Activity Report

CIC biomaGUNE

2016

CIC biomaGUNE
Biomaterialetako Ikerkuntza Kooperatiboko Zentroa
Centro de Investigación Cooperativa en Biomateriales

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Presentation

The Center for Cooperative Research in Biomaterials - CIC biomaGUNE, located in San Sebastián (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 Centers 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.

Professor Manuel Martín-Lomas was appointed first Scientific Director and took the initiative to shape the identity of the Center. After an initial phase where the first 8 research teams were selected from the international scientific community, the Molecular Imaging Facility was built and soon 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 Center.

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 programme is to contribute to the understanding of the functioning of biological systems at the molecular and nanometer scale. The main research lines are within the field of design, preparation and characterization of biofunctional nanostructures, to be used in the study of biological processes and the development of biomedical tools.

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.

In 2016 CIC biomaGUNE has celebrated its 10th anniversary with the organisation of a 1 day scientific event. In the course of these ten years, CIC biomaGUNE has established itself as a nationally and internationally recognised scientific leader and as a knowledge builder in the field of biomaterials. Among other achievements, this has led to the generation of knowledge (publications, patents, etc.), collaboration with international bodies and institutions as well as putting its facilities and scientific personnel at the service of the scientific community and the industrial sector.

PRESENTATION

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. The ISAB is currently formed by the following members:

Prof. Peter Morris – Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, UK

Prof. Lia Addadi – Weizmann Institute of Science, Rehovot, Israel

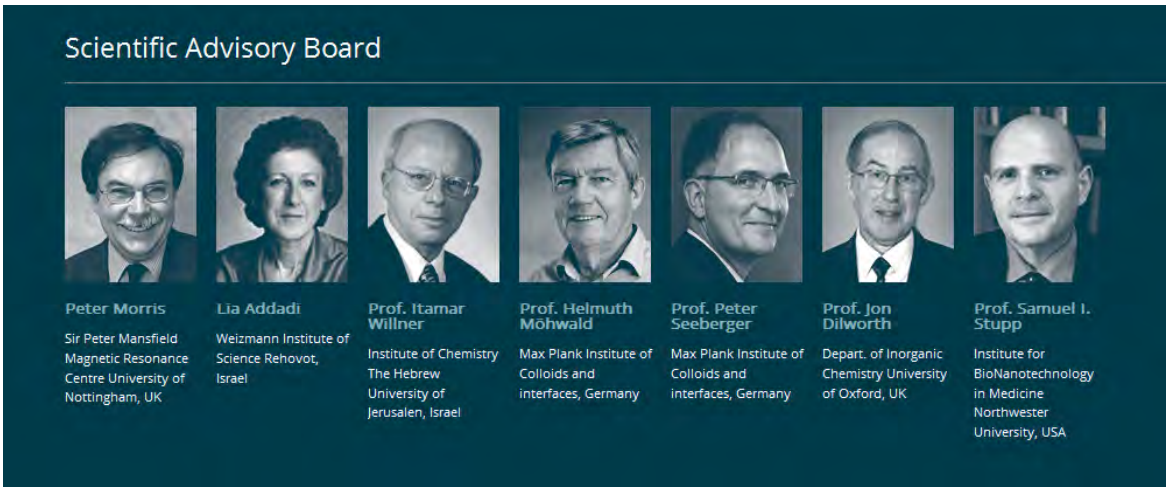
Prof. Itamar Willner – Institute of Chemistry, The Hebrew University of Jerusalem, Israel

Prof. Helmuth Möhwald – Max Plank Institute of Colloids and Interfaces, Postdam, Germany

Prof. Peter Seeberger – Max Plank Institute of Colloids and Interfaces, Postdam, Germany

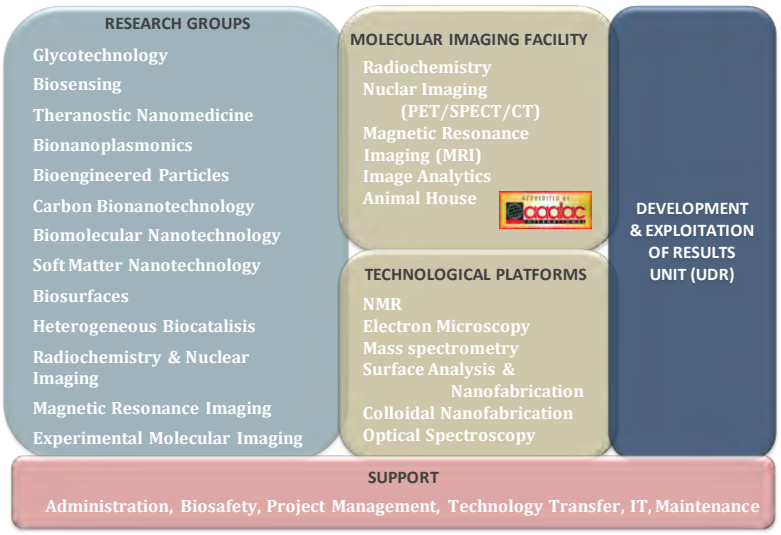
Prof. Jon Dilworth – Department of Inorganic Chemistry, University of Oxford, UK

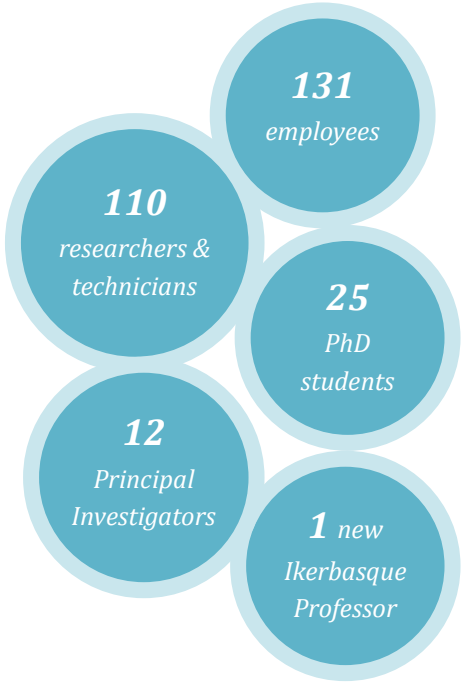
Prof. Samuel I. Stupp – Institute for BioNanotechnology in Medicine, Northwestern University, USA



Summary

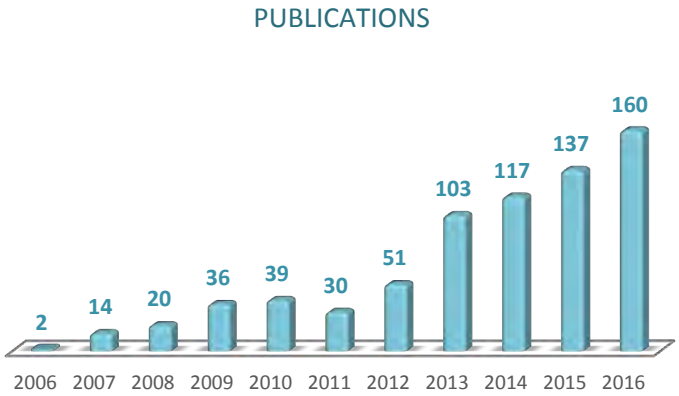
ORGANIZATION

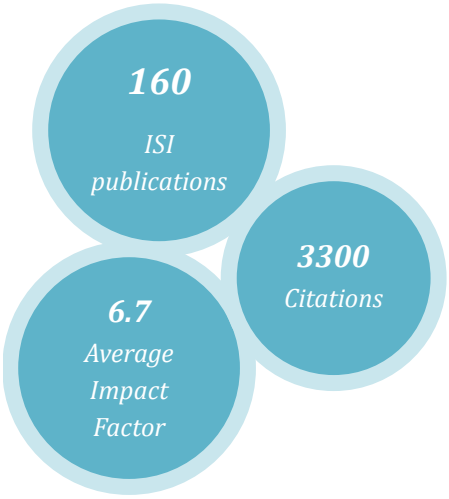




SCIENTIFIC OUTPUT

During 2016, **160** articles in high impact scientific journals have been published.





SUMMARY

FUNDING

During 2016, **15** new grants have been awarded with a total contribution of **4,950,510.50**€.

15 *new R&D research projects*

4.9 M€ *Research Funding*

24 *Research Agreements with institutions/ companies*

TECHNOLOGY TRANSFER

During 2016, **2** new patent applications have been filed, **4** patents have been granted, **2** patent rights licensed and one spin-off company has been launched, ***Asparia Glycomics***.

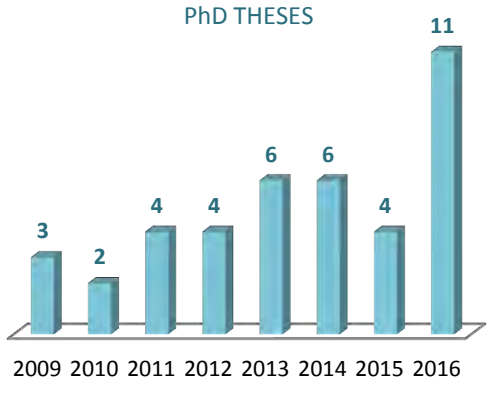
2 *Patent applications*

4 *Granted patents*

2 *Patent rights licensed*

1 *Spin-off launched*

TRAINING AND OUTREACH ACTIVITY



11 *PhD theses defended*

25 *On-going Theses*

42 *Guided Tours*

105 *Received research stays*

34 *Seminars*

150 *Impacts in Media*

Organization

The table below provides the distribution of CIC biomaGUNE's personnel as per November 2016.

CIC biomaGUNE'S Personnel

Principal Investigators	12
Associate Researchers	7
Research Assistants	1
Platform Managers	8
Laboratory Technicians and Platform Specialists	30
Postdoctoral Researchers	26
PhD Students	25
Direction and Administration	15
IT and Maintenance	6
Biosafety and Radioprotection	1
Total	**131**

Researchers from ***18*** *countries*

Argentina	Greece	Slovenia
Colombia	India	South Korea
Cyprus	Italy	Spain
Denmark	Lithuania	Tunisia
France	Mexico	UK
Germany	Russia	USA

ORGANIZATION

RECRUITMENTS OF GROUP LEADERS

- **Prof. Aitziber L. Cortajarena** joined CIC biomaGUNE in January 2016 as Ikerbasque Research Professor and new group leader.

Dr. Aitziber L. Cortajarena earned her Ph.D. in Biochemistry from the Universidad del País Vasco in 2002 working with Dr. Helena Ostolaza and Dr. Félix M. Goñi. Then, she joined the group of Dr. Lynne Regan at Yale University, USA, as a Postdoctoral Fellow. She worked on protein design, structure, and function. In 2006, she was Visiting Scientist at the Weizmann Institute, Israel, with Dr. Gilad Haran working on single molecule spectroscopy. Then, continued her work at Yale University, as an Associate Research Scientist with Dr. Regan. She joined IMDEA Nanociencia in 2010 and started her independent research group supported by Marie Curie-COFUND and Marie Curie IRG Programmes. Her research focuses on protein engineering toward the generation of functional nanostructures and bioinspired materials for applications in nanobiotechnology and nanomedicine. In 2015 she was awarded an ERC Consolidator Grant (ProNANO). During her research carrier, Prof. Cortajarena pioneered the use of tetratricopeptide proteins for nanotool and material development, which form the basis for the current research. At CIC biomaGUNE she will be leading the Biomolecular Nanotechnology group that will focus on protein engineering toward the generation of functional nanostructures and bioinspired materials for applications in nanobiotechnology and nanomedicine.

JOINT APPOINTMENTS

- **Prof. Juan Marque-Rivas** holds a part-time position with Swansea University (UK) since August 2016.

Dr. Juan C. Mareque-Rivas joined Swansea University in August 2016 as Co-Head of the new Department of Chemistry. He holds this position as a secondary affiliation next to his position as Ikerbasque Research Professor and Group Leader of the Theranostic Nanomedicine Laboratory at CIC biomaGUNE.

- **Dr. Ralf Richter** holds a part-time position with University of Leeds (UK) since October 2016.

Dr. Ralf Richter joined University of Leeds in October 2016 as a secondary affiliation next to his current position as Group Leader of the Biosurfaces Laboratory at CIC biomaGUNE.

ORGANIZATION

GROUP LEADERS

Glycotechnology
Niels Reichardt

Biosensing
Valery Pavlov

Theranostic Nanomedicine
Juan C. Mareque-Rivas
Ikerbasque Professor

Bionanoplasmonics
Luis Liz-Marzán
Ikerbasque Professor

Bioengineered Particles
Wolfgang Parak

Carbon Bionanotechnology
Maurizio Prato
Ikerbasque Professor

Biomolecular Nanotechnology
Aitziber L. Cortajarena
Ikerbasque Professor

Soft matter Nanotechnology
Sergio E. Moya

Biosurfaces
Ralf Richter

Radiochemistry and Nuclear Imaging
Jordi Llop

Magnetic Resonance Imaging
Torsten Reese

Magnetic Resonance Imaging
Pedro Ramos
Ikerbasque Professor

RESEARCH ASSOCIATES

Bionanoplasmonics
Marek Grzelczak
Ikerbasque Fellow

Bioengineered Particles
Mónica Carril
Ikerbasque Fellow

Heterogeneous Biocatalisis
Fernando López
Ikerbasque Fellow

Bionanoplasmonics
Javier Reguera
Ikerbasque Fellow

Bionanoplasmonics
Isabel García-Martín
CIBER-BBN

Experimental Molecular Imaging
Abraham Martín Muñoz

Theranostic Nanomedicine
Luca Salassa
Ramón y Cajal Fellow

Funding

During 2016, **15** new grants have been awarded with a total contribution of **4,950,510.50** €.

LIST OF FINANCED PROJECTS DURING 2016

PI	FUNDING AGENCY	CALL	AMOUNT	PERIOD	FULL TITLE
Aitziber L. Cortajarena	**European Commission**	ERC-2014-CoG	1,718,850.00	2016 - 2018	**ProNANO** - Protein-based functional nanostructures
Maurizio Prato	**European Commission**	FET FLAGSHIP H2020-Adhoc-2014-20	270,030.00	2016 - 2018	**GRAPHENE CORE1** - Graphene-based disruptive technologies
Luis Liz-Marzán	**European Commission**	ERC-PoC-2015	149,940.00	2016 - 2017	**READCELL** - System for the efficient and non-invasive harvesting and release of adherent CELLs controlled by light
Juan Mareque/ Jordi Llop	**European Commission**	H2020-MSCA-ITN-2015	495,745.92	2016 - 2020	**PET3D** -PET Imaging in Drug Design and Development
Luis Liz-Marzán	**European Commission**	H2020-MSCA-IF-2015	170,121.60	2016 - 2018	**CINMAB** - Chiral Plasmons in Protein-Nanoparticle Hybrid Materials for Application as Biosensors
Fernando López Gallego	**MINECO**	Retos de la Sociedad - proyectos I+D	79,000.00	2016-2018	**HeMUBI** - Heterogeneous and multi-functional biocatalysts for one-pot biosynthesis of 2-aminoalcohols. New horizons for the cell-free synthetic biology in solid-state.
Mónica Carril	**MINECO**	Retos de la Sociedad - proyectos I+D	40,000.00	2016-2018	**NANOFLUOR** - Nanopartículas fluoradas como nuevos agentes de contraste y sondas ON/OFF
Juan Mareque	**MINECO/ M ERA-NET**	Acciones de Programación Conjunta Internacional	90,000.00	2016 - 2019	**MediSURF** - Designed nanostructured bioactive surfaces for precision medicines

FUNDING

PI	FUNDING AGENCY	CALL	AMOUNT	PERIOD	FULL TITLE
Pedro Ramos	**GOBIERNO VASCO**	ELKARTEK 2016	830,238.98	2016-2017	**biomaGUNE 2016** - Investigación colaborativa en nuevas técnicas de imagen y biomateriales para el diagnostico y tratamiento de enfermedades del sistema nervioso central
Luis Liz-Marzán	**GOBIERNO VASCO**	RIS3_2016 Departamento de Salud	35,453.00	2016	**INvitro DIagnostics for CAncer TEsting (INDICATE)** - Desarrollo de un biosensor económico, sensible y rápido para detectar mutaciones en sangre asociadas a medicina personalizada
CIC biomaGUNE	**GOBIERNO VASCO**	RIS3_2016 Departamento de Salud	61,131.00	2016	Bio-Reactor automatizado para células adherentes
Luis Liz-Marzán	**GOBIERNO VASCO**	Ayudas a la organización de congresos	10,000.00	2016	International Conference on Self Assembly in Confined Spaces
CIC biomaGUNE	**Diputación Foral Guipúzcoa**	Programa RED-Infraestructura	100,000.00	2016-2017	**CONFOCAL** - Adquisición de un microscopio confocal de fluorescencia
Maurizio Prato	**Diputación Foral Guipúzcoa**	Programa RED - Investigación	100,000.00	2015 - 2016	**CA3DCNMP** - Construcción de nuevos andamios tridimensionales basados en la combinación de nanomateriales de carbono y polímeros conductores para cultivos de células electroactivas
Maurizio Prato	**AXA Foundation**	2016-LIFE-AXA CHAIR	800,000.00	2016 - 2023	**AXA-biomaGUNE Nanobiotechnology Chair**

Knowledge and Technology Transfer

During the last three years CIC biomaGUNE has made a substantial effort toward the establishment of a Technology Transfer Unit. This Unit acts as an incubator of ideas, with the main objective to transfer research results from CIC biomaGUNE into the market, by encouraging their exploitation and strengthening patent licensing. In addition, this Unit aims at establishing new contracts with companies, promoting cross-sectoral research and maximizing the transfer of knowledge and technology. Projects that can be matured in this unit are previously validated by the Scientific Director, who decides if the idea can benefit from the infrastructure / resources for its maturation.

SPIN-OFF INCUBATOR

The first project supported by the Tech Transfer Unit started in 2013 with the "Glycotech" project, which was developed during 2014 and 2015. In 2016 CIC biomaGUNE and private investors have come together to set up ***Asparia Glycomics***, a spin-off company specialized in the production and marketing of reagents, reference standards, kits and software for glycan analysis in clinical diagnosis and for quality control of biopharmaceuticals.

The business initiative markets the leading technology developed by the Glycotechnology laboratory led by Dr. Niels Reichardt to quantify glycans more accurately and faster than existing solutions on the market. *Asparia Glycomics* is offering unique stable isotope labeled glycans as internal standards, custom made quantification software and reagents for glycan analysis by mass spectrometry.

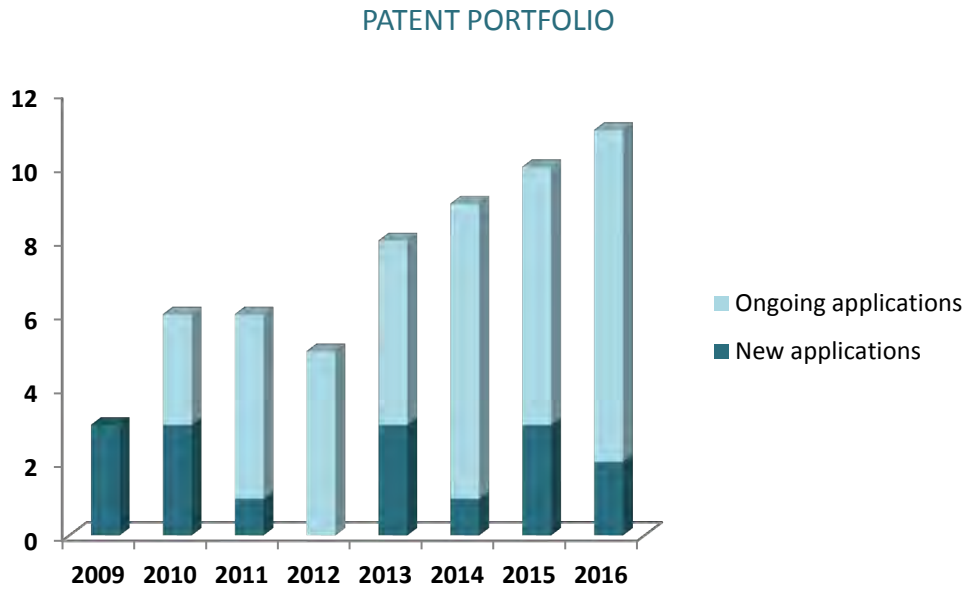
The company is led by Dr. Juan Echevarria, a co-developer of the technology, who moved to *Asparia Glyomics* from the Glycotechnology laboratory. The standards and kit solutions offered by *Asparia Glycomics* find multiple applications in clinical glycomics research, biopharmaceutical glycan analysis and glycobiology in general. For more information visit https://aspariaglycomics.com/

Asparia Glycomics

KNOWLEDGE & TECHNOLOGY TRANSFER

PATENTS

The generation of patents is one of the instruments that indicate the transfer of knowledge from the Center to Society and to business development. The graph below shows the evolution over the years:



2016 Patent Applications

- Pharmaceutical composition comprising fluorine-18 labelled gases – P16382304.0
- Uso de nanopartículas de oro para el tratamiento y la prevención del cáncer – ES201600160

2016 Granted Patents

- Method for the production of human thrombin and uses thereof – US9334526
- Method for the characterization of intermolecular interactions – US 9255928
- Methods for making microarrays and their uses – US9453838
- Non-intrusive agitation system – EP2951452

2016 Patent Rights Licensed

- Synthesis and use of isotopically-labelled glycans – PCT/EP2014/056737
- Uso de nanopartículas de oro para el tratamiento y la prevención del cáncer – ES201600160

KNOWLEDGE & TECHNOLOGY TRANSFER

RESEARCH AGREEMENTS WITH COMPANIES/INSTITUTIONS

During 2016 several collaboration agreements with the following companies/Institutions were in place:

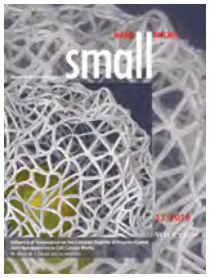
Scientific Output

COVER PAGES

Influence of Temperature on the Colloidal Stability of Polymer-Coated Gold Nanoparticles in Cell Culture Media

Zyuzin, M. V.; Honold, T.; Carregal-Romero, S.; Kantner, K.; Karg, M.; Parak, W. J.

Small **2016**, *12*, 1723–1731



Os_2 -Os_4 Switch Controls DNA Knotting and Anticancer Activity

Fu, Y.; Romero, M. J.; Salassa, L.; Cheng, X.; Habtemariam, A.; Clarkson, G. J.; Prokes, I.; Rodger, A.; Costantini, G.; Sadler

Angew. Chem. Int. Ed. **2016**, *55*, 8909–8912

Surface Enhanced Raman Scattering and Gated Materials for Sensing Applications: The Ultrasensitive Detection of *Mycoplasma* and Cocaine

Oroval, M.; Coronado-Puchau, M.; Langer, J.; Norah Sanz-Ortiz, M.; Ribes, A.; Aznar, E.; Coll, C.; Dolores Marcos, M.; Sancenon, F.; Liz-Marzan, L. M.; *et al.*

Chem. Eur. J. **2016**, *22*, 13488–13495

In Vivo Degeneration and the Fate of Inorganic Nanoparticles

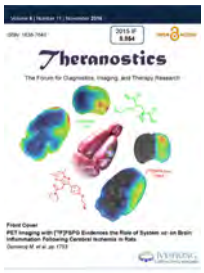
Feliu, N.; Docter, D.; Heine, M.; del Pino, P.; Ashraf, S.; Kolosnjaj-Tabi, J.; Macchiarini, P.; Nielsen, P.; Alloyeau, D.; Gazeau, F.; *et al.*

Chem. Soc. Rev. **2016**, *45*, 2440–2457

Encapsulation of Single Plasmonic Nanoparticles within ZIF-8 and SERS Analysis of the MOF Flexibility

S. Zheng, G.; de Marchi, S.; López-Puente, V.; Sentosun, K.; Polavarapu, L.; Pérez-Juste, I.; Hill, E. H.; Bals, S.; Liz-Marzán, L. M.; Pastoriza-Santos, I.; *et al.*

Small **2016**, *12*, 3935–3943



PET Imaging with [^{18} F]FSPG Evidences the Role of System Xc^- on Brain Inflammation Following Cerebral Ischemia in Rats

Domercq, M.; Szczupak, B.; Gejo, J.; Gómez-Vallejo, V.; Padro, D.; Gona, K. B.; Dollé, F.; Higuchi, M.; Matute, C.; Llop, J.; *et al.*

Theranostics **2016**, *6*, 1753–1767

SCIENTIFIC OUTPUT – PUBLICATIONS

Polyelectrolytes Multilayers to Modulate Cell Adhesion: A Study of the Influence of Film Composition and Polyelectrolyte Interdigitation on the Adhesion of the A549 Cell Line

Muzzio, N. E.; Pasquale, M. A.; Gregurec, D.; Diamanti, E.; Kosutic, M.; Azzaroni, O.; Moya, S. E.

Macromol. Biosci. ***2016****, 16, 482–495*

Cancer Cell Internalization of Gold Nanostars Impacts Their Photothermal Efficiency In Vitro and In Vivo: Toward a Plasmonic Thermal Fingerprint in Tumoral Environment

Espinosa, A.; Silva, A. K. A.; Sánchez-Iglesias, A.; Grzelczak, M.; Péchoux, C.; Desboeufs, K.; Liz-Marzán, L. M.; Wilhelm, C.

Adv. Healthc. Mater. **2016**, *5*, 1040–1048

Repeat protein scaffolds: Ordering photo- and electroactive molecules in solution and solid state

Mejías, S. H.; López-Andarias, J.; Sakurai, T.; Yoneda, S.; Erazo, K. P.; Seki, S.; Atienza, C.; Martín, N.; Cortajarena, A. L.

Chem. Sci. **2016**, *7*, 4842–4847

Dissociation Coefficients of Protein Adsorption to Nanoparticles as Quantitative Metrics for Description of the Protein Corona: A Comparison of Experimental Techniques and Methodological Relevance

Hühn, J.; Fedeli, C.; Zhang, Q.; Masood, A.; del Pino, P.; Khashab, N. M.; Papini, E.; Parak, W. J.

Int. J. Biochem. Cell Biol. **2016**, *75*, 148–161

Janus Gold Nanoparticles Obtained via Spontaneous Binary Polymer Shell Segregation

Percebom, A. M.; Giner-Casares, J. J.; Claes, N.; Bals, S.; Loh, W.; Liz-Marzan, L. M.

Chem. Commun. **2016**, *52*, 4278–4281

SCIENTIFIC OUTPUT – PUBLICATIONS

PUBLICATIONS

Babayevska, N.; Peplinska, B.; Jarek, M.; Yate, L.; Tadyszak, K.; Gapinski, J.; Iatsunskyi, I.; Jurga, S. Synthesis, Structure, EPR Studies and up-Conversion Luminescence of ZnO:Er^{3+}-Yb^{3+}@Gd_2O_3 Nanostructures. *RSC Adv.* **2016**, *6*, 89305–89312.

Bussy, C.; Hadad, C.; Prato, M.; Bianco, A.; Kostarelos, K. Intracellular Degradation of Chemically Functionalized Carbon Nanotubes Using a Long-Term Primary Microglial Culture Model. *Nanoscale* **2016**, *8*, 590–601.

Cepeda, J.; San Sebastian, E.; Padro, D.; Rodriguez-Dieguez, A.; Garcia, J. A.; Ugalde, J. M.; Seco, J. M. A Zn Based Coordination Polymer Exhibiting Long-Lasting Phosphorescence. *Chem. Commun.* **2016**, *52*, 8671–8674.

Domercq, M.; Szczupak, B.; Gejo, J.; Gómez-Vallejo, V.; Padro, D.; Gona, K. B.; Dollé, F.; Higuchi, M.; Matute, C.; Llop, J.; *et al.* PET Imaging with [^{18}F]FSPG Evidences the Role of System Xc^- on Brain Inflammation Following Cerebral Ischemia in Rats. *Theranostics* **2016**, *6*, 1753–1767.

Escudero, A.; Carrillo-Carrión, C.; Zyuzin, M. V.; Ashraf, S.; Hartmann, R.; Núñez, N. O.; Ocaña, M.; Parak, W. J. Synthesis and Functionalization of Monodisperse Near-Ultraviolet and Visible Excitable Multifunctional Eu^{3+}, Bi^{3+}:$REVO_4$ Nanophosphors for Bioimaging and Biosensing Applications. *Nanoscale* **2016**, *8*, 12221–12236.

Esguerra-Arce, A.; Esguerra-Arce, J.; Yate, L.; Amaya, C.; Coy, L. E.; Aguilar, Y.; Gutierrez, O.; Moya, S. Influence of the Al Content on the in Vitro Bioactivity and Biocompatibility of PVD $Ti_{1-x}Al_xN$ Coatings for Orthopaedic Applications. *RSC Adv.* **2016**, *6*, 60756–60764.

Feliu, N.; Docter, D.; Heine, M.; del Pino, P.; Ashraf, S.; Kolosnjaj-Tabi, J.; Macchiarini, P.; Nielsen, P.; Alloyeau, D.; Gazeau, F.; *et al.* In Vivo Degeneration and the Fate of Inorganic Nanoparticles. *Chem. Soc. Rev.* **2016**, *45*, 2440–2457.

Fleddermann, J.; Diamanti, E.; Azinas, S.; Košutić, M.; Dähne, L.; Estrela-Lopis, I.; Amacker, M.; Donath, E.; Moya, S. E. Virosome Engineering of Colloidal Particles and Surfaces: Bioinspired Fusion to Supported Lipid Layers. *Nanoscale* **2016**, *8*, 7933–7941.

Giner-Casares, J. J.; Reguera, J. Directed Self-Assembly of Inorganic Nanoparticles at Air/Liquid Interfaces. *Nanoscale* **2016**, *8*, 16589–16595.

Gomez-Vallejo, V.; Lekuona, A.; Baz, Z.; Szczupak, B.; Cossio, U.; Llop, J. Ion Beam Induced F-18-Radiofluorination: Straightforward Synthesis of Gaseous Radiotracers for the Assessment of Regional Lung Ventilation Using Positron Emission Tomography. *Chem. Commun.* **2016**, *52*, 11931–11934.

Gregurec, D.; Velasco-Lozano, S.; Moya, S. E.; Vazquez, L.; Lopez-Gallego, F. Force Spectroscopy Predicts Thermal Stability of Immobilized Proteins by Measuring Microbead Mechanics. *Soft Matter* **2016**, *12*, 8718–8725.

Gregurec, D.; Wang, G.; Pires, R. H.; Kosutic, M.; Luedtke, T.; Delcea, M.; Enrique Moya, S. Bioinspired Titanium Coatings: Self-Assembly of Collagen-Alginate Films for Enhanced Osseointegration. *J. Mater. Chem. B* **2016**, *4*, 1978–1986.

Hamon, C.; Sanz-Ortiz, M. N.; Modin, E.; Hill, E. H.; Scarabelli, L.; Chuvilin, A.; Liz-Marzán, L. M. Hierarchical Organization and Molecular Diffusion in Gold Nanorod/Silica Supercrystal Nanocomposites. *Nanoscale* **2016**, *8*, 7914–7922.

Hussain, S. Z.; Zyuzin, M. V.; Hussain, I.; Parak, W. J.; Carregal-Romero, S. Catalysis by Multifunctional Polyelectrolyte Capsules. *RSC Adv.* **2016**, *6*, 81569–81577.

Joshi, S. M.; Gómez-Vallejo, V.; Salinas, V.; Llop, J. Synthesis of ^{13} N-Labelled Polysubstituted Triazoles via Huisgen Cycloaddition. *RSC Adv.* **2016**, *6*, 109633–109638.

SCIENTIFIC OUTPUT – PUBLICATIONS

Kumar, J.; Thomas, K. G.; Liz-Marzán, L. M. Nanoscale Chirality in Metal and Semiconductor Nanoparticles. *Chem. Commun.* **2016**, *52*, 12555–12569.

Leon, V.; Gonzalez-Dominguez, J. M.; Fierro, J. L. G.; Prato, M.; Vazquez, E. Production and Stability of Mechanochemically Exfoliated Graphene in Water and Culture Media. *Nanoscale* **2016**, *8*, 14548–14555.

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SCIENTIFIC OUTPUT – PUBLICATIONS

Barandika, O.; Ezquerra-Inchausti, M.; Anasagasti, A.; Vallejo-Illarramendi, A.; Llarena, I.; Bascaran, L.; Alberdi, T.; De Benedetti, G.; Mendicute, J.; Ruiz-Ederra, J. Increased Aquaporin 1 and 5 Membrane Expression in the Lens Epithelium of Cataract Patients. *Biochim. Biophys. Acta Mol. Basis Dis.* **2016**, *1862*, 2015–2021.

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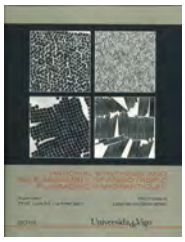
SCIENTIFIC OUTPUT – PHD THESES

PhD THESES

Leonardo Scarabelli (Outstanding PhD Award by Univ. of Vigo)
Rational Synthesis and Self-Assembly of Anisotropic Plasmonic Nanoparticles

Supervisor: Luis Liz-Marzán

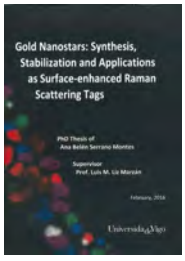
Date: 26/02/2016



Ana Belén Serrano
Gold Nanostars: Synthesis, Stabilization and Applications as Surface-enhanced Raman Scattering Tags

Supervisor: Luis Liz-Marzán

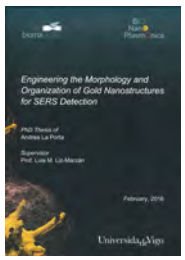
Date: 26/02/2016



Andrea La Porta
Engineering the Morphology and Organization of Gold Nanostructures for SERS Detection

Supervisor: Luis Liz-Marzán

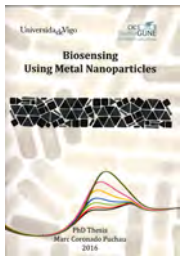
Date: 26/02/2016



Marc Coronado-Puchau
Biosensing Using Metal Nanoparticles

Supervisor: Luis Liz-Marzán

Date: 26/02/2016



Danijela Gregurec
Design, Physico- Chemical Characterization and Bioactivity Studies of Hybrid Nanostructured Titanium Surfaces for Enhanced Osseointegration

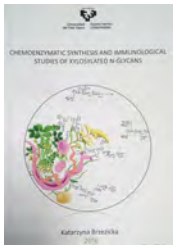
Supervisor: Sergio Moya
Date: 14/03/2016

SCIENTIFIC OUTPUT – PHD THESES

Emmanuel Ruggiero
Towards Near-Infrared Photoactivation of Anticancer Metal Complexes

Supervisor: Luca Salassa

Date: 13/05/2016



Katarzyna Brzezicka
Chemoenzymatic synthesis and immunological studies of xylosylated n-glycans

Supervisor: Niels Reichardt

Date: 07/06/2016

Joseba Irigoyen Otamendi
Fabrication and Characterization of Multilayered Assemblies based on Polyelectrolytes and Hybrid Systems with Carbon Nanomaterials for Applications in Nanofiltration and as Smart Surfaces

Supervisor: Sergio Moya

Date: 26/07/2016

Xinyue Chen
Physical principles underlying structure, mechanics and dynamic re-organization of hyaluronan-rich matrices — from tissues to supramolecular models in experiment and theory

Supervisor: Ralf P. Richter

Date: 29/07/2016

Larraitz Gil
Targeted Polymeric Nanoparticles: Radiolabelling with Ga-67 and in vivo Evaluation in a Mouse Model of Pancreatic Adenocarcinoma using Single Photon Emission Computerized Tomography

Supervisor: Jordi Llop

Date: 08/11/2016

Eleftheria Diamanti
Engineered Interfaces with Polyelectrolyte Multilayers, Lipid Bilayer Membranes and Virosomes for Biomedical Applications

Supervisor: Sergio Moya

Date: 19/12/2016

SCIENTIFIC OUTPUT – AWARDS & DISTINCTIONS

RESEARCH AWARDS AND DISTINCTIONS

Highly Cited Researchers

Luis Liz-Marzán and Maurizio Prato have been included in the 2016 lists of *Highly Cited Researchers* (*Clarivate Analytics*), in the fields of Chemistry (Liz-Marzán, Prato) and Materials Science (Liz-Marzán).

AXA Chair on Nanobiotechnology

The AXA Research Fund has awarded CIC biomaGUNE a permanent Chair to the team led by Professor Maurizio Prato. The funding amounts to 800,000 euros and will help us understand the practical applications of new materials, such as carbon nanotubes and graphene, in the field of neuroscience and spinal cord injuries.

Doctor Honoris Causa

Maurizio Prato received on June 28th a "Honoris Causa" doctoral degree from the University of Castilla-La Mancha. Prof. Prato has been recognized worldwide for his contributions to the science and applications of carbon nanostructures and mentored several researchers who are currently professors at UCLM.

ERC- Proof of Concept

Luis Liz Marzán awarded a Proof of Concept grant from the European Commission. The Proof of Concept funding supports ERC grant holders to bridge the gap between their research and the earliest stage of a marketable innovation.

Graphene Flagship

CIC biomaGUNE joins the Graphene Flagship Project to investigate the application of graphene in the generation of new biomedical implants. The Graphene Flagship macroproject is one of the greatest efforts ever made in Europe in the field of science. Maurizio Prato is leading the CIC biomaGUNE research team involved in the initiative. The Carbon Nanobiotechnology laboratory will focus on going deeper into the introduction of molecules with therapeutic properties into implants in order to increase the biocompatibility of these materials in nervous tissues.

Young Spanish Molecular Imaging Network

Abraham Martín and Mónica Carril, Chair and Co-Chair respectively, from the Young Spanish Molecular Imaging Network (youngSMIN). The youngSMIN is a pioneering molecular imaging community in Spain that aims to promote the formation of a network of young scientists working in the field of molecular imaging.

Outstanding PhD Award to Leonardo Scarabelli

The PhD thesis presented by Leonardo Scarabelli, "Rational Synthesis and Self-Assembly of Anisotropic Plasmonic Nanoparticles", has been selected by the University of Vigo for the Outstanding thesis award of 2016.

Best Presentation/ Poster Awards

Malou Henriksen-Lacey awarded for Outstanding Abstract at the International Conference on Nanomedicine and Nanobiotechnology, ICONAN 2016, for the work entitled "Thermosensitive nanogels with multiple anti-tumour associated effects".

SCIENTIFIC OUTPUT – EDITORIAL ACTIVITY

EDITORIAL ACTIVITY

Science
Board of Reviewing Editors – Luis Liz-Marzán

ACS Omega
Co- Editor-in-Chief – Luis Liz-Marzán

Langmuir
Senior Editor – Luis Liz-Marzán

ACS Nano
Associate Editor – Wolfgang Parak
Editorial Advisory Board – Luis Liz-Marzán, Maurizio Prato

Chemistry of Materials
Editorial Advisory Board – Luis Liz-Marzán, Wolfgang Parak

Accounts of Chemical Research
Editorial Advisory Board – Luis Liz-Marzán

Hybrid Materials
Editorial Advisory Board – Luis Liz-Marzán

Journal of Materials Chemistry B
International Editorial Advisory Board – Luis Liz-Marzán

Faraday Discussions
Advisory Board – Luis Liz-Marzán

Nanotoxicology
Editorial Board – Wolfgang Parak

Nanomaterials
Editorial Board – Wolfgang Parak

Scientific Reports
Associate Editor – Maurizio Prato
Editorial Board – Ralf Richter

Nano Today
Advisory Board – Luis Liz-Marzán

Colloids and Interface Science
Advisory Board – Wolfgang Parak

Colloids and Interface Science Communications
Advisory Board – Wolfgang Parak

Chemical Physics Letters
Advisory Board – Maurizio Prato

Nanotechnology
Sensing and Actuators Editor – Luis Liz-Marzán

Journal of Cerebral Blood Flow and Metabolism
Editorial Board– Abraham Martín

Frontiers of Biomechanics
Editorial Board – Ralf Richter

Theranostics
Editorial Board– Wolfgang Parak, Luis Liz-Marzán

Journal of Nanobiotechnology
Editorial Board - Wolfgang Parak

Angewandte Chemie
Editorial Board and International Advisory Board– Wolfgang Parak

ChemistryOpen
International Advisory Board – Luis Liz-Marzán

ChemNanoMat
International Advisory Board– Wolfgang Parak, Luis Liz-Marzán

Advanced Optical Materials
International Advisory Board – Luis Liz-Marzán

Particle & Particle Systems Characterization
Executive Editorial Board – Luis Liz-Marzán
Advisory Editorial Board – Wolfgang Parak

Chemistry – A European Journal
Editorial Board – Luis Liz-Marzán

ChemSusChem
Editorial Board – Maurizio Prato

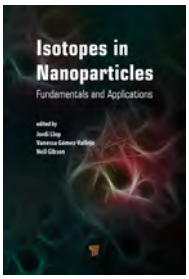
SCIENTIFIC OUTPUT – EDITORIAL ACTIVITY

GUEST EDITORIAL ACTIVITIES

Jordi Llop and Vanessa Gómez

Editors of the Book entitled:

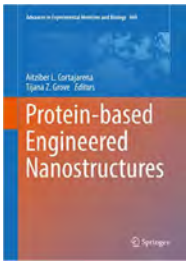
Isotopes in Nanoparticles: Fundamentals and Applications
Roig, J. L.; Gibson, P. N.; Gómez-Vallejo, V.
Pan Stanford Publishing: Singapore, **2016**



Aitziber L. Cortajarena

Editor of the Book entitled:

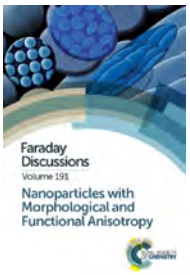
Protein-based Engineered Nanostructures
Cortajarena, A. L.; Grove, T.
Springer International Publishing AG, **2016**



Luis M. Liz-Marzán

Editor of the Faraday Discussions 191:

Nanoparticles with Morphological and Functional Anisotropy
Faraday Discuss., **2016**, *191*, 325–349



Marek Grzelczak

Editor of the Special Issue:

Controlled Nanocrystal Growth
Isr. J. Chem. **2016**, *56*, 192-261

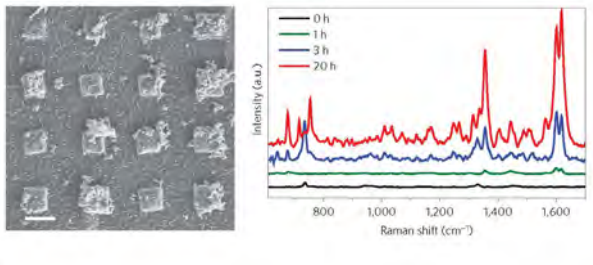
Luis M. Liz-Marzán

Editor of the Special Issue:

Advanced Particle Characterization Techniques
Part. Part. Syst. Charact. **2016**, *33*, 343–444

RESEARCH HIGHLIGHTS

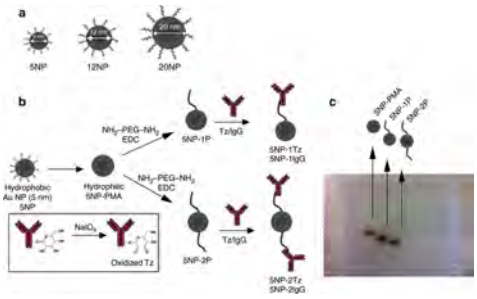
The Bionanoplasmonics Laboratory reports on the use of nanostructured plasmonic substrates for the SERS detection of quorum sensing in bacteria films



Detection and Imaging of Quorum Sensing in Pseudomonas Aeruginosa Biofilm Communities by Surface-Enhanced Resonance Raman Scattering
Bodelón, G.; Montes-Garcia, V.; Lopez-Puente, V.; Hill, E. H.; Hamon, C.; Sanz-Ortiz, M. N.; Rodal-Cedeira, S.; Costas, C.; Celiksoy, S.; Perez-Juste, J.; Pastoriza, I.; Liz-Marzán, L.
Nat. Mater. **2016**, *15*, 1203–1211

Most bacteria in nature exist as biofilms, which support intercellular signalling processes such as quorum sensing (QS), a cell-to-cell communication mechanism that allows bacteria to monitor and respond to cell density and changes in the environment. As QS and biofilms are involved in the ability of bacteria to cause disease, there is a need for the development of methods for the non-invasive analysis of QS in natural bacterial populations. Here, by using surface-enhanced resonance Raman scattering spectroscopy, we report rationally designed nanostructured plasmonic substrates for the *in situ*, label-free detection of a QS signalling metabolite in growing *Pseudomonas aeruginosa* biofilms and microcolonies. The *in situ*, non-invasive plasmonic imaging of QS in biofilms provides a powerful analytical approach for studying intercellular communication on the basis of secreted molecules as signals.

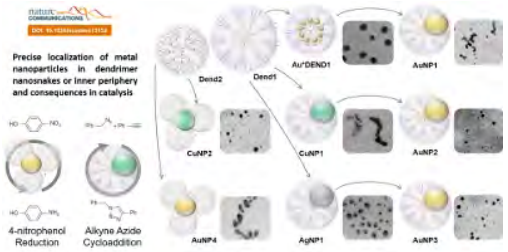
The Bioengineered Particles Laboratory in collaboration with the University of Milano reports on the active targeting of nanoparticles to tumours by conjugation with a precisely controlled number antibodies



Tumour homing and therapeutic effect of colloidal nanoparticles depend on the number of attached antibodies
Colombo, M.; Fiandra, L.; Alessio, G.; Mazzucchelli, S.; Nebuloni, M.; De Palma, C.; Kantner, K.; Pelaz, B.; Rotem, R.; Corsi, F.; Parak, W.; Prosperi, D.
Nat. Commun. **2016**, *7*, 13818

Active targeting of nanoparticles to tumours can be achieved by conjugation with specific antibodies. Specific active targeting of the HER2 receptor is demonstrated *in vitro* and *in vivo* with a subcutaneous MCF-7 breast cancer mouse model with trastuzumab-functionalized gold nanoparticles. The number of attached antibodies per nanoparticle was precisely controlled in a way that each nanoparticle was conjugated with either exactly one or exactly two antibodies. As expected, *in vitro* we found a moderate increase in targeting efficiency of nanoparticles with two instead of just one antibody attached per nanoparticle. However, the *in vivo* data demonstrate that best effect is obtained for nanoparticles with only exactly one antibody. There is indication that this is based on a size-related effect. These results highlight the importance of precisely controlling the ligand density on the nanoparticle surface for optimizing active targeting, and that less antibodies can exhibit more effect.

The Soft Matter Nanotechnology Lab in collaboration with CNRS, report on the rationalization of catalyst design through the understanding of the relationship between the location of nanoparticles in an organic matrix and their catalytic activity.



Precise Localization of Metal Nanoparticles in Dendrimer Nanosnakes or Inner Periphery and Consequences in Catalysis

Liu, X.; Gregurec, D.; Irigoyen, J.; Martinez, A.; Moya, S.; Ciganda, R.; Hermange, P.; Ruiz, J.; Astruc, D.

Nat. Commun. **2016**, *7*, 13152

Understanding the relationship between the location of nanoparticles (NPs) in an organic matrix and their catalytic performances is essential for catalyst design. Here we show that catalytic activities of Au, Ag and CuNPs stabilized by dendrimers using coordination to intradendritic triazoles, galvanic replacement or stabilization outside dendrimers strongly depends on their location. AgNPs are found at the inner click dendrimer periphery, whereas CuNPs and AuNPs are encapsulated in click dendrimer nanosnakes. AuNPs and AgNPs formed by galvanic replacement are larger than precursors and only partly encapsulated. AuNPs are all the better 4-nitrophenol reduction catalysts as they are less sterically inhibited by the dendrimer interior, whereas on the contrary CuNPs are all the better alkyne azide cycloaddition catalysts as they are better protected from aerobic oxidation inside dendrimers. This work highlights the role of the location in macromolecules on the catalytic efficiency of metal nanoparticles and rationalizes optimization in catalyst engineering.

The Carbon Bionanotechnology Lab together with researchers from Trieste, have demonstrated that graphene-based retain unaltered neuronal signaling properties and are suitable for carbon-based neural prosthetic devices.

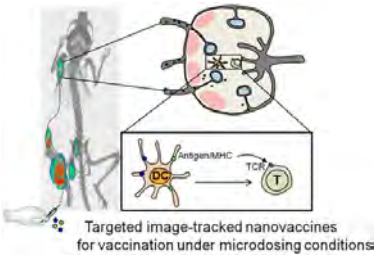
Graphene-Based Interfaces Do Not Alter Target Nerve Cells

Fabbro, A.; Scaini, D.; León, V.; Vázquez, E.; Cellot, G.; Privitera, G.; Lombardi, L.; Torrisi, F.; Tomarchio, F.; Bonaccorso, F.; Bosi, S.; Ferrari, A. C.; Ballerini, L.; Prato, M.

ACS Nano ***2016****, 10,* 615–623

Neural-interfaces rely on the ability of electrodes to transduce stimuli into electrical patterns delivered to the brain. In addition to sensitivity to the stimuli, stability in the operating conditions and efficient charge transfer to neurons, the electrodes should not alter the physiological properties of the target tissue. Graphene is emerging as a promising material for neuro-interfacing applications, given its outstanding physico-chemical properties. Here, we use graphene-based substrates (GBSs) to interface neuronal growth. We test our GBSs on brain cell cultures by measuring functional and synaptic integrity of the emerging neuronal networks. We show that GBSs are permissive interfaces, even when uncoated by cell adhesion layers, retaining unaltered neuronal signaling properties, thus being suitable for carbon-based neural prosthetic devices.

The Theranostic Nanomedicine and the Radiochemistry and Nuclear Imaging laboratories, report on the development and evaluation of a NP vaccine based on iron oxide-selective radio-gallium labeling suitable for SPECT/PET imaging



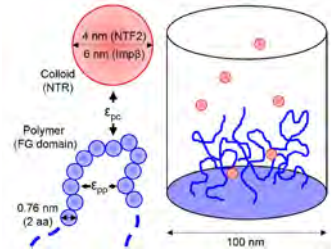
Microdosed Lipid-Coated ^{67}Ga-Magnetite Enhances Antigen-Specific Immunity by Image Tracked Delivery of Antigen and CpG to Lymph Nodes

Ruiz-de-Angulo, A.; Zabaleta, A.; Gomez-Vallejo, V.; Llop, J.; Mareque-Rivas, J. C.

ACS Nano **2016**, *10*, 1602–1618

Development of vaccines to prevent and treat emerging new pathogens and re-emerging infections and cancer remains a major challenge. An attractive approach is to build the vaccine upon a biocompatible NP that simultaneously acts as accurate delivery vehicle and radiotracer for PET/SPECT imaging for ultrasensitive and quantitative *in vivo* imaging of NP delivery to target tissues/organs. Success in developing these nanovaccines will depend in part on having a "correct" NP size and accommodating and suitably displaying antigen and/or adjuvants (*e.g.*, TLR agonists). Here we develop and evaluate a NP vaccine based on iron oxide-selective radio-gallium labeling suitable for SPECT(^{67}Ga)/PET(^{68}Ga) imaging and efficient delivery of antigen (OVA) and TLR 9 agonists (CpGs) using lipid-coated magnetite micelles. OVA, CpGs and rhodamine are easily accommodated in the hybrid micelles, and the average size of the construct can be controlled to be *ca*. 40 nm in diameter to target direct lymphatic delivery of the vaccine cargo to antigen presenting cells (APCs) in the lymph nodes (LNs). The results suggest that these nanosystems have considerable potential for image-guided development of targeted vaccines that are more effective and limit toxicity.

The Biosurfaces Lab in collaboration with UCL researchers conclude that a simple polymer-physics model may be sufficient to describe how the nucleus in each of our cells selectively allows the entrance and exit of certain molecules, while blocking others to protect genetic material and normal functions of the cell.



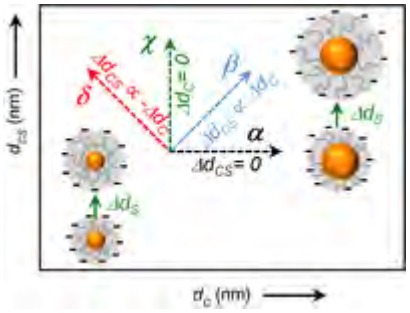
A Physical Model Describing the Interaction of Nuclear Transport Receptors with FG Nucleoporin Domain Assemblies

Zahn, R.; Osmanović, D.; Ehret, S.; Araya Callis, C.; Frey, S.; Stewart, M.; You, C.; Görlich, D.; Hoogenboom, B. W.; Richter, R. P.

eLife **2016**, *5*, e14119

The permeability barrier of nuclear pore complexes (NPCs) controls bulk nucleocytoplasmic exchange. It consists of nucleoporin domains rich in phenylalanine-glycine motifs (FG domains). As a bottom-up nanoscale model for the permeability barrier, we have used planar films produced with three different end-grafted FG domains, and quantitatively analyzed the binding of two different nuclear transport receptors (NTRs), NTF2 and Importin β, together with the concomitant film thickness changes. NTR binding caused only moderate changes in film thickness; the binding isotherms showed negative cooperativity and could all be mapped onto a single master curve. This universal NTR binding behavior – a key element for the transport selectivity of the NPC – was quantitatively reproduced by a physical model that treats FG domains as regular, flexible polymers, and NTRs as spherical colloids with a homogeneous surface, ignoring the detailed arrangement of interaction sites along FG domains and on the NTR surface. The success of this model implies that the basic mechanism underlying selective transport into and out of the cell nucleus could well be explained based on generic physical principles.

The Bioengineered Nanoparticles Lab publish a study on the physicochemical Properties of coated nanoparticles that determine their interaction with cells



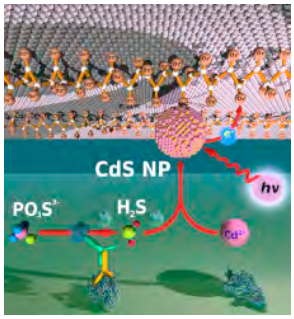
Basic Physicochemical Properties of Polyethylene Glycol Coated Gold Nanoparticles that Determine Their Interaction with Cells

del Pino, P.; Yang, F.; Pelaz, B.; Zhang, Q.; Kantner, K.; Hartmann, R.; Martinez de Baroja, N.; Gallego, M.; Moller, M.; Manshian, B. B.; Soenen, S.; Riedel, R.; Hampp, N.; Parak, W.

Angew. Chem. Int. Ed. **2016**, *55*, 5483–5487

A homologous nanoparticle library was synthesized in which gold nanoparticles were coated with polyethylene glycol, whereby the diameter of the gold cores, as well as the thickness of the shell of polyethylene glycol, was varied. Basic physicochemical parameters of this two-dimensional nanoparticle library, such as size, ζ-potential, hydrophilicity, elasticity, and catalytic activity, were determined. Cell uptake of selected nanoparticles with equal size yet varying thickness of the polymer shell and their effect on basic structural and functional cell parameters was determined. Data indicates that thinner, more hydrophilic coatings, combined with the partial functionalization with quaternary ammonium cations, result in a more efficient uptake, which relates to significant effects on structural and functional cell parameters.

The Biosensing laboratory report on the development of an innovative photoelectrochemical process (PEC) based on graphite electrode device for biosensing



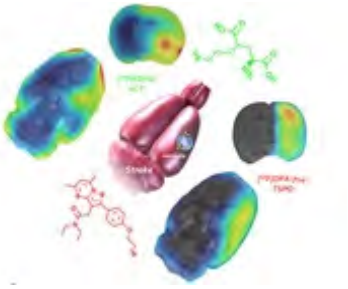
Photoelectrochemical detection of enzymatically generated CdS nanoparticles: Application to development of immunoassay

Barroso, J.; Saa, L.; Grinyte, R.; Pavlov, V.

Biosens. Bioelectron. **2016**, *77*, 323–329

We report an innovative photoelectrochemical process (PEC) based on graphite electrode modified with electroactive polyvinylpyridine bearing osmium complex (Os–PVP). The system relies on the in situ enzymatic generation of CdS quantum dots (QDs). Alkaline phosphatase (ALP) catalyzes the hydrolisis of sodium thiophosphate (TP) to hydrogen sulfide (H_2S) which in the presence Cd^{2+} ions yields CdS semiconductor nanoparticles (SNPs). Irradiation of SNPs with the standard laboratory UV-illuminator (wavelength of 365 nm) results in photooxidation of 1-thioglycerol (TG) mediated by Os–PVP complex on the surface of graphite electrode at applied potential of 0.31 V vs. Ag/AgCl. A novel immunoassay based on specific enzyme linked immunosorbent assay (ELISA) combined with the PEC methodology was developed. Having selected the affinity interaction between bovine serum albumine (BSA) with anti-BSA antibody (AB) as a model system, we built the PEC immunoassay for AB. The new assay displays a linear range up to 20 ng mL^{-1} and a detection limit (DL) of 2 ng mL^{-1} (S/N=3) which is lower 5 times that of the traditional chromogenic ELISA test employing p-nitro-phenyl phosphate (pNPP).

The Experimental Molecular Imaging and Radiochemistry and Nuclear Imaging Laboratories led by Dr. Abraham Martín and Dr. Jordi Llop in collaboration with the group of Prof. Carlos Matute and Dr. Maria Domercq at Achucarro Basque Center for Neuroscience, UPV/EHU have reported the identification of a novel therapeutic target that contributes to the inflammatory process underlying stroke



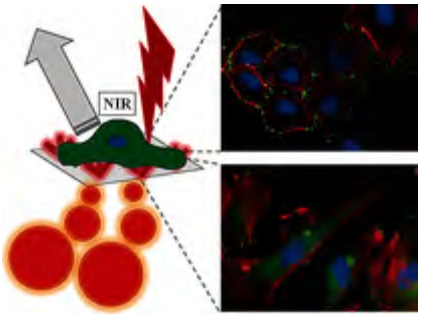
PET Imaging with [18F]FSPG Evidences the Role of System xc- on Brain Inflammation Following Cerebral Ischemia in Rats

Domercq M, Szczupak B, Gejo J, Gómez-Vallejo V, Padro D, Gona KB, Dollé F, Higuchi M, Matute C, Llop J, Martín A.

Theranostics **2016**, *11*, 1753-67

The ischemic stroke is considered one of the major causes of death and permanent disability in industrialized countries. The brain ischemia is produced as a consequence of a transient or permanent decrease of the cerebral blood flow that alters the level of the neurotransmitter glutamate after stroke, leading to irreversible neuronal damage. In addition, inflammation exacerbates neuronal loss preventing recovery in the acute phase of the ischemic episode. Recently, the same team of researchers reported the role played by the exchanger cystine/glutamate (System xc-) in the alteration of the glutamate levels that triggers neuronal damage after stroke. The present research evidences the role of this system during brain inflammation following ischemic stroke, thereby identifying a novel target for the theranostics of neuroinflammation.

The Bionanoplasmonics Lab propose the use of plasmonic substrates for cell growth and controlled detachment using remote near-IR irradiation, as a general method for cell culture in biomedical applications



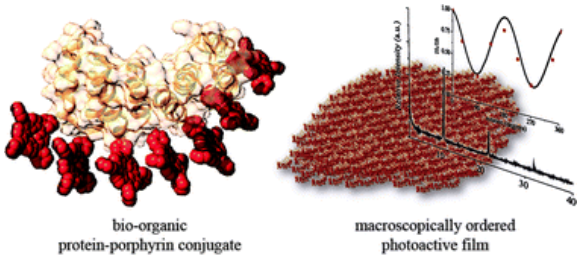
Plasmonic surfaces for cell growth and retrieval triggered by near-infrared light

Giner-Casares, J. J.; Henriksen-Lacey, M.; Garcia, I.; Liz-Marzan, L. M.

Angew. Chem. Int. Ed. **2016**, *55*, 974–978

Methods for efficient detachment of cells avoiding damage are required in tissue engineering and regenerative medicine. We introduce a bottom–up approach to build plasmonic substrates using micellar block copolymer nanolithography to generate a 2D array of Au seeds, followed by chemical growth leading to anisotropic nanoparticles. The resulting plasmonic substrates show a broad plasmon band covering a wide part of the visible and near-infrared (NIR) spectral ranges. Both human and murine cells were successfully grown on the substrates. A simple functionalization step of the plasmonic substrates with the cyclic arginylglycylaspartic acid (c-RGD) peptide allowed us to tune the morphology of integrin-rich human umbilical vein endothelial cells (HUVEC). Subsequent irradiation with a NIR laser led to highly efficient detachment of the cells with cell viability confirmed using the MTT assay. We thus propose the use of such plasmonic substrates for cell growth and controlled detachment using remote near-IR irradiation, as a general method for cell culture in biomedical applications.

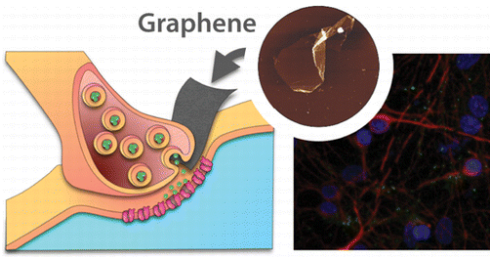
The Biomolecular Nanotechnology Lab in collaboration with researchers from the Universidad Complutense de Madrid and IMDEA, use a designed repeat protein scaffold to control the arrangement of photo- and electroactive molecules



Repeat Protein Scaffolds: Ordering Photo- and Electroactive Molecules in Solution and Solid State
Mejías, S. H.; López-Andarias, J.; Sakurai, T.; Yoneda, S.; Erazo, K. P.; Seki, S.; Atienza, C.; Martín, N.; Cortajarena, A. L.
Chem. Sci. **2016**, *7*, 4842–4847

The precise control over the organization of photoactive components at the nanoscale is one of the main challenges for the generation of new and sophisticated macroscopically ordered materials with enhanced properties. In this work we present a novel bioinspired approach using protein-based building blocks for the arrangement of photo- and electroactive porphyrin derivatives. We used a designed repeat protein scaffold with demonstrated unique features that allow for the control of their structure, functionality, and assembly. Our designed domains act as exact biomolecular templates to organize porphyrin molecules at the required distance. The hybrid conjugates retain the structure and assembly properties of the protein scaffold and display the spectroscopic features of orderly aggregated porphyrins along the protein structure. Finally, we achieved a solid ordered bio-organic hybrid thin film with anisotropic photoconductivity.

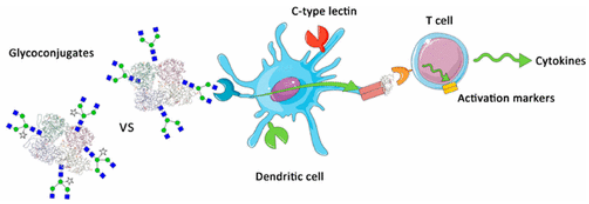
The Carbon Bionanotechnology Lab in collaboration with the Universities of Castilla la Mancha and Trieste, describe the ability of graphene oxide nanosheets to down-regulate neuronal signaling without affecting cell viability



Graphene Oxide Nanosheets Reshape Synaptic Function in Cultured Brain Networks
Rauti, R.; Lozano, N.; Leon, V.; Scaini, D.; Musto, M.; Rago, I.; Severino, F. P. U.; Fabbro, A.; Casalis, L.; Vazquez, E.; Kostarelos, K.; Prato, M; Ballerini, L.
ACS Nano **2016**, *10*, 4459–4471

Graphene offers promising advantages for biomedical applications. However, adoption of graphene technology in biomedicine also poses important challenges in terms of understanding cell responses, cellular uptake, or the intracellular fate of soluble graphene derivatives. In the biological microenvironment, graphene nanosheets might interact with exposed cellular and subcellular structures, resulting in unexpected regulation of sophisticated biological signaling. More broadly, biomedical devices based on the design of these 2D planar nanostructures for interventions in the central nervous system require an accurate understanding of their interactions with the neuronal milieu. Here, we describe the ability of graphene oxide nanosheets to down-regulate neuronal signaling without affecting cell viability.

The Glycotecnolgy laboratory in collaboration with the Universities of Hannover and Berlin demonstrate that small structural glycan modifications influence C-type lectin receptors (CLRs) recognition



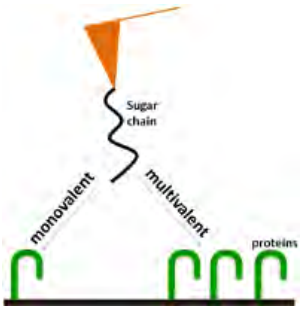
Influence of Core β-1,2-Xylosylation on Glycoprotein Recognition by Murine C-type Lectin Receptors and Its Impact on Dendritic Cell Targeting

Brzezicka, K.; Vogel, U.; Serna, S.; Johannssen, T.; Lepenies, B.; Reichardt, N.-C.

ACS Chem. Biol., **2016**, *11*, 2347–2356

Targeting antigens to dendritic cell subsets is a promising strategy to enhance the efficacy of vaccines. C-type lectin receptors (CLRs) expressed by dendritic cells are particularly attractive candidates since CLR engagement may promote cell uptake and may further stimulate antigen presentation and subsequent T cell activation. While most previous approaches have involved antibody-mediated CLR-targeting, glycan-based CLR targeting has become more and more attractive in recent years. In the present study, we show that small structural glycan modifications may markedly influence CLR recognition, dendritic cell targeting, and subsequent T cell activation. A biantennary N-glycan (G0) and its analogous O-2 core xylosylated N-glycan (XG0) were synthesized, covalently conjugated to the model antigen ovalbumin, and analyzed for binding to a set of murine CLR-Fc fusion proteins using lectin microarray. To evaluate whether the differential binding of G0 and XG0 to CLRs impacted dendritic cell targeting, uptake studies using murine dendritic cells were performed. Finally, effects of the ovalbumin glycoconjugates on T cell activation were measured in a dendritic cell/T cell cocultivation assay.

The Biosurfaces Lab in collaboration with the teams of David Jackson and Mark Howarth at the University of Oxford (UK) have published a method to probe the response of single and multiple bonds between sugars and proteins to mechanical force



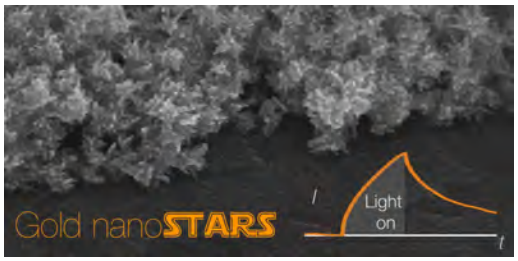
A single molecule assay to probe monovalent and multivalent bonds between hyaluronan and its key leukocyte receptor CD44 under force

Bano, F.; Banerji, S.; Howarth, M.; Jackson, D. G.; Richter, R.

Sci. Rep. **2016**, *6*, 34176

The interactions of specialized extracellular sugars from the glycosaminoglycan (GAG) family with proteins are important for the correct communication of cells with their environment. It is now also well established that mechanical stimuli are important for cellular communication. In this study, Bano et al have devised a method to study how bonds between GAGs and proteins respond to directed mechanical forces. The method exploits purpose-designed surfaces that afford immobilization of GAGs and proteins at controlled nanoscale organizations. It enables the study of individual molecular bonds but also how several bonds act in concert, an aspect that is particularly important for GAGs because these are polymers and thus can bind several proteins simultaneously. The authors applied the method to study the interaction of the GAG hyaluronan (HA) with CD44, a cell surface receptor that is important for the capture of cells by blood vessel walls and subsequent cell traffic into adjacent tissues. The molecular level insights gained should help understanding the regulation of the trafficking of immune cells (in inflammation), stem cells (in tissue repair) and cancer cells (in metastasis).

Researchers from the Bionanoplasmonics and Biosensing groups in collaboration with CIC nano GUNE reported on the photocatalytic regeneration of cofactor molecules using plasmonic particles of different shapes



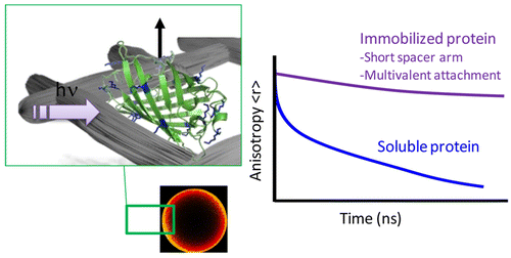
Plasmonic Substrates Comprising Gold Nanostars efficiently regenerate cofactor molecules

Sánchez-Iglesias, A.; Barroso, J.; Solís, D. M.; Taboada, J. M.; Obelleiro, F.; Pavlov, V.; Chuvilin, A.; Grzelczak, M.

J. Mater. Chem. A **2016**, *4*, 7045–7052

The light harvesting capacity of plasmonic nanoparticles is a fundamental feature for catalysing chemical reactions close to their surface. The efficiency of the photochemical processes depends not only on the geometrical aspects on a single particle level but also on the complexity of the multiparticle architectures. Although, the effect of the particle geometry is progressively understood in the relevant photochemical processes (water splitting and hydrogen evolution), there are experimental and theoretical needs for understanding the role of the shape in the multiparticle systems in the photocatalytic processes. Here we have shown that macroscopic plasmonic substrates comprising gold nanostars exhibit better efficiencies than nanorods or cubes in the photoregeneration of cofactor molecules. We performed photochemical and photoelectrochemical measurements, supported by theoretical simulations, showing that the unique geometry of nanostars – radially distributed spikes – contributes to stronger light absorption by the plasmonic film containing that type of nanoparticles.

The Heterogeneous Biocatalysis group in collaboration with researchers from CSIC report a new methodology based on fluorescence anisotropy to measure the mobility of immobilized proteins and how the anisotropy values can predict the thermal stability of the protein attached to solid and porous materials.



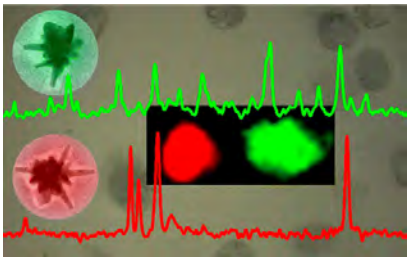
Two-Photon Fluorescence Anisotropy Imaging to Elucidate the Dynamics and the Stability of Immobilized Proteins

Orrego H.A., García C., Mancheño J.M., Guisán J.M., Lillo M.P. and López-Gallego F.J.

J. Phys. Chem. B **2016**, *120*, 485 - 491

Time/spatial-resolved fluorescence determines anisotropy values of supported-fluorescent proteins through different immobilization chemistries, evidencing some of the molecular mechanisms that drive the stabilization of proteins at the interfaces with solid surfaces. Fluorescence anisotropy imaging provides a normalized immobilization parameter that serves as a guide to study the effect of different immobilization parameters (length and flexibility of the spacer arm and multivalency of the protein-support interaction) on the final stability of the supported proteins. Proteins in a more constrained environment correspond to the most thermostable ones as was shown by thermal inactivation studies. This work contributes to explain the experimental evidences found with conventional methods based on observable measurements; thus this advanced characterization technique provides reliable molecular information about the immobilized proteins with sub-micrometer spatial resolution. Such information has been very useful for fabricating highly stable heterogeneous biocatalysts with high interest in industrial developments.

The Bioengineered and Bionanoplasmonics Nanoparticles groups laboratory propose the use of surface enhanced Raman scattering (SERS) nanotags for multiplexes cell discrimination



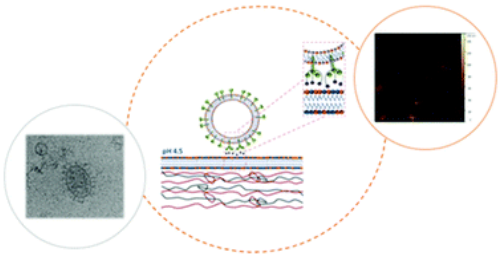
Surface Enhanced Raman Scattering Encoded Gold Nanostars for Multiplexed Cell Discrimination

Jimenez de Aberasturi, D.; Serrano-Montes, A. B.; Langer, J.; Henriksen-Lacey, M.; Parak, W. J.; Liz-Marzan, L. M.

Chem. Mater. **2016**, *28*, 6779–6790

Labeled nanoparticles have attracted much interest toward applications in bioimaging and diagnostics. In particular, surface enhanced Raman scattering (SERS) nanotags have been demonstrated to be excellent candidates for multiplexed imaging and biological detection. We propose an alternative, effective method to easily prepare gold nanostars exhibiting plasmon bands in the near-infrared range, encoded with Raman reporter molecules, concomitantly acting as capping agents which are then protected with an amphiphilic polymer. The resulting nanotags are non-cytotoxic and display long-term stability against aggregation and reporter leakage, while showing reproducible SERS signals suitable for multiplexing. These tags were used to distinguish five different types of breast cancer cells by imaging of a *quintuple* cell co-culture. Time-lapse SERS imaging of the co-culture was additionally performed, demonstrating the applicability of these nanotags for cell tracing over time scales above 24 h.

The Soft Matter Nanotechnology Laboratory reports on the Virosome engineering of colloidal particles and surfaces



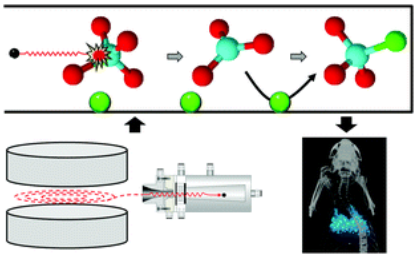
Virosome engineering of colloidal particles and surfaces: bioinspired fusion to supported lipid layers

Fledermann J., Diamanti E., Azinas S., Kosutic M., Dahne L., Estrela-Lopis I., Amacker M.,Donath E. and Moya S.E.

Nanoscale, **2016**, *8*, 7933 - 7941

Immunostimulating reconstituted influenza virosomes (IRIVs) are liposomes with functional viral envelope glycoproteins: influenza virus hemagglutinin (HA) and neuraminidase intercalated in the phospholipid bilayer. IRIVs are virus like nanoparticles similar to influenza virus envelopes but lacking any viral genetic material. The Soft Matter Nanotechnology Laboratory discovered that it is possible to fuse influenza virosomes on supported lipid membranes, both assembled on colloidal particles and planar surfaces. The fusion of the influenza virosomes is triggered by low pH, as occurring with influenza virus. IRIVs are fused to artificial supported lipid membranes assembled on polyelectrolyte multilayers assembled by means of the Layer by Layer technique. IRIVs were found to display a pH-dependent fusion mechanism, fusing at low pH, around 4, again in analogy to the influenza virus. Atomic Force Microscopy imaging shows that at low pH virosomes are integrated in the supported membrane displaying a reduced vertical thickness when they are fused at pH 4. Virosome fusion on supported membranes offers a novel strategy for the functionalization of supported membranes that can be used for the design of complex colloidal systems which can have applications in drug delivery or sensing devices.

The Radiochemistry and Nuclear Imaging laboratory and Platform describe a straightforward synthesis of F-18 radiofluorinated gas for the determination of regional lung ventilation



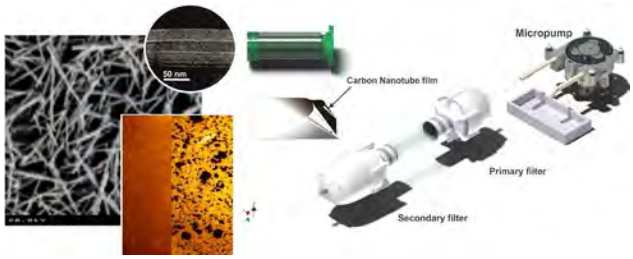
Ion Beam Induced F-18-Radiofluorination: Straightforward Synthesis of Gaseous Radiotracers for the Assessment of Regional Lung Ventilation Using Positron Emission Tomography

Gomez-Vallejo, V.; Lekuona, A.; Baz, Z.; Szczupak, B.; Cossio, U.; Llop, J.

Chem. Commun. **2016**, *52*, 11931–11934

A simple, straightforward and efficient method for the synthesis of $[^{18}F]CF_4$ and $[^{18}F]SF_6$ based on an ion beam-induced isotopic exchange reaction is presented. Positron emission tomography ventilation studies in rodents using $[^{18}F]CF_4$ showed a uniform distribution of the radiofluorinated gas within the lungs and rapid elimination after discontinuation of the administration.

The Surface Analysis and Fabrication platform at CIC biomaGUNE in collaboration with researchers from the Pontificia Universidad Javeriana (Colombia) and the NanoBioMedical Centre (Poland) report on the development of a pretreatment system to assist surface plasmon sensor-based measurements of arsenic in water with accurate detection.



Nanostructured and selective filter to improve detection of arsenic on surface plasmon nanosensors

Reyes, Y.C., Coy, L.E., Yate, L., Jurga, S., and González, E.E.

ACS Sensors, **2016**, 1, 725-731

In this work, the development of a pretreatment system to assist in-situ surface plasmon sensor-based measurement of arsenic in water is described. The system uses a primary filter made of non-activated cotton fibers for particulate matter and chemical retention agents and a secondary filter for retention of mercury, lead, and other heavy metals without alteration of the arsenic concentration in the collected water samples to be sensed. This secondary filter was made with amino-functionalized carbon nanotubes. The results of the operational assessment of this filter show a retention efficiency of 98% for suspended solids, 96% for mercury ions, and 2% for arsenic, a remarkable improvement toward the accurate detection and quantification of arsenic in contaminated waters.

Training Activities

The training activities of CIC biomaGUNE during 2016 can be summarized as follows: **34** seminars, received **105** research internships, organized more than **42** guided tours and **2** scientific workshops/events.

SEMINARS

CIC biomaGUNE runs a strong annual program of scientific seminars, which are delivered by internationally recognized local and foreign researchers, which contributes to the permanent education of its researchers and the scientific community. During 2016, **34** seminars were delivered.

26/01/2016
Understanding Language in the Brain: from the lab to the actual world
Prof. Manuel Carreiras – BCBL-Basque Center on Cognition, Brain and Language, Donostia-San Sebastián

09/02/2016
Gold Nanostars: Synthesis, Stabilization and Applications as Surface-enhanced Raman Scattering Tags
Ana Belén Serrano Montes – CIC biomaGUNE

09/02/2016
Rational Synthesis and Self-Assembly of Anisotropic Plasmonic Nanoparticles
Leonardo Scarabelli – CIC biomaGUNE

12/02/2016
Self-assembling Cyclic Peptide Nanotubes: Modulation of Internal and External Properties
Prof. Juan R. Granja – Center for Research in Biological Chemistry and Molecular Materials (CIQUS)

16/02/2016
Engineering the Morphology and Organization of Gold Nanostructures for SERS Detection
Andrea La Porta – CIC biomaGUNE

16/02/2016
Biosensing using metal nanoparticles
Marc Coronado – CIC biomaGUNE

23/02/2016
Hybrid organic-inorganic materials for optoelectronic devices
Dr. Rubén D. Costa – Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)

04/03/2016
Plasmonic Substrates for Biosensing and Nanomedicine
Dr. Roberto de la Rica – University of Strathclyde

10/03/2016
Exploring new frontiers, role of tumor-secreted exosomes in metastasis
Dr. Héctor Peinado Selgas – Spanish National Cancer Research Centre (CNIO), Madrid

11/03/2016
Design, Physico- Chemical Characterization and Bioactivity Studies of Hybrid Nanostructured Titanium Surfaces for Enhanced Osseointegration
Danijela Gregurec – CIC biomaGUNE

TRAINING ACTIVITIES – SEMINARS

18/03/2016
Biomaterial physical properties in tissue regeneration and disease
Dr. Amaia Cipitria – Charité - Universitätsmedizin Berlin

13/04/2016
Imaging Degradation
Prof. Sander Van Kasteren – Leiden Institute of Chemistry

15/04/2016
The Fight against Scientific Misconduct: Research Integrity and Good Scientific Practices
Prof. Pilar Goya – Instituto de Química Médica, CSIC, Madrid

18/04/2016
Synthesis of Functional Materials by Atomic Layer Deposition
Dr. Mato Knez – CIC nanoGUNE, San Sebastián, Spain

19/04/2016
Scientific Publishing From the Inside Out
Dr. Phillip Szuromi – Science Senior Editor, Knoxville, Tennessee, USA

28/04/2016
Microscopic dynamics of proteins: from energylandscapes to enzyme engineering
Dr. David De Sancho – CIC nanoGUNE, San Sebastián, Spain

13/05/2016
Towards Near-Infrared Photoactivation of Anticancer Metal Complexes
Emmanuel Ruggiero – CIC biomaGUNE, San Sebastián, Spain

18/05/2016
Exosomes: metabolic nano-machines encoding complex signals
Dr. Juan Manuel Falcón – CIC bioGUNE, San Sebastián, Spain

19/05/2016
NMR chemosensing with self-organized nanoparticle-based receptors
Dr. Fabrizio Mancin – Università di Padova, Italia

30/05/2016
Five dimensional optoacoustic imaging of small animals, humans and individual particles
Dr. Xosé Luis Deán Ben – Helmholtz Zentrum München - German Research Center for Environmental Health

03/06/2016
Chemonezymatic synthesis and immunological studies of xylosylated n-glycans
Katarzyna Brzezicka – CIC biomaGUNE, San Sebastián, Spain

10/06/2016
Artificial protein engineering for multimodal plasmonic colloid morphosynthesis and self-assembly
Prof. Erik Dujardin – CEMES, CNRS, Toulouse, France

TRAINING ACTIVITIES – SEMINARS

21/06/2016
In vivo imaging in (radio)pharmaceutical research: advantages and pitfalls
Sebastian Eigner – Charles University in Prague (Czech Republic)

22/06/2016
Designs for novel protein-based materials and supramolecular assemblies
Dr. Lynne Regan– Yale University, New Haven, USA

01/07/2016
Some Surprises and Open Questions in Soft and Particulate Matter
Prof. Steve Granik – IBS Center for Soft and Living Matter, South Korea

08/07/2016
Novel (Coordination) Polymer Nanoparticles for Advanced Theranostics
Dr. Daniel Ruiz-Molina – Catalan Institute of Nanoscience and Nanotechnology (ICN2), Barcelona

15/07/2016
Design of patchy polymers: biomimetic self-knotting chains
Dr. Ivan Coluzza – University of Vienna, Austria

19/07/2016
Physical principles underlying structure, mechanics and dynamic reorganization of hyaluronan-rich matrices — from tissues to supramolecular models in experiment and theory
Xinyue Chen – CIC biomaGUNE, San Sebastián, Spain

15/09/2016
Multiplexed PET: Towards simultaneous dual tracer PET imaging
Dr. Eduardo Lage – Instituto de Investigaciones Biomédicas "Alberto Sols" CSIC, UAM, Madrid

22/09/2016
Monodisperse particles used as building blocks to control 3D location of materials in functional devices
Prof. Daisuke Nagao – Tohoku University, Japan

06/10/2016
Strangely shaped plasmonic nanoparticles: stars and sponges
Prof. Thomas A. Klar– Johannes-Kepler-Universität Linz, Austria

03/11/2016
Targeted Polymeric Nanoparticles: Radiolabelling with Ga-67 and in vivo Evaluation in a Mouse Model of Pancreatic Adenocarcinoma using Single Photon Emission Computerized Tomography
Larraitz Gil Iceta – CIC biomaGUNE, San Sebastián, Spain

16/12/2016
Engineered Interfaces with Polyelectrolyte Multilayers, Lipid Bilayer Membranes and Virosomes for Biomedical Applications
Eleftheria Diamanti – CIC biomaGUNE, San Sebastián, Spain

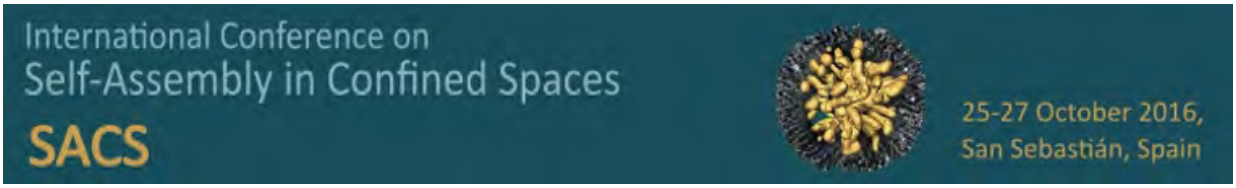
15/12/2016
Christmas Lecture: *Nanomedicine Chemistry and Nanotechnology: Synergies for a Better World*
Prof. Maurizio Prato –CIC biomaGUNE, San Sebastián, Spain

TRAINING ACTIVITIES – SCIENTIFIC EVENTS

SCIENTIFIC WORKSHOPS/CONFERENCES/EVENTS

Self-assembly in confined spaces - SACS16

The International Conference on Self-Assembly in Confined Spaces (SACS16), organized by the laboratory of Bionanoplasmonics at CIC biomaGUNE, took place between the 25th and 27th of October 2016 at the Miramar Royal Palace of San Sebastián. The meeting brought together some of the most active and recognized chemists, physicists, theoreticians, engineers, and biomedical researchers to discuss the use of self-assembly as a tool to design, organize and provide special functions to nanomaterials. The program covered the fields of molecular and nanoparticle Self-Assembly, interfacial properties, biomedical applications of self-assembled systems and advanced characterization techniques. The conference was attended by more than 120 researchers. During three days, 16 prominent scientists delivered plenary talks and selected researchers provided 18 contributed talks and 75 poster presentations.

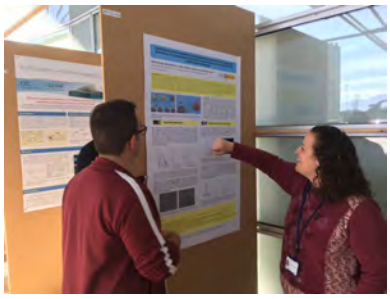


TRAINING ACTIVITIES – SCIENTIFIC EVENTS

CIC biomaGUNE 10th Anniversary

On the 2nd of December 2016 CIC biomaGUNE celebrated its 10th anniversary with a 1-day scientific seminar, which included four scientific talks, a poster session and a lunch that gathered together all CIC biomaGUNE employees. After the initial welcome speeches given by Jose María Mato and Luis Liz-Marzán General and Scientific Directors of CIC biomaGUNE, respectively, Professor Soledad Penadés, head of the Glyconanotechnology Lab at CIC biomaGUNE during 2006-2016, spoke about the work carried out by her group during the last ten years.

Prof. Penadés was followed by Professor Helmuth Möhwald from the Max-Planck Institute of Colloids and Interfaces (Golm, Germany), whose lecture was centered on functional films and capsules for biomedical applications. Prof. Möhwald is a member of the CIC biomaGUNE International Scientific Advisory Board. Dr. Juan C. Mareque-Rivas (CIC biomaGUNE) focused his intervention on the potentially perfect partnership between molecular imaging, nanoparticles and the immune system for cancer immunotherapy. Finally, Prof. Jesús María Ruiz-Cabello, Senior Researcher at the Spanish National Centre for Cardiovascular Research (CNIC, Madrid), gave a talk on new horizons in cardiovascular and pulmonary molecular and cellular imaging.



TRAINING ACTIVITIES

PHD PROGRAMMES

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**, CIC biomaGUNE participates in the following PhD programme:

- PhD in Colloid and Interface Science and Technology

JOINT PHD PROGRAM

Since 2016 CIC biomaGUNE is running a program of co-supervised PhD theses, in collaboration with other research institutions in the Basque Country:

TRAINING ACTIVITIES

- **POLYMAT**
  3D structures based on carbon materials and conductive polymers for electroresponsive cell cultures
  The project is jointly supervised by Maurizio Prato (CIC biomaGUNE) and David Mecerreyes (POLYMAT)

- **TECNALIA**
  Enzymatic Modulation of the morphology of nanoparticles and its application to biosensors
  The project is jointly supervised by Valery Pavlov (CIC biomaGUNE) and Nerea Briz (TECNALIA)

- **IIS BioCruces**
  Natural killer (NK) cells and cancer: development of new methods based on nanotechnology to increase the efficacy of anti-tumor inmunotherapy
  The project is jointly supervised by Juan Mareque (CIC biomaGUNE) and Francisco Borrego Rabasco (BioCruces).

- **IIS BIODONOSTIA**
  NMR Characterization of demielinization and remielinization processes in different in vivo and in vitro models
  The project is jointly supervised by Pedro Ramos (CIC biomaGUNE) and David Otaegui (BIODONOSTIA).

- **CIC bioGUNE**
  Glycoengineered Exosomes as Vehicles for Gene and Drug Delivery
  The project is jointly supervised by Niels Reichardt (CIC biomaGUNE) and Juan Falcón (CIC bioGUNE).

- **CIDETEC**
  Radiolabelling and preclinical evaluation of NPs as drug delivery systems: Application to infectious pulmonary diseases
  The project is jointly supervised by Jordi Llop (CIC biomaGUNE) and Iraida Loinaz (CIDETEC).

  Nanoemulsions as drug carriers: preclinical evaluation of pulmonary delivered paclitaxel-loaded nanocapsules
  The project is jointly supervised by Jordi Llop (CIC biomaGUNE) and Iraida Loinaz (CIDETEC).

TRAINING ACTIVITIES

INTERNATIONAL GRADUATE SCHOOL PROGRAMMES

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 a 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 Niels Reichardt (CIC biomaGUNE) and Jerry Turnbull (UoL).

- **Development of Plasmonic Hybrid Nano-Systems for Biodetection.** The project is jointly supervised by Luis Liz-Marzán (CIC biomaGUNE) and Mathias Brust (UoL).

- **Supramolecular structure and dynamics of extracellular matrix**. The project is jointly supervised by Ralf Richter (CIC biomaGUNE) and Dave Fernig and Dr. Ed Yates (UoL).

In 2016 a new Joint PhD agreement between **CIC biomaGUNE** and the **University of Manchester (UoM)** has been launched.

- **Metal Nanoparticles for Photoacoustic Imaging** The project is jointly supervised by Luis Liz-Marzán (CIC biomaGUNE) and Kostas Kostarelos (UoM).

TRAINING ACTIVITIES

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 Centre. The undergraduates are mentored and supervised by PhD students or a postdoctoral researchers and receive hands-on-training.

RESEARCH INTERNSHIPS

	2013	2014	2015	2016
Research stays **from** CIC biomaGUNE	14	47	30	**30**
Research stays **to** CIC biomaGUNE	45	67	59	**105**

Outreach

CIC biomaGUNE regularly receives visits from high-school and university students who come to have a closer look at our activity. These visits typically include a lecture about biomaterials in the context of life sciences, an open discussion with CIC biomaGUNE researchers, and a guided visit to six technical facilities/laboratories (Nanoparticle synthesis platform, Confocal microscope, Radiochemistry platform, Molecular Imaging Facility, Scanning Electron Microscope, Atomic Force Microscope). The program of visits is run by Ana Sánchez-Iglesias, Eneko San Sebastián, Daniel Padró and Vanessa López with the support from other Platform Managers as well as PhDs, Postdocs and Principal Investigators.

	2013	2014	2015	2016
Bachelor students visits	2	2	2	**2**
Undergraduate student program	1	2	2	**5**
Talks in schools	1		3	
Vocational Training program	1	3	4	**7**
Erasmus Placements	1	0	1	**7**
Guided visits at Molecular Imaging Facility	53	40	15	**42**
Pint of Science			1	**1**
Urban Zientzia				**1**
CIC Network Journal	2		1	**1**

January 2016. Visit from **2nd year Biosanitary Baccalaurate students from St. Patrick's English School**.

March 2016. Visit from **UPV-EHU Biotechnology - Molecular Biology and Biochemistry students**.

OUTREACH

March 2016. Visit from **SUMMA Aldapeta High School students**.

March 2016. Eneko Goia, **Mayor of San Sebastián**, **visit** CIC biomaGUNE. During the visit, CIC biomaGUNE's General Director, José M. Mato, and the Centre's Scientific Director, Luis M. Liz Marzán, led a tour of the Centre and Molecular Imaging Facility.

October 2016. Visit from **Colegio Inmakulada** (Tolosa, Guipúzcoa) visited the **Radioactive Facility of CIC biomaGUNE.** Hosted by Vanessa Gómez-Vallejo, the future Diagnostic Imaging Technicians were introduced in the research conducted in the Molecular Imaging Facility, with specific emphasis in the investigations developed in the Radiochemistry and Nuclear Imaging Group. The visitors were especially interested in the production of different radiotracers with application in diagnostic imaging and the preparation of radiopharmaceuticals for clinical use.

October 2016. Visit from **pathological anatomy students** from **Instituto Easo** vocational training centre. This visit was in the frame of the **Donostia WeekINN** (Innovation Week).

October 2016. Visit from the **Biomedicine Engineering School (Tecnun-Escuela de Ingenieros)** students of the **University of Navarra**. Hosted by Vanessa Gómez-Vallejo, the future engineers had the opportunity to visit the Molecular Imaging Facility, including the cyclotron, the radiochemistry laboratory and the different imaging areas.

December 2016. Visit from **Arratia BHI high school students** from Igorre.

PINT OF SCIENCE

Dr. Fernando López-Gallego, Ikerbasque Research Fellow, and Susana Carregal, postdoctoral fellow at CIC biomaGUNE, organized the "2016 Donostia-Pint of Science" event. This initiative brings Science to local bars, thereby breaking down the barriers that separate science from society.

During the edition of this year, within the session entitled “The image that heals us”, Pedro Ramos, Ikerbasque Professor at CIC biomaGUNE gave the following talk “**Functional Imaging by Magnetic Resonance: The amazing case of the center of emotional control in the brain of Atlantic salmon”** explaining the basics of MR functional imaging.

OUTREACH

OLATU TALKA – URBAN ZIENTZIA

Several PhDs and postdocs from CIC biomaGUNE (Susana Carregal-Romero, Judith Langer, Malou Henriksen-Lacey, Marta Sanz-Ortiz, Leonardo Scarabelli, María Sanromán) actively participated at the **Olatu Talka Urban Zientzia (Urban Science)** event organized at San Sebastián by giving an interactive talk entitled *"Rincón de la ciencia casera".*

CIC NETWORK

Within outreach activities, CIC biomaGUNE is involved in the production of the CIC NETWORK magazine, the science magazine of the Cooperative Research Centers. To date 16 issues have been published, the most recent one in June 2016.

OUTREACH

NEW CIC biomaGUNE WEBSITE

In 2016 CIC biomaGUNE has renewed its website, completely redesigned with an improved look.

OUTREACH

MEDIA

CIC biomaGUNE is additionally committed to disseminating research results not only to the scientific community but also to the general public. Such efforts are reflected in the table below.

	2013	2014	2015	2016
Impacts in General Media	21	14	82	**82**
Impacts in Institutional Media	4	8	3	**5**
Impacts Information Websites	30	45	75	**63**

Highlighted media appearances:

Date	Headline	Impacts Nº
02/02/2016	Aitziber L. Cortajarena joins CIC biomaGUNE as Ikerbasque Research Professor	**12**
10/02/2016	Three CIC biomaGUNE researchers included in the most cited scientists list elaborated by Thomson Reuters	**4**
10/03/2016	CIC biomaGUNE researchers succeed in efficiently harvesting cells and tissues using Infrared light	**21**
04/04/2016	CIC biomaGUNE joins the Graphene Flagship project to investigate the application of graphene in biomedical implants	**7**
04/05/2016	The access of certain molecules to the cell nucleus is governed by generic physical principles	**11**
15/07/2016	Research on carbon nanotube sponges advances towards spinal reconnection	**24**
08/08/2016	Materials have been designed which enable bacterial communication processes to be observed at very early stages	**11**
28/09/2016	A new system which allows the detection of cocaine at very low concentration levels has been developed	**24**
20/10/2016	The scientific elite in the field of nanotechnology come together in Donostia-San Sebastián at the International Conference on Self-Assembly in Confined Spaces (SACS 2016)	**8**
31/10/2016	Neuroscience applied to spinal cord injuries, new chair from the AXA Research Fund for CIC biomaGUNE	**9**
02/12/2016	10th Anniversary of CIC biomaGUNE	**11**
21/12/2016	CIC biomaGUNE sets up Asparia Glycomics to market its glycan analysis technology for clinical diagnosis	**7**

OUTREACH

The Twitter, Facebook and LinkedIn presence has remained, with an increase of the number of followers/connections to more than 630.

Twitter account (@CICbiomaGUNE): https://twitter.com/CICbiomaGUNE

	2015	2016
Followers	451	**638**
Profile visits	6071	**7433**
Tweet Impressions	61256	**60781**
Mentions	287	**343**

05/04/2016

CIC biomaGUNE joins the Graphene Flagship project to investigate the application of graphene in biomedical implants.


CIC biomaGUNE se suma a una investigación europea sobre las aplicaciones del grafeno

El grupo Graphene Flagship estudia el uso de este material en implantes biomédicos

DONOSTIA - El centro vasco de investigación en biomateriales CIC biomaGUNE se ha incorporado como nuevo miembro del proyecto europeo Graphene Flagship, una de las iniciativas de investigación de mayor envergadura de la Unión Europea, para investigar la aplicación del grafeno en implantes biomédicos de nueva generación.

Según explicó ayer CIC biomaGUNE en un comunicado, el personal investigador del centro en este proyecto será liderado por Maurizio Prato, "uno de los más cualificados expertos del mundo

25/05/2016

Aitziber L. Cortajarena, Ikerbasque Professor and leader of the Biomolecular Nanotechnology group at CIC biomaGUNE, interviewed at Basque TV channel Etb2 in the frame of the Program "Más de 3 millones".

16/06/2016

Research on carbon nanotube sponges advances towards spinal reconnection.


Puerta abierta a la reparación de lesiones medulares

Los científicos del centro donostiarra han identificado un material que favorece la interacción con el tejido nervioso

IGNACIO VILLAMEDREL

Conectar dos trozos de médula rota por un accidente. Algo que a día de hoy es una utopía quizá deje de serlo de aquí a una década gracias a una investigación que está llevando a cabo el Cic Biomagune de Donostia, y que se encuentra en su fase de ensayos clínicos con ratones. Dicho trabajo utiliza esponjas de nanotubos de carbono, un material preparado en laboratorio que consiste en un minúsculo hilo conductor de electricidad, que favorece la interacción con el tejido nervioso, explica el


La salud al alcance de la mano

Investigadores guipuzcoanos muestran sus avances en el ámbito de tratamientos médicos

Una máquina produce fármacos para engañar a los tumores, una camiseta vigila el corazón y con impulsos eléctricos se puede mover una mano

Francisco Servia y Jordi Llop, en un laboratorio del centro donostiarra Biomagune. / MICHELENA

JAVIER GUILLENEA,

Son gratificantes las informaciones sobre estudios científicos que abren las puertas a nuevos tratamientos médicos, pero ansiamos verlos. Todos queremos resultados concretos, pedimos a los investigadores que fabriquen

29/08/2016

The activities of the Radiochemistry Laboratory highlighted at the local press.

24/10/2016

Luis Liz-Marzán, Ikerbasque Professor and leader of the Bionanoplasmonics group at CIC biomaGUNE, interviewed at Onda Vasca Radio, in the frame of the program "Gipuzkoako Kale Nagusia (GKN)".


Entrevista a Luis Liz Marzán en GKN

Descripción de Entrevista a Luis Liz Marzán en GKN


AXA otorga a BiomaGUNE, en San Sebastián, una cátedra permanente de 800.000 euros

El fondo para la investigación de AXA concede a España una dotación de más de diez millones de euros repartidos en 18 proyectos

AXA Research Fund, el fondo para la investigación de AXA GROUP, ha otorgado al **Centro de Investigación Cooperativa en Biomateriales, Biomagune**, en San Sebastián, una cátedra permanente al equipo liderado por el científico Maurizio Prato, cuya dotación alcanza los 800.000 euros y servirá para conocer las aplicaciones prácticas de nuevos materiales, como los nanotubos de carbono y el grafeno, en el ámbito de la neurociencia y las lesiones medulares.

Redacción, 2 noviembre 2016

02/11/2016

Neuroscience applied to spinal cord injuries, new chair from the AXA Research Fund for CIC biomaGUNE.

02/12/2016

CIC biomaGUNE celebrates its 10th Anniversary.


LA VANGUARDIA Vida

CIC biomaGUNE celebra en San Sebastián su décimo aniversario con una jornada científica

El centro vasco de investigación en biomateriales CIC biomaGUNE ha celebrado este viernes su décimo aniversario con una jornada científica en la que ha participado el equipo de 130 personas que desarrollan su actividad en su sede del Parque Científico y Tecnológico de Gipuzkoa, en San Sebastián.

Lo + Visto

SAN SEBASTIÁN, 2 (EUROPA PRESS)

El centro vasco de investigación en biomateriales CIC biomaGUNE ha celebrado este viernes su décimo aniversario con una jornada científica en la que ha participado el equipo de 130 personas que desarrollan su actividad en su sede del Parque Científico y Tecnológico de Gipuzkoa, en San Sebastián.

21/12/2016

CIC biomaGUNE sets up Asparia Glycomics to market its glycan analysis technology for clinical diagnosis.

27/12/2016

Luis Liz-Marzán, Ikerbasque Professor and leader of the Bionanoplasmonics group at CIC biomaGUNE, interviewed at the Galician TV, V Televisión in the frame of the program "Más que contar".

«Más que contar» (parte2-27/12/16)

29/12/2016

Aitziber L. Cortajarena, Ikerbasque Professor and leader of the Biomolecular Nanotechnology group at CIC biomaGUNE, interviewed at Basque Radio EiTb in the frame of the Program "Graffiti".

Research Facilities

CIC biomaGUNE's state-of-the art facilities are depicted in the diagram below. The outer ring facilities are related to the Molecular Imaging Facility while the inner ring facilities refer to CIC biomaGUNE's Technological Platforms.

MOLECULAR IMAGING FACILITY

In October 2015, CIC biomaGUNE and National Center for Cardiovascular Research Carlos III (CNIC) signed an agreement for the joint management of part of its imaging facilities. With this agreement, the Network "**Distributed Biomedical Imaging Network (ReDIB)**" was founded within the ICTS framework "Unique technical scientific infrastructure" promoted by the Spanish Ministry of Economy and Competitiveness.

In 2016 the **ReDIB**, integrated by the Advanced Infrastructure in Translational Imaging (TRIMA) and the Platform for Molecular and Functional Imaging of CIC biomaGUNE, located respectively at the CNIC and CIC biomaGUNE has launched a new website. The web (www.redib.net) is presented as a dynamic site where the user will find all the necessary information about the creation and development of this new Singular Scientific and Technological Infrastructure (ICTS).

The ultimate objective of the distributed ICTS is to offer to the national and international scientific communities the possibility to conduct imaging studies from a multi-modal and fully translational perspective. The new website aims to keep the scientific community informed about the equipment available, the possibilities offered and the different managerial bodies of the ICTS; the website also aims to become the main platform to request access to the infrastructure through an open and competitive process.

www.cicbiomagune.es

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Gipuzkoako Foru Aldundia
ikerbasque Basque Foundation for Science
ciber-bbn
erc
AXA Research Fund