]. From all the chemical elements that integrate this group mercury is one of the more hazardous. Mercury ions can be transformed by some aquatic microorganisms into methylmercury, which subsequently bioaccumulates into the adipose tissues of fishes and marine mammals [2], to be later spread out into the nutritional chain affecting, therefore, to the entire ecosystem. As a consequence mercury (II) ion levels in water are continually monitored by government agencies, and regulatory commissions are dictating increasingly stringent regulations for the maximum permitted limits of mercury ions in water. Therefore the developing of new sensors able to selectively and sensitively detect mercury ions on aqueous media is still a challenge.

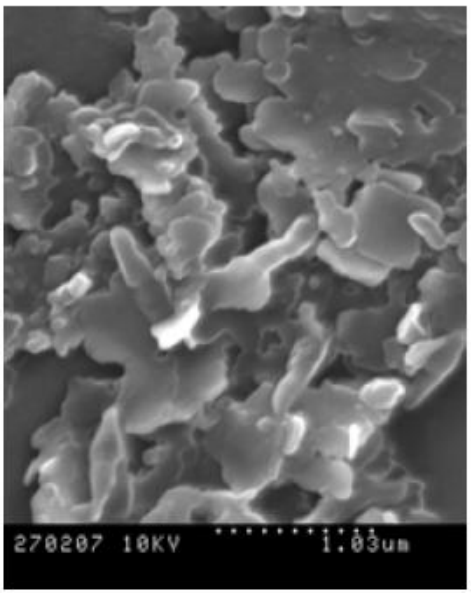
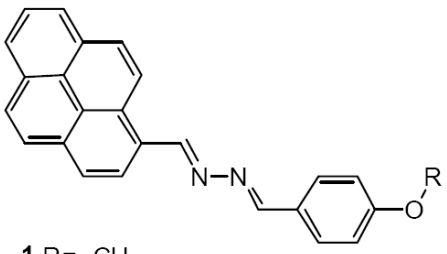


Figure 1: *SEM image of the mixed cellulose ester membrane after filtering the compound **1** nanoparticle suspension.*

In the literature, there are not many selective molecular mercury sensors, and the number of these, able to detect low levels of mercury supported on a solid substrate is limited. With this aim, herein we present two 1,4-disubstituted-2,3-diaza-1,3-butadiene derivatives (**1** and **2** Scheme 1) able to selectively detect mercury ions in aqueous media [3] that combined with different nanostructuration and analytical techniques allowed us to obtain highly sensitive solid-supported mercury probes matching the Hg^{2+} limit on potable water.



1 R= $-CH_3$

2 R= $-(CH_2CH_2O)_3(CH_2)_{11}SCOCH_3$

Scheme 1

Specifically, we have obtained a new kind of sensing probes using the reprecipitation method [4] technique to fabricate hybrid cellulose membranes by means of the filtration of an aqueous suspension of nanoparticles of the compound **1** through a mixed cellulose acetate membrane (Figure 1) resulting a composite material able to perform the *in situ* selective fluorescent detection of mercury (II) ions [5] present on water sources up to the ppb (µg/l) level. This concentration matches the restrictions established by the *Environmental Protection Agency1* for the presence of mercury on potable water.

In order to continuously monitor and control the concentration of mercury ions the use of sensing probes may not be the best alternative. More recently, we have been able to perform the functionalization of gold surfaces using self-assembled monolayers [6] of the properly design compound **2**, allowing us to use evanescent wave techniques such as surface plasmon resonance [7] (SPR) for the development of a mercury (II) sensor, that works as highly sensitive and selective probe able to detect mercury ions continuously even down to the ppt (ng/l) level on aqueous media (Figure 2).

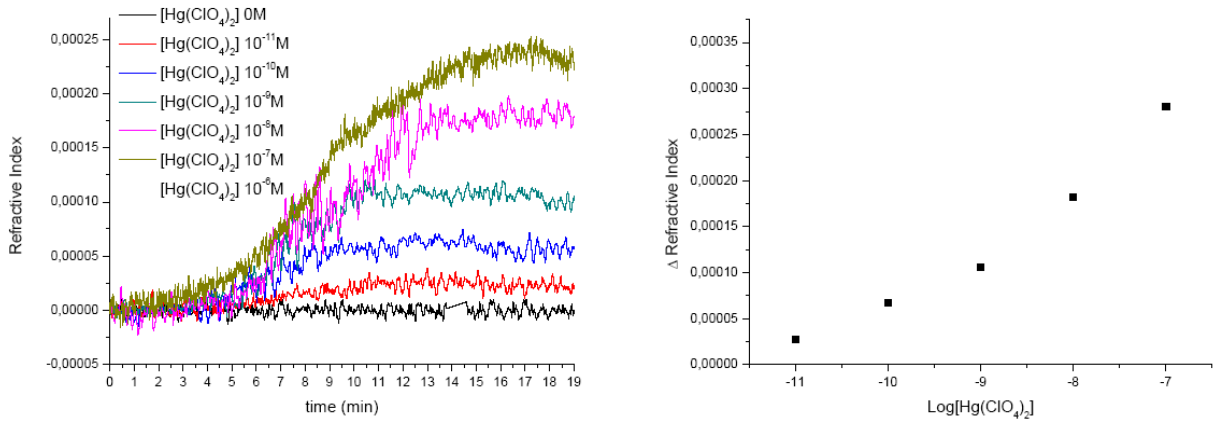


Figure 2: *a) SPR sensogram for mercury (II) detection b) SPR mercury (II) calibration curve.*

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EELS assessment of cation migration in (001) and (110) LCMO layers as a function of layer thickness

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Mixed-valence ferromagnetic manganite films, such as $La_{2/3}Ca_{1/3}MnO_3$ (LCMO), have been the object of much attention in recent years due to their potential applications in spintronics. However, expectations have been lowered by the negligible room-temperature magnetoresistance in tunnel junctions. Although the reasons for this behaviour are not yet fully known, it has been suggested that they may be linked to electronic phase separation.
Electron energy-loss spectroscopy (EELS) allows direct determination of local Mn oxidation state at the nanometric scale and is thus the most suitable technique for direct evaluation of the spatial distribution of phase separation, if in fact a phase separation exists. In addition, elemental quantification can be carried out by EELS, offering chemical information at the nanometric scale. In particular, both the Mn L_3 edge onset and the Mn L_3/L_2 intensity ratio have been demonstrated to be correlated with Mn oxidation state. Mn L_3 EELS edge and Mn L_3 / L_2 edge intensity ratio can be determined using home-made program MANGANITAS [1, 2]. This is a MATLAB routine that reads the EEL spectrum file and recalibrates energy axis. Then, it performs a fitting of both the background and continuum signal and subtracts them. Finally, it estimates Mn L_3 edge onset, fits Gaussian curves to both Mn L_3 and Mn L_2 edges, and integrates the Gaussian curves, using integration ranges that have been chosen by quantification of LCMO reference bulk samples with controlled stoichiometry.

Several EELS studies on epitaxial (001) manganite thin films have been reported in literature. A Ca migration toward manganite free surface in (001) textured LCMO/STO/LCMO structures was reported [3], whilst other authors [4] found no cation migration in the LSMO ($La_{2/3}Sr_{1/3}MnO_3$) /STO/LSMO system but did find a weak decrease in the Mn valence near the interfaces, attributed to a transfer of electrons from STO to LSMO. It has been observed that in LCMO films grown on $LaAlO_3$ substrates, which are under compressive strain, the La^{3+} ions migrate toward the top layer surface [1].

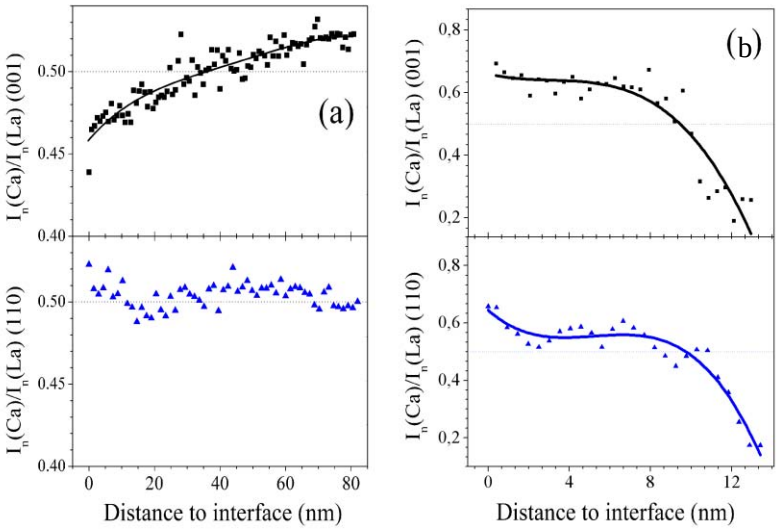

Figure 1: *(a) La/Ca ratio along (001) and (110) ~80 nm (a) and ~13 nm (b) thick LCMO films.*

On the other hand, very thin LCMO films seem to present an anomalous behaviour when compared to thicker films. In particular, they have been reported to have a different crystal structure [5].
Little attention has been paid, so far, to the crystallography, chemistry and electronic structure of (110) LCMO films, reported to display enhanced magnetic properties when compared to their (001) counterparts [6].
In the present work, a detailed (S)TEM-EELS characterization of (001) and (110) thin films of a wide rage of thicknesses will be presented. In particular, local deviations from layer nominal stoichiometry will be evaluated, and correlated with Mn oxidation state variation. Ca migration towards free surface in thicker LCMO films will be discussed as a stress relieving mechanism competing with other possible mechanisms, such as defect formation [2]. An anomalous thickness range (thinnest films) where a La migration towards free surface is promoted will also be discussed.

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Supramolecular interfacial engineering based on cyclodextrin-modified surfaces for biosensor applications

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Biosensor performance crucially depends on the proper functionalization of the transducer surface. The challenge is to properly design and engineer the surface functional groups in order to control the communication between the device and its bioenvironment. Strategies for biocomponent immobilization on electrodes include covalent attachment, physical adsorption and film deposition. The use of supramolecular interactions (i.e. host–guest interactions) is an attractive alternative to physical adsorption method as these interactions can be easily tuned by the appropriate selection of geometrically complementary host and guest molecules [1].

Cyclodextrins (CD) are a family of cyclic supramolecular receptors composed of glucopyranose units featuring a central hydrophobic cavity that allows the inclusion of several types of guest molecules of appropriate size to form inclusion complexes. Here we report two novel strategies for biosensor fabrication based on complementary supramolecular interactions between guest-appended proteins and cyclodextrin-modified electrodes.
The first strategy consists in the immobilization of a first layer of thiolated cyclodextrin polymer on a gold electrode followed by the supramolecular capture of adamantane-modified enzymes [2]. Successive enzyme layers are then attached using CD-modified gold nanoparticles (Au-CD) as supramolecular linkers, which due to their spherical shape provide the appropriate directionality to the supramolecular interactions. Layer-by-layer deposition has been studied by surface plasmon resonance, cyclic voltammetry and impedance spectroscopy and employed in the construction of amperometric biosensors (Figure 1).

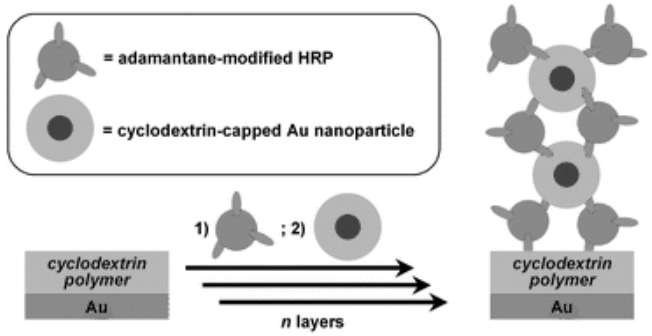

Figure 1: *Layer-by-layer self-assembly of enzymes on gold electrodes based on complementary cyclodextrin–adamantane supramolecular interactions*

The second strategy consists in the cyclodextrin modified surfaces as platforms for the immobilization of antibodies. The antibodies are covalently immobilized on adamantane-appended carriers based on biocompatible polysaccharides and deposited onto the cyclodextrin-modified electrodes (Figure 2). This architecture was employed in the construction of an immunosensor for the detection of celiac disease related targets.

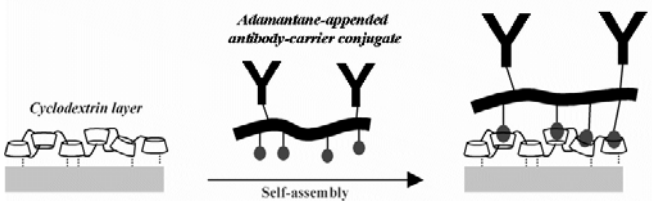

Figure 2: *Immobilization of antibodies on electrode surfaces via supramolecular interactions.*

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Phenomenology and models of exchange bias in core/shell nanoparticles

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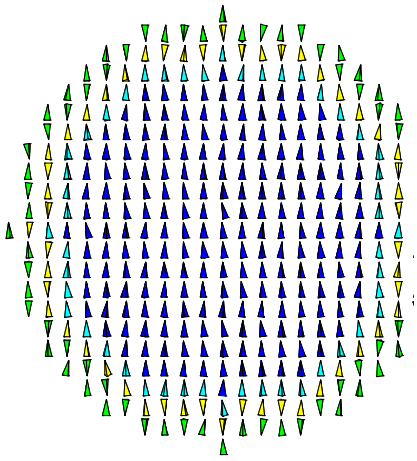

Figure 1:*Magnetic configuration of a nanoparticle with FM core/AF shell structure after a field cooling process.*

Magnetic nanomaterials present new magnetic and transport properties that arise due to a complex interplay between the intrinsic properties of the constituents (such as specifically tailored microstructure and finite size or surface effects) and the interactions among the entities forming them [1]. When reducing the size of magnetic particles to the nanoscale, surface and finite-size effects become fundamental in order to explain their unusual magnetic properties. Moreover, particle surfaces are exposed to environment and are, therefore, easily oxidized, resulting in compound structures with a ferromagnetic core surrounded by an antiferromagnet. When cooling in the presence of a magnetic field the magnetic order established at the shell may result in a pinning of magnetic moments at the interface between the two phases giving rise to the so-called exchange bias (EB) effect [2].

In this contribution, we will review our recent work on the modeling of magnetic nanoparticles focusing mainly on Monte Carlo (MC) simulation methods that we have applied to the study the microscopic origin of surface and EB effects in nanoparticles with core/shell structure [3,4]. The results of the simulations allow us to conclude that the increase of the exchange coupling across the core/shell interface leads to an enhancement of exchange bias and to an increasing asymmetry between the two branches of the loops (as can be seen in the example shown in Fig. 2), which are due to different reversal mechanisms. A detailed study of the magnetic order of the interfacial spins (see Fig. 1) shows compelling evidence that the existence of a net magnetization due to uncompensated spins at the shell interface is responsible for both phenomena and allows quantifying the loop shifts directly in terms of microscopic parameters with striking agreement with the macroscopic observed values. Moreover, our model has been applied to study how the above-mentioned effects are affected by the particle size, shell thickness, magnitude of the cooling field and temperature [5], showing that from the simulation results a deeper understanding of the phenomenology observed experimentally can be gained.

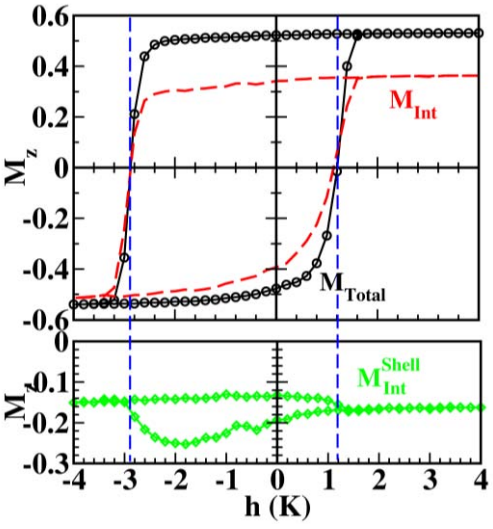

Figure 2: *Hysteresis loop of a core/shell nanoparticle (M_{Total}) obtained after field cooling displaying a shift in the direction of the applied field. The contribution of the interfacial spins (M_{Int}) is shown in dashed lines.*

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Control of the metal-oxide interface in pre-formed gold nanoparticles anchored to inorganic oxides. Implications for catalysis

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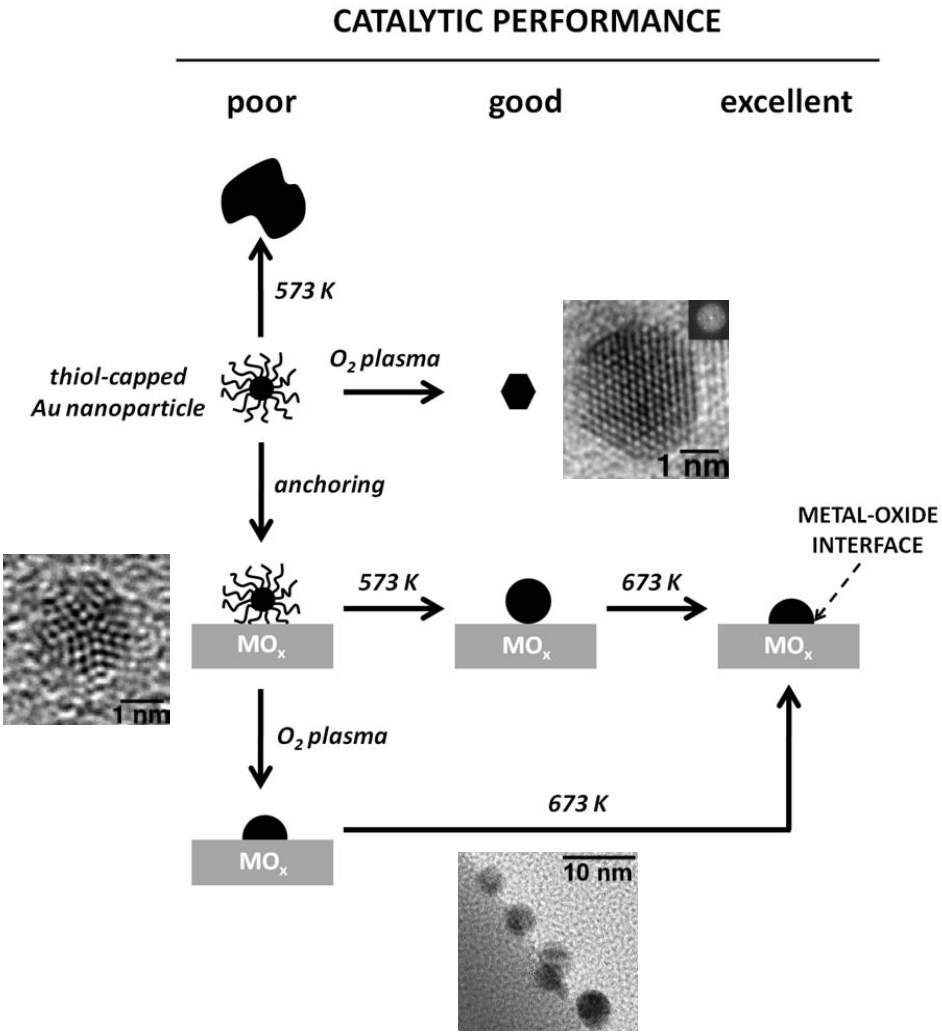
A key feature of nanoparticles acting as catalysts is that only a small part of their external surface provides the active sites where the reactions take place. The identification of catalytic active sites is a very vivid area of investigation encompassing a variety of disciplines, from basic research to applied engineering. However, the success is often limited by the nature of the catalysts themselves because the metal nanoparticles usually exhibit a wide range of sizes and facets, preventing accurate relationships between their properties and catalytic performance. Several approaches have been used to prepare nanoparticles on metal oxide supports including incipient wetness impregnation, co-precipitation, deposition-precipitation, ion exchange, gas-phase grafting, co-sputtering, organic capping, and dendrimer and micelle encapsulation [1]. Impregnation and precipitation methods are very simple and scalable, but normally suffer from precise particle size control. In contrast, organic capping and encapsulation methods produce size-controlled nanoparticles whose particle size is established before deposition on the metal oxide support [2-3]. Moreover, the coordinating ligands in the precursor solution and on the oxide surface prevent aggregation of the nanoparticles. In this work, we have prepared a variety of well-defined Au nanoparticles supported on TiO_2, TiO_2/SiO_2, and ZrO_2 from dodecanethiol-capped nanoparticles. When dispersed as fine particles of less than ~10 nm in dimension over selected metal oxides, gold exhibits exceptionally high activity in a variety of reactions. Samples have been characterized by high resolution transmission electron microscopy (HRTEM), X-ray photoelectron spectroscopy (XPS), atomic force microscopy (AFM), and temperature programmed reduction (TPR), and tested in several catalytic reactions, namely methane partial oxidation and epoxidation of propene for industrial purposes, and water gas shift and carbon monoxide preferential oxidation for fuel cell application. We have studied the contact structure between the Au nanoparticles and the oxide support following activation by cold oxygen plasma and calcination treatments and attempted to correlate it with catalytic activity in order to gain insight into the role of the metal-oxide interface and its effect on catalytic performance.

Our findings show that methane can be selectively oxidized into formic acid with O_2-H_2 mixtures under mild conditions over well-defined Au nanoparticles of about 3-4 nm in size treated under oxygen plasma. Catalytic activity is inhibited by surface stabilizing shells around Au nanoparticles or by thermal activation yielding Au nanoparticles larger than a critical diameter (see figure). In contrast, Au nanoparticles are stabilized following anchoring over inorganic oxide supports. High yields of propene oxide can be formed by epoxidation of propylene by N_2O over well-defined Au nanoparticles of about 5-6 nm supported on anatase and calcined at 673 K. For samples calcined at lower temperature or subjected to oxygen plasma treatment, the interaction between Au nanoparticles and TiO_2 is weak and poor catalytic performance is obtained, suggesting that the complex synergy created at the perimeter interface around Au nanoparticles appears essential for catalytic activity (see figure). The importance of the interaction between Au nanoparticles and the support is also evidenced in the water gas shift reaction by comparing the behavior of several ZrO_2-supported Au samples, with and without epitaxial growth. Finally, active Au catalysts for low-temperature CO preferential oxidation are designed with active metal-oxide interface, and their relevance for miniaturized fuel cell applications is discussed.



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Magnetism and biodistribution of high quality iron oxide nanoparticles suitable for applications in biomedicine

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Magnetic nanoparticles (NPs) [1] are promising materials for *in vivo* and *in vitro* applications in biomedicine, *e.g.* in targeted and selective drug delivery, magnetic resonance imaging or bio-sensing. In this framework, iron oxide is a first choice material due to its low toxicity and ease to be functionalized. Generally speaking, a nano-volume is desired for the magnetic entity with the highest possible saturation magnetization and superparamangnetic behaviour at room temperature. Methods for producing uniform γ-Fe_2O_3/Fe_3O_4 NPs of high magnetic quality meeting the criteria mentioned above are well described in literature [2,3], with the drawback of those NPs being usually hydrophobic, such that ligand exchange to a hydrophilic coating is required. In this work, we report on the bio-distribution in rodents of injected, hydrophilic high quality magnetic γ-Fe_2O_3/Fe_3O_4 NPs, synthesized by thermal decomposition of an organic Fe precursor in an organic phase in the presence of oleic acid as surfactant. The NPs were water dispersed by ligand exchange from oleic acid (as synthesized) to dimercaptosuccinic acid (DMSA) [2,3]. Zero field cooling and field cooling (ZFC/FC) curves and magnetization measurements of the particles dispersed in frozen liquid evidence that no aggregation is produced due to the ligand exchange process. Further more, no loss in saturation magnetization is produced during the process, while superparamagnetic behaviour is preserved, suggesting that those NPs are suitable for bio-applications. The water dispersed NPs have been introduced in living rodents by either subcutaneous or intravenous injection. Magnetization measurements of samples of liver, kidney and spleen of those rodents evidence various degrees of uptake of magnetic material depending of the organ, and points out to the intravenous way as an efficient administration way. Subcutaneous injection of the same dose of NPs yields almost no appreciable uptake in the organs. Magnetic data enable to quantitatively estimate the amount of magnetic material in each organ. Finally, the effect on the bio-distribution of implanting magnets in the body of the rodent is also studied.

The funding from the Spanish MEC (NAN2004-08805-CO4-02, NAN2004-08805-CO4-01, CONSOLIDER CSD2006-12, MAT2005–02454 and MAT2006-03999), and from the Catalan DURSI (2005SGR00969) are acknowledged.

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Theory of Doping in Silicon Nanowires

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In bulk host materials the study of the energetics of the formation of defects is a very welldeveloped topic, and formation energies are calculated according to the well-established expression due to Zhang and Northrup [1], where they are formulated in terms of the chemical potentials of the constituent species and the total energy of the system with the impurities.
On the other hand, for one-dimensional (1D) semiconductor systems the nonequivalence of the different constituent atoms in, say, a silicon nanowire (SiNW), in addition to the possible presence of surface passivation and the proper treatment of the defect charge state, render the straightforward application of the Zhang-Northrup formalism troublesome. In particular, the choice of the chemical potential of the atomic species involved is ill-defined, preventing calculations of the formation energy of self-interstitials, vacancies or substitutionals for semiconductor nanowires.

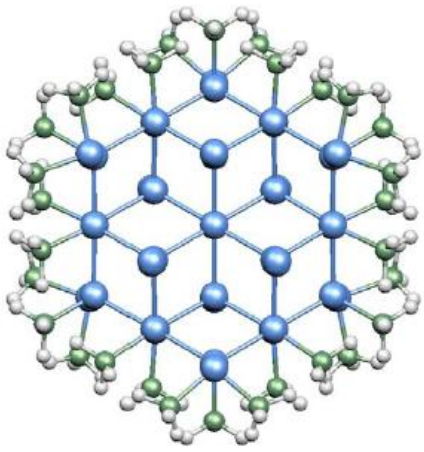

Figure 1: *Cross-section view of a 1.0 nm <111> SiNW with CH_3 passivation (see Ref. [4]).*

We will present a recently proposed framework for the calculation of formation energies of neutral and charged point defects in 1D systems [2]. The difficulties mentioned above are overcome thanks to the use of a construction involving as many unit cells as necessary to form a new *layer* of NW, and a derivation of the Madelung correction for systems with a dielectric *tensor* as opposed to a dielectric constant. We apply this formalism to two case studies with potential high impact for future nanoelectronics applications.

Surface segregation of dopants in CH3 passivated SiNWs — It was soon recognized that surface segregation was one of the most important limiting factors in the doping efficiency of thin SiNWs [3]. In presence of dangling bonds, dopant impurities are driven to the surface where they form electrical inactive complexes with the surface defects. We revise this scenario in the case of the novel methyl-passivated SiNWs (see Figure 1) that have been demonstrated experimentally recently [4], whose stability in air is believed to be superior with respect to more conventional H passivated wires.

Al solubility — We have studied Al point defects in 1 and 1.5 nm SiNWs grown along the <110> and <111> axes. Two reasons make Al impurities a very interesting case study: (i) group III elements can be efficient p-type dopants for Si, and the use of Al for doping in nanowires has indeed been proposed [5]; (ii) Al has proven to be a feasible alternative to Au as a catalyst for the epitaxial growth of SiNWs [6], having the considerable advantage of not introducing undesired midgap states that can act as traps and requiring lower growth temperatures. We find that, as in bulk, substitutionals are preferred over interstitials. However, although Al continues to behave as an acceptor in the SiNWs, the activation energy is strongly increased due to the quantum confinement effect. Also, we predict a solubility of Al in the studied NWs at least an order of magnitude larger than in bulk.

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Tailoring growth mechanisms in heteroepitaxy of complex oxides

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Complex oxides show an exciting variety of functional properties that make them extremely appealing for the development of new devices or improvement of current devices. The interest is even renewed after stimulating new results involving biferroic oxides and two-dimensional electron gases at oxide interfaces [1]. Properties of complex oxides usually depend greatly on small lattice distortions or chemical modifications. Whereas it can allow a fine control of the properties it also implies a very accurate control of the micro/nanostructure of the materials. Therefore, radical control of the oxides preparation is necessary. Particularly relevant is the precise control of the growth of epitaxial films. The understanding on oxide growth is still far from the understanding of epitaxy of semiconductors.

One of the most powerful tools to monitor in-real time the epitaxial growth is reflection high energy electron diffraction (RHEED). It can successfully used to control the epitaxy of complex oxides in spite of the high oxygen pressure usually required [2]. We have investigated heteroepitaxial growth (by means of pulsed laser deposition) of the ferromagnetic and conducting $SrRuO_3$ on $SrTiO_3$(001) substrates by means of RHEED and atomic force microscopy (AFM) with the objective of controlling the growth mechanisms. This is a key to fabricate heterostructures with atomically flat interfaces and with real-time control of the thickness at a submonolayer level. We will show that the control is achieved by i) control of diffusivity and density of the growing species, and ii) control of the step morphology of substrate and growing film.

A typical AFM topographic image of a $SrTiO_3$(001) with a TiO_2-termination is in Figure 1a. Terraces around 280 nm wide are separated by steps of 1 u.c. in height. The substrate surface is later in-situ checked by

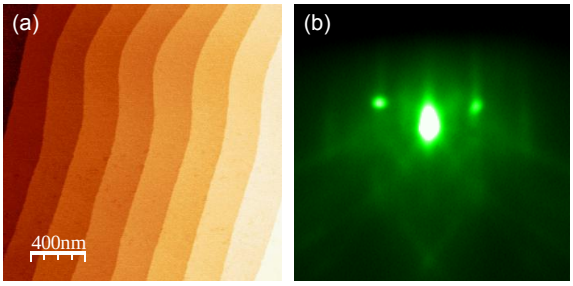

Figure 1: *(a) Topographic AFM image of a $SrTiO_3$(001) substrate after chemical treatment to have unique TiO_2-termination. (b) RHEED pattern of a $SrTiO_3$(001) substrate.*

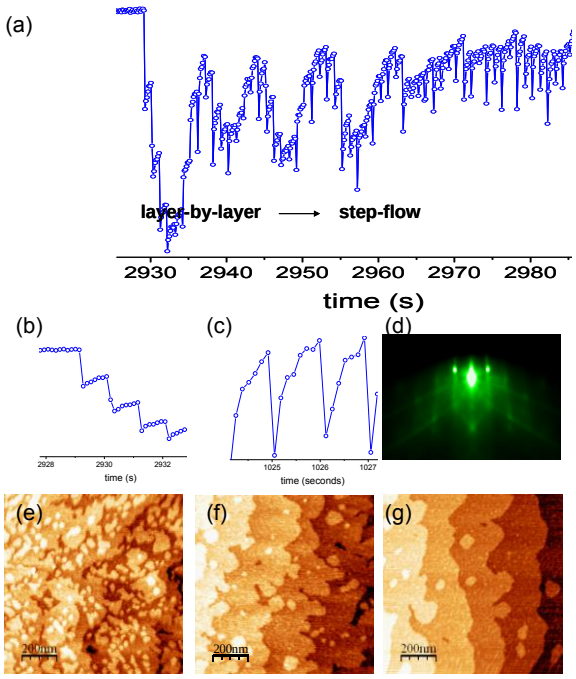

Figure 2: *(a) Time-resolved RHEED intensity during $SrRuO_3$ growth: (b) in the layer-by-layer mode, (c) in the step-flow mode. (d) RHEED pattern of the growing $SrRuO_3$ layer. Corresponding topographic AFM images of the quenched film surface: (e) after a half monolayer deposition in the layer-by-layer mode, (f) in the step-flow mode and (g) after growth interruption of 15 minutes.*

means of RHEED (Figure 1b). The straight substrate steps favour $SrRuO_3$ nucleation on the terraces, this is verified in real time by the RHEED oscillations that signal layer-by-layer growth (see the zoom of the curve in Figure 2b). The growth mode is ex-situ confirmed by AFM (Figure 2e). The formation of twp-dimensional islands causes a progressive step meandering, which favours a transition to step-flow growth mechanism [3,4]. This is illustrated in the RHEED intensity recovery after each laser pulse (Figure 2c) and ex-situ confirmed by AFM (Figure 2f). From intensity recovery curves diffusivity coefficients can be determined. We will show also that growth interruption during a few minutes causes straightening of the steps, and as a result the terrace morphology is recovered (Figures 2d and 2g). This is relevant since it causes a re-entrant layer-by-layer mechanism. The growing layer morphology can then be tailored by the growth mechanisms, therefore allowing a selection of the film morphology before continuing growth of other top layers.

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Carbon nanocapsules: blocking materials inside carbon nanotubes

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Many compounds have been filled inside single-walled carbon nanotubes (SWNTs), including inorganic salts, organic molecules, fullerenes, metals and water. Unprecedented structures and properties have been observed for the encapsulated material [1], which can also alter the properties of the SWNTs [2]. Filled carbon nanotubes have potential use in nano-electronic and nano-optoelectronic devices. Also filled SWNTs are envisaged as promising agents for medical applications including *in vivo* imaging, tumour targeting and drug delivery.

The most commonly used methods for the encapsulation of materials in carbon nanotubes are solution, vapour and molten phase capillary filling. After the filling step, and regardless of the chosen method, a large amount of non-encapsulated material is present in the sample. A key step towards the characterisation and application of filled SWNTs is the complete removal of this unwanted external material whilst preserving the encapsulated payload (of the same nature). For instance, in the case of medical applications, the absence of species outside the SWNTs will reduce the side effects during targeting.
Here we present two complementary methodologies for the containment of soluble materials in the interior of SWNTs: closing the ends of SWNTs by thermal annealing [3] and using fullerenes as SWNT corks [4] (Figure 1).

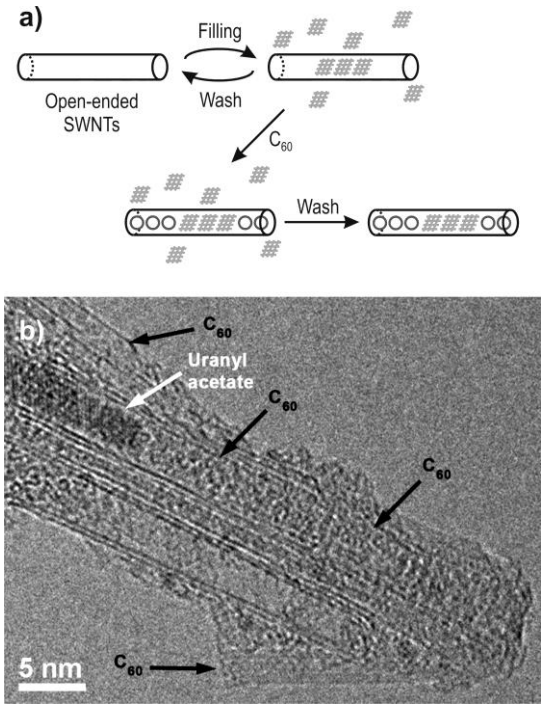

Figure 1: *a) Schematic representation of the fullerene corking method and b) high resolution transmission electron microscopy of C60-corked uranyl acetate filled SWNTs. Reproduced from ref. [4] by permission of The Royal Society*

SWNTs may be readily filled by direct heating to about 700-900 °C or higher in the presence of any material which is liquid and stable at that temperature and of which the liquid has a surface tension of less than about 170 mN/m [5]. On cooling the reaction mixture, the SWNTs are found to be filled with the chosen material and the ends of the filled SWNTs are closed [3]. We surmise that at high temperature the SWNTs spontaneously open to allow the molten materials to enter the SWNTs. On cooling, the openings in the CNT reclose and the internal material solidifies, often forming crystalline forms of filling material inside the CNTs. Since the resulting filled SWNTs are closed, the excess of the material external to the SWNTs may be dissolved away by choice of a suitable solvent. This high temperature filling method is limited mainly by the requirement that the chosen filling material is thermally stable as a melt, and for example, organic molecules can not be filled using this approach.

The alternative methods of filling SWNTs require that the closed as-made SWNTs first be opened at the ends. This can readily be accomplished by heating in steam at high temperature and then cooling in steam to room temperature [6, 7]. The resulting end-opened SWNTs may then be filled by solutions of the chosen material (ionic or covalent). Since the ends of the SWNTs remain opened, removal of the non-encapsulated material, external to the SWNTs would also result in the release of the encapsulated cargos. We have recently shown that fullerenes can be used as corks to block compounds inside open-ended SWNTs. The filled and blocked SWNTs can then be readily purified by stirring the sample in a suitable solvent. The reversibility of these "corks" is currently being studied. Potassium iodide and uranyl acetate have been used as model filling compounds since the highly scattering heavy elements, iodine and uranium are clearly visible by electron microscopy techniques. Recent results on the imaging of organic compounds encapsulated into SWNTs (erythrosine B and acetylsalicylic acid) will also be presented.

The authors thank Thomas Swan Ltd. for supplying SWNTs, and acknowledge support by a Marie Curie European Reintegration Grant within the 7th European Community Framework Programme.

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ORAL CONTRIBUTIONS

(PhD Parallel Session)

A case study of a metal/organic interface at the molecular level: a tip/C60 contact

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In this work, we analyze theoretically a Au/C_{60} interface based on the results obtained using DFT for a fully relaxed Au-tip/C_{60}/Au-tip geometry [1] with variable tip/tip distance, calculate the energy, forces, conductance and deformation, and discuss the organic/barrier formation at the molecular level comparing it with the full monolayer case [2]. We also analyze how this barrier formation at the molecular level can be related to the effective intrasite Coulomb interaction operating in the molecule (considered as a quantum dot). Finally, we also discuss how that Coulomb interaction allows us to obtain the transport energy gap of the molecule as a function of the tip-molecule distance.

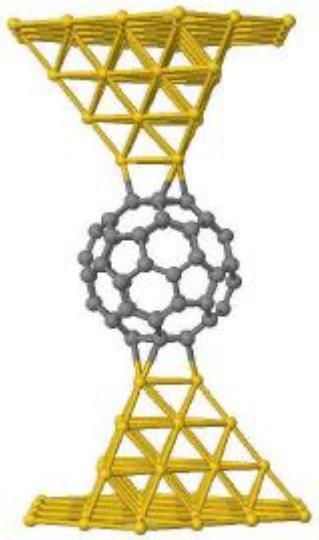

Figure 1: *Geometry of the C_{60} molecule between the gold tips*

The contact formation is analyzed by approaching each Au-tip in steps of 0.1 Å using a highly efficient MD-DFT code (FIREBALL [3]). After each step the atoms are relaxed to their corresponding minimum energy positions, excepting the atoms in the last Au-layer of both tips. We use the LDA exchange-correlation functional, and a basis set of short-range numerical atomic-like orbitals (NAOs). The electrical conductance of the system was calculated at each step of the deformation using a Keldish-Green´s function approach [4], together with the first principles tight-binding hamiltonian of the system.

We have also calculated the density of states at several steps of the tip approach and analyzed them in terms of the Unified-IDIS model [6] For each case, the LUMO and HOMO levels, the molecule Charge Neutrality Level, the Fermi energy (zero energy) and the initial metal workfunction, Φ_M, are shown. The CNL is calculated integrating the C_{60}-DOS up to charge neutrality conditions; the tip/C_{60}/tip contact reacts creating a potential, V^t, that tries to align the organic CNL and the metal workfunction. Following the IDIS-description of MO interfaces [6], we can relate the total potential difference, V^t, created between the tips and C_{60}, to the IDIS, V^{IDIS}, and to the "pillow" potential, V^{pillow}, in the following way:

$$V^t = V^{IDIS} + V^{pillow} \qquad (1)$$

where $V^{IDIS} = (1-S)(CNL-\Phi_M)$, and $V^{pillow} = S \cdot V_0^{pillow}$, S being the interface screening parameter and V_0^{pillow} the bare "pillow" potential induced by the compression of the electron metal tails at the MO interface due to the Pauli repulsion [6].

Our calculation also provides us with a method to obtain the effective coulomb interaction, U^{eff}, associated with the injection of an electron in the molecule. This can be done by rewriting equation (1) as follows:

$$V^t = (1-S)(CNL-\Phi_M) + S \cdot V_0^{pillow} = (1-S)(CNL-\Phi_M-V_0^{pillow}) + V_0^{pillow} \qquad (2)$$

then, U^{eff} is calculated dividing the charge transfer induced potential, $(1-S)(CNL-\Phi_M-V_0^{pillow})$, by the charge transfer itself:

$$U^{eff} = (1-S)(CNL-\Phi_M-V_0^{pillow}) / \delta q \equiv \delta V^{charge} / \delta q \qquad (3)$$

A similar equation for the LUMO and HOMO levels has also been found recently by Louie et al [7]. We have calculated the transport gap, as discussed in references [7, 8]; this gap is the LDA-energy gap plus U^{eff}; this yields for cases A, B and C, E_{gap}^{trans}=3.5 eV(A); 3.1 eV(B) and 3.1 eV(C). It should be mentioned that the calculated DOS has been obtained using a scissor operator that fit the C_{60} –energy gap [2] to the values just mentioned.
Results for the case of a tip/C_{60}/surface geometry will be also shown and compared with the previous geometries.

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Nanotube based thermal motors: sub-nanometer motion of cargoes driven by thermal gradients

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There is a growing effort in the scientific community to design and fabricate ever more versatile nanoelectromechanical systems (NEMS). Because carbon nanotubes are very small, mechanically robust and chemically inert, they have attracted considerable interest as NEMS components. In addition, their one-dimensional tubular shape offers a natural track for motion. This tubular shape restricts the motion to only a few degrees of freedom (typically translation or rotation), much as bearings do in every-day machines.

A new generation of nanotube based motors has been envisaged that takes advantage of the atomic corrugation for a new class of tracks [1]. For example, the motion of two coaxial nanotubes relative to one another is given by the track that results from the mutual atomic interaction between the nanotubes. In some cases, the track follows energy minima that can consist of helical orbits ranging from pure rotation to pure translation. In some others, the energy barrier for motion contains local minima and maxima, arranged e.g. as a twisted chess-board like pattern (see some examples in Fig. 1 C-E) [2].

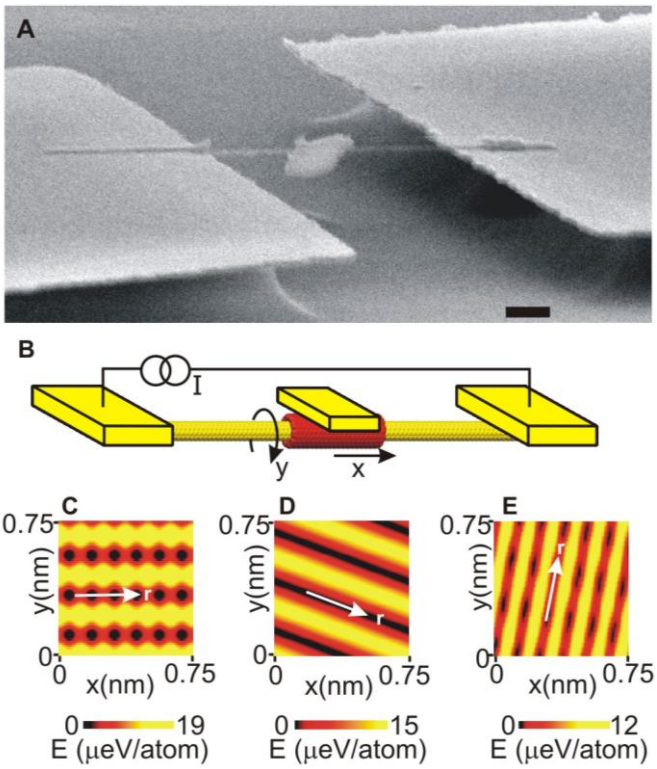

Figure 1: *Experimental setup. (A) Scanning electron microscope (SEM) image of one device. The scale bar is 300 nm. (B) Schematic of the nanotube motor and its degrees of freedom. The outer (red) nanotube moves with respect to the inner (yellow) nanotube. (C, D, E) Shape of the energy barrier for the relative motion between two coaxial nanotubes, namely (5,5)/(10,10), (29,9)/(38,8) and (27,12)/(32,17), respectively. The diameters of the inner tubes are 0.67, 2.7, and 2.7 nm, respectively. The white arrow indicates the easy axis of motion. The motion is modulated by a series of small periodic barriers in C and E, while vanishingly small friction is expected in D.*

Here we report on an artificial nanofabricated motor (Fig. 1 A,B) in which one short nanotube moves relative to another coaxial nanotube and we present two major advances. First, the atomic interaction between the nanotubes is shown to generate distinct kinds of motion for different devices, namely rotation and/or translation along the nanotube axis. Figure 2 shows an example of a translational motion. Second, we show that the motion is actuated by imposing a thermal gradient along the nanotube, allowing for sub-nanometer displacements. More specifically, the thermal gradient generates a phononic current in one nanotube that hits

and drags the second tube. This is, to our knowledge, the first experimental demonstration of displacive actuation at the nanoscale by means of a thermal gradient; we believe that thermal gradient actuation offers many possibilities in the design of novel nanoelectromechanical systems.

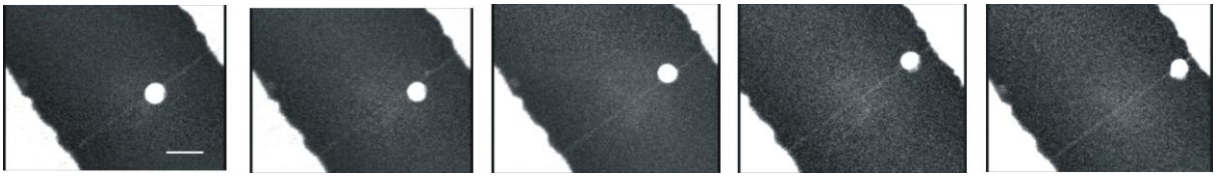

Figure 2: *Translational motion. Top down SEM images where the gold cargo is moving along the nanotube. The motion is actuated by passing a large electrical current through the nanotubes. Note that the driving mechanism for the motion is not due to electromigration, but comes from the thermal gradient along the nanotubes (induced by the electrical current). The metal plate, which initially had a rectangular shape, melted through Joule heating, and became a ball. The scale bar is 400 nm.*

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Adsorption and cyclo-dehydrogenation of polycyclic aromatic hydrocarbons on Pt surfaces: towards the synthesis of heterofullerenes

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Controlled synthesis of fullerenes and heterofullerenes on surfaces is a preceding step towards the development of a true fullerene-based molecular electronics. Given the limitations of the current preparation techniques based on graphite vaporization, new methods are required for the rational, size-controlled synthesis of fullerenes, heterofullerenes, and endohedral fullerenes.

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

The process is catalysed by reactive substrates, as Pt, which favours strong surface-molecule interactions. We have thoroughly studied with STM and large-scale DFT calculations (using both efficient local orbital basis methods FIREBALL [2] and OPENMX [3] and standard plane-wave approaches like VASP [4]) the interaction of the polycyclic planar precursors with different surfaces. Particularly, we have found that this system has the capability to induce a local separation of the chiral molecular species induced upon surface adsorption. The number of established bonds between the substrate and molecule seems to play a key-role in the properties of the system.

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

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Study of DNA mobility in 20 nm channels using AC and DC electric fields

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We studied the mobility of λ-DNA in 20 nm channels using combined AC and DC fields. We present the mobility results of using 1kHz AC fields added to DC fields. Mainly we found that at DC fields below 20kV/m, the DNA mobility was significantly increased by the added AC, however, at DC fields above 20kV/m, no influence was observed.
In a previous investigation of the DNA transport in 20nm channels under DC electric fields, it was observed that the DNA mobility was strongly dependent on the applied field strength [1]. The mobility increased with the field, and the DNA moved fluently. But above 30kV/m, the DNA moved intermittently and the mobility decreased. For the explanation of this behaviour two hypotheses were made: steric trapping and dielectrophoretic (DEP) trapping [1]. Here we use the AC fields to try to increase the DEP forces possibly generated by imperfections on the channel surface, when the DC fields were applied.

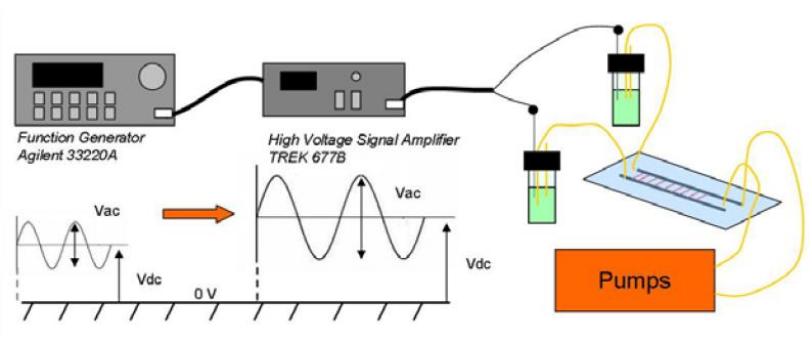

Figure 1: *Experimental setup, it shows the electronic devices used to generate the signal, which combines both DC and AC voltages. The output of the amplifier is connected to the chip by two reservoirs. Due to the high conductivity of the TBE buffer the field is applied homogenously a long of the two microchannels, which are connected by the 100 nanochannels. The buffer is applied by the syringe pumps via powder-blasted holes and fused silica capillaries*

The nanochannels were manufactured in fused silica chips by wet etching. Nanochannels were 3μm width, 20nm height and 500 μm length, connecting two microchannels containing the sample and buffer. The surface roughness measured by AFM was 0.7 nm rms. The λ-DNA (48kbp) was labelled by YOYO-1 and diluted in a TBE buffer containing 2.5% polyvinylpyrrolidone (PVP) to reduce electroosmotic flow and 3% β-mercaptoethanol to suppress DNA photobleaching [1]. The measurements were done with an inverted microscope and a fluorescence camera.
Figure 1 schematically presents the experimental setup used to apply the electric field. We used a function generator to supply an AC signal with 1kHz, where the amplitude defined the intensity of the AC field, and the offset defined the DC field. In order to apply the required high voltage to move the DNA in the nanochannels we used a high-voltage amplifier, which was connected to the chip via the waste reservoirs. We characterised the amplifier response in order to know the relation between the generated signal and the applied signal. We detected a deviation of 0.5 V DC voltage and 0.01V amplitude.

Figure 2 shows the observed variation in the mobility due to the AC applied amplitude. As mentioned earlier, when the DC field is below 20kV/m the amplitude increases significantly but when the field is above 20kV/m there is no effect of the AC field. This is shown in the in the 40 and 120kV/m plot where the mobility is practically stable. Note that the 120kV/m plot

shows a significant decrease in the mobility, which is in agreement with the effect previously published when only DC fields were used [1].

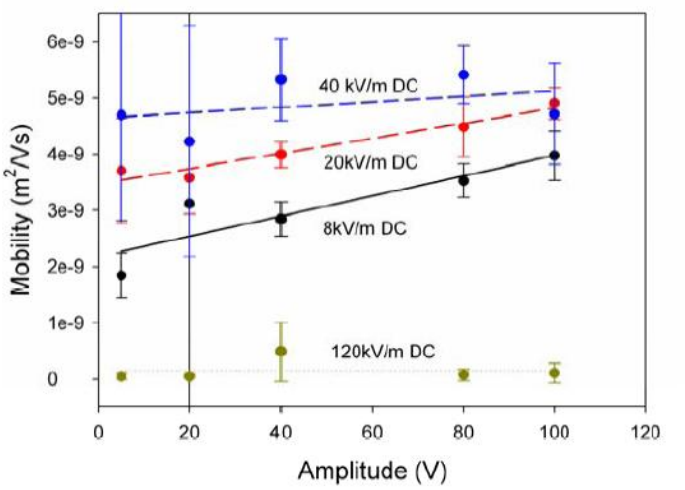

Figure 2: *The measured mobility of DNA versus the applied amplitude in volts, for different intensities of DC field. The mobility increases significantly when DC fields below 20 kV/m were applied, at 40 kV/m the mobility is not influenced. And for higher fields the mobility decrease drastically and there no effect with the mobility too.*

Figure 3 shows the existence of a similar behaviour for the mobility as a function of the DC field applied whatever the amplitude of the AC signals (5V, 40V and 80V). It is shown a strong dependency with the DC voltages applied (note, that at low DC voltages the mobility increases with the amplitude as shown in Figure 2). The final conclusion is that these results are in contradiction with a dielectrophoretic explanation of the observed intermittent movement, because it is not affected by the introduction a more inhomogeneous field. We therefore conclude that the trapping of DNA is due to the steric effects, which at high DC fields could be important, due to the strong elongation of the DNA in the direction of movement.

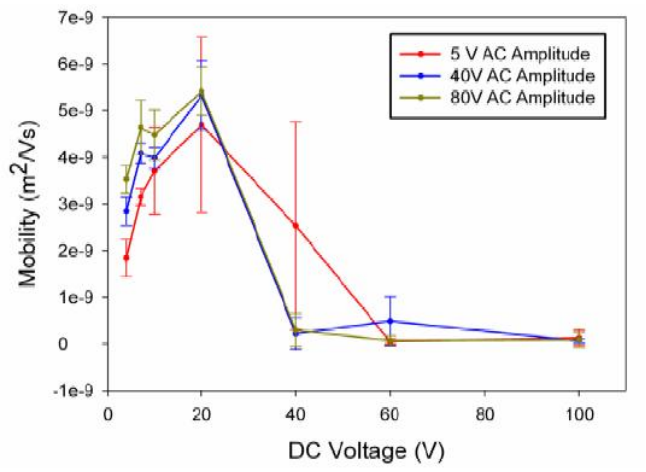

Figure 3: *The measured mobility of DNA versus the applied DC voltage, for different AC amplitudes in Volts. There are no general effects of the different AC intensities, and the mobility decreasing for DC voltages over 20V is also produced, which correlates with the intermittent movement reported. It indicates no influence on the behavior by the addition of AC, showing the hypothesis of the steric effects.*

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High Frequency Behavior of the Datta-Das and Resonant Spin Lifetime Transistors

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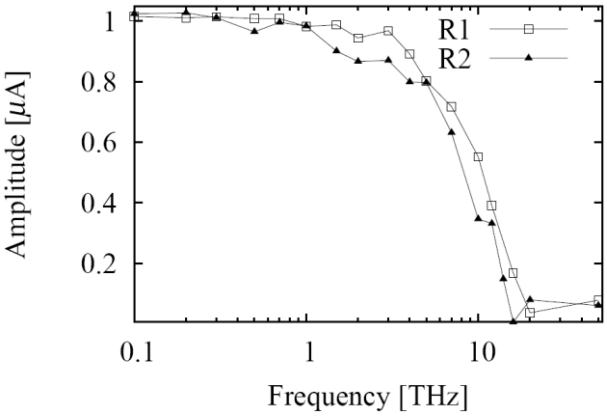

Figure 1: *Amplitude of the current for several Rashba modulating frequencies. R1 and R2 correspond to two different range of modulation of the Larmor frequency. A cutoff frequency of 7.2 THz (6.1 THz) is observed for the range R1 (R2).*

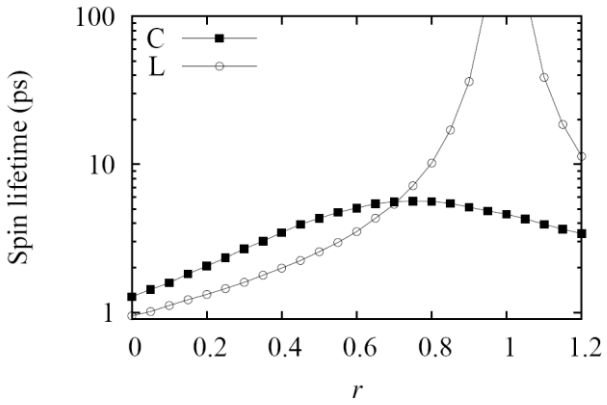

Figure 2: *Spin lifetime calculated using θ(k^3) terms in the Rashba spin Hamiltonian (C) and with only θ(k) terms (L).*

Monte Carlo simulations of spintronic devices is a well known technique [1]; but, usually, no attention is paid to the spin-dependent electron injection process, limiting the validity of the simulations to the time-independent regime. We have recently developed an injection model [2] that allows the simulation of AC devices, and which we have used to study the ultimate limiting factors on the maximum operating frequency (ω_c) of two types of spin field-effect transistors; namely the Datta-Das (DDST) [3] and the non-ballistic resonant spin lifetime transistor (RSLT) [4, 5]. We have found [6] that, for the DDST, ω_c is determined by the transit time of electrons through the channel, rather than by intrinsic parameters of the spin such as the Larmor frequency or the spin lifetime. Thus, ω_c of the DDST will be similar to that of the analogous high electron mobility structure (HEMT), possibly not providing any significant advantage in terms of operating speed.
Our studies of the RSLT show similar results, with ω_c again determined by the transit time through the channel. We also analyzed the influence on the spin lifetime of θ(k^3) terms in the Rashba spin Hamiltonian [7]. These cubic terms, never considered before the present work, have been seen to dramatically affect both the current characteristics and the dynamic behavior of the device, and thus they must be considered for a complete description of the RSLT.
Our findings should call for a reevaluation of the high speed operation prospects for spin-based transistors.

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Massive fabrication of single-walled carbon nanotube field effect transistors

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First field effect transistors (FET) based on individual carbon nanotubes (CNTs) were fabricated in 1998 [1,2]. Since then, different strategies have been proposed to overcome the main challenges to achieve batch, high throughput and massive fabrication of these devices, among them, gaining control over the chiral vector and over the growth direction of the nanotube, which still remain subjects of research.
We present a process for massive fabrication of back-gated SWCNT-FET structures at wafer scale. This technology provides a platform to obtain a very high number of structures (~140,000 per 4 inch wafer) for statistical analysis of CNT-FET electrical and physical characteristics. In addition, it can enable the production of CNT-FET based sensors at an affordable cost.
The technological process is composed of 15 CMOS compatible microfabrication steps. The definition of the devices is accomplished by photolithography, instead of using electron beam lithography as in previous works [3]. Main steps of the process are summed up in Figure 1. CNT catalyst consists in a Fe/Mo/Al_2O_3 solution that is spin coated and then patterned by a lift-off process. CNT synthesis takes place in a rapid thermal CVD system at 800ºC using CH_4 and H_2. Catalyst deposition and growth conditions are optimized in order to have very few, one or zero SWCNTs being contacted by drain and source. As usual, metallic and semiconducting CNTs are randomly obtained.

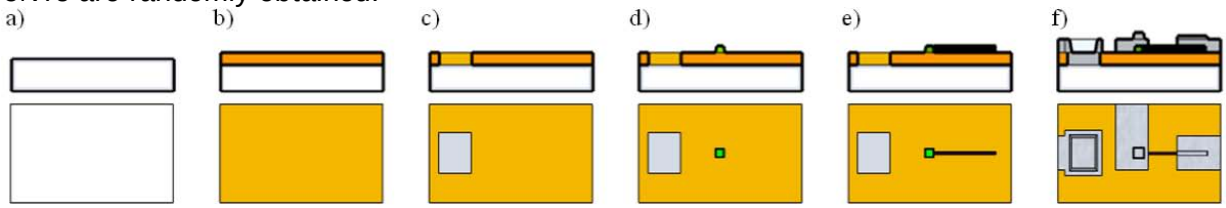

Figure 1: *Technological process: a) P doped Si substrate; b) thermal oxidation of Si; c) selective dry etching of the SiO_2 layer; d) selective deposition of the catalyst material; e) CVD synthesis of SWCNTs; f) patterning, deposition and lift-off of the metal layer.*

A photograph of a 100 mm diameter wafer containing thousands of functional SWCNT-FET devices is shown in Figure 2(a). Optical microscope images in (b) show the high density of structures forming one of the chips and magnification of one of the different contact metals designs. AFM image in (c) shows one SWCNT-FET device with one SWCNT being contacted by both source and drain electrodes. The gap is 0.7 microns in this case.

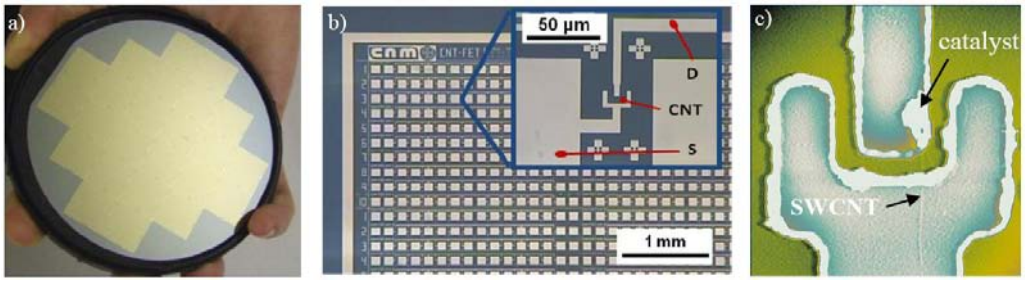

Figure 2: *a) 4 inch SWCNT-FET wafer; b) details of one of the twenty four chips on the wafer and one of the CNT-FET structures; c) 10 x 10 µm² AFM image of one functional SWCNT-FET structure.*

An automatic probe system is used to obtain the electronic characteristic of the devices in a two step procedure (Figure 3). First, drain-source (IDS) electrical current at every CNT-FET structure is measured for V_G=-5V and V_{DS}=0.3V. Then, a computational selection of devices is done to distinguish short circuit, open circuit, operative transistors and contacted metallic SWCNTs. In this way, the impact of the geometrical and process parameters can be evaluated. Based on this selection, individual I_{DS}/V_{GS} measurements for different values of V_{DS} are performed in the pre-selected transistors.

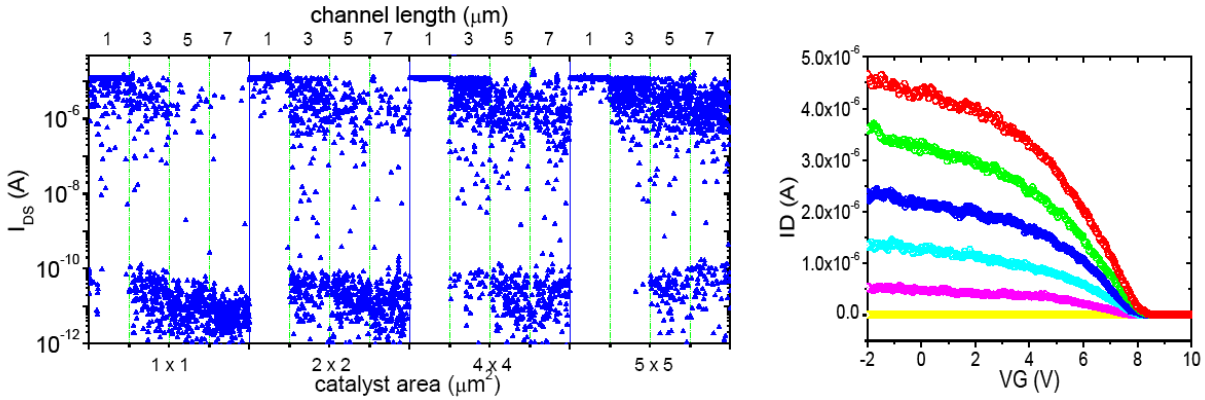

Figure 3: *Electrical characterization of the devices. a) Automatically obtained "map" of one of the chips containing 5,760 structures. The impact of the catalyst deposition area and of the gap between source and drain on the number of working transistors is observed. After examining the data, individual measurements are performed only on devices showing a semiconducting characteristic (b).*

In conclusion, we present a technological process and a characterization procedure for massive fabrication and characterization of semiconducting SWCNT-FET structures. The platform is now being used for experiments on electric characterization of SWCNTs and the technology can also be applied to the fabrication of SWCNT based NEMS and sensors.

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Nanoscale infrared near-field mapping of free-carrier concentration in single semiconductor nanowires

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

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

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

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

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

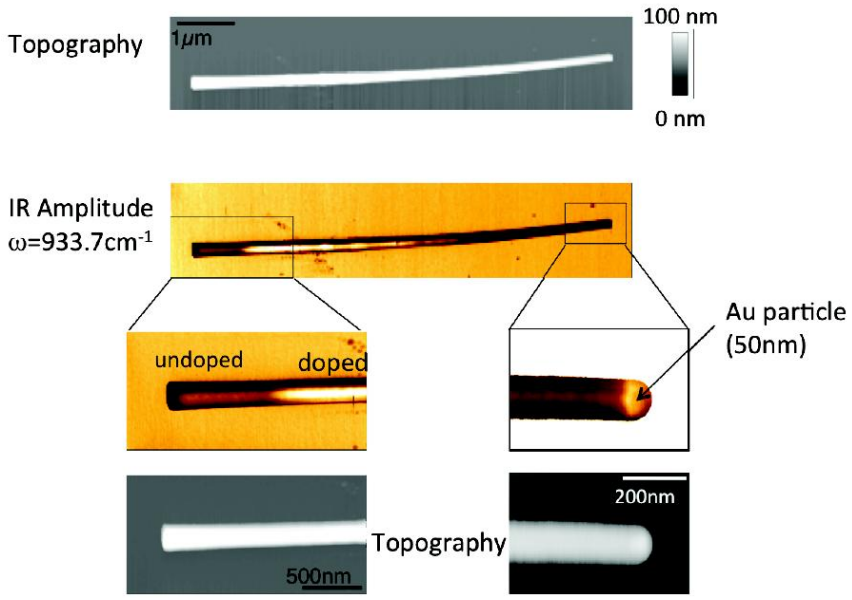

Figure 1: *Topography and infrared amplitude s_2 of a representative InP nanowire recorded simultaneously at an IR laser frequency of 933.7cm^{-1} (10.71μm wavelength). The infrared images clearly reveal the differently doped nanowire sections and the material contrast between InP and the gold particle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

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Conformational-controlled networking of H-bonded assemblies on surfaces

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Directional intermolecular forces are considered promising candidates to study and prepare networks that could undergo phase transitions through a thermally-induced change of molecular conformation which in turn leads to a variation of intermolecular interactions. The intermolecular force that will be exploited is the H-bond due to their intermolecular interaction strength and geometry which can be controlled by the number and arrangement of available H-bonding donor and acceptor moieties.

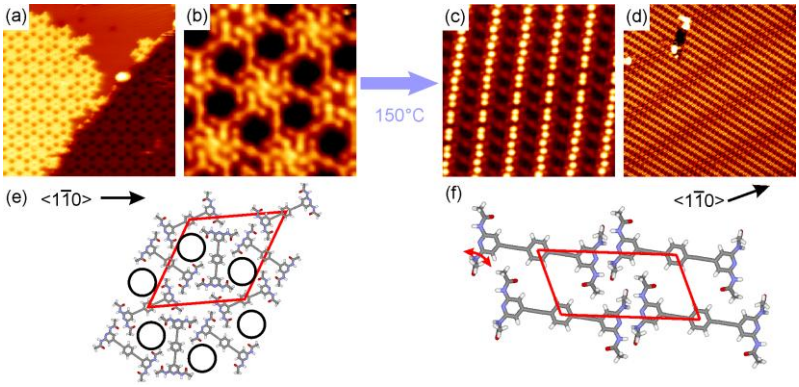

Figure 1: *a) STM image (34 × 34 nm², V_{bias} = –1.7 V, I_t = 20 pA, T = 77 K) of **1** on Ag(111). b) STM image (7 × 7 nm², V_{bias} = -1.7 V, I_t = 20 pA, T = 77 K) showing the porous network in detail. c), d) STM images (a: 10 × 10 nm², V_{bias} = -2 V, I_t = 12 pA, T = 77 K; b: 39 × 39 nm², V_{bias} = –1.5 V, I_t = 12 pA, T = 77 K) of **1** on Ag(111) after thermal annealing at 420 K. In d) a periodic modulation can be seen which is attributed to different conformations of the acetyl residues. e) Model for the porous network of **1** on Ag(111). The red rhombus indicates the unit cell while the black circles highlight the pores. f) Proposed model for the close-packed assembly.*

The 2D self-organization of a conjugated molecule bearing terminal 2,6- di(acylamino)pyridine moieties [1], which are well known to form H-bonds, on a Ag(111) surface under ultrahigh vaccum has been studied by STM. For sample prepared at room temperature, the molecules arrange in a hexagonal network (Figure 1a-b). Combining the information derived from STM and low-energy electron diffraction (LEED) measurements, a commensurate superstructure is found with the molecules arranged in a rhombic unit cell. In Figure 1e the structural model for this ad-layer is shown while the pores visible in the STM image in Figure 2b are denoted by back circles and the black arrow indicates a high symmetry direction of the Ag substrate.
The hexagonal porous network formed at room temperature deposition is transformed into a commensurate close packed rhombic pattern (Figure 1c-d) by a thermally induced trans-cis inversion of the terminal groups. This transformation can be explained by the fact that the system wants to minimize its energy: at the same time the free surface energy is minimized while the number of H-bonds per terminal group is doubled from two to four.

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Fucikova	Anna	Czech Republic	Nanobiotechnologies	*Development of new biolabels based on silicon nanocrystals and nanodiamonds*	PA
Galan Cascales	Teresa	Spain	Nanobiotechnologies	*Fabrication by Dip-Pen Nanolithography of Polypyrrole Nanowires for DNA biosensors*	PA
Galdikas	Arvaidas	Lithuania	Other	*Analysis of depth profile components at the Interface of Ti6242 Alloy and TiNi Coatings after High Temperature Oxidation in Air*	PB
Gamaly	Eugene	Australia	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Young's modulus for graphitic mono-atomic layer (graphene)*	PB

Ganjkhanlou	Yadolah	Iran	Nanostructured and nanoparticle based materials	*Distribution of Eu ion in nano-size Y2O3:Eu Nanopowder prepared by solution combustion method*	PA
García Castelló	Javier	Spain	Nanobiotechnologies	*Integrated optical sensor using silicon ring resonators*	PA
Garcia del Muro	Montse	Spain	Nanostructured and nanoparticle based materials	*In situ TEM observation of nucleation and growth of co particles in zirconia matrix*	PB
Garcia-Barrasa	Jorge	Spain	NanoChemistry	*High antibacterial effect of silver nanoparticles prepared from an organometallic compound*	PA
Garcia-Martin	Antonio	Spain	NanoOptics & NanoPhotonics	*Magento-photonic properties of Nickel inverse opals*	PB
García-Mochales	Pedro	Spain	Theory and modelling at the nanoscale	*Merging nanowires breakage results for different stretching directions to compare with experimental ones*	PB
Ghafari-nazari	Ali	Iran	Nanobiotechnologies	*Silver nanocomposites for antibacterial tile*	PB
Gicquel	Maud	France	NanoOptics & NanoPhotonics	*Insights in optical properties of bundled carbon nanotubes for telecommunications applications: a preliminary comparative study with individualized carbon nanotubes*	PB
Giner	Ignacio	Spain	Nanostructured and nanoparticle based materials	*Fabrication of Langmuir-Blodgett films incorporating*	PA
Goel	Vishya	Canada	Nanostructured and nanoparticle based materials	*Photoluminescence of rare earth doped upconverting NaYF4 nanoparticles*	PA
Gomes	Maria	Portugal	Nanostructured and nanoparticle based materials	*Growth and characterization of Mn- doped ZnO/TiO2 multilayered nanostructures grown by pulsed laser deposition*	PB
Gómez-Coca	Silvia	Spain	Theory and modelling at the nanoscale	*Theoretical Study of Functionalized Nanotubes between Transition Metal Atoms*	PA
Gori	Paola	Italy	Theory and modelling at the nanoscale	*Supramolecular effects of chiral molecules on metallic surfaces: D-alaninol on Cu(100) as a case study*	PB
Grützmacher	Detlev	Germany	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Epitaxy of ordered arrays of semiconductor nanostructures on substrates patterned by EUV interference and e-beam lithography*	PB
Grym	Jan	Czech Republic	Nanostructured and nanoparticle based materials	*Electrophoretic deposition of palladium nanoparticles on InP for hydrogen sensors*	PB
Guarrotxena	Miren	USA	Nanobiotechnologies	*Nanostructured antitags-based biosensors for sensitive detection by SERS enhancement*	PB
Guillemot	Laure-Hélène	Spain	Nanostructured and nanoparticle based materials	*Formulation of surfactant-polymer systems for the synthesis of hybrid organic-inorganic nanocomposites*	PA
Hanna Varghese	Saino	Japan	Nanobiotechnologies	*Development of Biosensors based on Single wall Carbon nanotubes and Aptamers*	PA
Hanschmidt	Kelli	Estonia	Nanostructured and nanoparticle based materials	*Study of gelation during the formation of sol-gel fibres*	PA
Heber	Frederik	Germany	Graphene / Carbon nanotubes based nanoelectronics and field emission	*A molecular dynamics study on fullerene-implanted carbon nanotori as electromagnetic sensing and emitting devices*	PA

Hedderich	Regine	Germany	Other	*Materials for Energy*	PB
Heeg	Sebastian	Germany	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Quantitative Composition of a SWCNT sample: Raman Scattering vs. Photoluminescence*	PA
Hernáez	Miguel	Spain	NanoOptics & NanoPhotonics	*Agarose optical fiber humidity sensor based on surface plasmon resonance in the infra-red region*	PA
Hernáez	Miguel	Spain	NanoOptics & NanoPhotonics	*Optical Fiber pH Sensor based on Surface Plasmon Resonance in the Infra-red Region*	PA
Hinterstein	Manuel	Germany	Nanostructured and nanoparticle based materials	*Field induced phase transition and formation of microdomains from polar nanoregions in lead free ferroelectrics*	PA
Hussien	Muataz	Saudi Arabia	Nanostructured and nanoparticle based materials	*Effect of Reaction Temperature on the Production of Carbon Nanotubes on a Silicon Dioxide Wafer*	PB
Hwang	Sung-Ho	Korea	Nanostructured and nanoparticle based materials	*Preparation and Characterization of Layered Double Hydroxides throughout Determination of Size Controllable Synthetic Parameters*	PB
Idigoras	Olatz	Spain	Nanomagnetism and Spintronics	*Kerr microscopy studies of magnetization reversal uniformity in thin Co-films*	PA
Iglesias	Oscar	Spain	Theory and modelling at the nanoscale	*Microscopic origin of exchange bias in inverted core/shell magnetic nanoparticles*	PB
Ihm	Kyuwook	Korea	Nanostructured and nanoparticle based materials	*Structural phase Transition of Low-coverage Pentacene on SiO2 and Au surfaces*	PB
Iraizoz Muñoa	Ion	Spain	Nanostructured and nanoparticle based materials	*Oxygen sensor based on the thermoelectric effect*	PA
Irure	Ainhoa	Spain	Nanobiotechnologies	*Paramagnetic Gd-based Gold Glyconanoparticles as MRI Contrast Agents for Brain Tumor Detection*	PA
Jeong	Sohee	Korea	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*NQD-SWNT FETs Assembled using Dielectrophoresis*	PB
Ji	Wei	Canada	Theory and modelling at the nanoscale	*Spin-resolved STM simulation of graphene nanoribbon*	PB
Jimenez	David	Spain	Theory and modelling at the nanoscale	*Accurate prediction of the gate tunneling current for surrounding gate MOSFETs*	PB
Jiménez	David	Spain	Nanofabrication tools & nanoscale integration	*Exploiting the negative capacitance region of ferroelectric oxides for surface potential amplification in metal-ferroelectric-insulator-semiconductor devices*	PB
Jimenez Diaz	Roman	Spain	Nanofabrication tools & nanoscale integration	*Individual Nanowires Contacted onto Microhotplates: A Strategy for Improving the Performance of Gas Nanosensors*	PA
Juanola-Feliu	Esteve	Spain	Nanobiotechnologies	*Nanobiotechnologies: technology transfer and commercialization in Spain*	PA
Kalbac	Martin	Czech Republic	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Electrochemical Charging of Single Walled Carbon Nanotubes: An in-situ Raman Spectroelectrochemical Study*	PB
Kaltzakorta	Idurre	Spain	NanoChemistry	*Study on the effect of sol-gel parameters on the size and morphology of silica microcapsules containing different organic compounds*	PA

Kam	Alicia	Canada	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Novel nano-template based quantum dot devices*	PB
Kang	Chang Soo	Korea	Nanostructured and nanoparticle based materials	*The Characteristics of SILC in Silicon Oxide for SoC*	PB
Kazemzad	Mahmood	Iran	NanoChemistry	*Catalytic application of mesoporous silicas in Synthesis of substituted Imidazoles under microwave irradiation and solvent-free conditions*	PA
Ke	Youqi	Canada	Nanomagnetism and Spintronics	*Specular to Diffusive Scattering in Fe/MgO/Fe Magnetic Tunnel Junctions*	PA
Kim	Bongsoo	Korea	NanoChemistry	*NEXAFS and Photoemission Spectroscopy Study for O-Phthalaldehyde (OP) molecule on the H-terminated Si(001) Surface*	PB
Kjelstrup-Hansen	Jakob	Denmark	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Conduction and electroluminescence from organic continuous and nanofiber thin films*	PB
Klar	Philipp	Germany	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Raman spectroscopy of graphene in difeerent dielectric environments*	PA
Kobe	Spomenka	Slovenia	Nanostructured and nanoparticle based materials	*Icosahedral Ti-Zr-Ni thin films*	PB
Kokado	Satoshi	Japan	Nanomagnetism and Spintronics	*Spin-atomic vibration interaction and spin-flip Hamiltonian of a single atomic spin*	PB
Kometani	Noritsugu	Japan	Nanostructured and nanoparticle based materials	*Preparation of size-controlled silver nanoparticles by the hydrothermal method*	PB
Korytár	Richard	Spain	Theory and modelling at the nanoscale	*Band selection and disentanglement using maximally-localized Wannier functions: the cases of Co impurities in bulk copper and the Cu (111) surface*	PA
Koval	Peter	France	Theory and modelling at the nanoscale	*Product basis set in TDDFT: molecular absorption spectra within linear response.*	PB
Kovylina	Miroslavna	Spain	Nanomagnetism and Spintronics	*Magnetoresistance in positive and negative exchange bias Ni/FeF2 bilayered antidots*	PA
Krull	Cornelius	Spain	SPM	*Homochiral monolayers of Cu-Phthalocyanine driven by adsorption induced electronic chirality*	PA
Laoui	Tahar	Saudi Arabia	Nanostructured and nanoparticle based materials	*Properties of Copper Coated with Carbon Nanotubes*	PB
Lee	Kyoung Jae	Korea	Other	*H2O Induced Structural Modification of Pentacene Crystal*	PA
Lee	Soo-Keun	Korea	Nanostructured and nanoparticle based materials	*Hydrothermal synthesis and characterization of nano-flake magnesium hydroxides from magnesium oxide*	PB
Lepage	Dominic	Canada	NanoOptics & NanoPhotonics	*Surface plasmon effects induced by uncollimated emission of semiconductor microstructures*	PA
Liao	Siyu	France	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Compact modeling of Optically-Gated Carbon NanoTube Field Effect Transistor*	PA
Lim	Sang Kyoo	Korea	Nanostructured and nanoparticle based materials	*Preparation of Electrically Conductive PET Film with Al-doped Zinc Oxide Nanorods*	PB

Lin	Ta-Chun	Taiwan	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Magneto-optical study of single InAs/GaAs quantum rings*	PA
López Ortega	Alberto	Spain	Nanomagnetism and Spintronics	*Hetero-Onion-like, multilayered, core-Fe3O4|shell1-MnFe2O4|shell2-γ-Mn2O3 nanoparticles*	PA
Loucaides	Neophytos	Cyprus	Theory and modelling at the nanoscale	*Numerical simulation of Dielectrophoresis and AC Electroosmosis for DNA trapping including the particle steric effect*	PA
Maillard	Arnaud	Canada	Theory and modelling at the nanoscale	*Electronic Properties of Organic Photovoltaic rr-P3HT/C60 Ordered Blend*	PA
Manning	Brendan	Spain	Nanobiotechnologies	*The use of photolabile oligonucleotides in the fabrication of patterned surfaces*	PA
Mañanes	Ángel	Spain	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Length dependence of half-metallicity on zigzag carbon nanotubes*	PB
Mañanes	Angel	Spain	Nanobiotechnologies	*Aggregate model for the vibrational properties of hydroxyapatites*	PB
Martinez	Benjamin	Spain	Nanostructured and nanoparticle based materials	*Self-assembling of Magnetic Nanoparticle onto Technological Substrates*	PB
Martins	Nelson	Portugal	Nanobiotechnologies	*A DNA Chip for the detection of microorganisms in water samples – Design and preliminary results*	PB
Martsinovich	Natalia	UK	Theory and modelling at the nanoscale	*Aggregation of Polycarboxylic Acids into Self-Assembled Molecular Networks: A Theoretical Study*	PB
May	Patrick	Germany	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Temperature Dependence of the Optical Transitions in Single-walled Carbon Nanotubes*	PA
Mc Dermott	Shane	Ireland	Theory and modelling at the nanoscale	*Tunnel Currents across Silane Diamines/Dithiols and Alkane Diamines/Dithiols*	PA
Medina	Ernesto	Venezuela	Nanomagnetism and Spintronics	*Spin polarisation of electrons using chiral molecular potentials*	PB
Mendez	Maria	Spain	Nanostructured and nanoparticle based materials	*Synthesis and characterization of europium-doped La2O3 nanoparticles*	PA
Méndez Ramos	Jorge	Spain	Nanostructured and nanoparticle based materials	*White-light up-conversion emission in transparent sol-gel derived glass-ceramics containing rare-earth doped YF3 nano-crystals*	PB
Méndez Ramos	Jorge	Spain	Nanostructured and nanoparticle based materials	*Up-conversion in Yb3+-Ho3+-Tm3+ co-doped NaYF4 nano-crystals embedded in a silica glass synthesized by sol-gel route*	PB
Mereni	Lorenzo	Ireland	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*A New Pyramidal Quantum Dots System: achieving high optical quality in an uniform, site-controlled system*	PA
Miguel	Nuria	Spain	Nanobiotechnologies	*Optimization and scaled-up of a method for the preparation of dispersions formed by isolated magnetic nanoparticles for biomedical applications*	PA
Mikhailova	Maya	Russia	NanoOptics & NanoPhotonics	*Mid-infrared light emitting diodes and high-speed photodiodes based on type II heterostructures with deep AlSb/InAsSb/AlSb quantum wells in active layers*	PB
Miranda	Álvaro	Spain	Theory and modelling at the nanoscale	*Molecular doping in Silicon Nanowires: an ab-initio study*	PA

Molina	Luis M.	Spain	Theory and modelling at the nanoscale	*Selective synthesis of small gold clusters with odd or even sizes*	PB
Montero Rodríguez	María Belén	Spain	Nanostructured and nanoparticle based materials	*Analysis by ATR-FTIR of the curing process in epoxy resins modified with two different Polyhedral Oligomeric Silsesquioxanes (POSS).*	PA
Morales Masis	Monica	Netherlands	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Understanding the physics of conductance switches*	PA
Morillo Martin	Diego	Spain	NanoChemistry	*Fe3O4 nanoparticles-loaded Cellulose Sponge: novel system for the Arsenic removal from aqueous solution*	PA
Müller	Matthias	Germany	NanoChemistry	*Raman Study of Electronic Properties of Propylamin-functionalized Single-walled Carbon Nanotubes*	PA
Muraviev	Dmitri N.	Spain	NanoChemistry	*New nanosized catalytic system for Biginelli reaction*	PB
Nadejde	Claudia	Romania	Nanostructured and nanoparticle based materials	*Experiments regarding the role of magnetic/non-magnetic stirring in the process of ferrophase preparation for stable magnetic fluids*	PA
Nair	Remya	Japan	Nanostructured and nanoparticle based materials	*Size tuning and oxygen plasma induced pore formation on silica nanoparticles*	PA
Najari	Montssar	France	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Physics-Based Compact Model for Schottky Barrier Carbon Nanotube FET*	PA
Nasibulina	Larisa	Finland	Nanostructured and nanoparticle based materials	*A novel approach to create strong and conductive construction materials*	PA
Nazarpour	Soroush	Spain	Nanostructured and nanoparticle based materials	*Inconsistent behavior of electrical conductivity in Pd thin film as a function of film thickness*	PA
Nemes - Incze	Peter	Hungary	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Realizing a crystallographic orientation dependent chemical etching of graphene*	PA
Neumann	Ingmar	Spain	Nanomagnetism and Spintronics	*Spin dependent tunneling in ferromagnet/insulator/paramagnet junctions*	PA
Nikolova	Liliya	Canada	Other	*In situ observations of the Dynamics at Nanoscale by Ultrafast Transmission Electron Microscopy*	PA
Ning	Zhanyu	Canada	Theory and modelling at the nanoscale	*Conductance of Au-BDT-Au molecular wires: A quantitative analysis*	PA
Nuansing	Wiwat	Spain	Nanofabrication tools & nanoscale integration	*Crystalline Structure of ElectrospunPeptide*	PA
Nüssl	Rudolf	Germany	Nanostructured and nanoparticle based materials	*High Power Durable Nano Resonators with Epitaxial Aluminum Electrodes*	PA
O'Mahony	Joseph	Ireland	SPM	*Computer based methods for accurate background removal in SPM metrology applications*	PB
Ono	Takahito	Japan	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Integration Process of Carbon Nanotube Piezoresistive Elements into Microsensors*	PB
Ormaza Saezmiera	Maider	Spain	Nanostructured and nanoparticle based materials	*Two-dimensional bands of rare earth/gold surface alloys measured with ARPES*	PA

Pacheco	Monica	Chile	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Quantum transport in carbon-based nanostructures perturbed by time-dependent potentials*	PB
Park	Jae Young	Korea	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Sensing Properties of Oxide Core-Shell Nanofibers Synthesized by a Novel Two-Step Method*	PA
Passeggi	Mario César Guillermo	Argentina	SPM	*Initial growth stages of AlF3 on Cu(100): an STM study*	PB
Patrone	Lionel	France	SPM	*Role of labile bonding in stochastic switching of molecular conductance studied by STM*	PB
Peláez	Samuel	Spain	Theory and modelling at the nanoscale	*Mechanical Properties of Metallic Pentagonal Nanowires: Temperature Dependence*	PA
Peña	Luis	Spain	Nanostructured and nanoparticle based materials	*Magnetic Properties of Self-Assembled Cobalt Nanoparticles Crystal Superlattices*	PA
Pérez-Jiménez	Ángel J.	Spain	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Effects of molecular pi-stacking on the conductance of nanographene-gold junctions*	PB
Pinilla	Elena	Spain	SPM	*STM Study of Magnetic Polyoxometalates on HOPG Surfaces*	PA
Piñeiro Rodríguez	Alberto	Spain	Theory and modelling at the nanoscale	*Phase separation in La_(1-x)Ca_(x)MnO_(3) via nanoscale doping inhomogeneities*	PA
Pisanello	Ferruccio	France	NanoOptics & NanoPhotonics	*Colloidal nanocrystals for quantum information technology*	PA
Plaado	Margo	Estonia	Nanostructured and nanoparticle based materials	*Characterization of carbon nanotube fibers prepared by dielectrophoresis*	PA
Podrazky	Ondrej	Czech Republic	Nanostructured and nanoparticle based materials	*Alumina Nanopowder and Europium Co-doped Silica Optical Fibers*	PB
Pohlenz	Dieter	Denmark	SPM	*QPlus AFM with small oscillation amplitudes and high frequencies at 5 K*	PB
Prida	Victor	Spain	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Synthesis an characterization of highly ordered FexPd100-x nanowire arrays by template assisted electrodeposition*	PB
Queitsch	Ute	Germany	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Quantitative determination of the mobility and sliding friction force of gas phase deposited nanoparticles from their agglomeration behavior*	PA
Ranjan	Mukesh	Germany	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Optical anisotropy of self-aligned Ag nanoparticles and nanowires on pre-rippled Si surfaces*	PA
Rezanka	Pavel	Czech Republic	Nanostructured and nanoparticle based materials	*Cysteine Gold Nanoparticles in Open-tubular Capillary Electrochromatography*	PA
Ricoma	Marcal	Spain	Other	*Formation and characterization of electrically induced nanodiodes in thin oxide films*	PA
Rocheleau	Philippe	Canada	Theory and modelling at the nanoscale	*Extension of the Source-Sink Potential (SSP) approach for multiple channels conductance calculations*	PA
Ronci	Fabio	Italy	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Low temperature STM/STS study of silicon nanowires grown on the Ag(110) surface*	PB

Rosales	Luis	Chile	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Transport properties of graphene ribbons with a random distribution of side attached benezene-like molecules*	PB
Rubio-Garcia	Javier	France	NanoChemistry	*Multi-solvent ZnO stable colloidal dispersions via organometallic method*	PA
Ruiz Nicolas	Patricia	Spain	Other	*Eykes: a new software application for analyzing Transmission Electron Microscopy images of nanoparticles*	PA
Ruiz Nicolás	Patricia	Spain	Nanostructured and nanoparticle based materials	*Synthesis of Polymer Stabilized Palladium Nanoparticles by Wet Chemical and Electrochemical Routes*	PA
Safaei	Maryam	Iran	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Experimental design for determination of effective parameters in hydrothermal synthesis of TiO2-derived nanotubes*	PA
Salamanca	Laura	Spain	Other	*Application of Convergent Technologies (Nano-Bio-Info-Cogno) in Health: The Ibero-NBIC Network*	PB
Salundi	Aigi	Estonia	Nanostructured and nanoparticle based materials	*Alkoxide gel nanofilm cracking processes for creating of novel structures*	PA
Sanchez	Florencio	Spain	Nanostructured and nanoparticle based materials	*Self-nanostructuration of the chemical termination of SrTiO3(001) substrates: templates for fabrication of functional oxide nanostructures*	PB
Sanchez-Portal	Daniel	Spain	Theory and modelling at the nanoscale	*On the Magnetism of Substitutional Transition-Metal Impurities in Graphenic Nanostructures*	PB
Santiago Gonzalez	Beatriz	Spain	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Synthesis and fluorescent properties of gold atomic clusters*	PA
Santos	Hernan	Spain	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Carbon nanoelectronics: unzipping tubes into graphene ribbons*	PB
Santos	Nuno	Portugal	Nanomagnetism and Spintronics	*Ferromagnetic resonance in nanometric epitaxial Fe3Si films on (111)Ge*	PA
Sanz Monasterio	Mikel	Spain	Nanostructured and nanoparticle based materials	*Grown and characterization of semiconductor nanostructures by laser ablation*	PB
Sañudo	E. Carolina	Spain	Nanomagnetism and Spintronics	*Synthesis and magnetic properties of dimers of weakly magnetically coupled molecules*	PB
Saraidarov	Tsiala	Israel	Nanostructured and nanoparticle based materials	*Synthesis of Silver Nanoparticles and Stabilization in Different Liquid and Solid Sol-Gel Matrices.Optical and Structural Characterization.*	PB
Sashchiuk	Aldona	Israel	Nanostructured and nanoparticle based materials	*Temperature dependence of the ground-state exciton in PbSe core, and relevant core-shell colloidal quantum dot structures*	PB
Sassiat	Nicolas	Ireland	Nanostructured and nanoparticle based materials	*Charge Transport in Plasmonic Nanocrystal-Molecule Nanostructures*	PB
Sassiat	Nicolas	Ireland	Nanostructured and nanoparticle based materials	*Modeling of Nanocrystal-Molecule Nanostructure Formation*	PA
Saura	Xavier	Spain	Theory and modelling at the nanoscale	*Monte Carlo Modelling of Electron Transport in Si Quantum-Wire Double-Gate MOSFETs in Presence of Atomistic Impurities*	PA
Schäffel	Franziska	Germany	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Shedding light on the crystallographic etching of graphene at the atomic scale*	PA

Schmidt	Grégory	France	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Tuning of metallic vs semiconducting selectivity in the reaction of diazonium with SWNT to enhance CNTFETs performances*	PA
Schmidt	Grégory	France	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Photosensitization of carbon nanotubes using photosynthetic proteins to optoelectronic applications*	PA
Sempere	Julia	Spain	Other	*The NanoSost project: towards to a sustainable, responsible and safe nanotechnology*	PB
Seral-Ascaso	Andrés	Spain	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Chemical Design for the Tailored Production of Metal-Doped Nanostructured Carbon Foam by Laser Ablation*	PA
Serrate	David	Spain	SPM	*Engineering Spin Structures on the Atomic Scale*	PB
Sharma	Deepali	India	NanoChemistry	*Synthesis and Characterization of Zinc Oxide Nanostructures Under Different Reaction Conditions*	PA
Sheka	Elena	Russia	Nanomagnetism and Spintronics	*Magnetism of nanocarbons: fullerene c60 and graphene*	PB
Shin	Hyun-Joon	Korea	Other	*Scanning photoelectron microscopy for nanomaterials and nanodevice characterization*	PB
Sobolev	Nikolai	Portugal	Nanomagnetism and Spintronics	*Magnetic properties of Co, Al and Mn, Al co-doped ZnO films*	PB
Son	Jong-Tae	Korea	Nanostructured and nanoparticle based materials	*Surface modified Li1.05Ni0.35Co0.25Mn0.4O2 cathode material by using nano particle coating for lithium secondary battery*	PB
Soreta	Tesfaye Refera	Spain	Nanostructured and nanoparticle based materials	*Nanostructured Surface Preparation for Enhancement of Sensitivity of Electrochemical DNA Sensors*	PA
Soriano	David	Spain	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Magnetic zigzag graphene nanoribbons from carbon nanotubes*	PA
Sorokin	Pavel	Russia	Graphene / Carbon nanotubes based nanoelectronics and field emission	*The investigation of two-dimensional semiconducting nanostructures based on single graphene sheets with "lines" of adsorbed hydrogen*	PB
Sorokin	Pavel	Russia	Graphene / Carbon nanotubes based nanoelectronics and field emission	*The theoretical study of the atomic and electronic structure of graphene biribbons*	PB
Stöffler	Dominik	Germany	SPM	*Scanning probe measurements and electromigration of metallic nanostructures under ultra-high vacuum conditions*	PA
Sulima	Torsten	Germany	Nanostructured and nanoparticle based materials	*High Power Durable Resonators fabricated with Aluminum-Scandium-Alloys*	PB
Sun	Hong-Tao	Japan	Nanostructured and nanoparticle based materials	*A General Route to Efficient Near-Infrared Emission of Optically Active Nanozeolites*	PB
Suñol	Joan Josep	Spain	Nanostructured and nanoparticle based materials	*Nanostructured materials developed by controlled annealing*	PB
Tätte	Tanel	Estonia	Nanostructured and nanoparticle based materials	*Preparation of different shape metal oxide micro- and nanostructures by gelation of oligomeric metal alkoxide concentrates*	PB
Tenas Ricart	Joaquin	Spain	NanoChemistry	*Epoxy Based Hybrid Materials Using Functionalised Alkoxysilanes*	PA

Tohidlou	Esmail	Iran	Nanostructured and nanoparticle based materials	*Effect of Zn addition on optical properties and microstructure of Y2O3:Eu nanopowders by solution combustion method*	PB
Torrent-Burgues	Juan	Spain	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Fabrication and characterization of well-ordered mono and multilayer Langmuir-Blodgett films incorporating zinc phthalocyanines*	PB
Tosolini	Giordano	Spain	Nanofabrication tools & nanoscale integration	*Silicon microcantilevers with MOSFET detection*	PA
Trelka	Marta	Spain	NanoChemistry	*Epitaxial growth of organic nanocrystals with antiferroelectrical stacking*	PA
Trojahn	Ulrike	Canada	Other	*Development and Characterization of EGFR-targeted Iron-oxide Nanoparticles for Improved Magnetic Resonance Imaging of Brain Tumors.*	PA
Umemura	Kazuo	Japan	Nanobiotechnologies	*Nanoporous biosilica produced by diatom cells cultured in the presence of metals.*	PB
Urban	Christian	Spain	Nanostructured and nanoparticle based materials	*Charge-Transfer-Induced Structural Rearrangements at Both Sides of Organic Acceptor/Metal Interfaces*	PA
Urrutia Azcona	Aitor	Spain	Nanostructured and nanoparticle based materials	*An antibacterial surface coating composed of PAH/SiO2 nanostructurated films by Layer by Layer*	PA
Vasile	Bogdan Stefan	Romania	Nanostructured and nanoparticle based materials	*Yttria totally stabilized zirconia nanoparticles obtained through the pyrosol method*	PB
Vasile	Otilia-Ruxandra	Romania	Nanostructured and nanoparticle based materials	*New nanostructured materials based electrochemical microsensors*	PB
Vasiliu	Cristina	Romania	NanoOptics & NanoPhotonics	*Relation between Macroscopic and Microscopic Hyperpolarizability of Er(III) complexes with organic mixed ligands*	PB
Vega	Andrés	Spain	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Impact of dimerization and stretching on the transport properties of molybdenum atomic wires*	PB
Veverkova	Lenka	Czech Republic	NanoChemistry	*Interaction of oxoanions with gold nanoparticles modified by porfyrin-brucine conjugate studied by ECD spectroscopy*	PA
Vidal	Gabriel	Spain	Other	*Measurement of Repulsive Casimir Forces Using Silicon Membranes*	PA
Vilà	Anna	Spain	Nanofabrication tools & nanoscale integration	*Study of characteristics of GIZO based TFT devices in the sub-micron scale*	PB
Vilar Vidal	Noelia	Spain	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Synthesis of fluorescent copper clusters*	PA
Vílchez	Alejandro	Spain	Nanostructured and nanoparticle based materials	*Preparation of magnetic polystyrene-divinylbenzene hybrid nanocomposites*	PA
Voinova	Marina	Sweden	Theory and modelling at the nanoscale	*Theoretical Analysis of Acoustical Microsensors Response in Nanobiology Applications*	PB
Vuillaume	Dominique	France	Nanostructured and nanoparticle based materials	*Functional Model of Nanoparticle-Organic Memory Transistor for Use as a Spiking Synapse*	PB
Wang	Zhao	Switzerland	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*In-situ mechanical testing of nanowires and nanodots*	PB
Wang	Zhao	Switzerland	Graphene / Carbon nanotubes based nanoelectronics and field emission	*Electrostatics of Carbon Nanotubes and Graphene: Electric Charges and Deformation.*	PB

Yagüe	Jose Luis	Spain	Nanostructured and nanoparticle based materials	*Surface nanostructuration to increase polypyrrole adhesion deposited by PECVD*	PA
Yang	Sangsun	Korea	Nanostructured and nanoparticle based materials	*Characterization of Cu Nano-colloid Prepared by Wire Electric Explosion Process in Liquid*	PB
Yáñez Vilar	Susana	Spain	Other	*Study of the dielectric properties of La0.67Ca0.33MnO3 nanoparticles and La0.67Ca0.33MnO3@SiO2 nanocomposites*	PA
Yate	Luis	Spain	Nanostructured and nanoparticle based materials	*Nanocomposite a-C:Cr coatings deposited by shielded cathodic vacuum arc*	PA
Yoshida	Akihito	Japan	Nanostructured and nanoparticle based materials	*Synthesis and spectroscopic properties of silver:dye composite nanoparticles with a double-shell structure*	PA
Zhu	Beien	Belgium	Low dimensional materials (nanowires, clusters, quantum dots, etc.)	*Nanowire formation by means of coalescence of small gold clusters encapsulated inside carbon nanotubes*	PA
Zotti	Linda Angela	Spain	Theory and modelling at the nanoscale	*Revealing the role of anchoring groups in the electrical conduction through single-molecule junctions*	PB
Zubizarreta	Xabier	Spain	Theory and modelling at the nanoscale	*First-principles linewidths of quantum-well states in Pb(111) thin films.*	PA
Zvatora	Pavel	Czech Republic	NanoChemistry	*Boronic acid modified silver nanoparticles for saccharide recognition*	PA

Session PA (153)

Presenting Author		Country	Poster Title
TOPIC: Carbon Nanotubes Based Nanoelectronics and Field Emission			
Adam	Élyse	Canada	*Electroluminescence in carbon nanotube network field-effect transistors*
Amr	Issam	Saudi Arabia	*The Role of Reaction Temperature on the Growth of Carbon Nanomaterials*
Barreiro	Amelia	Spain	*Transport properties of graphene in the high-current limit*
Heber	Frederik	Germany	*A molecular dynamics study on fullerene-implanted carbon nanotori as electromagnetic sensing and emitting devices*
Heeg	Sebastian	Germany	*Quantitative Composition of a SWCNT sample: Raman Scattering vs. Photoluminescence*
Klar	Philipp	Germany	*Raman spectroscopy of graphene in difeerent dielectric environments*
Liao	Siyu	France	*Compact modeling of Optically-Gated Carbon NanoTube Field Effect Transistor*
May	Patrick	Germany	*Temperature Dependence of the Optical Transitions in Single-walled Carbon Nanotubes*
Najari	Montssar	France	*Physics-Based Compact Model for Schottky Barrier Carbon Nanotube FET*
Nemes - Incze	Peter	Hungary	*Realizing a crystallographic orientation dependent chemical etching of graphene*
Santos	Hernan	Spain	*Carbon nanoelectronics: unzipping tubes into graphene ribbons*
Schäffel	Franziska	Germany	*Shedding light on the crystallographic etching of graphene at the atomic scale*
Schmidt	Grégory	France	*Tuning of metallic vs semiconducting selectivity in the reaction of diazonium with SWNT to enhance CNTFETs performances*
Schmidt	Grégory	France	*Photosensitization of carbon nanotubes using photosynthetic proteins to optoelectronic applications*
Soriano	David	Spain	*Magnetic zigzag graphene nanoribbons from carbon nanotubes*
TOPIC: Low-Dimensional Materials			
Bilan	Stefan	Spain	*Pyrrolo-TTF-based molecular electronics*
Bracko	Ines	Slovenia	*Hydrothermal synthesis and characterization of one-dimensional titanate-based nanostructures*
Choi	Sun-Woo	Korea	*Synthesis of Metal Nanoparticles in Solutions by Gamma-ray Illumination and Their Physical Properties*
Druzhinina	Tamara	Netherlands	*Selective growth of carbon nanotubes by microwave irradiation*

Presenting Author		Country	Poster Title
Escartín	José María	Spain	*Far-infrared spectrum of few-electron concentric quantum rings*
Fernández Regúlez	Marta	Spain	*Piezoresistive Cantilevers based on Si nanowire array strain gauges*
Lin	Ta-Chun	Taiwan	*Magneto-optical study of single InAs/GaAs quantum rings*
Mereni	Lorenzo	Ireland	*A New Pyramidal Quantum Dots System: achieving high optical quality in an uniform, site-controlled system*
Morales Masis	Monica	Netherlands	*Understanding the physics of conductance switches*
Park	Jae Young	Korea	*Sensing Properties of Oxide Core-Shell Nanofibers Synthesized by a Novel Two-Step Method*
Queitsch	Ute	Germany	*Quantitative determination of the mobility and sliding friction force of gas phase deposited nanoparticles from their agglomeration behavior*
Ranjan	Mukesh	Germany	*Optical anisotropy of self-aligned Ag nanoparticles and nanowires on pre-rippled Si surfaces*
Safaei	Maryam	Iran	*Experimental design for determination of effective parameters in hydrothermal synthesis of TiO2-derived nanotubes*
Santiago Gonzalez	Beatriz	Spain	*Synthesis and fluorescent properties of gold atomic clusters*
Seral-Ascaso	Andrés	Spain	*Chemical Design for the Tailored Production of Metal-Doped Nanostructured Carbon Foam by Laser Ablation*
Vilar Vidal	Noelia	Spain	*Synthesis of fluorescent copper clusters*
Zhu	Beien	Belgium	*Nanowire formation by means of coalescence of small gold clusters encapsulated inside carbon nanotubes*
TOPIC: Nanobiotechnologies			
Castro	Laura	Spain	*Extracellular biosynthesis of gold nanoparticles using sugar beet pulp*
Chiriacò	Maria Serena	Italy	*EIS Biochips for studying cell cultures*
Esteban Ferrer	Daniel	Spain	*Nanoscale Impedance Microscopy on single bacteria. A theoretical study.*
Faucher	Luc	Canada	*Impact of agglomeration on the relaxometric properties of gadolinium oxide nanoparticles as a contrast agent for MRI*
Fucikova	Anna	Czech Republic	*Development of new biolabels based on silicon nanocrystals and nanodiamonds*
Galan Cascales	Teresa	Spain	*Fabrication by Dip-Pen Nanolithography of Polypyrrole Nanowires for DNA biosensors*
García Castelló	Javier	Spain	*Integrated optical sensor using silicon ring resonators*
Hanna Varghese	Saino	Japan	*Development of Biosensors based on Single wall Carbon nanotubes and Aptamers*
Irure	Ainhoa	Spain	*Paramagnetic Gd-based Gold Glyconanoparticles as MRI Contrast Agents for Brain Tumor Detection*
Juanola-Feliu	Esteve	Spain	*Nanobiotechnologies: technology transfer and commercialization in Spain*
Manning	Brendan	Spain	*The use of photolabile oligonucleotides in the fabrication of patterned surfaces*
Miguel	Nuria	Spain	*Optimization and scaled-up of a method for the preparation of dispersions formed by isolated magnetic nanoparticles for biomedical applications*
Vergaro	Viviana	Italy	*Halloysite Clay Nanotubes: Characterization, Biocompatibility and Use as Drug Carriers*

Presenting Author		Country	Poster Title
TOPIC: Nanochemistry			
Abd El-Fattah	Zakaria	Spain	*Adsorption of Functionalized Fullerene Molecules on Different Noble Metal Substrates: An STM Study*
Alonso	Amanda	Spain	*Recyclable Catalytically Active Superparamagnetic Polymer-Metal Nanocomposites with enhanced Structural Parameters*
Dávila Ibáñez	Ana Belén	Spain	*Silica-coated cobalt boride nanoparticles synteshis, magnetic characterization and functionalization*
de Mendoza	Paula	Spain	*Design of New Polyaromatic Scaffolds for Nano-Scale Molecular Electronics*
Garcia-Barrasa	Jorge	Spain	*High antibacterial effect of silver nanoparticles prepared from an organometallic compound*
Kaltzakorta	Idurre	Spain	*Study on the effect of sol-gel parameters on the size and morphology of silica microcapsules containing different organic compounds*
Kazemzad	Mahmood	Iran	*Catalytic application of mesoporous silicas in Synthesis of substituted Imidazoles under microwave irradiation and solvent-free conditions*
Morillo Martin	Diego	Spain	*Fe3O4 nanoparticles-loaded Cellulose Sponge: novel system for the Arsenic removal from aqueous solution*
Müller	Matthias	Germany	*Raman Study of Electronic Properties of Propylamin-functionalized Single-walled Carbon Nanotubes*
Pérez Mirabet	Leonardo	Spain	*Syntesis and magnetic properties of monodisperse mixt ferrite nanoparticles*
Rubio-Garcia	Javier	France	*Multi-solvent ZnO stable colloidal dispersions via organometallic method*
Sharma	Deepali	India	*Synthesis and Characterization of Zinc Oxide Nanostructures Under Different Reaction Conditions*
Tenas Ricart	Joaquin	Spain	*Epoxy Based Hybrid Materials Using Functionalised Alkoxysilanes*
Trelka	Marta	Spain	*Epitaxial growth of organic nanocrystals with antiferroelectrical stacking*
Veverkova	Lenka	Czech Republic	*Interaction of oxoanions with gold nanoparticles modified by porfyrin-brucine conjugate studied by ECD spectroscopy*
Zvatora	Pavel	Czech Republic	*Boronic acid modified silver nanoparticles for saccharide recognition*
TOPIC: Nanofabrication Tools and Nanoscale Integration			
Afshar	Fatemeh	Spain	*On the Electrical properties of the C/Au thin film electrode deposited Over LTCC substrate*
Alayo	Nerea	Spain	*Technological development for step and repeat imprint lithography*
Dadvand	Afshin	Canada	*Multifunctional organic field-effect transistors based on phentyl-vinyl end-capped of anthracene and tetracene*
Druzhinina	Tamara	Netherlands	*Chemistry on the nanometer-scale – electro-oxidatively generated nanometer patterns functionalized by self-assembled monolayers*

Presenting Author		Country	Poster Title
Jimenez Diaz	Roman	Spain	*Individual Nanowires Contacted onto Microhotplates: A Strategy for Improving the Performance of Gas Nanosensors*
Nuansing	Wiwat	Spain	*Crystalline Structure of ElectrospunPeptide*
Tosolini	Giordano	Spain	*Silicon microcantilevers with MOSFET detection*
TOPIC: Nanomagnetism and Spintronics			
Corredor Vega	Edna	Spain	*Magnetic properties in strained double epitaxial nickel films with perpendicular magnetic anisotropy*
Idigoras	Olatz	Spain	*Kerr microscopy studies of magnetization reversal uniformity in thin Co-films*
Ke	Youqi	Canada	*Specular to Diffusive Scattering in Fe/MgO/Fe Magnetic Tunnel Junctions*
Kovylina	Miroslavna	Spain	*Magnetoresistance in positive and negative exchange bias Ni/FeF2 bilayered antidots*
López Ortega	Alberto	Spain	*Hetero-Onion-like, multilayered, core-Fe3O4|shell1-MnFe2O4|shell2-γ-Mn2O3 nanoparticles*
Neumann	Ingmar	Spain	*Spin dependent tunneling in ferromagnet/insulator/paramagnet junctions*
Santos	Nuno	Portugal	*Ferromagnetic resonance in nanometric epitaxial Fe3Si films on (111)Ge*
TOPIC: NanoOptics & NanoPhotonics			
Babuty	Arthur	France	*Near field observation of surface plasmons generated electrically*
Fernández Torrado	Jorge	Spain	*Interaction between LSP and SPP in magnetoplasmonic structures*
Hernáez	Miguel	Spain	*Agarose optical fiber humidity sensor based on surface plasmon resonance in the infra-red region*
Hernáez	Miguel	Spain	*Optical Fiber pH Sensor based on Surface Plasmon Resonance in the Infra-red Region*
Lepage	Dominic	Canada	*Surface plasmon effects induced by uncollimated emission of semiconductor microstructures*
Pisanello	Ferruccio	France	*Colloidal nanocrystals for quantum information technology*
TOPIC: Nanostructured and Nanoparticle Based Materials			
Aguiló-Aguayo	Noemi	Spain	*Statistics-based experimental design to study the formation of carbon-coated magnetic nanoparticles by plasma arc*
Ballesteros	Luz Marina	Spain	*Langmuir and Langmuir-Blodgett Films Study of a New Phenylene Ethynylene Oligomer*
Barbosa	José	Portugal	*Structural characterization of nanogranular BaTiO3-NiFe2O4 thin films deposited by laser ablation on Si/Pt substrates*

Presenting Author		Country	Poster Title
Barrera	E. William	Spain	*Synthesis of Tm3+:Lu2O3 layers on silica spheres via modified pechini sol gel process*
Bellas García	Rosa María	Spain	*Cure and mechanical properties of styrene butadiene rubber-organomontmorillonite nanocomposites*
Berriozabal	Gemma	Spain	*Novel One-pot Synthesis of Organic-functionalized Silica Nanoparticles*
Caglar	Burak	Spain	*Description of CNTs intercalated structures obtained by CVD*
Caicedo	Julio Cesar	Colombia	*Enhancement of Tribological Properties in Steel by Using a [TiCN/TiNbCN]n Multilayer Nanostructured System*
Delafosse	Gregory	France	*Fullerenes C60 self-assembled on functionalized surfaces*
Dembele	Kadiatou Thérèse	Canada	*Improvement of Dye Sensitized Solar cells (DSSCs) energy efficiency by Carbon nanotubes (CNTs) incorporation in their active layer*
Ettaoussi	Mohammed Said	Spain	*Nanoparticle Heterocoalescence Induced by Deposition*
Foca-nici	Ecaterina	Romania	*Synthesis and microstructural investigation of Mn xZn 1-xFe 2O4 magnetic fluids*
Ganjkhanlou	Yadolah	Iran	*Distribution of Eu ion in nano-size Y2O3:Eu Nanopowder prepared by solution combustion method*
Giner	Ignacio	Spain	*Fabrication of Langmuir-Blodgett films incorporating*
Goel	Vishya	Canada	*Photoluminescence of rare earth doped upconverting NaYF4 nanoparticles*
Guillemot	Laure-Hélène	Spain	*Formulation of surfactant-polymer systems for the synthesis of hybrid organic-inorganic nanocomposites*
Hanschmidt	Kelli	Estonia	*Study of gelation during the formation of sol-gel fibres*
Hinterstein	Manuel	Germany	*Field induced phase transition and formation of microdomains from polar nanoregions in lead free ferroelectrics*
Iraizoz Muñoa	Ion	Spain	*Oxygen sensor based on the thermoelectric effect*
Mendez	Maria	Spain	*Synthesis and characterization of europium-doped La2O3 nanoparticles*
Montero Rodríguez	María Belén	Spain	*Analysis by ATR-FTIR of the curing process in epoxy resins modified with two different Polyhedral Oligomeric Silsesquioxanes (POSS).*
Mutlu	Toygan	Spain	*Study of the supercapacitive behavior of carbon-nanotubes based electrodes prepared by CVD and PECVD*
Nadejde	Claudia	Romania	*Experiments regarding the role of magnetic/non-magnetic stirring in the process of ferrophase preparation for stable magnetic fluids*
Nair	Remya	Japan	*Size tuning and oxygen plasma induced pore formation on silica nanoparticles*
Nasibulina	Larisa	Finland	*A novel approach to create strong and conductive construction materials*

Presenting Author		Country	Poster Title
Nazarpour	Soroush	Spain	*Inconsistent behavior of electrical conductivity in Pd thin film as a function of film thickness*
Nüssl	Rudolf	Germany	*High Power Durable Nano Resonators with Epitaxial Aluminum Electrodes*
Ormaza Saezmiera	Maider	Spain	*Two-dimensional bands of rare earth/gold surface alloys measured with ARPES*
Peña	Luis	Spain	*Magnetic Properties of Self-Assembled Cobalt Nanoparticles Crystal Superlattices*
Plaado	Margo	Estonia	*Characterization of carbon nanotube fibers prepared by dielectrophoresis*
Rezanka	Pavel	Czech Republic	*Cysteine Gold Nanoparticles in Open-tubular Capillary Electrochromatography*
Ruiz Nicolás	Patricia	Spain	*Synthesis of Polymer Stabilized Palladium Nanoparticles by Wet Chemical and Electrochemical Routes*
Salundi	Aigi	Estonia	*Alkoxide gel nanofilm cracking processes for creating of novel structures*
Sassiat	Nicolas	Ireland	*Modeling of Nanocrystal-Molecule Nanostructure Formation*
Soreta	Tesfaye Refera	Spain	*Nanostructured Surface Preparation for Enhancement of Sensitivity of Electrochemical DNA Sensors*
Urban	Christian	Spain	*Charge-Transfer-Induced Structural Rearrangements at Both Sides of Organic Acceptor/Metal Interfaces*
Urrutia Azcona	Aitor	Spain	*An antibacterial surface coating composed of PAH/SiO2 nanostructurated films by Layer by Layer*
Vílchez	Alejandro	Spain	*Preparation of magnetic polystyrene-divinylbenzene hybrid nanocomposites*
Yagüe	Jose Luis	Spain	*Surface nanostructuration to increase polypyrrole adhesion deposited by PECVD*
Yate	Luis	Spain	*Nanocomposite a-C:Cr coatings deposited by shielded cathodic vacuum arc*
Yoshida	Akihito	Japan	*Synthesis and spectroscopic properties of silver:dye composite nanoparticles with a double-shell structure*
TOPIC: Other			
Colón	Joan	Spain	*Evaluation of Toxicity Assays on Au, Ag and Fe3O4 Nanoparticles*
Lee	Kyoung Jae	Korea	*H2O Induced Structural Modification of Pentacene Crystal*
Nikolova	Liliya	Canada	*In situ observations of the Dynamics at Nanoscale by Ultrafast Transmission Electron Microscopy*
Ricoma	Marcal	Spain	*Formation and characterization of electrically induced nanodiodes in thin oxide films*
Ruiz Nicolas	Patricia	Spain	*Eykes: a new software application for analyzing Transmission Electron Microscopy images of nanoparticles*

Presenting Author		Country	Poster Title
Trojahn	Ulrike	Canada	*Development and Characterization of EGFR-targeted Iron-oxide Nanoparticles for Improved Magnetic Resonance Imaging of Brain Tumors.*
Vidal	Gabriel	Spain	*Measurement of Repulsive Casimir Forces Using Silicon Membranes*
Yáñez Vilar	Susana	Spain	*Study of the dielectric properties of La0.67Ca0.33MnO3 nanoparticles and La0.67Ca0.33MnO3@SiO2 nanocomposites*
TOPIC: Scanning Probes Methods			
Borowik	Lukasz	France	*Electrostatic properties of doped silicon nanocrystals probed by Kelvin force microscopy*
Boz	Serpil	Switzerland	*Controlling the organization and heat induced coupling of biphenyl derivatives on metal surfaces*
Engstrøm	Daniel	Denmark	*Wafer scale fabrication of AFM probes with carbon nanotube tips using a nanostencil*
Krull	Cornelius	Spain	*Homochiral monolayers of Cu-Phthalocyanine driven by adsorption induced electronic chirality*
Pinilla	Elena	Spain	*STM Study of Magnetic Polyoxometalates on HOPG Surfaces*
Stöffler	Dominik	Germany	*Scanning probe measurements and electromigration of metallic nanostructures under ultra-high vacuum conditions*
TOPIC: Theory and Modelling at the Nanoscale			
Alarcón	Alfonso	Spain	*Explicit computation of Coulomb and exchange interactions for N-electrons in open quantum systems using Bohm trajectories*
Albareda	Guillem	Spain	*Many-particle effects in the electric power of nanoscale open systems*
Benali	Abdelilah	Spain	*High frequency modeling of classical and quantum nanoscale electron devices*
Douas	Maysoun	Spain	*MC simulation of water meniscus in nanocavities*
Echeverry	Juan Pablo	Spain	*Self-consistent calculations of the surface electronic excitations in K(110) adsorbed layer on Be(0001) substrate*
Gómez-Coca	Silvia	Spain	*Theoretical Study of Functionalized Nanotubes between Transition Metal Atoms*
Korytár	Richard	Spain	*Band selection and disentanglement using maximally-localized Wannier functions: the cases of Co impurities in bulk copper and the Cu (111) surface*
Loucaides	Neophytos	Cyprus	*Numerical simulation of Dielectrophoresis and AC Electroosmosis for DNA trapping including the particle steric effect*
Maillard	Arnaud	Canada	*Electronic Properties of Organic Photovoltaic rr-P3HT/C60 Ordered Blend*
Mc Dermott	Shane	Ireland	*Tunnel Currents across Silane Diamines/Dithiols and Alkane Diamines/Dithiols*
Miranda	Álvaro	Spain	*Molecular doping in Silicon Nanowires: an ab-initio study*

Presenting Author		Country	Poster Title
Ning	Zhanyu	Canada	*Conductance of Au-BDT-Au molecular wires: A quantitative analysis*
Peláez	Samuel	Spain	*Mechanical Properties of Metallic Pentagonal Nanowires: Temperature Dependence*
Piñeiro Rodríguez	Alberto	Spain	*Phase separation in La_(1-x)Ca_(x)MnO_(3) via nanoscale doping inhomogeneities*
Rocheleau	Philippe	Canada	*Extension of the Source-Sink Potential (SSP) approach for multiple channels conductance calculations*
Saura	Xavier	Spain	*Monte Carlo Modelling of Electron Transport in Si Quantum-Wire Double-Gate MOSFETs in Presence of Atomistic Impurities*
Zubizarreta	Xabier	Spain	*First-principles linewidths of quantum-well states in Pb(111) thin films.*

Session PB (139)

Presenting Author		Country	Poster Title
TOPIC: Carbon nanotubes based nanoelectronics and field emission			
Agnus	Guillaume	France	*Carbon Nanotube programmable devices for adaptive architectures*
Biel	Blanca	Spain	*Chemically-induced Mobility Gaps in Graphene Nanoribbons: Upscaling Device Performances*
Bourlon	Bertrand	France	*Probing nanoscale fluid environment around individual carbon nanotube*
Casiraghi	Cinzia	Germany	*Raman Spectroscopy of Graphene Edges*
Gamaly	Eugene	Australia	*Young's modulus for graphitic mono-atomic layer (graphene)*
Kalbac	Martin	Czech Republic	*Electrochemical Charging of Single Walled Carbon Nanotubes: An in-situ Raman Spectroelectrochemical Study*
Legagneux	Pierre	France	*Carbon nanotube based photocathodes for X-ray sources and microwave amplifiers*
Maine	Sylvain	France	*Carbon nanotubes films for the detection of mid-infrared light*
Mañanes	Ángel	Spain	*Length dependence of half-metallicity on zigzag carbon nanotubes*
Ono	Takahito	Japan	*Integration Process of Carbon Nanotube Piezoresistive Elements into Microsensors*
Pacheco	Monica	Chile	*Quantum transport in carbon-based nanostructures perturbed by time-dependent potentials*
Pérez-Jiménez	Ángel J.	Spain	*Effects of molecular pi-stacking on the conductance of nanographene-gold junctions*
Rosales	Luis	Chile	*Transport properties of graphene ribbons with a random distribution of side attached benezene-like molecules*
Santos	Hernan	Spain	*Carbon nanoelectronics: unzipping tubes into graphene ribbons*
Sorokin	Pavel	Russia	*The investigation of two-dimensional semiconducting nanostructures based on single graphene sheets with "lines" of adsorbed hydrogen*
Sorokin	Pavel	Russia	*The theoretical study of the atomic and electronic structure of graphene biribbons*
Wang	Zhao	Switzerland	*Electrostatics of Carbon Nanotubes and Graphene: Electric Charges and Deformation.*
TOPIC: Low dimensional materials (nanowires, clusters, quantum dots, etc.)			
Baldea	Ioan	Germany	*Characterization of assembled quantum dots and single-electron transistors by photoemission and photoabsorption*
Barbara	Paola	USA	*Zero-bias anomalies in multisection carbon nanotube FETs*
Chapuis	Pierre-Olivier	Spain	*3-omega measurements of thermal conductivities of materials for low thermal resistances*

Presenting Author		Country	Poster Title
Coati	Alessandro	France	*Nanofaceting of vicinal Ni surfaces induced by Ag deposit*
Cotta	Mônica	Brazil	*III-V semiconductor nanowires: structural vs. electrostatic properties*
Della Rocca	Maria Luisa	France	*Electronic transport in gold electromigrated nanogap*
Diaz Crespo	Rosario	Spain	*Magnetostatic interaction in Fe-Co nanowire arrays*
Eremeev	Sergey	Russia	*Vibrations of tetrahedral Co and Cu clusters on Cu(111) surface*
Grützmacher	Detlev	Germany	*Epitaxy of ordered arrays of semiconductor nanostructures on substrates patterned by EUV interference and e-beam lithography*
Jeong	Sohee	Korea	*NQD-SWNT FETs Assembled using Dielectrophoresis*
Kam	Alicia	Canada	*Novel nano-template based quantum dot devices*
Kjelstrup-Hansen	Jakob	Denmark	*Conduction and electroluminescence from organic continuous and nanofiber thin films*
Prida	Victor	Spain	*Synthesis an characterization of highly ordered FexPd100-x nanowire arrays by template assisted electrodeposition*
Orellana	Pedro	Chile	*An array of quantum dots as a spin filter device by using Dicke and Fano effects*
Poborchii	Vladimir	Japan	*Edge-enhanced Raman scattering in Si nanostructures: Single nanowire Raman detection at ~ 1 nW laser excitation power*
Ronci	Fabio	Italy	*Low temperature STM/STS study of silicon nanowires grown on the Ag(110) surface*
Torrent-Burgues	Juan	Spain	*Fabrication and characterization of well-ordered mono and multilayer Langmuir-Blodgett films incorporating zinc phthalocyanines*
Vega	Andrés	Spain	*Impact of dimerization and stretching on the transport properties of molybdenum atomic wires*
Wang	Zhao	Switzerland	*In-situ mechanical testing of nanowires and nanodots*
TOPIC: Nanobiotechnologies			
Eritja	Ramon	Spain	*Use of photolabile oligonucleotides in the fabrication of patterned surfaces*
Ghafari-nazari	Ali	Iran	*Silver nanocomposites for antibacterial tile*
Guarrotxena	Miren	USA	*Nanostructured antitags-based biosensors for sensitive detection by SERS enhancement*
Mañanes	Angel	Spain	*Aggregate model for the vibrational properties of hydroxyapatites*
Martins	Nelson	Portugal	*A DNA Chip for the detection of microorganisms in water samples – Design and preliminary results*
Umemura	Kazuo	Japan	*Nanoporous biosilica produced by diatom cells cultured in the presence of metals.*
Yang	Yong Suk	Korea	*Preparation and characteristics of solution-processable organic thin film transistors on a PES substrate*

Presenting Author		Country	Poster Title
TOPIC: Nanochemistry			
Elsaeed	Shimaa	Egypt	*Synthesis and Characterization of Crosslinked (NIPA-co-AAc) Copolymer as a Thermoresponsive Nanohydrogel*
Gómez	Idalia	Mexico	*Highly luminescent Nanostructures of CdS and ZnS prepared by microwaves heating: effect of ions metal concentration*
Kim	Bongsoo	Korea	*NEXAFS and Photoemission Spectroscopy Study for O-Phthalaldehyde (OP) molecule on the H-terminated Si(001) Surface*
Muraviev	Dmitri N.	Spain	*New nanosized catalytic system for Biginelli reaction*
TOPIC: Nanofabrication Tools and Nanoscale Integration			
Chang	Won-Seok	Korea	*Fabrication of Multi-walled Carbon Nanotubes based Nanoelectrode Arrays for Bio Probe*
Jiménez	David	Spain	*Exploiting the negative capacitance region of ferroelectric oxides for surface potential amplification in metal-ferroelectric-insulator-semiconductor devices*
Vilà	Anna	Spain	*Study of characteristics of GIZO based TFT devices in the sub-micron scale*
TOPIC: Nanomagnetism and Spintronics			
Belobrov	Peter I	Russia	*Magnetization of diamond-graphene flakes composites*
Cefalas	Alciviadis-Constantinos	Greece	*Structural and compositional properties of Sm-Fe-Ta magnetic nanospheres prepared by pulsed-laser deposition at 157 nm in N2*
Delgado Acosta	Fernando	Spain	*Electronic structure and inelastic transport through a single magnetic adatom*
Estrader Bofarull	Marta	Spain	*Exchange bias in inverted Antiferromagnetic-core|Ferrimagnetic-shell nanoparticles*
Kokado	Satoshi	Japan	*Spin-atomic vibration interaction and spin-flip Hamiltonian of a single atomic spin*
Medina	Ernesto	Venezuela	*Spin polarisation of electrons using chiral molecular potentials*
Sañudo	E. Carolina	Spain	*Synthesis and magnetic properties of dimers of weakly magnetically coupled molecules*
Sheka	Elena	Russia	*Magnetism of nanocarbons: fullerene c60 and graphene*
Sobolev	Nikolai	Portugal	*Magnetic properties of Co, Al and Mn, Al co-doped ZnO films*
TOPIC: NanoOptics & NanoPhotonics			
Brink	Daniel J	South Africa	*Optical properties of chirped nano structures*
Cascales	Concepcion	Spain	*Morphology controlled hydrothermal synthesis processes and emission near 2 μm of Tm3+- doped Lu2O3 nanostructures*
Chang	Won-Seok	Korea	*The Design and Fabrication of a Tip-on-Aperture Near-Field Scanning Optical Microscope Probe for High Resolution Patterning*
Chenani	Maryam	Iran	*Preparation and characterization of copper (i) oxide nanolayer*
Froufe	Luis	Spain	*Strong dispersive effects in the light-scattering mean free path in photonic gaps*
Froufe	Luis	Spain	*Observation of enhanced optical gain in photonic crystals*
Garcia-Martin	Antonio	Spain	*Magento-photonic properties of Nickel inverse opals*
Gicquel	Maud	France	*Insights in optical properties of bundled carbon nanotubes for telecommunications applications: a preliminary comparative study with individualized carbon nanotubes*

Presenting Author		Country	Poster Title
Mikhailova	Maya	Russia	*Mid-infrared light emitting diodes and high-speed photodiodes based on type II heterostructures with deep AlSb/InAsSb/AlSb quantum wells in active layers*
Parreu	Isabel	Spain	*Synthesis and characterization of Yb3+ doped scandium oxide nanocrystals*
Vasiliu	Cristina	Romania	*Relation between Macroscopic and Microscopic Hyperpolarizability of Er(III) complexes with organic mixed ligands*
TOPIC: Nanostructured and Nanoparticle Based Materials			
Balcells	Lluis	Spain	*Self-assembled multifunctional Fe/MgO nanospheres for MRI and hyperthermia*
Calderó	Gabriela	Spain	*Preparation and characterization of hydrophobic polysaccharide derived nanoparticles obtained in O/W nano-emulsions by low-energy methods*
Elbaile	Laura	Spain	*Magnetic behaviour of non-contacting Ni nanoparticles encapsulated in vertically aligned carbon nanotubes*
Fonseca	Antonio	Belgium	*Nanoparticles at Nanopart*
Garcia del Muro	Montse	Spain	*In situ TEM observation of nucleation and growth of co particles in zirconia matrix*
Gomes	Maria	Portugal	*Growth and characterization of Mn- doped ZnO/TiO2 multilayered nanostructures grown by pulsed laser deposition*
Grym	Jan	Czech Republic	*Electrophoretic deposition of palladium nanoparticles on InP for hydrogen sensors*
Hussien	Muataz	Saudi Arabia	*Effect of Reaction Temperature on the Production of Carbon Nanotubes on a Silicon Dioxide Wafer*
Hwang	Sung-Ho	Korea	*Preparation and Characterization of Layered Double Hydroxides throughout Determination of Size Controllable Synthetic Parameters*
Ihm	Kyuwook	Korea	*Structural phase Transition of Low-coverage Pentacene on SiO2 and Au surfaces*
Kang	Chang Soo	Korea	*The Characteristics of SILC in Silicon Oxide for SoC*
Kobe	Spomenka	Slovenia	*Icosahedral Ti-Zr-Ni thin films*
Kometani	Noritsugu	Japan	*Preparation of size-controlled silver nanoparticles by the hydrothermal method*
Laoui	Tahar	Saudi Arabia	*Properties of Copper Coated with Carbon Nanotubes*
Lee	Soo-Keun	Korea	*Hydrothermal synthesis and characterization of nano-flake magnesium hydroxides from magnesium oxide*
Lim	Sang Kyoo	Korea	*Preparation of Electrically Conductive PET Film with Al-doped Zinc Oxide Nanorods*
Martinez	Benjamin	Spain	*Self-assembling of Magnetic Nanoparticle onto Technological Substrates*
Méndez Ramos	Jorge	Spain	*White-light up-conversion emission in transparent sol-gel derived glass-ceramics containing rare-earth doped YF3 nano-crystals*
Méndez Ramos	Jorge	Spain	*Up-conversion in Yb3+-Ho3+-Tm3+ co-doped NaYF4 nano-crystals embedded in a silica glass synthesized by sol-gel route*
Podrazky	Ondrej	Czech Republic	*Alumina Nanopowder and Europium Co-doped Silica Optical Fibers*
Sanchez	Florencio	Spain	*Self-nanostructuration of the chemical termination of SrTiO3(001) substrates: templates for fabrication of functional oxide nanostructures*
Sanz Monasterio	Mikel	Spain	*Grown and characterization of semiconductor nanostructures by laser ablation*

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Saraidarov	Tsiala	Israel	*Synthesis of Silver Nanoparticles and Stabilization in Different Liquid and Solid Sol-Gel Matrices.Optical and Structural Characterization.*
Sashchiuk	Aldona	Israel	*Temperature dependence of the ground-state exciton in PbSe core, and relevant core-shell colloidal quantum dot structures*
Sassiat	Nicolas	Ireland	*Charge Transport in Plasmonic Nanocrystal-Molecule Nanostructures*
Skoric	Branko	Yugoslavia	*Nano modification of hard coatings with ion implantation*
Son	Jong-Tae	Korea	*Surface modified Li1.05Ni0.35Co0.25Mn0.4O2 cathode material by using nano particle coating for lithium secondary battery*
Sulima	Torsten	Germany	*High Power Durable Resonators fabricated with Aluminum-Scandium-Alloys*
Sun	Hong-Tao	Japan	*A General Route to Efficient Near-Infrared Emission of Optically Active Nanozeolites*
Suñol	Joan Josep	Spain	*Nanostructured materials developed by controlled annealing*
Tätte	Tanel	Estonia	*Preparation of different shape metal oxide micro- and nanostructures by gelation of oligomeric metal alkoxide concentrates*
Tohidlou	Esmail	Iran	*Effect of Zn addition on optical properties and microstructure of Y2O3:Eu nanopowders by solution combustion method*
Vasile	Bogdan Stefan	Romania	*Yttria totally stabilized zirconia nanoparticles obtained through the pyrosol method*
Vasile	Otilia-Ruxandra	Romania	*New nanostructured materials based electrochemical microsensors*
Vuillaume	Dominique	France	*Functional Model of Nanoparticle-Organic Memory Transistor for Use as a Spiking Synapse*
Yang	Sangsun	Korea	*Characterization of Cu Nano-colloid Prepared by Wire Electric Explosion Process in Liquid*
TOPIC: Other			
Bourlon	Bertrand	France	*Carbon nanotube-based MEMS devices : gas sensor application*
Galdikas	Arvaidas	Lithuania	*Analysis of depth profile components at the Interface of Ti6242 Alloy and TiNi Coatings after High Temperature Oxidation in Air*
Hasan	Musarrat	Korea	*Improvement of TFT properties by hydrogen defect passivation for high performance flexible electronics device application*
Hedderich	Regine	Germany	*Materials for Energy*
Herrera	Barbara	Chile	*The Mechanism of Methanol Decomposition. A Theoretical Study Based on the Reaction Force Analysis*
Salamanca	Laura	Spain	*Application of Convergent Technologies (Nano-Bio-Info-Cogno) in Health: The Ibero-NBIC Network*
Sempere	Julia	Spain	*The NanoSost project: towards to a sustainable, responsible and safe nanotechnology*
Shin	Hyun-Joon	Korea	*Scanning photoelectron microscopy for nanomaterials and nanodevice characterization*
Song	Kigook	Korea	*Molecular Orientations of Nematic Liquid Crystals in Bar Coating Process*
TOPIC: Scanning Probes Methods			
O'Mahony	Joseph	Ireland	*Computer based methods for accurate background removal in SPM metrology applications*
Passeggi	Mario César Guillermo	Argentina	*Initial growth stages of AlF3 on Cu(100): an STM study*
Patrone	Lionel	France	*Role of labile bonding in stochastic switching of molecular conductance studied by STM*
Pohlenz	Dieter	Denmark	*QPlus AFM with small oscillation amplitudes and high frequencies at 5 K*

Presenting Author		Country	Poster Title
Porti	Marc	Spain	*Conductive AFM analysis of the trapping properties of SiO2 tunnel layers for non-volatile memory devices*
Serrate	David	Spain	*Engineering Spin Structures on the Atomic Scale*
TOPIC: Theory and Modelling at the Nanoscale			
Atanasov	Ivailo	Belgium	*Thermodynamic properties of Au-Pd nanostructured surfaces studied by atomic scale modeling*
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Cheng	Daojian	Belgium	*Assessment of the carbon-nickel interaction for atomistic simulation of carbon nanofiber growth*
Chernozatonskii	Leonid	Russia	*Modelling of graphene-nanotube structures: architecture, properties and applications*
Cordero	Nicolas A.	Spain	*A DFT study of the interaction of sulfuric acid with bilayer graphene*
Dabbagh	Hossein	Iran	*Nano scale surface and reaction mechanism study of (R)- and (S)-2-butanol over 100 surface alumina: Experimental vs. DFT*
Foerster	Dietrich	France	*Applications in molecular physics of a basis in the space of orbital products*
García-Mochales	Pedro	Spain	*Merging nanowires breakage results for different stretching directions to compare with experimental ones*
Gori	Paola	Italy	*Supramolecular effects of chiral molecules on metallic surfaces: D-alaninol on Cu(100) as a case study*
Iglesias	Oscar	Spain	*Microscopic origin of exchange bias in inverted core/shell magnetic nanoparticles*
Ji	Wei	Canada	*Spin-resolved STM simulation of graphene nanoribbon*
Jimenez	David	Spain	*Accurate prediction of the gate tunneling current for surrounding gate MOSFETs*
Koval	Peter	France	*Product basis set in TDDFT: molecular absorption spectra within linear response.*
Martsinovich	Natalia	UK	*Aggregation of Polycarboxylic Acids into Self-Assembled Molecular Networks: A Theoretical Study*
Molina	Luis M.	Spain	*Selective synthesis of small gold clusters with odd or even sizes*
Sanchez-Portal	Daniel	Spain	*On the Magnetism of Substitutional Transition-Metal Impurities in Graphenic Nanostructures*
Voinova	Marina	Sweden	*Theoretical Analysis of Acoustical Microsensors Response in Nanobiology Applications*
Zotti	Linda Angela	Spain	*Revealing the role of anchoring groups in the electrical conduction through single-molecule junctions*

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Only fully registered participants (payment processed) are listed below.
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Ramon-Laca	Joaquin	Phantoms Foundation	Spain
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Trojahn	Ulrike	McGill University	Canada
Tsukagoshi	Kazuhito	MANA, NIMS	Japan
Umemura	Kazuo	Tokyo University of Science	Japan
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Vallauri	Dario	Politecnico di Torino	Italy
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Vasile	Bogdan Stefan	University Politehnica Bucharest	Romania
Vasile	Otilia-Ruxandra	National Institute of Research for Electrochemistry and Condensed Matter	Romania
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Vergaro	Viviana	Università del Salento	Italy
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Vidal	Gabriel	Universitat Autònoma de Barcelona	Spain
Vieu	Christophe	LAAS / CNRS	France
Vijayaraghavan	Saranyan	University of Basel	Switzerland
Vilà	Anna	Universitat de Barcelona	Spain
Vilar Vidal	Noelia	University of Santiago de Compostela	Spain
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Zvatora	Pavel	Institute of Chemical Technology Prague	Czech Republic

NOTES

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nanoICT School 2009

San Sebastian - Spain / October 26-30, 2009

nanoICT School 2009

NanoPhotonics - NanoOptics - Modeling

	Monday 26/10/2009	Tuesday 27/10/2009	Wednesday 28/10/2009	Thursday 29/10/2009	Friday 30/10/2009
AM	Courses	Courses	Invited Talks	Courses	Courses
	Lunch	Lunch	Lunch	Lunch	Lunch
PM	Courses	Courses	Invited Talks	Courses	Courses
	School 1 NanoOptics and NanoPhotonics		nanoICT only-day Workshop		School 2 NanoICT modelling issues

Confirmed Professors

School 1: NanoOptics and NanoPhotonics (October 26-27, 2009)

- Remi Carminati (ESPCI, France)
- Rainer Hillenbrand (CIC nanoGUNE Consolider, Spain)
- Luis Froufe (ICMM-CSIC, Spain)
- Juan Jose Saenz (Universidad Autonoma de Madrid, Spain)
- Niek van Hulst (ICFO, Spain)

School 2: nanoICT modelling issues (October 29-30, 2009)

- Javier Aizpurua (DIPC, Spain)
- Uzi Landman (Georgia Tech, USA)
- Massimo Macucci (Pisa University, Italy)
- Pablo Ordejon (ICMAB, Spain)
- Stephan Roche (CEA-INAC, France)
- Daniel Sanchez-Portal (CSIC - UPV - DIPC, Spain)

Participation of approximately 40 young scientists is planned (20 per school).
Grants covering registration fee, travel and accommodation will be available.

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