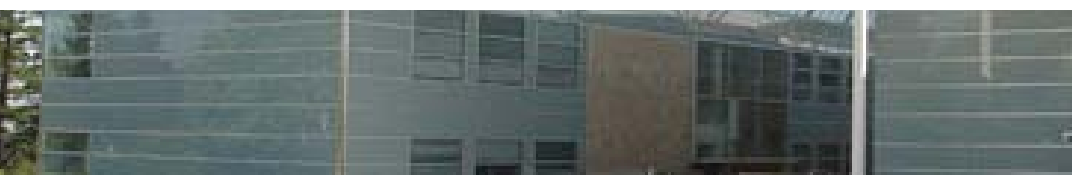
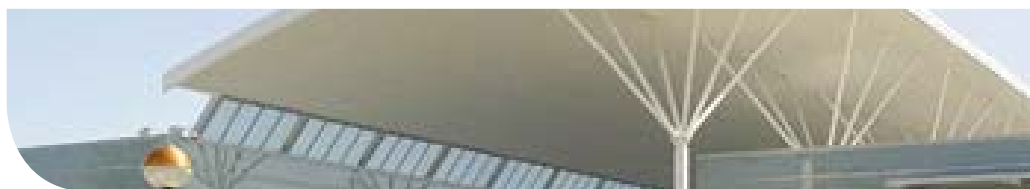


# ACTIVITY REPORT



# 2014



## CONTENTS

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## PRESENTATION

### Presentation

The Center for Cooperative Research in Biomaterials - CIC biomaGUNE ([www.cicbiomagune.es](http://www.cicbiomagune.es)), located in San Sebastian (Spain), was officially opened in December 2006. CIC biomaGUNE is a non-profit research organization created to promote scientific research and technological innovation at the highest levels in the Basque Country following the BioBasque policy in order to create a new business sector based on biosciences. Established by the Government of the Basque Country, CIC biomaGUNE constitutes one of the Centres of the CIC network, the largest Basque Country research network on specific strategic areas, having the mission to contribute to the economical and social development of the country through the generation of knowledge and speeding up the process that leads to technological innovation.

The first phase for the setting of CIC biomaGUNE was to build laboratories to house up to 8 research teams. The scientific leaders were selected from the international scientific community. Along 2007 and 2008, the activity concentrated on building the Molecular Imaging Facility, which was approved as a National Facility by the Spanish Government in 2010. The most recent landmark has been the appointment of a new Scientific Director in 2012, which settled the maturity of the Centre.

CIC biomaGUNE has established a state of the art research program at the interface between the chemical, biological and physical sciences with a main emphasis on molecular scale properties and applications of biological nanostructures. The final aim of this program is to contribute to the understanding of the functioning of biological systems at the molecular and nanometer scale.

The main research lines lie within the design, preparation and characterization of biofunctional nanostructures and their in vitro and in vivo biological evaluation.

These research lines include the synthesis and characterization of biofunctional nanoparticles, studies on molecular self-assembly, nano-fabrication techniques toward nano-devices, bioconjugation of surfaces and study of interface processes, research on basic aspects of the interface design and the production of biologically relevant patterns at the nanometer scale for protein- surface and cell-surface interaction studies.

This basic knowledge may permit, in the long run, to improve the ability to intervene at different stages of a disease by developing early diagnosis methods, "smart" treatments, as well as triggering self-healing mechanisms.

The Molecular Imaging Facility is a technological platform of high relevance at the European level, in preclinical imaging. It empowers the research capacity at CIC biomaGUNE and provides high expertise service to research centres, hospitals and companies.

CIC biomaGUNE, in close collaboration with CIC bioGUNE, is committed to identifying new opportunities in the field of biosciences through a pathway of excellence in research, both answering to international challenges and contributing to the development of a new biotech sector in the Basque Country.

## PRESENTATION

The General Director is **Prof. José María Mato** and since January 2013 **Prof. Luis Liz-Marzán** is the Scientific Director of CIC biomaGUNE, succeeding **Prof. Manuel Martín-Lomas**, who has been the Founding Scientific Director of CIC biomaGUNE, from 2006 to end of 2012.

The assessment of the scientific activity of CIC biomaGUNE is carried out by the International Scientific Advisory Board (ISAB), composed of internationally distinguished scientists active in CIC biomaGUNE's research fields. It is currently comprised of the following members:

**Prof. Peter Morris**

Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, UK

**Prof. Lia Adaddi**

Weizmann Institute of Science, Rehovot, Israel

**Prof. Itamar Willner**

Institute of Chemistry, The Hebrew University of Jerusalem, Israel

**Prof. Helmuth Möhwald**

Max Plank Institute of Colloids and Interfaces, Germany

**Prof. Peter Seeberger**

Max Plank Institute of Colloids and Interfaces, Germany

**Prof. Jon Dilworth**

Department of Inorganic Chemistry, University of Oxford, UK

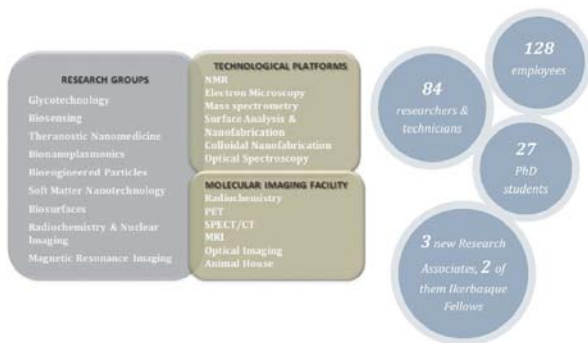
**Prof. Samuel I. Stupp**

Institute for BioNanotechnology in Medicine, Northwestern University, USA

## SUMMARY

### Organization

A change in the internal organization of the research groups was implemented during 2014. The previously existing research units: Biofunctional Nanomaterials, Biosurfaces and Molecular Imaging were suppressed and each laboratory was given a specific name that provides information about the research line each group carries out. The new organization resulted in the following research groups:



### Funding

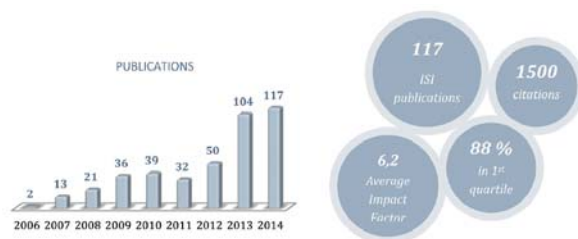
Since January 2014, 15 new grants have been awarded with a total contribution of 2,842,973.80€.



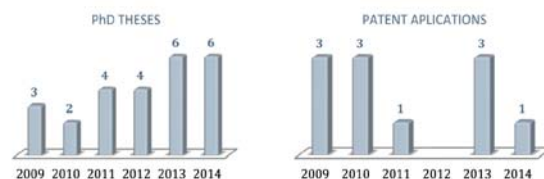
## SUMMARY

### Scientific Output

During 2014, 117 articles in high impact scientific journals have been published



Also in 2014, 6 PhD theses have been defended and one new patent application has been filed.



### Training and Outreach Activity



## ORGANIZATION

### Organization

The table below provides the distribution of CIC biomaGUNE's personnel as per November 2014

#### CIC biomaGUNE'S Personnel

Principal Investigators	11
Associate Researchers	8
Visiting Professors	1
Research Assistants	1
Platform Heads	9
Laboratory Technicians and Platform Specialists	31
Animal Caretaker	1
Postdoctoral researchers	22
PhD students	27
Direction and Administration	9
IT and Maintenance	7
Biosafety and Radioprotection	1
<b>Total</b>	<b>128</b>

### New Researchers

During 2014 three research associates joined CIC biomaGUNE:

- Fernando López Gallego (Ikerbasque Research fellow) joined CIC biomaGUNE in January 2014

**Dr. López Gallego** studied Biochemistry at Universidad Autónoma de Madrid and obtained his PhD in molecular biology at the same university in 2007. Then he was postdoctoral associate at the University of Minnesota from 2007 to 2010. In 2010 he was awarded with a "Juan de la Cierva" fellowship to work as research associate in the Institute of Catalysis and Petrochemistry (CSIC). In 2013, he moved to REPSOL as researcher in the biotechnology department. In 2014 he obtained an Ikerbasque fellowship to join CIC biomaGUNE as research associate. His research has mainly focused on heterogeneous biocatalysis to optimize enzymes as catalysts of green and sustainable chemical processes. Over the past 11 years he authored 61 peer reviewed publications in international journals, 50% of the articles are published in 1st quartile journals and many of them are top-ranked (best 10%) in their respective fields. The impact of his research in different scientific areas is supported by an H-index of 23 with more than 1600 total citations.

## ORGANIZATION

- Pedro Ramos Cabrer joined the MRI laboratory in May 2014

**Dr. Ramos Cabrer** graduated in 1994 in chemistry by the University of Santiago de Compostela. In 2000 he obtained a PhD from the Physical Chemistry of Colloids Laboratory, University of Santiago. In 2008 he obtained an MSc degree as expert in experimental animals for biomedical research, C Category by the University of Granada. He worked as postdoctoral researcher at the In vivo NMR Laboratory, Max Planck Institute for Neurological Research (Cologne) 12/2003-12/2006. After a long period abroad, he returned to Spain as Parga Pondal Researcher (Galician Government) at the Clinical University Hospital of Santiago de Compostela (12/2006-02/2010) and then as Miguel Servet Researcher (Spanish Ministry of Health) at the same hospital (02/2010-10/2014). He has been visiting researcher at the Laboratory of Nanomedicine of the Translational and Molecular Imaging Institute at Mount Sinai Hospital in New York (07-11/2013), collaborating docent of the Department of Medicine of the University of Santiago de Compostela (2008-2014) and member of the bioethics committee of the same university (2011-2014). He has an H-index of 21, 52 publications in indexed journals, 4 registered patents, 6 book chapters and over 60 papers, courses and invited lectures. He has been principal investigator of 2 research grants of the Spanish National Plan, and one of Xunta de Galicia, and participated as a researcher in 2 RETICS networks and in 12 other grants.

- Javier Reguera Gómez (Ikerbasque Research fellow) joined the Bionanoplasmonics laboratory in November 2014

**Dr. Reguera** received a Bachelor degree in Physics in 2001 and a PhD in Materials Science in 2008 at the University of Valladolid (Spain). From 2003-2008 he worked as assistant lecturer at the school of Industrial Engineering at the same university. He performed postdoctoral work at MIT (2009-2011) and at EPFL (2011-2014). In 2014 he joined CIC biomaGUNE as Ikerbasque research fellow. Javier Reguera has co-authored over 22 articles and two book chapters, which received over 500 citations leading to an h-index of 12. He obtained the best doctoral thesis award by the Group of Polymers of the Spanish Royal Societies of Physics and Chemistry and the extraordinary prize by the school of Science (Univ. Valladolid). He has also been awarded with a Fulbright fellowship. His research activity at CIC biomaGUNE will focus on the self-assembly of anisotropic nanoparticles and their use in biomedicine.

## ORGANIZATION

### Research Groups









A change in the internal organization of the research groups was implemented during 2014. The previously existing research units: Biofunctional Nanomaterials, Biosurfaces and Molecular Imaging were suppressed and each laboratory was given a specific name that provides information about the research line each group carries out.

As a result, CIC biomaGUNE currently comprises the following research groups:

### Group Leaders

<p><b>Glycotechnology</b> Niels Reichardt</p> 	<p><b>Glyconanoparticles</b> Soledad Penadés</p> 	<p><b>Biosensing</b> Valery Pavlov</p> 	<p><b>Theranostic Nanomedicine</b> Juan C. Mareque-Rivas <i>Ikerbasque Professor</i></p> 	<p><b>BioNano Plasmonics</b> Luis Liz-Marzán <i>Ikerbasque Professor</i></p> 
<p><b>Bioengineered Particles</b> Wolfgang Parak</p> 	<p><b>Soft Matter Nanotechnology</b> Sergio E. Moya</p> 	<p><b>Biosurfaces</b> Ralf Richter</p> 	<p><b>Radiochemistry and Nuclear Imaging</b> Jordi Llop</p> 	<p><b>Magnetic Resonance Imaging</b> Torsten Reese</p> 

### Research Associates

<p><b>BioNano Plasmonics</b> Marek Grzelczak <i>Ikerbasque Fellow</i></p> 	<p><b>Bioengineered Particles</b> Mónica Carril <i>Ikerbasque Fellow</i></p> 	<p><b>Heterogeneous Biocatalysis</b> Fernando López <i>Ikerbasque Fellow</i></p> 	<p><b>BioNano Plasmonics</b> Javier Reguera <i>Ikerbasque Fellow</i></p> 
<p><b>Glyconanoparticles</b> Isabel García-Martín <i>CIBER-BBN</i></p> 	<p><b>Experimental Molecular Imaging</b> Abraham Martín Muñoz</p> 	<p><b>Theranostic Nanomedicine</b> Luca Salassa <i>Ramón y Cajal Fellow</i></p> 	<p><b>Magnetic Resonance Imaging</b> Pedro Ramos Cabrer</p> 

## FUNDING

Since January 2014, 15 new grants have been awarded with a total contribution of **2,842,973.80€**.

### List Of Financed Projects Since January 2014

PI	Funding Agency	Call	Amount	Period	Full Title
Niels Reichardt	European Commission	H2020-MSCA-ITN-2014	798,390.92	2015 - 2018	IMMUNOSIAPE - Selective Carbohydrate Immunomodulators targeting C-type Lectin Receptors on Antigen Presenting Cells
Juan Mareque	European Commission	H2020-MSCA-ITN-2014	226,272.96	2015 - 2018	TOLLerant - Toll-Like Receptor 4 activation and function in diseases: an integrated chemical-biology approach.
Sergio Moya	European Commission	H2020-MSCA-RISE-2014	772,020.00	2015 - 2018	HYMADE - Hybrid Drug Delivery Systems upon Mesoporous Materials, Self Assembled Therapeutics and Virosomes
CIC biomaGUNE	MINECO	Acciones de dinamización: Europa Redes y Gestores	151,000.00	2014-2017	European Research, Development & Innovation Projects Office
Marek Grzelczak	MINECO	Explora Ciencia	36,300.00	2014-2016	REPLICANT - Desarrollo de Protocélulas a partir de Cristales Plasmonicos Autoreplicantes
Luis Liz-Marzán/ Marek Grzelczak	MINECO	Retos	258,051.00	2014-2017	AutoNanoThera - Reproducible Synthesis and Assembly of Plasmonic Nanostructures for Theranostics
Sergio Moya/Jordi Llop	MINECO	Retos	201,995.92	2014-2017	NanoFate - Translocation, Biological Fate and Biointeractions of Engineered Nanoparticles with Biomedical Applications and for Nanosafety Evaluation.
Altur Lecuona	MINECO	Personal Técnico de Apoyo (BRHH)	36,000.00	2014 - 2016	PTA Technician
Sergio Moya/Jordi Llop	GOBIERNO VASCO	Proyectos de investigación básica y/o aplicada	28,000.00	2014-2017	Translocación, Destino Biológico y Biointeracciones de Nanomateriales con Aplicaciones Biomédicas e Industriales para su Evaluación Toxicológica.
Juan Mareque	GOBIERNO VASCO	Programa de Perfeccionamiento y Movilidad del Personal Investigador	9,973.00	2014	Nanopartículas con nanobodies de tiburón para aplicaciones en terapia y diagnóstico
Sergio Moya/Jordi Llop	Diputación Foral Guipúzcoa	Programa RED- Equipos	35,976.00	2014-2015	GERMANIO - Adquisición de un espectrómetro gamma de alta resolución para la caracterización de materiales radiactivos
Valery Pavlov/ Luis Liz-Marzán	Diputación Foral Guipúzcoa	Programa RED - Investigación	83,000.00	2014 - 2015	ECN-DETER - Aplicación en bioanálisis de la producción enzimática de las Nanopartículas catalíticas
Jordi Llop	Fundació La Marató (TV3)	2013 call- Neurodegenerative diseases	90,175.00	2015-2017	Setting a rational screening program for trans-synytretin- $\beta$ -binding stabilizing compounds that may lead to potential Alzheimer's disease modulating drugs
Marek Grzelczak	BBVA Foundation	Proyectos Individuales	39,819.00	2015	Almacenamiento de energía solar en las partículas coloidales
Luis Liz-Marzán	King Saud University	Distinguished Scientist Fellowship Program	85,000.00	2014-2015	Mixed clusters of metal and magnetic nanoparticles for applications in pollutant detection

## FUNDING

### Research contracts with Institutions/Companies

During 2014 several research contracts with the following institutions/companies were in place:



## SCIENTIFIC OUTPUT

### Scientific Output

The scientific activity of CIC biomaGUNE during 2014 can be summarized as follows: 117 publications in high impact scientific journals, 6 PhD theses defended and 1 new patent application.

### Cover Pages

- Enzymatic Growth of Metal and Semiconductor Nanoparticles in Bioanalysis**  
V. Pavlov  
*Part. Part. Syst. Charact.* **2014**, 1, 36-45
- 
- A general approach toward polymer-coated plasmonic nanostructures**  
M. Grzelczak, A. Sánchez-Iglesias, L. M. Liz-Marzán.  
*CrystEngComm* **2014**, 16, 9425-9429
- 
- Light Harvesting and Photoemission by Nanoparticles for Photodynamic Therapy**  
A.G. Arguinoniz, E. Ruggiero, A. Habtemariam, J. Hernández-Gil, L. Salassa, J. C. Mareque-Rivas  
*Part. Part. Syst. Charact.* **2014**, 1, 46-75
- 
- Gold Nanowire Forests for SERS Detection**  
A. La Porta, M. Grzelczak, L. M. Liz-Marzán.  
*ChemistryOpen* **2014**, 3, 146-151
- 
- Gold Spiky Nanodumbbells: Anisotropy in Gold Nanostars**  
S. M. Novikov, A. Sánchez-Iglesias, M. K. Schmidt, A. Chuvilin, J. Aizpurua, M. Grzelczak, L. M. Liz-Marzán  
*Part. Part. Syst. Charact.* **2014**, 1, 77-80
- 
- Pen-on-Paper Approach Toward the Design of Universal SERS Substrates**  
L. Polaravapu, A. La Porta, S. Novikov, M. Coronado-Puchau, L. Liz-Marzán.  
*Small* **2014**, 10, 3065-3071
- 
- Exploiting Hydrophobic Interactions at the Nanoscale**  
M. Grzelczak, L. M. Liz-Marzán.  
*J. Phys. Chem. Lett.* **2014**, 5, 2455-2463
- 
- An Iron Oxide Nanocarrier for dsRNA to Target Lymph Nodes and Strongly Activate Cells of the Immune System**  
M. Cobaleda-Siles, M. Henriksen-Lacey, A. Ruiz de Angulo, A. Bernecker, V. Gómez Vallejo, B. Szczipak, J. Llop, G. Pastor, S. Plaza-García, M. Jauregui-Osoro, L. K. Meszaros, J. C. Mareque-Rivas.  
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Arosio, D.; Chiodo, F.; Reina, J. J.; Marelli, M.; Penadés, S.; van Kooyk, Y.; Garcia-Vallejo, J. J.; Bernardi, A. **Effective Targeting of DC-SIGN by A-Fucosylamide Functionalized Gold Nanoparticles.** *Bioconjugate Chem.* **2014**, 25, 2244-2251.

Shiohara, A.; Wang, Y.; Liz-Marzán, L. M. **Recent Approaches toward Creation of Hot Spots for SERS Detection.** *J. Photoch. Photobio. C* **2014**, 21, 2-25.

Gupta, S.; Reviakine, I. **The Sweeter Aspects of Platelet Activation: A Lectin-Based Assay Reveals Agonist-Specific Glycosylation Patterns.** *Biochim. Biophys. Acta* **2014**, 1840, 3423-3433.

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## PHD THESES

- Dr. Camilla Matassini**  
Novel syntheses of iminosugars and their conjugation to gold nanoparticles for biological studies  
**Supervisor: Dr. Marco Marradi**  
Date: 20/03/2014
- Dr. Swapti Gupta**  
Selective Activation of Platelets by Surfaces and Soluble Agonists  
**Supervisor: Dr. Ilya Reviakine**  
Date: 21/03/2014
- Dr. Yuan Qiu**  
Fabrication, Surface Engineering, Cellular Uptake and Cytotoxicity of Metallic and Polymeric Nanoparticles  
**Supervisor: Dr. Sergio Moya**  
Date: 27/06/2014
- Dr. Teodoro Alonso**  
Impedances Studies of Transport Phenomena in Supramolecular Polymer Assemblies  
**Supervisor: Dr. Sergio Moya**  
Date: 30/06/2014
- Dr. Vijay Gaja**  
Synthesis and preclinical evaluation of <sup>13</sup>N-labeled azo compounds for  $\beta$ -amyloid imaging and synthesis of carborane derivatives for radiolabeling with positron emitters  
**Supervisor: Dr. Jordi Llop**  
Date: 22/07/2014
- Dr. Carlos Pérez Campaña**  
Direct activation of metal oxide nanoparticles: application to biodistribution studies using positron emission tomography  
**Supervisor: Dr. Jordi Llop**  
Date: 24/07/2014

## PATENT APPLICATIONS

### Patent Applications

#### Sample Slides for Laser Desorption Ionisation (LDI) Mass Spectrometry and Optical Microscopy

A. Beloqui Elizazu, C. Lopez de la Orden, L.A. Yate Gomez, N.-C. Reichardt  
*GB Pat. Appl. GB6936413 (Priority date March 20, 2014)*

### Patent Extensions 2014

#### Synthesis and use of isotopically-labelled glycans

N.-C. Reichardt, B. Echeverria  
*GB Pat. Appl. GB1305986. Priority date April 3, 2013*

- Extension to PCT - PCT Int. Appl. PCT/EP2014/056737 - 03/04/2014

#### Sample plates for surface assisted laser desorption ionization mass spectrometry

N.-C. Reichardt, J. Calvo, J. Etxebarria-Ruiz  
*GB Pat. Appl. GB1307914. Priority date May 2, 2013*

- Extension to PCT - PCT Int. Appl. PCT/EP2014/058953 - 1/05/2014

#### Method for the production of human thrombin and uses thereof

V. Pavlov, L. Saa-Pena and A. Virel-Sanchez  
*PCT/EP2012/071572. Priority date November 4, 2011*

- PCT National Phase Entry in Canada for PCT/EP2012/071572 - 2.854.418 - 02/05/2014
- PCT National Phase Entry in the USA for PCT/EP2012/071572 - 14355079 - 29/04/2014
- EPO Regional Entry of PCT/EP2012/071572 - EP12786887.5 - 16/05/2014

#### Methods for making microarrays and their uses

A. Beliqui- Elizazu, N.-C. Reichardt  
*US Pat. Appl. US 61777202. Priority date March 12, 2013.*

- US patent application 14/203611 (11/03/2014)

## AWARDS & DISTINCTIONS

### Research Awards and Distinctions

#### Highly Cited Researchers

Luis Liz-Marzán and Wolfgang Parak have been included in the new lists of Highly Cited Researchers (Thomson Reuters), in two fields: Chemistry and Materials Science.

#### 2014 Medal of the Royal Spanish Society of Chemistry

Awarded to Luis Liz-Marzán by the Royal Spanish Society of Chemistry (RSEQ) as recognition for his scientific career. This is the most prestigious award granted by the institution that represents the chemistry scientific community of Spain.

#### 2014 Francqui Chair

Awarded to Luis Liz-Marzán by the Catholic University of Leuven. The "Francqui Chairs" are awarded to renowned Belgian or non-Belgian scientists for stays at Belgian universities, where they should participate in the scientific life and provide specialized teaching.

#### Tribute to the Scientific Career of Prof. Manuel Martín-Lomas

The XI Biannual Meeting of the Carbohydrate Group of the Spanish Royal Society of Chemistry (XI Jornadas de Carbohidratos) has been dedicated to Manuel Martín-Lomas in recognition of his scientific career.

#### Best oral presentation

The work entitled "Diseño e Implementación de un Sistema de Microfluidos para la Síntesis de [18F]FDG Mediante Reacción en Fase Sólida", carried out by the Radiochemistry and Nuclear Imaging group at CIC biomaGUNE in Collaboration with IK4-Ikerlan, and presented by Dr. Jordi Llop in the "34º Congreso de la Sociedad Española de Medicina Nuclear e Imagen Molecular", has been awarded with the prize to the best oral presentation.

#### ERC Starting Grant awarded to former CIC biomaGUNE PhD student

Dr. Mihaela Delcea, who completed her PhD thesis at CIC biomaGUNE in 2009 under the supervision of Dr. José Luis Toca Herrera, has been one of the 2014 awardees of the prestigious ERC Starting Grants from the European Research Council. Her project will be carried out at University Medicine Greifswald (Germany).

#### Veni award from NWO awarded to former CIC biomaGUNE's PhD student

Fabrizio Chiodo, who received the PhD under the supervision of Prof. Soledad Penadés at CIC biomaGUNE, has been awarded with the prestigious Veni subsidy from the NOW. Veni is targeted at outstanding researchers who have recently obtained their PhD to conduct independent research and develop their ideas for a period of three years. His project will be conducted at the University of Leiden (The Netherlands).

## EDITORIAL ACTIVITY



## EDITORIAL ACTIVITY



### Guest Editorial Activities



Luis Liz-Marzán served as guest editor of the first issue of volume 31 issue 1 of Particle & Particle Systems Characterization is dedicated to particle research in the Basque Country. All the articles in this issue are offered for free (open access).

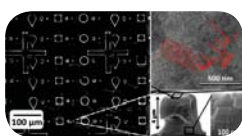


Luis Liz-Marzán served as co-guest editor (with Catherine J. Murphy and Jianfang Wang) of a special issue of Chemical Society Reviews on "Nanoplasmonics" (07 June 2014, Issue 11, page 3813 to 3994).



## RESEARCH HIGHLIGHTS

The BioNanoPlasmonics laboratory at CIC biomaGUNE together with the BIOMICS group from UPV-EHU reports a method for the patterning of substrates with gold nanoparticle supercrystals

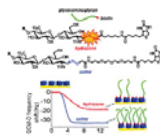


Hierarchical Self-Assembly of Gold Nanoparticles into Patterned Plasmonic Nanostructures  
C. Hamon, S. Novikov, L. Scarabelli, L. Basabe-Desmonts, L.M. Liz-Marzán  
*ACS Nano*, **2014**, 8, 10694-10703

The integration of nanoparticle superstructures into daily life applications faces major challenges including the simplification of the self-assembly process, reduced cost, and scalability. It is, however, often difficult to improve on one aspect without losing on another. We present in this paper a benchtop method that allows patterning a macroscopic substrate with gold nanoparticle supercrystals in a one-step process. The method allows parallelization, and patterned substrates can be made with high-throughput. The self-assembly of a variety of building blocks into crystalline superstructures takes place upon solvent evaporation, and their precise placement over millimeter scale areas is induced by confinement of the colloidal suspension in micron-sized cavities. We mainly focus on gold nanorods and demonstrate their hierarchical organization up to the device scale. The height of the formed nanorod supercrystals can be tuned by simply varying nanorod concentration, so that the topography of the substrate and the resulting optical properties can be readily modulated. The crystalline order of the nanorods results in homogeneous and high electric field enhancements over the assemblies, which is demonstrated by surface-enhanced Raman scattering spectroscopy.

The Biosurfaces laboratory at CIC biomaGUNE together with researchers in Grenoble has established an Oxime ligation method for the selective conjugation of GAGs

A Quartz Crystal Microbalance Method to Study the Terminal Functionalization of Glycosaminoglycans  
Dhruv Thakar, Elisa Migliorini, Liliane Guerente, Rabia Sadir, Hugues Lortat - Jacob, Didier Boturyn, Olivier Renaudet, Pierre Labbe and Ralf P. Richter.

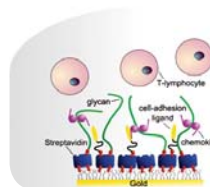


*Chem. Commun.*, **2014**, 50, 15148-15151

The method compares the biotinylation of GAGs (hyaluronan and heparan sulphate) at their reducing end via two different chemoselective ligation chemistries: the popular hydrazine ligation and oxime ligation, which so far had not been used for GAGs. To characterize the GAG conjugates, the researchers followed the binding of biotinylated GAG conjugates to surfaces displaying a biotin-capturing protein monolayer, using QCM-D. The researchers found that conjugates functionalized via oxime ligation are stable in comparison to the commonly used hydrazine ligation. Oxime ligation was established as a facile, one-step and versatile method in that it can be applied to GAGs of various (most likely any) types and sizes. Moreover, QCM-D together with a suitably functionalized sensor surface was shown to be instrumental for the characterization of conjugates made from chemically complex molecules such as GAGs, providing information about reaction yields, sample degradation and sample composition, which is difficult to assess with conventional analytical techniques, in particular when the amount of sample is limited to a few micrograms. The methods should find broad use, as tools in the glycosciences and in biotechnological applications. In particular, the control over and stability of GAG conjugates is crucial towards the reliable preparation of GAG-functionalized surfaces and scaffolds for tissue engineering and fundamental biological studies.

## RESEARCH HIGHLIGHTS

Method for the fabrication of well-defined and tuneable biomimetic surfaces that display GAGs together with other biomolecules

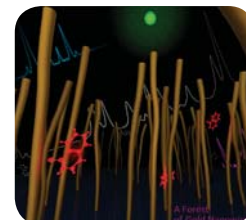


Well-defined biomimetic surfaces to characterize glycosaminoglycan-mediated interactions on the molecular, supramolecular and cellular levels

Migliorini E, Thakar D, Sadir R, Pleiner T, Baleux F, Lortat-Jacob H, Coche-Guerente L, Richter RP.  
*Biomaterials*, **2014**, 35, 8903-15

The method is based on a generic immobilization platform, i.e. a streptavidin monolayer that serves as a 'molecular breadboard' for the attachment of desired molecules at tuneable surface density and controlled orientation and lateral mobility. Exquisite control was afforded through the engineering of surfaces and biomolecules, and a set of surface-sensitive in situ analysis techniques, including quartz crystal microbalance and spectroscopic ellipsometry. The researchers analyze the interactions between a selected GAG (heparan sulphate, HS) and a signalling molecule that promotes the migration of immune cells (the chemokine CXCL12 $\alpha$ ) to demonstrate the versatility of the surfaces for biomolecular and cellular interaction studies. They find that immune cells can adhere specifically to surfaces presenting GAG-bound CXCL12 $\alpha$  even in the absence of a classical cell adhesion ligand. The surface biofunctionalization strategy should be broadly applicable for functional studies that require a well-defined supramolecular presentation of GAGs along with other matrix or cell-surface components. It may also be used for the design of chemokine-loaded implantable devices for regenerative medicine or tissue remodelling purposes.

The BioNanoPlasmonics laboratory reports on the vertically growth of gold nanowires on a solid support to be used as SERS substrates

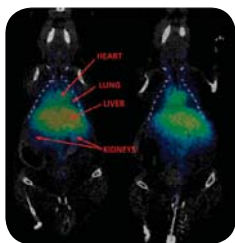


Gold Nanowire Forests for SERS Detection  
A. La Porta, M. Grzelczak, L.M. Liz-Marzán  
*ChemistryOpen* **2014**, 3, 146-151

This manuscript describes the controlled growth of such gold nanowires and their corresponding plasmonic properties. Simple wet chemistry has been applied to control the vertical growth of gold nanowires on a glass substrate. As a consequence, the longitudinal localized surface plasmon band position can be tuned from 656 to 1477 nm in a few minutes by simply controlling the growth rate and time. This allowed us to select the optimum conditions for maximum electromagnetic enhancement and performance in surface enhanced Raman scattering (SERS) detection. SERS measurements confirmed the uniform and reproducible distribution of the nanowires on the substrate, with the subsequent high reproducibility of hot spot formation. Detection of malachite green in water and of 1-naphthalenethiol from the gas phase are demonstrated as proof-of-concept applications of these three-dimensional SERS substrates. Plasma cleaning was used to remove the adsorbed analytes and reuse the nanowire forest for subsequent detection measurements.

## RESEARCH HIGHLIGHTS

The group of Dr. Jordi Llop, in collaboration with Dr. Vanessa Gómez-Vallejo at the Radiochemistry Platform and researchers at ICMAB-CSIC has developed a general strategy for the radiolabelling of COSANs



COSAN as a molecular imaging platform: synthesis and "in vivo" imaging

Kiran B. Gona, Adnana Zaulet, Vanessa Gómez-Vallejo, Francesc Teixidor Jordi Llop, Clara Viñas

*Chem. Commun.* **2014**, 50, 11415-11417

A labelling method for the covalent attachment of radioiodine to the boron-rich 8-1-cobaltabisdicarbollide (1-COSAN) and a bi-functional (iodine and PEG) COSAN derivative, [3,3'-Co(8-1-1,2-C<sub>2</sub>B<sub>9</sub>H<sub>10</sub>)-(8'-(OCH<sub>2</sub>CH<sub>2</sub>)<sub>2</sub>COOC<sub>6</sub>H<sub>5</sub>-10,20-C<sub>2</sub>B<sub>9</sub>H<sub>10</sub>)], is reported. Biodistribution studies in rodents using dissection/gamma counting and in vivo nuclear imaging have been performed. The general strategy reported here can be applied in the future to COSAN derivatives bearing a wide range of functionalities. Hence, the strategy may have a significant impact in the evaluation of potential BNCT (Boron Neutron Capture Therapy) agents.

The BioNanoPlasmonics laboratory reports on the use of plasmonic inks to write SERS substrates



Pen-on-Paper Approach Toward the Design of Universal Surface Enhanced Raman Scattering Substrates

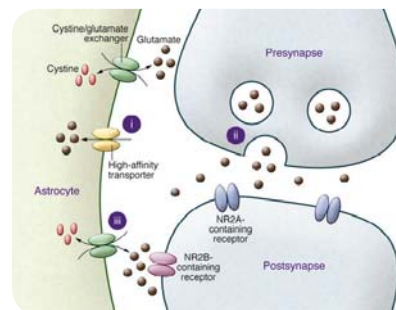
L. Polavarapu, A. La Porta, S.M. Novikov, M. Coronado-Puchau, L.M. Liz-Marzán

*Small*, **2014**, 10, 3065 - 3071

The translation of a technology from the laboratory into the real world should meet the demand of economic viability and operational simplicity. Inspired by recent advances in conductive ink pens for electronic devices on paper, we present a "pen-on-paper" approach for making surface enhanced Raman scattering (SERS) substrates. Through this approach, no professional training is required to create SERS arrays on paper using an ordinary fountain pen filled with plasmonic inks comprising metal nanoparticles of arbitrary shape and size. We demonstrate the use of plasmonic inks made of gold nanospheres, silver nanospheres and gold nanorods, to write SERS arrays that can be used with various excitation wavelengths. The strong SERS activity of these features allowed us to reach detection limits down to 10 attomoles of dye molecules in a sample volume of 10 µL, depending on the excitation wavelength, dye molecule and type of nanoparticles. Furthermore, such simple substrates were applied to pesticide detection down to 20 ppb. This universal approach offers portable, cost effective fabrication of efficient SERS substrates at the point of care. This approach should bring SERS closer to the real world through ink cartridges to be fixed to a pen to create plasmonic sensors at will.

## RESEARCH HIGHLIGHTS

The researchers Dr. Abraham Martín and Dr. Jordi Llop from CICbiomaGUNE's Molecular Imaging Unit in collaboration with researchers from the Achucarro Center and the UPV/EHU have discovered a new therapeutic target for brain damage resulting from stroke



Extrasynaptic glutamate release through cystine/glutamate antiporter contributes to ischemic damage

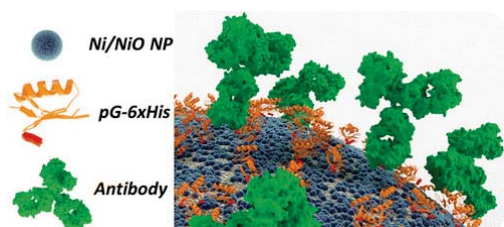
F. N. Soria, A. Pérez-Samartín, A. Martín, K. B.Gona, J. Llop, B. Szczupak, J. C. Chara, C. Matute and María Domercq

*Journal of Clinical Investigation*, **2014**, 124, 3645-55.

Cerebral ischemia is the third cause of death and the first cause of disability in industrialised countries. It occurs as a result of the transient or permanent reduction in cerebral blood flow and causes irreversible neuronal damage. A considerable part of this deterioration is due to the change in the levels of glutamate, the most abundant excitatory neurotransmitter in the brain that, in turn, acts as a powerful neurotoxin when its concentration is raised, as occurs during ischemia. This new finding underscores the importance of a molecule, the cystine-glutamate exchanger (xCT), in the increase in the concentration of glutamate to toxic levels in experimental models that reproduce the main characteristics of stroke in patients. The work carried out by the Achucarro and UPV/EHU researchers shows that during cerebral ischemia the glutamate is transported outside the cell via the xCT exchanger, and is accumulated up to levels that are lethal for the neurons. In turn, the CIC biomaGUNE researchers have observed by Positron Emission Tomography that xCT levels are increased in rat brain subjected to ischemia, which underlines its importance in the stroke process. As a conclusion, it follows that this research carried out on experimental animals will open up the door for the development of new neuroprotective treatments by means of drugs that are directed against the xCT exchanger in order to mitigate the cerebral damage and neurological disorders caused by cerebral ischemia.

## RESEARCH HIGHLIGHTS

The BioNanoPlasmonics laboratory, in collaboration with the Colloid Chemistry Group from U. Vigo, reports on the use of doped paper as bioactive scaffold



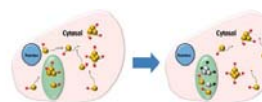
Nickel Nanoparticle-Doped Paper as a Bioactive Scaffold for Targeted and Robust Immobilization of Functional Proteins

G. Bodelón, S. Mourdikoudis, L. Yate, I. Pastoriza-Santos, J. Pérez-Juste, L.M. Liz-Marzán  
*ACS Nano*, **2014**, 8, 6221-6231

Cellulose-based materials are widely used in analytical chemistry as platforms for chromatographic and immunodiagnostic techniques. Due to its countless advantages (e.g., mechanical properties, three-dimensional structure, large surface to volume area, biocompatibility and biodegradability, and high industrial availability), paper has been rediscovered as a valuable substrate for sensors. Polymeric materials such as cellulosic paper present high protein capture ability, resulting in a large increase of detection signal and improved assay sensitivity. However, cellulose is a rather nonreactive material for direct chemical coupling. Aiming at developing an efficient method for controlled conjugation of cellulose-based materials with proteins, we devised and fabricated a hybrid scaffold based on the adsorption and in situ self-assembly of surface-oxidized Ni nanoparticles on filter paper, which serve as "docking sites" for the selective immobilization of proteins containing polyhistidine tags (His-tag). We demonstrate that the interaction between the nickel substrate and the His-tagged protein G is remarkably resilient toward chemicals at concentrations that quickly disrupt standard Ni-NTA and Ni-IDA complexes, so that this system can be used for applications in which a robust attachment is desired. The bioconjugation with His-tagged protein G allowed the binding of anti-Salmonella antibodies that mediated the immuno-capture of live and motile Salmonella bacteria. The versatility and biocompatibility of the nickel substrate were further demonstrated by enzymatic reactions.

## RESEARCH HIGHLIGHTS

The laboratories of Dr. S. Moya and Prof. S. Penadés report on the aggregation and dynamics of fluorescently-labelled glyco-gold nanoparticles by means of Fluorescence Correlation Spectroscopy (FCS) in the intracellular environment

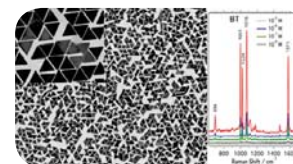


A Quantitative Study of the Intracellular Dynamics of Fluorescently Labelled Glyco-Gold Nanoparticles via Fluorescence Correlation Spectroscopy

Richard A. Murray, Yuan Qiu, Fabrizio Chiodo, Marco Marradi, Soledad Penadés, and Sergio E. Moya  
*Small*, **2014**, 10, 2602-2610

The use of Fluorescence Correlation Spectroscopy (FCS) for quantitative analysis in biological environments is gaining popularity as it yields information on key physical and chemical parameters such as diffusion time and average number of fluorescent molecules, which ultimately allows for the determination of the local concentration and size of the species under study. Gold nanoparticles coated with glucose and fluorescently-labelled with HiLyte Fluor647 (Glc-Au-Hi NPs) were incubated with HepG2 cells (hepatocytes). FCS was used to visualise the presence of single NPs or NP aggregates following uptake and to estimate, locally, NP concentrations within the cells. FCS data were successfully recorded after applying a "pre-bleaching" methodology which allowed the effective removal of the immobile NP fraction. The diffusion time of Glc-Au-Hi NPs in the intracellular environment was measured and compared with the diffusion time in water and cell media. Overall, we demonstrated that the "pre-bleaching" FCS strategy can be applied for studying the intracellular dynamics of biofunctionalised gold NPs and for increasing the knowledge about the state of NPs within the cell.

The BioNanoPlasmonics laboratory reports on the synthesis and properties of monodisperse gold nanotriangles



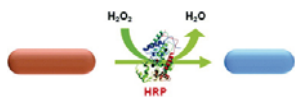
Monodisperse Gold Nanotriangles: Size Control, Large-Scale Self-Assembly, and Performance in Surface-Enhanced Raman Scattering

L. Scarabelli, M. Coronado-Puchau, J.J. Giner-Casares, J. Langer, L.M. Liz-Marzán  
*ACS Nano*, **2014**, 8, 5833-5842

Au nanotriangles display interesting nano plasmonic features with potential application in various fields. However, such applications have been hindered by the lack of efficient synthetic methods yielding sufficient size and shape monodispersity, as well as by insufficient morphological stability. We present here a synthesis and purification protocol that efficiently addresses these issues. The size of the nanotriangles can be tuned within a wide range by simply changing the experimental parameters. The obtained monodispersity leads to extended self-assembly, not only on electron microscopy grids but also at the air-liquid interface, allowing transfer onto centimeter-size substrates. These extended monolayers show promising performance as surface-enhanced Raman scattering substrates, as demonstrated for thiophenol detection.

## RESEARCH HIGHLIGHTS

The laboratories of Dr. Valery Pavlov and Prof. Liz-Marzán report on the use of gold nanorods for blood glucose detection



Enzymatic etching of gold nanorods by horseradish peroxidase and application to blood glucose detection  
L. Saa, M. Coronado-Puchau, V. Pavlov, L. M. Liz-Marzán

*Nanoscale* **2014**, 6, 7405-7409

Gold nanorods (AuNRs) have become some of the most used nanostructures for biosensing and imaging applications due to their plasmon-related optical response, which is highly sensitive toward minute changes in the AuNR aspect ratio. In this context, H<sub>2</sub>O<sub>2</sub> has been used to trigger the chemical etching of AuNRs, thereby inducing a decrease of their aspect ratio. However, special conditions and relatively high concentrations of H<sub>2</sub>O<sub>2</sub> are usually required, preventing the applicability of the system for biotransformation purposes. To overcome this limitation we have introduced a biocatalytic species, the enzyme horseradish peroxidase (HRP) that is able to induce a gradual oxidation of AuNRs in the presence of trace concentrations of H<sub>2</sub>O<sub>2</sub>. Interestingly, the presence of halide ions has also been found to be essential for this process. As a consequence, other enzymatic reactions, such as those catalyzed by glucose oxidase, can be easily coupled to HRP activity, allowing the detection of different amounts of glucose. On the basis of these findings, we developed a highly sensitive and simple colorimetric assay that can be read out by the naked eye and allows the detection of physiological glucose concentrations in human serum.

The Glycotechnology laboratory reports on the use of weathering steel for LDI-MS

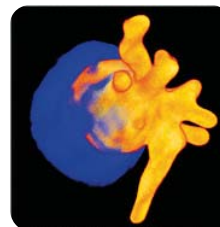


Nanostructured weathering steel for matrix-free laser desorption/ionization mass spectrometry and imaging of metabolites, drugs and complex glycans  
Etxebarria J., Calvo J. and Reichardt N.C.  
*Analyst*, **2014**, 139, 2873 - 2883

Weathering steel is widely employed as a maintenance-free construction material e.g. for steel bridges and railway cars and for sculptures or decorative elements due to their characteristic red colour. The Glycotechnology Laboratory headed by Niels Reichardt and Manuel Martín-Lomas has employed this material to prepare sample plates for matrix-free laser desorption/ionization mass spectrometry (LDI-MS) of small molecules up to a mass range of around 1500 Da. The effective UV absorption, heat conductivity and porosity of the nanostructured inner rust layer formed during passivation determine the excellent performance in LDI-MS for a broad range of different analyte classes. This inexpensive material was evaluated in a series of relevant analytical applications ranging from the matrix-free detection of serum metabolites, lactose quantification, or lipid analysis in milk, to the glycoprofiling of antibodies and imaging mass spectrometry of brain tissue samples. The original sample plate has been further optimized to improve performance (see picture) and is currently being evaluated for food metabolite analysis.

## RESEARCH HIGHLIGHTS

The BioNanoPlasmonics laboratory in collaboration with the University of Antwerpen, reports on the synthesis of gold-silica Janus Nanostars



A Protecting Group Approach toward Au-Silica Janus Nanostars

D. Rodríguez-Fernández, T. Altantzis, H. Heidari, S. Bals, L.M. Liz-Marzán  
*Chem. Commun.* **2014**, 50, 79-81

In this article, the concept of protecting groups, widely used in organic chemistry, has been applied for the synthesis of Janus nanoparticles comprising a spherical gold core half covered with a silica semishell and with gold tips branching out from the other half. Advances on the colloidal synthesis of Janus particles allowed us to deposit silica half shells on metallic spheres, which were then used as hard masks to prevent the growth of gold spikes over the whole surface. The mask can be easily removed by dissolving silica in aqueous solution, thus completing the similarity with protecting groups in Organic chemistry. These particles exhibit optical properties similar to those of gold nanostars in solution, but enhanced anisotropy can be expected for oriented assemblies by exploiting the Janus conformation. This configuration opens up new possibilities to apply the plasmonic properties of gold nanostars, as well as a variety of chemical functionalizations on the silica component.

The Lab. of GlycoNanotechnology in collaboration with the VU University Medical Center of Amsterdam and the Institute of Biology of Leiden University has published an article where the role of the "non-self" carbohydrate galactofuranose (GalF) in host-pathogen interactions is studied by using gold nanoparticles coated with multiple copies of GalF as a model system



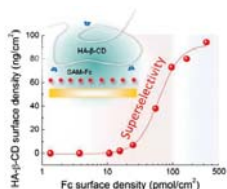
Galactofuranose-Coated Gold Nanoparticles Elicit a Pro-inflammatory Response in Human Monocyte-Derived Dendritic Cells and Are Recognized by DC-SIGN

Fabrizio Chiodo, Marco Marradi, Joohee Park, Arthur F. J. Ram, Soledad Penadés, Irma van Die, and Boris Tefsen  
*ACS Chem. Biol.* **2014**, 9, 383-389

Small gold particles (~2 nm diameter) coated with different amount of the "non-self" carbohydrate galactofuranose (GalF-GNPs) are specifically recognized by the anti-GalF antibody EB-A2, which is widely used to detect galactomannan in the serum of Aspergillus patients. Human monocyte-derived dendritic cells (DCs) bind to GalF-GNPs, probably via the C-type lectin DC-SIGN, and this binding increased as the number of GalF-moieties per particle was higher. Furthermore, GalF-GNPs elicited a pro-inflammatory response in DCs, as demonstrated by the up-regulation of surface maturation markers and secretion of pro-inflammatory cytokines. Soluble GalF-NH<sub>2</sub> did not cause the pro-inflammatory effects seen for the GalF-GNPs, indicating the importance of multivalency for this activation mechanism. These data indicate that "suitably presented" GalF is recognized by the human innate immune system and that GalF-GNPs are synthetic tools that can help understanding the role of GalF in host-pathogen interactions.

## RESEARCH HIGHLIGHTS

The Biosurfaces Lab has developed a well-defined, highly specific and tunable model system based on host-guest interactions that provides the first direct evidence for superselectivity in the multivalent binding of polymers to surfaces.



### Superselective Targeting Using Multivalent Polymers

Galina V. Dubacheva, Tine Curk, Bortolo M. Mognetti, Rachel Auzely-Velty, Daan Frenkel, and Ralf P. Richter  
*J. Am. Chem. Soc.*, **2014**, 136, 1722 - 1725

The experiments combined synthetic chemistry with several surface characterization techniques such as quartz crystal microbalance, spectroscopic ellipsometry and electrochemistry. The measurements revealed that multivalent polymers can exhibit a pronounced superselective binding behavior. Superselectivity means that the polymer surface density increases faster than linearly with the density of binding sites on the surface. Using analytical modeling, it has been shown that superselectivity is a consequence of multivalency and is enhanced by the ability of polymers to interpenetrate, a unique feature in comparison with other multivalent scaffolds such as particles. The potential tunability of the developed model system (e.g. in terms of affinity, polymer valency, polymer linker) shall be explored in future work and should provide additional mechanistic insights into the regulation of multivalent binding. It should help to understand the regulation of multivalent interactions in biological systems and provide means for the rational design of polymers for tunable, superselective targeting.

The group of Dr. Salassa has shown how upconversion nanocrystals can be exploited to trigger the photochemistry of transition metal complexes using near infrared light.



### Near Infrared Photoactivation of a Ru Polypyridyl Complex by Upconverting Nanoparticles

Ruggiero, E.; Habtemariam, A.; Yate, L.; Mareque-Rivas, J. C.; Salassa, L.  
*Chem. Commun.*, **2014**, 50, 1715-1718.

NaYF<sub>4</sub>:Yb<sup>3+</sup>/Er<sup>3+</sup> nanocrystals upconvert near infrared light (980 nm) into higher energy visible photons capable of effecting the photo-dissociation of the monodentate pyridyl ligand in cis-[Ru(hpy)<sub>2</sub>(py)<sub>2</sub>]Cl<sub>2</sub>: opening an opportunity for advancing the use of photoactivatable metal complexes in medicine and biology.

## TRAINING ACTIVITIES & OUTREACH

### Training Activities and Outreach

The training activities and outreach of CIC biomaGUNE during 2014 can be summarized as follows: 39 seminars, received 70 research internships, organized 45 open doors/interactive tours and appeared 67 times in the media.

### Seminars

18/12/2014

Christmas Lecture: Nanomedicine: Two decades inspiring the next. Can radiochemistry lend a hand?  
*Dr. Jordi Llop - CIC biomaGUNE, San Sebastián, Spain*

10/12/2014

Patchy Nanoparticles, Synthesis, Properties and Characterization  
*Dr. Javier Reguera - CIC biomaGUNE, San Sebastián*

27/11/2014

Multicomponent and Cascade Reactions: New Opportunities for Natural Product Synthesis and Medicinal Chemistry  
*Dr. Félix Rodríguez - Universidad de Oviedo, Spain*

21/11/2014

Controlled Synthesis and Novel Properties of 2-Dimensional Materials: From Doped Graphene to WS<sub>2</sub> monolayers and more  
*Prof. Mauricio Terrones - Penn State University, USA*

13/11/2014

From the laboratory to industrial application  
*Prof. Avelino Corma - CSIC, UPV, Spain*

29/10/2014

Electrostatic interactions in biological brushes  
*Dr. Ekaterina Zhulina - Russian Academy of Sciences, Russia*

29/10/2014

Synergies Between Chemistry and Nanosciences: Applications to Nanomedicine  
*Prof. Maurizio Prato - Università degli Studi di Trieste, Italy*

27/10/2014

A model for the mechanism of protein stabilization by mono- and oligo-saccharides  
*Dr. Allen Minton - NIH, USA*

24/10/2014

The mystery of starch granule: A multiscale biomaterial  
*Prof. Serge Perez - CERMAV, France*

21/10/2014

Looking and Listening to Light from Liposome Nanostructures for Cancer Theranostics  
*Prof. Kostas Kostarelos - University of Manchester, UK*

## TRAINING ACTIVITIES & OUTREACH

- 14/10/2014**  
Colloidal Assembly of Surfactant/Oligomer Complexes: Self Assembly, Photophysics and Antimicrobial Activity  
*Prof. David G. Whitten - University of New Mexico, USA*
- 10/10/2014**  
Nanoporous silicon and alumina technologies in nanomedicine  
*Prof. Lluís F. Marsal - Universitat Rovira i Virgili, Tarragona*
- 02/10/2014**  
Synthesis at the Frontier: Catalytic Methods and DNA Binders  
*Prof. José Luis Mascareñas - Universidad de Santiago de Compostela*
- 22/09/2014**  
Shark VNAR domains - biologics with bite  
*Dr. Caroline Barelle - University of Aberdeen, UK*
- 19/09/2014**  
Brain Imaging of neurologic diseases: focus on Stroke and Multiple Sclerosis  
*Dr. Abraham Martin - CIC biomaGUNE, San Sebastián, Spain*
- 09/09/2014**  
Measuring and understanding order and disorder in nanoscale semiconductors  
*Prof. Bradley F. Chmelka - University of California, USA*
- 27/08/2014**  
Surfactant and polymer dispersions with liquid crystalline cores  
*Prof. Watson Loh - Instituto de Química - Unicamp, Brazil*
- 25/08/2014**  
Designed biomaterials for mediating cell migration and cellular uptake  
*Prof. Dr. Changyou Gao - Zhejiang University, China*
- 29/07/2014**  
One of the smallest possible drugs: biological activity and cellular imaging of carbon monoxide  
*Prof. Dr. Ulrich Schatzschneider - Würzburg University, Germany*
- 21/07/2014**  
Direct activation of metal oxide nanoparticles: application to biodistribution studies using positron emission tomography  
*Carlos Pérez Campaña - CIC biomaGUNE*
- 18/07/2014**  
Optical forces: a link between classical and quantum mechanics  
*Dr. Mathieu Juan - Macquarie University, Australia*
- 03/07/2014**  
Design and synthesis of gold nanoparticles with potential use in 19F-MRI  
*Mónica Carril - CIC biomaGUNE, San Sebastián*
- 24/06/2014**  
Impedance studies of transport phenomena in supramolecular polymer assemblies  
*Teodoro Alonso - CIC biomaGUNE, San Sebastián, Spain*

## TRAINING ACTIVITIES & OUTREACH

- 23/06/2014**  
Fabrication, Surface Engineering, Cellular Uptake and Cytotoxicity of Metallic and Polymeric Nanoparticles  
*Yuan Qiu - CIC biomaGUNE, San Sebastián, Spain*
- 17/06/2014**  
The HIV glycan shield as a target for broadly neutralizing antibodies  
*Dr. Katie Doores - Kings College London, UK*
- 28/05/2014**  
Photoactivation of Anticancer Metal Complexes Using Upconversion Nanoparticles  
*Dr. Luca Salassa - CIC biomaGUNE, San Sebastián, Spain*
- 16/05/2014**  
Diffusion of proteins in bicontinuous microemulsion: Anomalous sub-diffusion induced by controlled crowding  
*Prof. Dr. Thomas Hellweg - Bielefeld University, Germany*
- 08/05/2014**  
Radiological characterization of lung damage, remodeling and response to treatment in respiratory diseases  
*Prof. Arrate Muñoz - Universidad de Navarra, Spain*
- 15/04/2014**  
Bestowing chirality to well-defined gold clusters  
*Prof. Dr. Thomas Bürgi - Université de Genève, Switzerland*
- 11/04/2014**  
Nanoparticle-cell interactions: Importance of protein structure  
*Dr. Christine Payne - Georgia Institute of Technology, USA*
- 04/04/2014**  
The power of one: what can be learned by studying individual molecules?  
*Dr. Johann Hofkens - University of Leuven, Belgium*
- 03/04/2014**  
Application of Plasmonic Nanoparticles in Self-assembly and Photochemistry  
*Ikerbasque Fellow Dr. Marek Grzelczak - CIC biomaGUNE, San Sebastián, Spain*
- 25/03/2014**  
Design of organometallic platinum-group metallodrugs for bio-catalysis and photo-activation  
*Prof. Abraha Habtemariam - Ikerbasque Visiting Professor*
- 20/03/2014**  
Theranostics in the Central Nervous System: promises and pitfalls  
*Dr. Pedro Ramos - University of Santiago de Compostela*
- 20/02/2014**  
Multimodal Optical Coherence Tomography  
*Prof. Wolfgang Drexler - Medical University Vienna, Austria*
- 03/02/2014**  
PNA-programmed Self Assemblies in Chemical Biology  
*Prof. Nicolas Winssinger - University of Geneva, Switzerland*

## TRAINING ACTIVITIES & OUTREACH

17/01/2014

Designing inorganic nanoparticles for therapy and diagnosis  
*Dr. Jesús Martínez de la Fuente - University of Zaragoza, Spain*

10/01/2014

Multi-enzyme systems in solid-phase; The new wave of the synthetic biology  
*Dr. Fernando López Gallego - Instituto de Catálisis y petroquímica - CSIC, Spain*

09/01/2014

From hard to soft: a journey of chondroitin sulphate proteoglycans (CSPGs) in the regeneration and plasticity of the nervous system

*Dr. Jessica C.F. Kwok -Cambridge Centre for Brain Repair, UK*

### 8TH Anniversary Lecture

On the 14th of November CIC biomaGUNE commemorated its eight anniversary with a special guest, Professor Avelino Corma, a renowned Spanish scientist who has accumulated many awards throughout his career; the latest one being the Prince of Asturias Award for Technical & Scientific Research 2014.

Professor Avelino Corma delivered a keynote lecture entitled "From the laboratory to industrial application".



### PhD Program

In partnership with the University of the Basque Country (UPV/EHU), CIC biomaGUNE participates in the following PhD programmes:

- PhD in Synthetic and Industrial Chemistry
- PhD in Applied Chemistry and Polymeric Materials
- PhD in Molecular Biology and Biomedicine
- PhD in Medicine and Surgery



Also in partnership with the University of Vigo (UVIGO), CIC biomaGUNE participates in the following PhD programmes:

- PhD in Colloid and Interface Science and Technology

Universidade de Vigo

## TRAINING ACTIVITIES & OUTREACH

### International Graduate School Program

Since 2011 CIC biomaGUNE and CIC bioGUNE together with the University of Liverpool (UoL) run the International joint graduate school program, aimed at implementing 4-year joint PhD degrees.

The objective of the joint PhD program is to provide PhD students with top quality multidisciplinary training at the interface between the fields of biology, chemistry, nanobiotechnology and materials science. The students benefit from an international training and are exposed to different research areas. The joint training of PhD candidates fosters closer ties and cooperation between research groups and researchers of both CICs and the UoL.



The following PhD projects are currently running:

Chemical biology tools for structure-function studies on heparan sulfates: decoding specificity in fgf signalling.

The project is jointly supervised by Dr. Niels Reichardt (CIC biomaGUNE) and Prof. Jerry Turnbull (UoL).

Development of Plasmonic Hybrid Nano-Systems for Biodetection.

The project is jointly supervised by Prof. Luis Liz-Marzán (CIC biomaGUNE) and Prof. Mathias Brust (UoL).

Supramolecular structure and dynamics of extracellular matrix.

The project is jointly supervised by Dr. Ralf Richter (CIC biomaGUNE) and Prof. Dave Fernig and Dr. Ed Yates (UoL).

### Undergraduate Student Program

In partnership with the University of the Basque Country (UPV/EHU), CIC biomaGUNE is actively participating in the following MSc courses by providing lectures and direction of master thesis:

- Master in Molecular Biology and Biomedicine
- Master in Nanoscience
- Master in Chemistry and Polymers



## Vocational Training Program

CIC biomaGUNE has agreements with CPES CESA BHIP and Don Bosco, Centers for Intermediate and Superior level vocational training in the fields of Chemistry or Biosciences to host training internships of students. Every year several training placements take place at different laboratories of the center. The undergraduates are mentored and supervised by PhD students or a postdoctoral researchers and receive hands-on-training.



## High School Summer Student Program

For the first year, CIC biomaGUNE has taken part in the Youth and Science programme from the Fundació Catalunya-La Pedrera. CIC biomaGUNE has participated in the activities of the programme by receiving a high-school student for 3 weeks in summer into the laboratories of the Centre as part of the Research Centre stays programme. The undergraduate was mentored and supervised by a PhD student and carried out a research project in addition to receiving training. Moreover by the end of the internship the student was required to present a short report and presentation of the work and results obtained.



## Research Internships

Argentina 8 / USA 1 / Brazil 6 / Spain 23 / Italy 7 / France 3 / Switzerland 1  
Poland 1 / United Kingdom 2 / Germany 10 / China 7 / New Zealand 1

**Paula Carrasquedo** (Tecnun), 07/10/2014 - 21/12/2014. Host: Prof. Juan Mareque

**Lars Dähne** (Surflay), 13/10/2014 - 12/11/2014. Host: Dr. Sergio Moya

**Marcelo Henrique Sousa** (Universidade de Brasília), 15/10/2014 - 15/11/2014. Host: Dr. Sergio Moya

**Janna Fledermann** (Universität de Leipzig), 27/10/2014 - 17/11/2014. Host: Dr. Sergio Moya

**Damien Mertz** (IPCMS Estrasburgo), 03/11/2014 - 12/11/2014. Host: Dr. Sergio Moya

**Gabriella Egri** (Surflay), 30/10/2014 - 29/11/2014. Host: Dr. Sergio Moya

**Jorge Blanco González** (UPV-EHU), 10/11/2014 - 15/09/2015. Host: Prof. Soledad Penadés

**Isabel Gil** (Hospital de Bellvitge), 01/12/2014 - 23/12/2014. Host: Dr. Jordi Llop

**Álvaro González** (UPV-EHU), 01/12/2014 - 30/09/2015. Host: Prof. Wolfgang Parak

**Druv Thakar** (Universidad Joseph Fourier), 08/12/2014 - 19/12/2014. Host: Dr. Ralf Richter

**Peter Knoll** (Wilhelmspital), 15/12/2014 - 19/12/2014. Host: Dr. Boguslaw Szczupak

**Emma Sery** (University of Liverpool), 10/06/2013 - 30/06/2015. Host: Dr. Niels Reichardt

**Beatriz Pelaz** (Philipps University of Marburg, Germany), several visits between 01/10/2013 - 30/04/2015. Host: Prof. Wolfgang Parak

**Stavros Azinas** (CIC biomaGUNE), 07/10/2013 - 06/01/2015. Host: Dr. Ralf Richter

**Martin Mayer** (University of Bayreuth), 07/01/2014 - 28/03/2014. Host: Prof. Luis Liz-Marzán

**Douglas Dyer** (University of California San Diego), 06/01/2014 - 14/02/2014. Host: Dr. Ralf Richter

**Jakub Ostapko** (Polish Academy of Sciences), 20/01/2014 - 14/02/2014. Host: Prof. Luis Liz-Marzán

**Naiara Muro** (CEIT), 07/01/2014 - 30/06/2014. Host: Eneko San Sebastián

**Cyrille Hamon** (University of Rennes), 07/01/2014 - 05/01/2015. Host: Prof. Luis Liz-Marzán

**Esteban Piccini** (Inifta), 15/01/2014 - 15/03/2014. Host: Dr. Sergio Moya

**Lorena Cortaz** (Inifta), 15/01/2014 - 15/02/2014. Host: Dr. Sergio Moya

**Mª Aparecida Godoy** (Universidade de Brasília), 21/01/2014 - 25/02/2014. Host: Dr. Sergio Moya

**Albert Strauss** (Universidad Hospital de Heidelberg), 26/01/2014 - 01/02/2014. Host: Dr. Jordi Llop

**Peter Knoll** (Wilhelmspital), 26/01/2014 - 01/02/2014. Host: Dr. Jordi Llop

**Christian Weis** (Universidad Hospital de Heidelberg), 26/01/2014 - 01/02/2014. Host: Dr. Jordi Llop

**Xabier Unamuno** (Tecnun), 03/02/2014 - 30/06/2014. Host: Dr. Juan Mareque and Dr. Sergio Moya

**Zhengwei Mao** (Universidad de Zhejiang), 06/02/2014 - 20/03/2014. Host: Dr. Sergio Moya

**Pengfei Jiang** (Universidad de Zhejiang), 06/02/2014 - 07/08/2014. Host: Dr. Sergio Moya

**Jimena Tuninetti** (Inifta), 15/02/2014 - 15/05/2014. Host: Dr. Sergio Moya

**Eliana María Maza** (Inifta), 15/02/2014 - 15/05/2014. Host: Dr. Sergio Moya

**Maddi Ibarbia** (Tecnun), 03/03/2014 - 30/05/2014. Host: Dr. Valery Pavlov

**Cinzia Marceddu** (University of Bologna), 03/03/2014 - 27/06/2014. Host: Dr. Jordi Llop

**Triana Hidalgo Maraver** (D. Bosco), 12/03/2014 - 03/06/2014. Host: Dr. Valery Pavlov

**Ianire Zúñiga Martín** (D. Bosco), 12/03/2014 - 03/06/2014. Host: Dr. Soledad Penadés

**Liliana Mangas** (Molypharma), 17/03/2014 - 02/06/2014. Host: Molypharma

**Iván Bandres** (CPES CESA BHIP), 05/03/2014 - 06/06/2014. Host: Dr. Torsten Reese

**José Alberto Rodríguez** (Centro de Investigación en Química Aplicada (CIQA)), 17/03/2014 - 15/06/2014. Host: Dr. Sergio Moya

**Roland Ziolo** (Centro de Investigación en Química Aplicada (CIQA)), 17/03/2014 - 10/05/2014. Host: Dr. Sergio Moya

**Ahmet Bekdemir** (EPFL), 28/04/2014 - 30/05/2014. Host: Prof. Luis Liz-Marzán

**Fabrice Laye** (KIT), 28/04/2014 - 30/05/2014. Host: Prof. Luis Liz-Marzán

**Mary Ann Elvina Xavier** (Universidad de Brasília), 14/04/2014 - 28/11/2014. Host: Dr. Sergio Moya



## TRAINING ACTIVITIES & OUTREACH

- Ana María Percebom** (Universidad de Brasilia), 05/05/2014 – 03/05/2015. Host: Prof. Luis Liz-Marzán
- Arturo Morales Portillo** (Universidad de Granada), 05/05/2014 – 31/07/2014. Host: Prof. Soledad Penadés
- Tatiane Oliveira dos Santos** (Universidad de Goiás), 25/05/2014 - 14/06/2014. Host: Dr. Sergio Moya
- Juan Antonio Moreno** (Fundación Jiménez Díaz), 02/06/2014 - 06/06/2014. Host: Dr. Mónica Carril
- Waldemar Marmisollé** (Consejo Nacional de Ciencia y Tecnología, Argentina), 16/06/2014 - 15/08/2014. Host: Dr. Sergio Moya
- Layza Alejandrina Arizmendi** (Centro de Investigación en Química Aplicada (CIQA), 09/06/2014 - 08/08/2014. Host: Dr. Sergio Moya
- Daniele Mantione** (POLYMAT), 19/05/2014 - 18/05/2015. Host: Dr. Luca Salassa
- Maite del Corte** (Universidad Francisco de Vitoria, Madrid), 02/06/2014 - 30/07/2014. Host: Dr. Valery Pavlov
- Candida Pipitone** (University of Palermo), 27/06/2014 - 02/09/2014. Host: Dr. Luca Salassa
- Pamela Benzan** (University of Palermo), 27/06/2014 - 02/09/2014. Host: Dr. Luca Salassa
- Alessandro Chiara** (University of Palermo), 27/06/2014 - 02/09/2014. Host: Dr. Luca Salassa
- Giulia Licciardi** (University of Palermo), 27/06/2014 - 02/09/2014. Host: Dr. Luca Salassa
- Clara Fabregat** (Programa Joves i Ciència, Fundació La Pedrera), 01/07/2014 - 18/07/2014. Host: Prof. Luis Liz-Marzán
- Germán Riva** (CSIC), 07/06/2014 – 11/07/2014. Host: Dr. Ralf Richter
- Alex Marki** (CSIC), 07/07/2014 – 16/07/2014. Host: Dr. Ralf Richter
- Marta Urtizberea Merino** (UAB), 07/07/2014 – 01/09/2014. Host: Dr. Jordi Llop
- Ainhoa Urribarren** (UAB), 03/07/2014 – 31/07/2014. Host: Dr. Niels Reichardt
- Shan Yu** (Zhejiang University), 22/07/2014 - 15/10/2014. Host: Dr. Sergio Moya
- Ming Zhou** (Zhejiang University), 16/07/2014 - 13/08/2014. Host: Dr. Sergio Moya
- Wenbiao Xu** (Zhejiang University), 22/07/2014 - 21/09/2014. Host: Dr. Sergio Moya
- Pu Zhang** (Zhejiang University), 22/07/2014 - 21/09/2014. Host: Dr. Sergio Moya
- Changyou Gao** (Zhejiang University), 15/08/2014 - 10/09/2014. Host: Dr. Sergio Moya
- Brendan Darby** (University of Wellington), 25/08/2014 - 12/09/2014. Host: Prof. Luis Liz-Marzán
- Anna Li Volsi** (University of Palermo), 15/09/2014 - 15/12/2014. Host: Prof. Luis Liz-Marzán
- Paolín Rocío Cáceres Vélez** (Universidad de Brasilia), 17/09/2014 - 15/12/2014. Host: Dr. Sergio Moya
- Lluís Marsal** (University Rovira i Virgili), 02/10/2014 - 31/12/2014. Host: Prof. Luis Liz-Marzán
- Aiseta Baradji** (University of Liverpool), 01/10/2014 - 01/10/2016. Host: Dr. Ralf Richter
- Ander Urien Telleria** (University of Navarra), 01/10/2014 - 31/12/2014. Host: Dr. Sergio Moya
- Svetlana Avvakumova** (University Milano Bicocca), 06/10/2014 - 02/11/2014. Host: Prof. Luis Liz-Marzán

## TRAINING ACTIVITIES & OUTREACH

### Open Days and Visits

CiC biomaGUNE regularly receives visits from high-school and university students who come to the center to have a closer look at our activity. Visits typically include a lecture about biomaterials and/or nuclear imaging in the context of life sciences, an open discussion with researchers of the center, and a guided visit to the laboratories and facilities including the Molecular Imaging Platform.



**March 2014.** Visit from *UPV-EHU Chemistry students*. Hosted by Prof. Manuel Martín-Lomás and Dr. Jordi Llop.

**March 2014.** Visit from *SUMMA Aldapeta high school students*. Hosted by Prof. Manuel Martín-Lomás and Dr. Jordi Llop.

**September 2014.** Open Day at the Molecular Imaging Platform: Basic introduction to radiochemistry and PET. Hosted by Eunice Sofia Da Silva and Sameer Manohar Joshi, PhD students of the Radiochemistry and Nuclear Imaging Group.

**October 2014.** Visit from *researchers members of the ETP- Nanomedicine*. Hosted by Dr. Sergio Moya and Dr. Marco Marradi (Soft Matter Nanotechnology Laboratory)

**October 2014.** Visit from *TECNUN (University of Navarra) Biomedical Engineering students*. Hosted by Dr. Vanessa Gómez (Radiochemistry and Nuclear Imaging Laboratory)

**October 2014.** Visit from *La Salle (Beasain) high school students*. Hosted by Dr. Juan José Giner and Dr. Dorleta Jimenez de Aberasturi (BioNanoPlasmonics Laboratory)

**January-December 2014.** A total of 41 guided tours to CiC biomaGUNE's facilities including the Molecular Imaging Facilities were given to all invited speakers from the CiC biomaGUNE seminars programme.

TRAINING ACTIVITIES & OUTREACH

Media



During 2014 CICbiomaGUNE has joined Twitter @CICbiomaGUNE

Additionally, several press releases, highlights and videos on CICbiomaGUNE's research activities have been released on the local and national media:



**14/12/2014**  
On the news: a video explaining how the research conducted at CICbiomaGUNE can contribute in the fight against cancer for the annual telethon broadcast by EITB (Basque country TV channel) to raise funds for scientific research.

**15/10/2014**  
Interview by Euskadi Innova to Prof. Luis Liz-Marzán, scientific director of CICbiomaGUNE



**Dos investigadores del País Vasco, beneficiarios de la Fundación BBVA**  
Los investigadores del País Vasco se encuentran entre los beneficiarios de los premios de la Fundación BBVA. Son María González (Gueyo, País Vasco, UPV), un investigador postdoctoral en BioNanotecnología Laboratorial en el CICbiomaGUNE, en B...

**03/10/2014**  
The award of the BBVA Research Grant to Marek Grzelczak was reflected by the media.

**17/09/2014**  
On the news: About the results obtained in the frame of the collaboration established between CICbiomaGUNE, UPV and Achucarro BERC researchers "Identification of a key molecule in the development of future therapies for brain damage from stroke"



TRAINING ACTIVITIES & OUTREACH

**28/07/2014**  
Press release: about the work conducted at CICbiomaGUNE on the frame of the European Project PneumoNP  
CICbiomaGUNE cooperates in the European fight against antibiotic resistance  
The PneumoNP Project was created to develop inhalable antibiotics modified using nanotechnology



**27/06/2014**  
Prof. Luis Liz-Marzán, scientific director of CICbiomaGUNE interviewed at "Entrada Libre" from Eitb (Basque Country's TV Channel)

**30/05/2014**  
Press release: The XI Biannual Meeting of the Carbohydrate Group of the Spanish Royal Society of Chemistry (XI Jornadas de Carbohidratos) was dedicated to Manuel Martín-Lomas in recognition of his scientific career.

**19/05/2014**  
The award of the 2014 Medal from the Royal Society of Chemistry (RSEQ) to Professor Luis Liz-Marzán as a recognition of his scientific career was reflected in several media (newspapers, radio, specialized media and social media). You can find a media collection here.

**09/05/2014**  
Press release: Bringing nanotechnology to real life: Ink with nanoparticles for rapid diagnosis



**12/03/2014**  
Press release: Gold nanoparticles to detect nerve gases and pesticides.

**10/02/2014**  
Press release: Gold and Silica nanoparticles imitate the two faces of the god Janus. (press clipping collection)



**03/01/2014**  
On the news: About the results obtained in the frame of the collaboration established between CICbiomaGUNE and Complutense University of Madrid researchers "the potential of hyaluronic acid for combating respiratory disorders of newborns".

[www.cicbiomagune.es](http://www.cicbiomagune.es)

