B·DEBATE International Center for Scientific Debate BARCELONA

ICN Institut Català de Nanotecnologia | ibb

NANO-TECHNOLOGIES IN HEALTH

CURRENT CHALLENGES AND FUTURE PROSPECTS

October, 9th, 10th and 11th, 2013

COSMOCAIXA BARCELONA. C/ ISAAC NEWTON, 26. BARCELONA

B·DEBATE IS AN INITIATIVE OF: biocat, "la Caixa" Foundation

WITH THE COLLABORATION OF: UAB CEI Campus of International Excellence, ibec, nanonica

WITH THE SUPPORT OF: AEI minetur agrupaciones empresariales innovadoras, FEDER "Una manera de hacer Europa" UNIÓN EUROPEA

B·Debate International Center for Scientific Debate

BARCELONA

"B·Debate strives to help position Barcelona as a benchmark in generating knowledge and Catalonia as a country of scientific excellence"

B·Debate is an initiative of Biocat with support from "la Caixa" Foundation which aims to drive top-notch international scientific events to foster debate, collaboration and open exchange of knowledge among experts of renowned national and international prestige. The debates are focused on the integration of diverse disciplines of science in order to tackle major scientific and societal challenges.

NANO-TECHNOLOGIES IN HEALTH

CURRENT CHALLENGES AND FUTURE PROSPECTS

NANO-TECHNOLOGIES IN HEALTH

CURRENT CHALLENGES AND FUTURE PROSPECTS

October, 9th, 10th and 11th, 2013

WELCOME

Dear colleagues and friends,

On behalf of the Organizing Committee, it is our great pleasure to welcome speakers and attendees to the B-Debate Workshop on ***Nanotechnologies in Health: Current Challenges and Future Prospects***. The workshop has been designed to provide an innovative and comprehensive overview of the latest research developments in Nanomedicine and to discuss about the main challenges for the next years.

We are also very happy to have distinguished speakers and attendees that can friendly discuss in an informal environment about the future of the Nanotechnologies. The speakers assure that the meeting will be a major scientific event this year and we hope that contributions from the attendees from many different disciplines will enrich the discussion. In assembling the program, much credit goes to the members of the Scientific Committee, who suggested many of the invited speakers, for which we are grateful.

We would like to express our thanks to the biotech companies (Nanonica and Nanotargeting), to the Institute for Bioengineering of Catalonia and to the Campus d'Excel·lència Internacional - Universitat Autònoma de Barcelona for their generous support, Finally we would like to thank our staff, colleagues and friends for their help, support and advice in planning and arranging this meeting.

We hope that you will enjoy the Workshop and that your interaction with your colleagues from many different countries will stimulate a creative exchange of ideas and will be personally rewarding. We also hope and trust that you will enjoy your visit to the exciting city of Barcelona, Catalonia.

Yours sincerely,

Antonio Villaverde, Victor Puntes, Nerea Roher (Scientific Leaders) and **B·Debate**

PROGRAM

Wednesday, October, 9th, 2013

9:00	**Registration**
9:15	**Welcome** **Enric Banda**, Director of Science, Research and Environment, "la Caixa" Foundation **Laia Arnal,** Head of Research and Scientific Debate, Biocat **Xavier Daura**, Director, Institut de Biomedicina i Biotecnologia (IBB) **Victor Puntes**, Research Professor at Institut Català de Nanociència i Nanotecnologia (ICN)
9:30	**SESSION 1: NANODIAGNOSTICS: CHALLENGES AND PERSPECTIVES** Chair: **Arben Merkoçi**, Institut Català de Nanociència i Nanotecnologia (ICN), Barcelona, Spain
9:40	**Keynote Speaker - Nanodiagnostics: From Nanoparticle-based Amplified Multiplexed Bioelectronic Detection to Nanomachine-based Bioseparations** **Joseph Wang**, University of California (UCSD), San Diego, USA
10:30	**Nano -and Quantum- Biodevices for Cancer Diagnosis, Cancer Therapy, and IPS Cell Based Regenerative Medicine** **Yoshinobu Baba**, Nagoya University, Japan
11:00	**Coffee break**
11:30	**Control of Neurotransmission with Light** **Pau Gorostiza**, IBEC, Barcelona, Spain
12:00	**Temperature – The "Ignored" Factor at the NanoBio Interface** **Wolfgang Parak**, University of Marburg, Germany
12:30	**Open Debate**
13:00	**Lunch**
14:00	**SESSION 2: CHALLENGES AND OPPORTUNITIES IN NANODRUG DELIVERY SYSTEMS** Chair: **Antonio Villaverde**, Institut de Biomedicina i Biotecnologia (IBB), Barcelona, Spain
14:10	**Keynote Speaker - Unravelling Graphene for Drug Delivery** **Kostas Kostarelos**, School of Medicine & National Graphene Institute, **University of Manchester**, UK
15:15	**Biomedical Applications of Polyhydroxyalkanoates Binding Proteins** **George Guo-Quiang Chen**, University of Tsinghua, Beijing, China
15:45	**Coffee break**
16:00	**Polymer-Based Nanopharmaceuticals: Challenges and Opportunities** **Maria José Alonso**, Universidad Santiago de Compostela, Spain
16:30	**Multifunctional Nanovesicle-Bioactive Conjugates and Nanomedicines Prepared by a One-Step Scalable Method Using Expanded CO_2 Solvents** **Jaume Veciana**, ICMAB-CSIC, Barcelona, Spain
17:00	**End of session**
18:00	**Visit to the Cosmocaixa**
19:00	**Cocktail at Cosmocaixa**

PROGRAM

Thursday, October, 10th, 2013

9:30	**SESSION 3: NOVEL APPLICATIONS IN HEALTH** Chair: **Victor Puntes**, Institut Català de Nanociència i Nanotecnologia (ICN), Barcelona, Spain
9:40	**Keynote Speaker- Nanostructured Materials and Systems for Biomedical Applications** **Jackie Y. Ying**, Institute of Bioengineering and Nanotechnology, Singapore
10:30	**Complex Dynamic Substrate Control: Dual Tone Hydrogel Photoresists** **Andrea Kasko**, University of California (UCLA), Los Angeles, USA
11:00	**Coffee break**
11:30	**Cell Mechanotyping for Health and Disease** **Amy Rowat**, University of California (UCLA), Los Angeles, USA
12:00	**Human Engineered Enzymes for Cancer Therapy** **George Georgiou**, University of Texas, USA
13:00	**Lunch**
14:30	**SESSION 4: RISKS OF NANOTECHNOLOGIES: HEALTH AND ENVIRONMENTAL ISSUES** Chair: **Maria Jesús Buxó**, Universitat de Barcelona (UB), Barcelona, Spain
14:40	**Keynote Speaker – Challenges in Preclinical Characterization of Engineered Nanomaterials** **Marina Dobrovolskaia**, Ph.D., USA
15:45	**Coffee break**
16:15	**Implementing Rapid *in vivo* Assessments of the Nano/Bio Interface to Advance Greener Nanotechnology** **Robert Tanguay**, Oregon State University, USA
16:45	**A Disease-Specific Nanomedicine Platform for the Treatment of Autoimmunity** **Pere Santamaria**, Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Barcelona, Spain and **University of Calgary**, Canada
17:15	**Open Debate**

PROGRAM

Friday, October, 11th, 2013

9:30	**SESSION 5: ADDRESSING THE FUTURE: THREATS AND OPPORTUNITIES** Chair: **Josep Corbella**, Scientific Journalist, Barcelona, Spain
9:40	**Keynote Speaker - Nanomedicine(s) the Future: Threats and Opportunities** **Ruth Duncan**, Cardiff, United Kingdom
10:30	**Towards in Silico Nanotoxicology** **Robert Rallo,** Universitat Rovira i Virgili, Tarragona, Spain
11:00	**Coffee break**
11:30	**Future Opportunities in Cancer Nanotechnology - Perspective from National Cancer Institute, USA** **Piotr Grodzinski**, NCI Alliance for Nanotechnology in Cancer at the National Cancer Institute, Bethesda, Maryland, USA
12:00	**Open Debate**
13:00	**Concluding remarks and end of session**

SCIENTIFIC COMMITTEE

Victor Puntes, ICREA Research Professor at the **Institut Català de Nanociència i Nanotecnologia (ICN)**, Barcelona, Spain

Victor Puntes obtained in 1998 his Ph.D. degree in Physics at the Universitat de Barcelona. He is the group leader of the Inorganic Nanoparticles Group at Institut Català de Nanotecnologia since 2005. He then moved to Berkeley as a postdoc in the Lawrence Berkeley National Laboratory. He is also group leader and research professor at Institució Catalana de Recerca i Estudis Avançats (ICREA)since 2005 and associate professor at Universitat de Barcelona from 2008. Víctor Punted is the founder and director of Nanowiki (www.nanowiki.info), the scientific director of the Centre for NanoBioSafety and Sustainability (CNBSS, www.cnbss.eu), scientific advisor for Nanotargeting () and referee for different journals such as Nature Nanotechnology, Nano Letters, Journal of American Chemical Society, etc. He has published more than 80 research articles and he has about 3,500 citations.

Nerea Roher, Researcher at **Institut de Biotecnologia i de Biomedicina** (IBB) and Physiology Department, **Universitat Autònoma de Barcelona (UAB)**, Barcelona, Spain

Nerea Roher obtained a degree in Biochemistry and Molecular Biology at Universitat Autònoma de Barcelona in 1995. After finishing her Ph.D. in 2002, she worked for one year as associate professor at Dep. Biochemistry and Molecular Biology (Universitat Autònoma de Barcelona) and then she obtained a postdoctoral fellow at Faculty of Biosciences, UAB, then at Faculty of Biology (UB) and finally at Faculty of Biosciences, Animal Physiology Department at UAB. She had stayed at Physiology, Development and Neurosciences Department (Cambridge University) as a postdoctoral short term stay.

Antonio Villaverde, Researcher at **Institut de Biotecnologia i de Biomedicina** (IBB) and Full Professor of Microbiology at **Universitat Autònoma de Barcelona (UAB)**, Barcelona, Spain

Antonio Villaverde is Full Professor at UAB, coordinator of the Master programme on Advanced Biotechnology and the doctorate program on Biotechnology at the UAB and coordinator of the Protein Production Platform CIBER-UAB. He is also a group leader at the Institute for Biotechnology and Biomedicine at the UAB and group leader at the CIBER Network on Bioengineering, Biomaterials and Nanomedicine (ISCIII). He is member of the Spanish Platform of Nanomedicine, associated partner to the Austrian Center of Industrial Biotechnology (ACIB) and UAB delegate at the European Technological Platform of Nanomedicine. Antonio Villaverde is the founder and editor-in-chief of Microbial Cell Factories. He received his Ph.D. in 1985 from the UAB. He had obtained EMBO fellowships during his career to develop his research in laboratories such as Laboratoire de Pharmacologie et Toxicologie Fondamentals de Tolouse, France, Departament of Virology, Laussane, Switzerland. He also developed research stages in Department of Biochemistry and Molecular Genetics (Imperial College), London; at National Research Centre for Biotechnology Ltd (GBF), Braunschweig… Antonio Villaverde has more than 170 publications, and he has edited one journal and two books.

INVITED SPEAKERS

Wednesday, October, 9th, 2013

Arben Merkoçi, ICREA Research Professor and Group Leader at Nanobioelectronics and Biosensors Group, **Institut Català de Nanotecnologia and CIN2 (ICN-CSIC),** Barcelona, Spain

Chair of the SESSION 1: NANODIAGNOSTICS: CHALLENGES AND PERSPECTIVES

Dr. Merkoçi has published around 160 peer review research papers (index factor 28), including two Chemical Review, Chemical Society Reviews and other high impact papers and has been cited around 4000 times (from ISI web of knowledge) by other papers. The starting of independent scientific career of Dr. Merkoçi has been based on funding gotten by competitive awarding. He has got several national and international grants related to nanomaterials application in biosensors, 'Ramon Areces' project award (2004), three renewable research projects (2004-2005, 2006-2008; 2009-2011) and cooperation (with Italy & Japan) national projects from Ministry of Science in Spain (MEC). He was awarded also from Spanish government a CONSOLIDER project (as partner) and from regional government two projects: a technological development projects (VALTEC) and the distinction of 'Recognized research group'. Dr. Merkoçi has also been involved in EU projects. FP5 (Rosepromilk), FP6 (WARMER) and lastly FP7 (NADINE) and a NATO for Peace Project (in collaboration with Prof. I.Willner, Prof. J.Wang) beside other national projects related to technological developments (with UAB, Hospital Sant Joan de Deu etc.). After his PhD (1991) at Tirana University (Albania), working in the exciting field of Ion-Selective-Electrodes (ISEs) designs and applications in clinical and environmental analysis, Dr. Merkoçi worked as postdoc at some of the most important European research centres working in the sensors area, gaining invaluable experiences from several distinguished professors: 2002 in Hungary with the Prof. Pungor, considered as 'the father' of ISEs; 1992-1993, in Greece, with Prof. M. Karayannis, working in the field of catalytic based sensors; 1993-1994, in Italy working with Prof. C. Maccà in the field of potentiometric & voltammetric theoretical calculations and practical applications; 1997-2006, with Prof. S. Alegret, in the field of enzyme and DNA based sensors. During 2002 Dr. Merkoçi was proud to be member & assistant in the research team of Prof. Joseph Wang (NMSU, USA) the most internationally known in the field of electrochemical biosensors and one of the top 10 most cited chemists in the world. Due to the results obtained during his scientific career and on an international based competition he obtained on 2008 the highest scientific position given in Catalonia (Spain): ICREA Research Professor to work as Group Leader at Catalan Institute of Nanotechnology (ICN) in Bellaterra (Barcelona).

Joseph Wang, Professor of Nanoengineering at **University of California San Diego** (UCSD), USA

After holding a Regents Professor and Manasse Chair positions at NMSU Joseph Wang moved to ASU where he served as the Director of the Center for Bioelectronics and Biosensors (Biodesign Institute). He joined UCSD NanoEngineering Dept. in 2008. He also serves as the Chief Editor of the Wiley journal *Electroanalysis*. The research interests of Dr. Wang include the development of nanomotors and nanoactuators, bioelectronics and biosensors, nanomotors and nanoactuators, adaptive "smart" on-demand sensor systems, and remote sensing. He has authored over 850 research papers, 10 books, 12 patents, and 35 chapters (H Index 92).

Nanodiagnostics: from Nanoparticle-based Amplified Multiplexed Bioelecronic Detection to Nanomachine-based Bioseparations

Over the past two decades we have witnessed an enormous activity aimed at designing new electrochemical biosensing devices based on nanoparticles, nanotubes or nanowires, and towards the use of electrochemical routes - particularly template-assisted electrodeposition - for preparing nanostructured materials. Nanomaterials such as carbon nanotubes, gold nanoparticles, or silicon nanowires have thus made a major impact on the field of electrochemical biosensors, ranging from glucose enzyme electrodes to DNA hybridization sensors. For example, various nanoparticles have been used towards effective electrical communication between the redox proteins and the electrodes or as amplification tags for ultrasensitive electrochemical bioaffinity assays. Template-prepared functionalized microenegines have been shown extremely useful for capturing, transporting, isolating and detecting a wide range of target bioanalytes. The 'on-the-fly' isolation of cancer cells, proteins, or DNA targets from complex raw biological matrices has thus been illustrated.

Yoshinobu Baba, Professor of Department of Applied Chemistry, Graduate School of Engineering, **Nagoya University**, Japan

Yoshinobu Baba is also Director of FIRST Research Center for Innovative Nanobiodevice, Nagoya University and Vice Director of Synchrotron Radiation Research Center, Nagoya University. He is an Associate Editor of *Anal. Chem.* and serving to over 20 scientific journals, including *Nanoscale* and *Biomicrofluidics*, as an editorial/advisory board member. He is a co-initiator for the world largest Nanotech/Nanobio International Meeting and Exhibition. He is a general chair of numerous international meetings (microTAS, MSB, NanoBioEXPO, ISMM). He has been admitted as a Fellow of the Royal Society of Chemistry and received numerous awards for his contributions in nanobiotechnology: MERCK Award in 2004, award from the Applied Physics Society of Japan in 2006, and The CSJ (Chemical Society of Japan) award for creative work in 2008. His major area of interest is nanobiosicence and nanobiotechnology for omics, systems biology, medical diagnosis, tissue engineering, and molecular imaging.

Nano- and Quantum-Biodevides for Cancer Diagnosis, Caner Therapy, and IPS Cell Based Regenerative Medicine

Nano-/quantum-biodevice is a piece of contrivance, equipment, machine, or component, which is created by the overlapping multidisciplinary activities associated with nano-/quantum-technology and biotechnology, intended for biological, medical, and clinical purposes. During the past decade, nano-/quantum-biodevice has progressively begun to focus on the establishment of main four fields of biomedical applications of nanotechnology, including 1) diagnostic devices, 2) molecular imaging, 3) regenerative medicine, and 4) drug delivery systems. In this lecture, I will describe the development of nano-/quantum-biodevices for biomedical applications, including single cancer cell diagnosis for cancer metastasis, circulating tumor cell (CTC) detection by microfluidic devices, nanopillar devices for ultrafast analysis of genomic DNA and microRNA, nanopore devices for single DNA and microRNA sequencing, nanowire devices for exosome analysis, single-molecular epigenetic analysis, quantum switching *in vivo* imaging of iPS cells and stem cells, and quantum technology-based cancer theranostics. Euglena-based "biomimetic mechanical system" enables us to develop reliable circulating tumor cell (CTC) separation and detection technique for cancer metastasis diagnosis. Immunopillar devices realized the fast and low invasive "from blood to analysis" type biomarker detection of cancer with fM detection sensitivity within 2 min. Additionally, nanopillar devices give us ultrafast separation of DNA and microRNA within 60 μs and nanopillar-nanopore integrated nanobiodevice enables us ultrafast single molecular DNA sequencing. Nanowire devices coupled with super-resolution optical microscopy are extremely useful to analyze exosomes from cancer cells and exosomal microRNA analysis. Quantum dots are applied to develop quantum-biodevices for single cancer cell diagnosis, single molecular epigenetic analysis, quantum switching *in vivo* imaging for iPS cell based regenerative medicine, and theranostic devices for cancer diagnosis/therapy.

Pau Gorostiza, ICREA Research Professor at the **Institute for Bioengineering of Catalonia (IBEC)**, Barcelona, Spain

Pau Gorostiza graduated in physics at the Universitat de Barcelona (UB), where he also obtained his Ph.D. (European Doctorate) in the field of semiconductor electrochemistry. He also worked at the microscopy facility of the UB, where he gained experience in AFM and STM of biological samples, as well as in nanotechnology applied to materials science. He has visited the CNRS and the Université Pierre et Marie Curie in Paris (France), and the University of California at Berkeley (USA). His recent works include the development of optical switches for remotely controlling neuronal activity. He obtained a Young Biomedical Investigator Award of the Francisco Cobos Foundation, a Career Development Award of the Human Frontier Science Program (HFSP) and a Starting Grant of the European Research Council (ERC). He is currently ICREA Research Professor at the Institute for Bioengineering of Catalonia (IBEC).

Control of Neurotransmission with Light

Optical switches are chemical compounds that undergo subtle and reversible structural changes when illuminated with light of different colours. These photoswitchable compounds can be designed to regulate the activity of proteins with light and therefore to remotely control cellular processes with precise spatiotemporal patterns of illumination. We propose using optical switches to control the fundamental processes of cellular secretion: exocytosis (the discharge of material from vesicles at the cell surface to the outside of the cell, a process triggered by the presence of calcium) and endocytosis (the process of engulfing proteins and molecules into the cell in the form of an "endocytic vesicle", which is orchestrated by a large number of proteins and culminates by the action of the protein dynamin). Secretion is important to release hormones and proteins in an organism or out of it, and it is essential for the transmission of nerve impulses from one neuron to another (neurosecretion). The specific objectives are to develop and test optical switches to achieve: (1) control of exocytosis using channels at the cell membrane that allow calcium entry into the cell and that can be open and closed with light, and (2) control of endocytosis using compounds that inhibit in a light-dependent manner, dynamin or other proteins involved in the endocytic process.

Wolfgang Parak, Full Professor (chair) for Experimental Physics at the **Philipps-University of Marburg**, Germany

Wolfgang Parak obtained his Ph.D. at the Institute of Applied Physics (Ludwig Maximilians Universität München, Germany) in 1999. He had a post-doctoral fellow at Department of Chemistry at the University of California at Berkeley (USA). Between 2003 and 2006 he was the leader of a Junior Research Group (Emmy-Noether fellowship of the German Research Foundation, equivalent to Assistant Professor), hosted at the Ludwig Maximilians Universität München, at the Institute for Applied Physics and at the Center for Nanosciencel. In 2005 Parak obtained a position as Associate Professor for Physical Chemistry at the Ludwig Maximilians Universität München for the Summer Semester. In 2009 he received the "Nanoscience" - award 2008 from the Association of Nanotechnology-Centres Germany (AGenNT) and, in 2012, the Chinese Academy of Sciences Visiting Professorship for Senior International Scientists.

Temperature – The "Ignored" Factor at the NanoBio Interface

Upon incorporation of nanoparticles (NPs) into the body, they are exposed to biological fluids, and their interaction with the dissolved biomolecules leads to the formation of the so-called protein corona on the surface of the NPs. The composition of the corona plays a crucial role in the biological fate of the NPs. While the effects of various physico-chemical parameters on the composition of the corona have been explored in depth, the role of temperature upon its formation has received much less attention. In this work, we have probed the effect of temperature on the protein composition on the surface of a set of NPs with various surface chemistries and electric charges. Our results indicate that the degree of protein coverage and the composition of the adsorbed proteins on the NPs surface depend on the temperature at which the protein corona is formed. Also, the uptake of NPs is affected by the temperature. Temperature is, thus, an important parameter that needs to be carefully controlled in quantitative studies of bio-nano interactions.

Antonio Villaverde, Researcher at **Institut de Biotecnologia i de Biomedicina** (IBB) and Full Professor of Microbiology at **Universitat Autònoma de Barcelona (UAB)**, Barcelona, Spain

Chair of the SESSION 2: CHALLENGES AND OPPORTUNITIES IN NANODRUG SYSTEMS

(See his CV at the Scientific Committee Section)

Kostas Kostarelos, Professor at School of Medicine & National Graphene Institute, **University of Manchester**, United Kingdom

Kostas has recently been appointed Professor of Nanomedicine with the Faculty of Medical & Human Science and to lead biomedical research and applications of the National Graphene Institute at the University of Manchester. He has been invited Fellow of the Royal Society of Medicine (FRSM), Fellow of the Institute of Nanotechnology (FIoN) and Fellow of the Royal Society of Arts (FRSA) all in the United Kingdom. In 2010 he was awarded the Japanese Society for the Promotion of Science (JSPS) Professorial Fellowship with the National Institute of Advanced Industrial Science and Technology (AIST) in Tsukuba, Japan. Kostas obtained his PhD from the Department of Chemical Engineering, Imperial College London. Previously he was at the faculty at Cornell University Weill Medical College, NY, USA and Imperial College London, UK. He held the Chair of Nanomedicine and was Head of the Centre for Drug Delivery Research at UCL School of Pharmacy, University College London for the last ten years.

Unravelling Graphene for Drug Delivery

Graphene has entered a phase of maturity in its development that is characterized by its explorative utilization in various types of applications and fields ranging from electronics to biomedicine. Graphene materials today have mainly been explored as components of biosensors and for construction of matrices in tissue engineering. The capacity of graphene to act as a drug delivery platform has also been reported, however not as coherently. Among the recent advances made with graphene-related materials, their use as components of innovative delivery systems is full of promise, however there are serious challenges facing these exciting new tools both in terms of biological activity and toxicological profiling *in vitro* and *in vivo*. This talk will attempt to offer some perspective and propose a step-wise approach in the development of graphene for biomedical applications and in particular delivery system engineering. In this way we rationally expect to unravel the unparalleled physicochemical properties of graphene to constitute feasible clinical tools offering improved functionality and previously unavailable capabilities.

George Guo-Quiang Chen, Professor at **Tsinghua University**, Beijing, China

Dr. George Guo-Qiang Chen is also, since 2006, a member of the Board of Directors for China Biotechnology Association. He holds a BSc in Applied Chemistry from South China University of Technology (1985) and a PhD in Microbiology from the Graz University of Technology, Austria (1989). He then completed two postdoctoral trainings at the University of Nottingham, UK (1990-1992) and the University of Alberta, Canada (1992-1994). In 1994 he joined the University of Tsinghua as an Associate Professor, where he later became a full member of staff as Professor of Microbiology. Professor Chen has more than 25 years of R&D experience on microbial physiology, microbial polymer production and applications. He has published over 200 international peer reviewed papers, and holds 23 issued patents and 29 pending patents. Furthermore, Dr.Chen is an associate editor of the "Journal of Biotechnology", and "Microbial Cell Factories", and sits in the editorial board of various other prestigious journals including "Current Opinions in Biotechnology", "Applied Microbiology and Biotechnology" and "Biomaterials". His main area of research since 1986 has been microbial metabolic engineering and biomaterials. Furthermore, after joining Tsinghua University in 1994, he has been actively involved in promoting the microbial Bio- and Material Industries in China.

Biomedical Applications of Polyhydroxyalkanoates Binding Proteins

Polyhydroxyalkanoates (PHA) are hydrophobic polyesters produced by a variety of bacteria. Over the past many years. PHA have been used to develop many applications both as a bioplastic and as bioimplant materials. Recently, several proteins associated with PHA *in vivo* synthesis termed PHA binding proteins have been found to be useful as biomaterials surface modifiers, biosurfactants, specific drug delivery matrix anchorages, fusion proteins for protein purification, for endotoxin removal and as a heterogeneous two-hybrid system for studying protein interactions. In this lecture, these applications will be discussed.

Maria José Alonso, Research Center on Molecular Medicine (CIMUS), School of Pharmacy, **University of Santiago de Compostela**, Spain

Maria José Alonso is full professor of Biopharmaceutics and Pharmaceutical Technology at the University of Santiago de Compostela (USC) since 1998. She served as Vice-Rector of Research and Innovation of the USC from June 2006 to July 2010. In this role, she built a new cross-disciplinary research organization model which has deserved the recognition of "Excellence" by the Spanish Government and placed her University among the Spanish Campus of International Excellence. She also dedicated efforts to increase the participation and visibility of women in sciences. She graduated from the School of Pharmacy in 1982 and received a Ph.D. degree in Pharmaceutical Technology in 1985. She has been a member of the USC Faculty since 1987, first as an assistant professor and, one year later, as an Associate Professor. She has worked as a post-doctoral research fellow at the University of Paris-Sud, France (1986-87) and as a visiting professor at the University of Angers, France (1989), and at the Massachusetts Institute of Technology (1991-92). Alonso, widely known for her contributions to vaccine/drug delivery nanocarriers, was a pioneer in this area in Spain. She has been responsible of more than 30 competitive research projects, She has always combined her research activity with a wide range of educational activities including her participation in several Ph.D. educational European programs and work-shops. Alonso was elected a member of the Galician Academy of Pharmacy and The Royal National Academy of Pharmacy in 2010. She has served as a member of several scientific and advisory boards of the most relevant international associations in the drug delivery and nanomedine. Currently, she is a member of the coordination committee of the Spanish Platform of Nanomedicine and a member of the European Technology Platform on Nanomedicine. Alonso's interests include wide activities in research and education and their projection in a global context. She is a trustee of the non-for-profit Foundation of Innovation Bankinter and has provided advice to the Spanish Ministry of Sciences and Innovation (MICINN) on a new Law of Science and Technology and other issues related to "Science and Poverty" (within the context of the European Year for combating poverty and social exclusion).

Polymer-Based Nanopharmaceuticals: Challenges and Opportunities

The advances made over the last decade in the field of nanomedicine have been largely related to the progress in the biomedical field (improved knowledge of disease mechanisms, identification of new targets and new bioactive compounds…etc) and the nanomaterials field (new biomaterials and nanotechnologies). The nanopharmaceutical technology area has also contributed making it feasible the nanoencapsulation and controlled delivery of complex molecules, as well as defining ways to scale-up the production of nanomedicines. Nevertheless, a significant amount of this research relies in making "mee too" delivery carriers, while the most creative activity still needs to confront great hurdles for its translation to the clinic. Our group, being committed with the translation of ideas from the university through novel pharmaceutical technology, has designed novel polymer-based delivery carriers intended to transport drugs and antigens across biological barriers and to deliver them to the target tissue. During my presentation I would like to focus on the different applications of the nanocarriers we have designed as well as the challenges and opportunities for their exploitation. These applications include cancer therapy, nanovaccines and oral delivery of complex macromolecules. More information about these applications and the literature associated to them can be found at: http://webspersoais.usc.es/mariaj.alonso

Jaume Veciana, Head of the Department of Molecular Nanoscience and Organic Materials at the **Institut de Ciència dels Materials de Barcelona** (ICMAB) and member of the **CIBER-BBN,** Barcelona, Spain

Jaume Veciana obtained his degree in Chemistry in 1973 from the University of Barcelona and four years later a Ph.D. from the same university. After a postdoctoral stash at John Hopkins University and upon returning to Barcelona, he became a group leader at the CSIC in 1985, where he also holds a Research Professor chair since 1996. Dr. Veciana has published over 260 original articles and during the last decade has been one of the most cited Spanish scientists, specially in the Chemistry area. He is member of several international committees, including the International Advisory Committee and the Technical Committee of Materials, as well as from the American Chemical Society. He has also received several awards, including the 2005 Science Award from DuPont, or the Research Award from the Spanish Chemistry Society (2004) among others. Furthermore, he holds over 15 patents and his group has received international recognition for its translational research results and entrepreneur activities. His main research lines are within the fields of molecular nanoscience and organic functional materials. The multidisciplinary research carried out by his group is aimed at the self-assembly, nanostructuring and processing of functional (bio- and electro-active) molecules as crystals, particles, vesicles, and structured or self-assembled monolayers on various substrates showing non-conventional chemical, physical and biological properties. We use several methodologies for such a processing but a special emphasis is made with supercritical fluids. The resulting molecular organizations/systems are studied and used in the fields of molecular and large-area electronics, molecular magnetism, nanomedicine and biomaterials as well as for environmental applications.

Multifunctional Nanovesicle-Bioactive Conjugates and Nanomedicines Prepared by a One-Step Scalable Method Using Expanded CO_2 Solvents

A simple one-step methodology for preparing multifunctional nanovesicle-bioactive conjugates will be presented. This method is readily amenable to the integration/encapsulation of multiple components, like peptides, proteins, enzymes, into the vesicles in a single-step yielding sufficient quantities for clinical research becoming, thereby, nanocarriers to be used in nanomedicine for drug delivery purposes. A couple of examples of novel nanomedicines prepared by this methodology will be presented and their advantages discussed.

INVITED SPEAKERS

Thursday, October, 10th, 2013

Victor Puntes, ICREA Research Professor at the **Institut Català de Nanociència i Nanotecnologia (ICN)**, Barcelona, Spain

Chair of the SESSION 3: Novel Applications in Health

(See his CV at the Scientific Committee Section)

Jackie Y. Ying, Executive Director of **Institute of Bioengineering and Nanotechnology**, Singapore

Since 2003, Jackie Y. Ying is managing Director of the Institute of Bioengineering and Nanotechnology. She obtained a B.E. in Chemical Engineering from The Cooper Union (1987), an M.A. in Chemical Engineering from Princeton University (1988) and a Ph.D. in Chemical Engineering from the same university in 1991. Since 1992 she is an assistant professor at the Massachusetts Institute of Technology, USA, Department of Process Engineering. She has received numerous honours and awards, the latest (2012) being the Jubilee Medal and Lectureship from the International Union of Biochemistry and Molecular Biology (IUBMB). Other recognitions, to mention a few, include the Asian Innovation Silver Award, Wall Street Journal Asia, 2011, the Singapore Ministry of Education Service to Education Award, 2011 or the Great Woman of Our Time Award for Science and Technology, Singapore Women's Weekly, 2008. During this year she was named as one of the "One Hundred Engineers of the Modern Era" by the American Institute of Chemical Engineers (Centennial Celebration) and in 2005 she was elected Member of the German National Academy of Sciences, Leopoldina. In addition, Dr. Ying is and has been member of the advisory boards of several societies, such as the Society for Biological Engineering (2007-present) and the Society of Nanoscience and Nanotechnology Asia (2006-present). Furthermore, she is and has been member of numerous advisory and editorial boards from international journals.

Nanostructured Materials and Systems for Biomedical Applications

Nanostructured materials have been developed for various biomedical applications. They have been designed as stimuli-responsive drug delivery systems and sustained protein delivery systems. Nanocomposite systems have also been designed to provide simultaneous drug delivery and bioimaging functions as theranostic systems. They can be synthesized with unique carrier materials that offer synergistic therapeutic effects with the drugs to be delivered.In addition, nanostructure processing has been employed in creating synthetic cell culture substrates for the expansion and controlled differentiation of stem cells. Nanotechnology has also been combined with microfabrication to obtain engineered tissue scaffolds and diagnostic devices.

Andrea Kasko, Assistant Professor of Bioengineering at the **UCLA Henry Samueli School of Engineering and Applied Science**, USA

Andrea Kasko is an assistant professor in the Bioengineering Department. Her research is centered on developing polymeric materials for bioengineering applications. Her research group is specifically interested in designing stimuli-responsive biomaterials for applications in drug delivery and tissue engineering, and in making biomimetic materials that recapture biological function. In other words, they make new materials that can be used to understand and treat disease, sometimes by copying nature's design principles. Andrea Kasko received her doctorate in Polymer Science from the University of Akron, a Master's degree in Macromolecular Science and Engineering at Case Western Reserve University, and a Bachelor's degree in Chemistry from the University of Michigan. After finishing her doctoral work, Andrea spent two years as a post-doctoral research associate with the Howard Hughes Medical Institute, working at the University of Colorado, Boulder, in Chemical and Biological Engineering.

Complex Dynamic Substrate Control: Dual Tone Hydrogel Photoresists

Hydrogels are widely utilized as artificial extracellular matrices, but current materials are unable to completely recapitulate the geometric, mechanical and dynamic characteristics of natural tissues. We have developed an approach to dynamically tune both topography and elasticity in a single photoresponsive hydrogel substrate. Upon exposure to spatially controlled doses of light, a topographically and mechanically patterned (feature size 100 nm – 2 m) surface forms. Atomic force microscopy was used to investigate changes in topographical feature size and elastic moduli of the hydrogel surface as a function of irradiation time and wavelength. These photodegradable hydrogels can act as both positive and pseudo-negative photoresists, depending on exposure time and wavelength. By carefully controlling the aspect ratio (surface area to depth) of micropatterned features, unique swelling-induced ordered microstructures can be formed on the surface. These dual-tone hydrogel photoresists therefore allow dynamic tunability in both topography and elasticity, enabling the fabrication of complex and anisotropic biomaterials.

Amy Rowat, Assistant Professor in the **Department of Integrative Biology & Physiology, UCLA**, USA

Amy Rowat is Assustant Professor and member of the UCLA Jonsson Comprehensive Cancer Center, Broad Stem Cell Research Center, Bioengineering Department, Center for Biological Physics, and Business of Science Center. Rowat earned degrees in: B.Sc. Honors Physics (1998); B.A. Asian Studies, French, & Math (1999); M.Sc. Chemistry (2000); and Ph.D. Physics (2005).

Cell Mechanotyping for Health and Disease

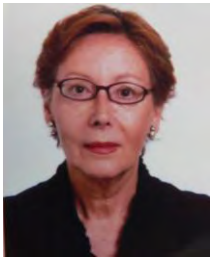
Cell and nucleus mechanical properties are implicated in physiological processes from circulation to migration; cell 'mechanotype' is also altered in a wide spectrum of diseases. For example, profound structural and mechanical changes occur to cells during malignant transformation. To understand the molecular origins of cell mechanotype, we are developing a mechanotyping platform to probe cell and nucleus mechanical properties with high throughput. Here I will present the key technologies of our platform, which exploit flow on the micron-scale as a method to probe cell mechanical properties. We are using this platform to reveal that: (1) human ovarian cancer cells that are resistant to chemotherapy drugs have a distinct mechanotype; and (2) cancer cell mechanotype correlates with other hallmark features, including their invasion and migration potential. Our results provide insight into the physical properties of cancer cells, and suggest the potential value of mechanotyping for prognosis and treatment.

George Georgiou, Cockrell Endowed Professor at the **University of Texas**, USA

Dr. Georgiou is also a member of the Institute for Cell and Molecular Biology at the University of Texas, Austin. Dr. Georgiou received his B.Sc. degree in Chemical Engineering from the University of Manchester, U.K. and his Ph.D. from Cornell in 1987. He is a member of the U.S. National Academy of Engineering and a Fellow of the American Society for Microbiology, the American Association for the Advancement of Sciences, and the American Institute of Medical and Biological Engineers. He has received numerous awards including the AIChE Professional Progress Award for outstanding contributions to Chemical Engineering by an individual under 45 (2003), was elected member of the National Academy of Engineering in 2005 and named "One of the Top 100 Eminent Chemical Engineers of the Modern Era" by AIChE (2008). In 2011 he was elected Member of the Institute of Medicine (IOM). His research is focused on the discovery and pharmacological optimization of protein therapeutics and applied immunology by capitalizing on state of the art protein engineering, directed evolution and systems biology technologies. He has developed several protein-based therapies for disease including co-developing the leading approach under consideration for treatment of inhaled anthrax, currently undergoing clinical evaluation. Other research currently in progress includes an array of therapeutic enzymes in preclinical development, the engineering of antibodies for protection against Severe Acute Respiratory Syndrome (SARS) and the discovery of proteins that can treat autoimmune diseases such as rheumatoid arthritis.

Human Engineered Enzymes for Cancer Therapy

Tumors display abnormal metabolism and have a high requirement for certain amino acid or other metabolites which they acquire from blood. Under conditions where required amino acids or metabolites are depleted the tumor cells die with rapid kinetics whereas non-malignant cells are largely unaffected. The use of amino acid depleting enzymes as a therapeutic approach for cancer has been investigated for over 40 years; however because the human genome does not encode enzymes with the desired catalytic and pharmacological characteristics and non-human enzymes elicit adverse immunological responses and are not suitable for therapy. We have engineered and developed a series of engineered therapeutic enzymes that are PEGylated to form enzyme nano particles which persist in circulation for long times and can effectively deplete metabolites required for certain tumors. We have shown that enzyme therapy is very effective in mouse xenograft models. Two of these enzymes are currently in preclinical development for cancer therapy in humans.



Maria Jesús Buxó, Full Professor Cultural Anthropology, **University of Barcelona**, Barcelona, Spain

Chair of the SESSION 4: RISKS OF NANOTECHNOLOGIES. HEALTH AND ENVIRONMENTAL ISSUES

Maria Jesús Buxó is full Professor of Cultural Anthropology, University of Barcelona, Researcher at the Observatory of Bioethics and Law and she is also member of Bioethics Committee, UB.

Marina Dobrovolskaia, Ph.D., USA

Dr. Dobrovolskaia received her M.S. degree from the Kazan State University in Russia, her Ph.D. from the N.N. Blokhin Cancer Research Center of the Russian Academy of Medical Sciences in Moscow, Russia, and completed two postdoctoral trainings in immunology at the National Cancer Institute in Frederick, MD and the University of Maryland in Baltimore, MD. She worked as a Research Scientist in a GLP laboratory at PPD Development, Inc. in Richmond, VA where she was responsible for the design, development and validation of bioanalytical ligand-binding assays to support pharmacokinetic and toxicity studies in a variety of drug development projects. Her areas of expertise include nanoparticle immunotoxicity, nanoimmunology, innate immunity, immunogenicity, cell signaling and analytical methodology.

Challenges in Preclinical Characterization of Engineered Nanomaterials

Nanoparticle interaction with components of the immune system is of interest to both environmental toxicology and nanomedicine community due to the increased use of these materials in various areas of industry and medicine. Nanopartices can be engineered to either avoid immune system to to specifically interact with it. The effects may be good or bad depending on the intended use of nanomaterials. Preclinical safety is important step before a nanoparticle may be used in animals and patients, and this step involves many challenges. This presentation will review some of the challenges with preclinical analysis of nanomedicines.

Robert Tanguay, Environmental and Molecular Toxicology and the **Oregon Nanoscience and Microtechnologies Institute** and the **Safer Nanomaterials and Nanomanufacturing Initiative**, Corvallis, United States

He currently holds a Distinguished Professor position on Environmental and Molecular Toxicology at the University of Oregon, the highest honor that this university gives to its faculty for their teaching and collaborative research in biomedical sciences and environmental health science. He also leads the Sinnhuber Aquatic Research Laboratory since 2003, where he has created a world-class zebrafish research facility. Tanguay and other scientists use zebrafish as a model organism to study environmental effects on human health. Dr. Tanguay holds a B.A in Biology from the California State University at San Bernardino, CA, (1988), and a Ph.D. from the University of California at Riverside (1995).
His research interests are diverse although for most of his studies his group uses zebrafish ***(Danio rerio)*** as a model, with the aim to improve human and environmental health.

Implementing Rapid in Vivo Assessments of the Nano/Bio Interface to Advance Greener Nanotechnology

The rapid rate of discovery and development in the nanotechnology field will undoubtedly increase both human and environmental exposures to engineered nanomaterials. Whether these exposures pose a significant risk remains uncertain. Despite recent collective progress there remain gaps in our understanding of the nanomaterials physiochemical properties that drive or dictate biological responses. The development and implementation of rapid, relevant and efficient testing strategies to assess these emerging materials prior to large-scale exposures could help advance this exciting field. I will present a powerful approach that utilizes a dynamic *in vivo* zebrafish embryonic assay to rapidly define the biological responses to nanomaterial exposures. Early developmental life stages are often uniquely sensitive to environmental insults, due in part to the enormous changes in cellular differentiation, proliferation and migration required to form the required cell types, tissues and organs. Molecular signaling underlies all of these processes. Most toxic responses result from disruption of proper molecular signaling, thus, early developmental life stages are perhaps the ideal life stage to determine if nanomaterials perturb normal biological pathways. Through automation and rapid throughput approaches, a systematic and iterative strategy has been deployed to help elucidate the nanomaterials properties that drive biological responses.

Pere Santamaria, Group Leader at **IDIBAPS**, Barcelona, Spain, and Professor at **University of Calgary**, Canada

Pere Santamaria obtained a degree in Medicine at University of Barcelona in 1983. After his spesialisation in immunology and cell biology during his Ph.D. (University of Barcelona, 1987), he received a honorary fellow at Dept. of Medicine, University of Minnesota. He has completed two postdoctoral researche: postdoctoral fellow, at Institute of Human Genetics, University of Minnesota (1980 - 1990) and postdoctoral associate, at Dept. of Medicine, University of Minnesota (1989 – 1992). He was assistant professor at University of Calgary, Albert, between 1992 and 1996, and associate professor at this unviersity between 1996 and 2002. Since 2002 he is Chair at Julia McFarlane Diabetes Research Centre (University of Calgary), acting head at Dept. of Microbiology and Infectious Diseases at University of Calgary. He is also director of Julia McFarlane Diabetes Research Centre since 2004 and Scientific Founder at Parvus Therapeutics Inc. since 2008. Pere Santamaria is member of the American Association for the Advancement of Science, the American Association of Immunologists, the Canadian Diabetes Association and the Canadian Society for Immunology.

A Disease-Specific Nanomedicine Platform for the Treatment of Autoimmunity

Our work focuses on advancing nanomedicines for the treatment of autoimmune diseases. The complexity of spontaneous autoimmune responses is a barrier to the design of strategies that can selectively purge the immune system of autoreactivity without impairing systemic immunity. We have discovered that treatment with NPs coated with mono-specific, disease-relevant peptide-major histocompatibility complexes (pMHC) can restore normoglycemia in diabetic animals and resolve limb paralysis in animals affected by experimental autoimmune encephalomyelitis. We have established that pMHC-NP therapy functions by expanding, in an epitope-specific manner, autoantigen-experienced regulatory T-cells that suppress the recruitment of other autoantigenic specificities. This expansion is dramatic, correlates with therapeutic efficacy, including duration of disease reversal, and can be monitored by analysis of peripheral blood, thereby functioning as a biomarker of therapeutic efficacy. I will briefly describe the experimental results that led to the discovery of the paradigm and therapeutic approach, will present unpublished new data on experiments testing several of its predictions, and will summarize our ongoing efforts for clinical translation.

INVITED SPEAKERS

Friday, October, 11th, 2013

Josep Corbella, Scientific journalist of *La Vanguardia*

Chair of the SESSION 5: ADDRESSING THE FUTURE: THREATS AND OPPORTUNITIES

Josep Corbella is a journalist of *La Vanguardia.* He is responsible for science and health information since 1993. He had previously worked in the supplement Medicine and Quality of Life of *La Vanguardia* (1990-1993), in the *Diari de Barcelona* (1988-1990) and the magazine *Carrer Gran* (1985-1988). He is coauthor of the books *La cocina de la salud* (co-written with Ferran Adrià and Valentin Fuster - 2010), *La ciencia de la salud* (co-authored with Valentin Fuster - 2006) and *Sapiens* (co-written with Eudald Carbonell, Salvador Moya and Robert Hall - 2000). He has collaborated with RAC1 radio station since 2000. He also conducts a weekly scientific information in the program *Versio RAC1*, led by Toni Versio Clapés, since 2012.

Ruth Duncan, Director of the Centre for Polymer Therapeutics at the Welsh **School of Pharmacy**, Cardiff University, UK

Ruth Duncan also currently holds the honorary positions of Professor Emerita in Cardiff University, and Visiting Professor at the University of Greenwich and Centro de Investigación Príncipe Felipe, Valencia. She is also a member of a number of Institutional and International Advisory Boards and Committees; e.g. President of the Advisory Board of the Spanish Ciber-bbn, and member of the Scientific Advisory Boards of the Filarete Foundation (Milan), Vall D'Hebron Research Institute (Barcelona) and the iMed Institute, Faculty of Pharmacy, University of Lisbon. After finishing her Ph.D. studies at Keele University on the mechanisms of endocytosis (1979), she established an interdisciplinary group at Keele interested in the rational design of polymeric anticancer conjugates (Cancer Research Campaign's Polymer Controlled Drug Delivery Group). After licensing to Farmitalia Carlo Erba the first polymer anticancer conjugates developed together with the Institute of Macromolecular Chemistry Prague she joined the company in 1992 in Milan as Head of New Technologies/Project Team Leader where she was responsible of transferring the first synthetic polymer anticancer conjugates arising from her work into clinical trials. Returning to academia in 1994 she established the Centre for Polymer Therapeutics at the London School of Pharmacy and in 2000 the group transferred to Cardiff She was elected Co-Chair of the Gordon Research Conference on Drug Carriers in Biology and Medicine in 1998, and in 2004 was elected the Science Chair of the British Pharmaceutical Conference. She is a past member of the CPS sub committee of the UK Medicines and Health Regulatory Agency and is currently a member of the European Medicines Agency AD Hoc Advisory Committee on Nanomedicine.

Nanomedicine(s) the Future: Threats and Opportunities

After the turn of the millennium there was a sudden convergence of interests within many scientific disciplines that gave rise to multidisciplinary teams exploring the frontiers of nanoscale science relating to biomedical nanotechnologies. The field of 'Nanomedicine' was born offering the potential to generate more effective diagnostics, therapeutics, surgical tools and biomedical materials able to aid the prevention and/or treatment of life-threatening and debilitating diseases. In this context nanomedicine(s) have been described as "purpose-designed" drugs and drug delivery systems (often composed of multiple components) having at least one dimension in the nano-size range designed as drugs, for drug targeting (organ-specific, cell-specific or subcellular targeting), controlled and/or site-specific release and improved drug transport across biological barriers. New vaccines and imaging agents (including theranostics) have also been proposed. Now, a decade on, it is timely to review the emerging technologies that have not only given rise to interesting scientific publications, but that have real potential to ultimately yield important 'medical products' able to realise the healthcare benefit to society foreseen. In reality nano-sized advanced drug delivery systems are not new, e.g. colloidal iron has been used to treat anaemia since the 1930's. There is growing clinical experience (successes and failures) gathered over >4 decades with many 1st generation nanomedicines already in routine clinical use. Going forward it is possible to build on the many lessons learnt regarding clinical trial design, methodology for quantitation of PK and body distribution (nanomedicines are usually internalised by cells via endocytosis), and not least, using nanomedicine-relevant biomarkers, select those patients for treatment most likely to benefit from such therapies. In addition, the increasing number of 1st generation nanomedicines beginning to come off-patent has stimulated Regulatory Authority discussion regarding product-specific critical features controlling safety and efficacy in order to ensure equivalent performance of 'follow-on products' can be achieved. The current status of the field and opportunities and challenges to realisation of full potential of nanomedicine(s) will be discussed.

Robert Rallo, Associate Professor of Computer Science and Artificial at **Universitat Rovira i Virgili**, Tarragona, Spain

Robert Rallo holds a BSc in Chemistry from Universitat de Barcelona and a Ph.D. on Chemical Engineering from Universitat Rovira i Virgili. He is the head of the Research Group on Bioinformatics & Computational Engineering (BIOCENIT), which is an interdisciplinary research group that strives to improve quality of life by better understanding the complexity of relevant processes and interactions in nature, science and society. His research focuses on multi-scale modeling of complex systems of industrial or environmental relevance. Rallo is also the Director of the Advanced Technology Innovation Center (ATIC) that participates in the TECNIO network of Generalitat de Catalunya. In 2007 he was visiting professor in the Department of Chemical and Biomolecular Engineering at the University of California Los Angeles (UCLA). Since 2008 he is also a faculty member of the Center for Environmental Implications of Nanotechnology (CEIN). Since 2013 he serves as Chair for the Modeling WG in the EU NanoSafety Cluster and has also been appointed to serve as the EU co-chair of the US-EU Nano-Dialogue Community of Research on Predictive Modeling and Health.

Towards *in Silico* Nanotoxicology

The development of future generations of *safe-by-design* nanoparticles requires understanding of the mechanisms that govern their effects and interactions with living organisms. Traditionally, animal testing has been considered as the most reliable source of data for hazard and risk assessment. However, the huge amount of possible types of nanoparticles makes the application of traditional toxicity testing methods unfeasible for nanomaterials. Alternative testing strategies, combining *in vitro* high content screening with *in silico* toxicity prediction tools, are thus fundamental to ensure the safe application of nanotechnology. *In silico* nanotoxicology is based on the establishment of robust and reliable relationships between structure and properties of nanoparticles and their interactions with biological systems (i.e., structure-activity relationships, SAR). Despite the incipient efforts in nanotoxicity modeling, the large number of possible nanoparticle types (e.g., diverse combinations of core, surface modifications, functionalization, morphology and size) hinders the development of universal models. The establishment of robust SARs for nanoparticles requires large repositories of high quality characterization data (structure, physicochemical properties, endpoint information) that are not yet available. It is thus fundamental to put in place the proper computational strategies to accelerate the extraction and integration of existing information into consistent repositories so that *in silico* nanotoxicology models can be developed and validated.

Piotr Grodzinski, Director of **NCI Alliance for Nanotechnology in Cancer at the National Cancer Institute**, Bethesda, USA

Piotr Grodzinski coordinates program and research activities of the Alliance which dedicates around $150M over funding period of 5 years to form interdisciplinary centers as well as fund individual research and training programs targeting nanotechnology solutions for improved prevention, detection, and therapy of cancer. Dr. Grodzinski is materials scientist by training, but like many others found bio- and nanotechnology fascinating. In mid-nineties, he left the world of semiconductor research and built a large microfluidics program at Motorola Corporate R&D in Arizona. The group made important contributions to the development of integrated microfluidics for genetic sample preparation with its work being featured in Highlights of Chemical Engineering News and Nature reviews. After his tenure at Motorola, Dr. Grodzinski was with Bioscience Division of Los Alamos National Laboratory where he served as a Group Leader and an interim Chief Scientist for DOE Center for Integrated Nanotechnologies (CINT). Dr. Grodzinski received Ph.D. in Materials Science from the University of Southern California, Los Angeles in 1992. He is an inventor on 17 patents and published 58 peer-reviewed papers, 10 book chapters. Dr. Grodzinski has been an invited speaker and served on the committees of numerous conferences in the past years.

Future Opportunities in Cancer Nanotechnology - Perspective from National Cancer Institute, USA

Nanotechnology has been providing novel, paradigm shifting solutions to medical problems and to cancer, in particular. In order to further these research goals, NCI formed a program called Alliance for Nanotechnology in Cancer which was initiated in 2004. The Alliance funds Centers of Cancer Nanotechnology Excellence, the development of nanotechnology platforms, and two training programs: Cancer Nanotechnology Training Centers and Path to Independence Awards. An intramural arm of the Alliance - Nanotechnology Characterization Laboratory provides a characterization support to evaluate clinically promising nanomaterials and establish their physical, pharmacological and toxicological characteristics. In this presentation we will briefly state a current status of cancer nanotechnology efforts funded by the program and then focus on future opportunities and strategies in this field. Further progress is likely to follow two parallel tracks. First one will be associated with on-going translation to the clinical environment; while the second with the development of new tools and techniques in research arena. It is expected that small molecule drugs in nanoparticle-based formulations currently undergoing clinical trials will be joint by other modes of therapy including siRNAs, kinase inhibitors, and others. Active targeting, when appropriate will be used more frequently. In order to make translational efforts more wide spread, access to reliable GLP characterization and GMP manufacturing facilities will need to become more available. Imaging techniques based on nanoparticles will be designed to operate in multi-functional manner; whether it is ability to probe and monitor tumor microenvironment in addition to imaging tumor mass itself, capability of multi-modality imaging, or use of theranostic functions of diagnosis and subsequent treatment. The use of nanotechnologies in intra-operative imaging to guide real time surgery is also expected to expand. In vitro diagnostic devices have matured to a stage in which the development of additional device modalities with new transduction methods does not seem necessary. These devices will be however, increasingly used to collect data for sophisticated multi-parameter analysis allowing to correlate levels of different biomarkers, optimize reliable panels which are required to determine presence of the disease, and determine response of individual patients to different modes of therapies.

ADDITIONAL INFORMATION

Suggested Readings

National Center for Biotechnology Information advances science and health
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2426787/

Information about Nanomedicine
http://en.wikipedia.org/wiki/Nanomedicine

Information about Nanomedicine
http://www.wifinotes.com/nanotechnology/what-is-nanomedicine.html

European Technology Platform of Nanomedicine
http://www.etp-nanomedicine.eu/public

Genetic Science Learning Center
http://learn.genetics.utah.edu/content/begin/cells/scale/

Nanotechnology at the National Institutes of Health
http://www.nih.gov/science/nanotechnology/

National Cancer Insitute. Alliance for Nanotechnology
http://nano.cancer.gov/

The Open source Handbook of Nanoscience and Nanotechnology
http://en.wikibooks.org/wiki/Nanotechnology

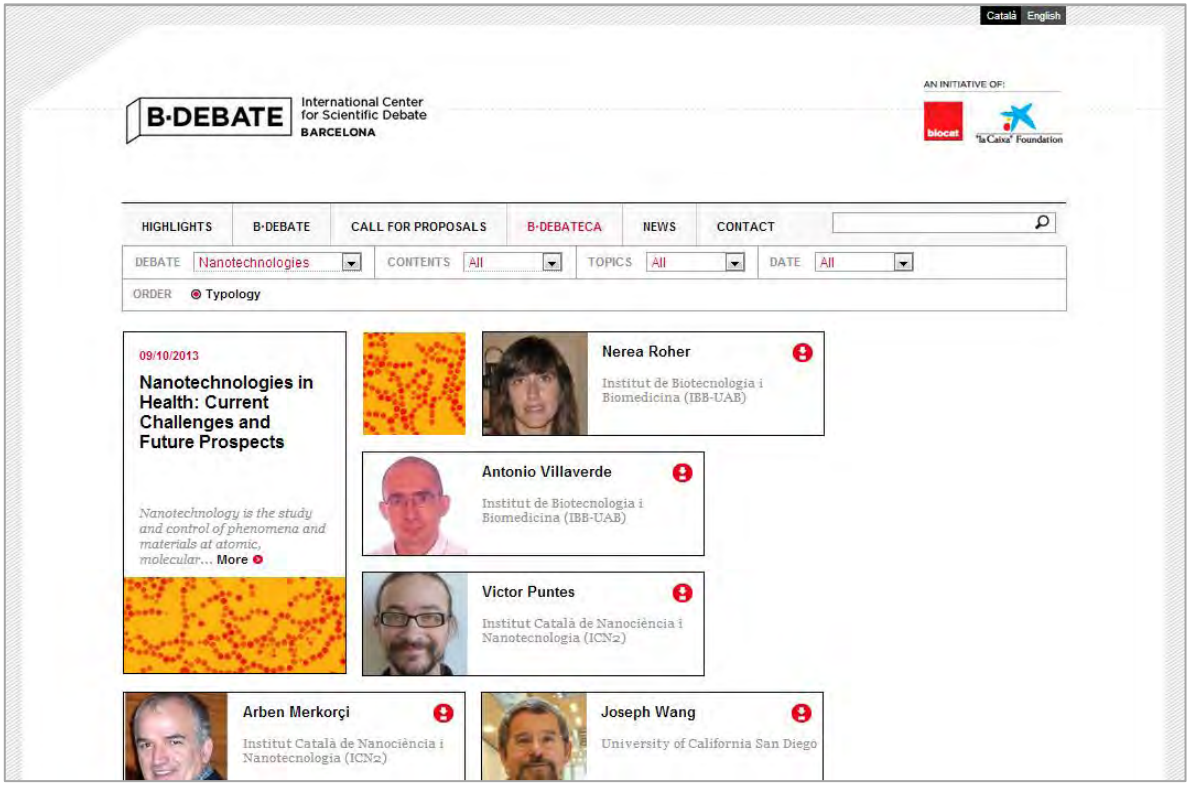
Balancing the promises. Nanomedicine vs nanotoxicity.
http://issuu.com/victorpuntes/docs/nanotechnology_balancing_the_promises/1

OUTCOMES

B·Debateca

On the website of **B·Debate**, you will find all the information related with the celebration of the meeting that includes reports, conclusions, scientific documents, interviews with the experts, speaker's CVs, presentations, videos, images, press documentation and other related materials. We invite you to visit the section **B·Debateca** on www.bdebate.org !

Contents of the meeting "NANO-TECHNOLOGIES IN HEALTH: CURRENT CHALLENGES AND FUTURE PROSPECTS"



FOLLOW UP ON TWITTER

#BDebate
@BDebate
www.bdebate.org

PRACTICAL INFORMATION

Debates venue

CosmoCaixa Barcelona
C/ Isaac Newton, 26 08022 Barcelona, Spain
http://obrasocial.lacaixa.es/laCaixaFoundation/home_en.html

Speakers' hotel

Hotel Balmoral Barcelona
Via Augusta, 5
08006 Barcelona, Spain
Phone: +34 932178700

http://www.hotelbalmoral.com/

Contact person during the event

Laia Arnal — B·Debate
larnal@biocat.cat | Phone: +34 662 315 529 | +34 93 310 33 30

Margarita Navia — CEI-UAB
Margarita.navia@uabcat| Phone: +34 675 688 405 | +34 93 586 868 943

ORGANIZERS

B·Debate International Center for Scientific Debate Barcelona is a Biocat initiative with support from "la Caixa" Foundation. It drives first-rate international scientific debates, to foster dialogue, collaboration and open exchange of knowledge with prestigious national and international experts, to approach complex challenges of high social interest in life sciences. B·Debate sees debate as a powerful, effective way to generate knowledge and strives to help position Barcelona as a benchmark in generating knowledge and Catalonia as a country of scientific excellence. More info: www.bdebate.org

---

The **Catalan Institute of Nanoscience and Nanotechnology (ICN2)** is a private foundation with the objective of becoming a world-renowned centre for nanoscience and nanotechnology research. It is part of CERCA, the network of Research Centres launched by the Catalan Government as a cornerstone of its long-term strategy to foster development of a knowledge-based economy. ICN2's research lines focus on the newly discovered physical and chemical properties that arise from the fascinating behaviour of matter at the nanoscale. The Institute is devoted to studying and understanding fundamental physical phenomena associated to state variables; investigating new properties derived from tailored nanostructures; and establishing new processes for the conception and fabrication of new nanodevices. This work enables functionalisation of nanoparticles, encapsulation of active agents and creation of new nanodevices and nanosensors, through frontier science that has direct implications for various sectors (health, food, energy, the environment, etc.). ICN2 actively promotes collaboration among scientists from diverse backgrounds (physics, chemistry, biology, engineering), seeking to integrate their knowledge to complete its mission. The Institute trains researchers in nanotechnology, offering studentships as well as doctoral and post-doctoral positions. ICN2 holds seminars and workshops to unite scientists, engineers, technicians, business people and policy makers. We disseminate our research results in the media and provide public forums on general nanotechnology information and on our work. ICN2 has already experienced success in directly transferring its patented technologies to industry: ICN2 has launched one start-up company, is currently evaluating two more and is now pursuing numerous commercial contracts. The Institute is actively seeking new commercialisation partners for myriad early stage technologies. More info: www.icn.cat

---

The **Institut de Biotecnologia i de Biomedicina** (IBB) was created in 1970 as a research institute of the Universitat Autònoma de Barcelona (UAB) to promote fundamental biological research. In the year 2000, the focus of research evolved towards the Biotechnology and Biomedicine fields, with the aim of advancing scientific findings into translational results. At present, the Institute hosts 18 research groups organised into 3 programmes and working in 7 areas of expertise: Bioinformatics, Cellular Biology, Structural Biology, Genomics, Immunology, Microbiology and Proteomics. This multidisciplinary character, one of the most relevant characteristics of the IBB, allows for a broad approach to biological problems, both basic and applied. The IBB is also highly engaged in academic training at the undergraduate and postgraduate levels. Among the over 200 researchers currently working at the IBB, there are lecturers and professors from the UAB, ICREA and other senior researchers, postdoctoral fellows, and students in training. The IBB also shares its campus building with small biotech companies and technological platforms including Genomics and Bioinformatics (SGB), Proteomics and Structural Biology (SEPBioES) and Cytometry, Cell culture and Antibody Production (SCAC). These services were born within the IBB and now work independently, offering services to IBB researchers, the UAB community and external users. At the IBB we are compromised with doing research to tackle current problems in Health and Biotechnology, for the wellbeing of society. More info: http://ibb.uab.cat

COLLABORATORS

CosmoCaixa offers interactive, enjoyable science and an open door for anyone who is eager to learn and understand and who never stops wondering why things are the way they are. **CosmoCaixa Barcelona** boasts the Geological Wall and the Amazon Flooded Forest, wich features more than 100 plant and animal species that convince visitors they have been transported from the Mediterranean to the very heart of the tropical jungle. In addition to its permanent facilities –Bubble Planetarium, digital Planetarium, Click and Flash, Touch, touch! and Explore your five senses– and its open areas, CosmoCaixa offers a scientific and educational programme that includes exhibitions, workshops, conferences, courses and debates involving experts from all over the world. More info: http://obrasocial.lacaixa.es/laCaixaFoundation

The **Universitat Autònoma de Barcelona** (UAB) was one of the first Spanish universities to be recognized as **Campus of International Excellence** (CEI) by the Spanish Ministry of Education. This award represents a recognition to dynamism shown by the UAB in recent years. The project UAB-CEI: "Promoting Knowledge, Encouraging Innovation" has been a tool that helped us to improve teaching, research and knowledge transfer. In this sense, our strategies of smart specialization and aggregation are the grounds to create an ecosystem of innovation. This ecosystem facilitates a multidisciplinary and collaborative research which is oriented to tackling societal challenges. The Campus of International Excellence UAB-CEI has been an opportunity to promote relevant changes in the concept of "traditional campus" and the relationship with our region, aligned with the strategy of the European Union Horizon2020. It has also been an excellent opportunity to start a process of debate on the role to be played by our university, both at international level, as a leading institution and locally, as a driving force in the socio-economic development of the territory. More info: http://www.uab.es/cei/

The **Institute for Bioengineering of Catalonia** (IBEC) is an interdisciplinary research centre focused on bioengineering and nanomedicine, based in Barcelona.IBEC's mission is to conduct high quality research that, while creating knowledge, contributes to a better quality of life, improves health and creates wealth. The institute establishes close links with international research centres, universities, hospitals and industry to exchange talent and develop and execute projects.IBEC was established in 2005 by the Ministries of Innovation, Universities and Enterprises and Health of the Generalitat de Catalunya (Autonomous Government of Catalonia), the University of Barcelona (UB) and the Technical University of Catalonia (UPC). Today, IBEC's relationship with the UB and UPC researchers continues to operate under a framework agreement signed in 2008.The institute currently has 16 research groups and 250 researchers and staff from 20 different countries. More info: www.ibecbarcelona.eu/

Nanonica is a Business Angels investment company devoted to the transfer of breakthrough early-stage projects from academia to industry in the areas of nanotechnology and microtechnology with clearly defined objectives: Identify the best talents, expertise and projects to address the needs of the industry; Enable companies to identify existing know-how and attractive projects in universities and research centers that meet their needs and expectations; Develop and commercialise the results of academic breakthrough research. Nanonica's mission is to create added value transforming ideas into marketable products. More info: http://www.nanonica.com/

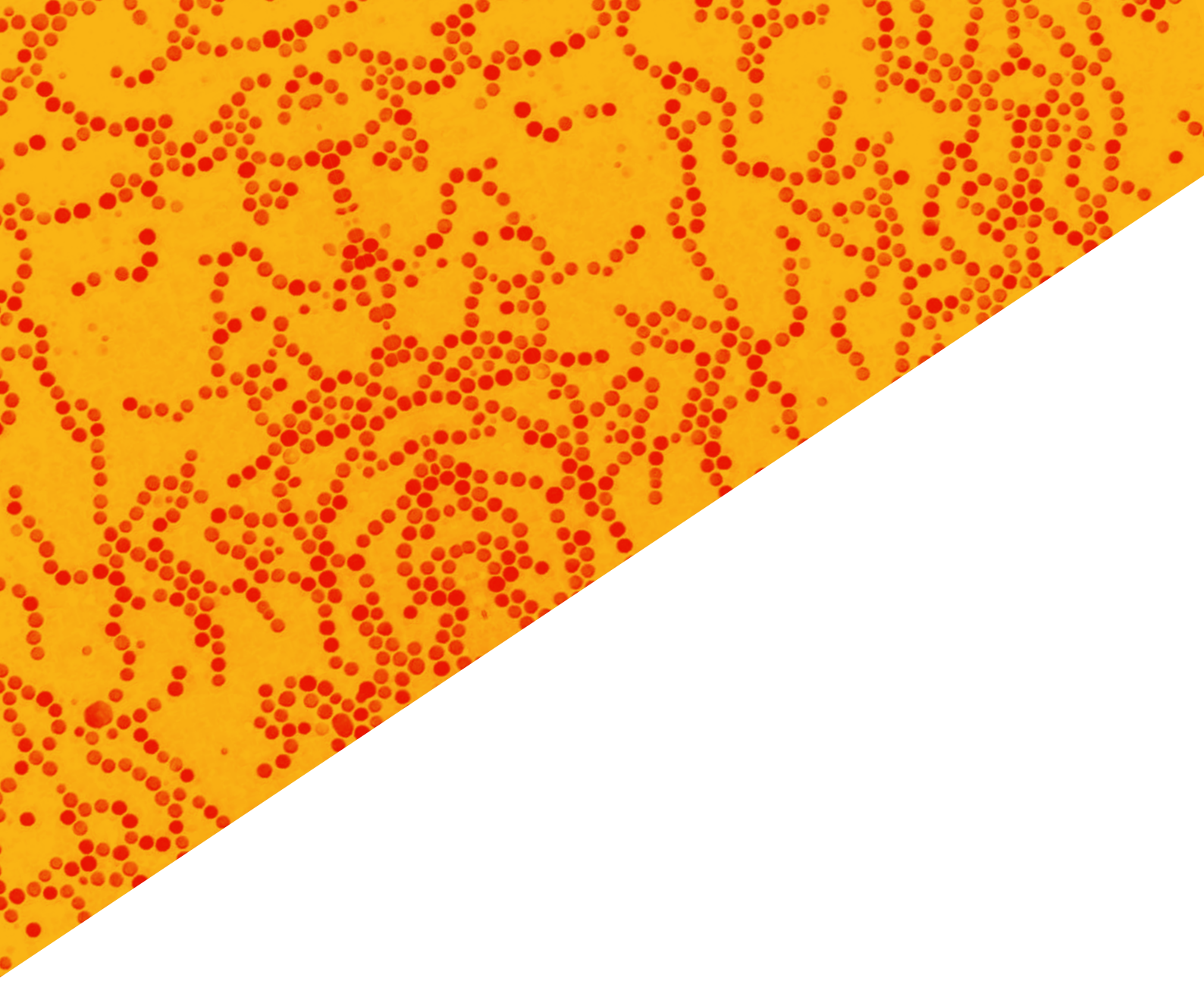
NOTES

NOTES

NOTES

NOTES

NOTES



B·DEBATE
International Center
for Scientific Debate
BARCELONA

Passeig de Gràcia,
nº 103, 3ª planta
08008 Barcelona

T. +34 93 310 33 30
info@bdebate.org
www.bdebate.org

AN INITIATIVE OF:

biocat

"la Caixa" Foundation