3rd Ed. INTERNATIONAL POSTDOCTORAL PROGRAM

CAMPUS VIDA RESEARCH CENTERS NETWORK

Eligible Research Topics at CiQUS

The *Center for Research in Biological Chemistry and Molecular Materials* (CiQUS) of the University of Santiago de Compostela offers within this 3rd Ed. International Postdoctoral Program the research lines below.

(Note: In order to prepare the research proposal, candidates must select one of the eligible research topics)

Bimetallic catalysis for direct functionalization of hydrocarbons

Supervisor: Martín Fañanás-Mastral

Description: The selective functionalization of hydrocarbons is one of the major challenges in modern synthetic organic chemistry. This project aims at developing novel methodologies based on cooperative bimetallic catalysis that allow for the conversion of hydrocarbons derived from fossil resources into highly valuable compounds. In particular, the candidate will work on the development of enantioselective C-C bond forming reactions and their application in natural product synthesis. A strong background in organometallic catalysis and/or synthetic organic chemistry is highly recommended.

Design and synthesis of novel nanographenes: from molecules to devices

Supervisors: Enrique Guitián, Dolores Pérez and Diego Peña

Description: The candidate will have the opportunity to work in one of the projects currently ongoing in our labs. The first one exploits the chemistry of arynes for the construction of nanographenes and other extended, functional PAHs with application in molecular electronics. A second one, which is developed in tight collaboration with surface physicists, is aimed to study single molecule chemistry and on-surface synthesis, including structurally defined graphene nanoribbons with tailored electronic properties.

Development of novel metamaterials based on self-assembled 2D/3D nanoparticle supercrystals.

Supervisors: Pablo del Pino and Francisco Rivadulla

Description: Supercrystals composed of binary or tertiary mixtures of self-assembled ordered inorganic nanoparticles (NPs), that is, metamaterials, offer new and exciting technological advances with potentially tunable optoelectronic and magnetic properties. These arise from the symmetry-controlled interaction of electronic states among individual NPs by controlling inter-NP spacing/composition and by material processing. In this line, the project proposed focuses on the development of novel NP-based supercrystals having stimuli-tunable magnetotransport properties. To this aim, the groups of Francisco Rivadulla and Pablo del Pino will form an interdisciplinary hub with complementary expertise. The candidate should have sound experience in colloidal chemistry and nanomagnetism.

Development of stimuli-responsive nanocarriers for "smart" drug delivery

Supervisors: Pablo del Pino and Javier Montenegro

Description: The efficient delivery of nanocarriers into the cytoplasmic matrix, circumventing their storage in the phago-lysosome as viruses do, remains largely elusive. In this line, the project proposed focuses on the development of next generation "smart" nanocarriers with two main capabilities: virus-like dynamic intracellular features and remote control by external electromagnetic fields. To this aim, the groups of Javier Montenegro and Pablo del Pino will form an interdisciplinary hub with complementary expertise. The candidate should have sound experience in colloidal/organic chemistry and bionanointeractions.

Enzymatic Nanoreactors

Supervisor: Eduardo Fernández-Megía

Description: Nanometric-sized vesicles encapsulating enzymes or macromolecular catalysts are the focus of great attention for the production of biologically relevant molecules under physiological conditions. However, applications in drug delivery and diagnosis are usually hampered by the low stability of vesicles or a poor membrane permeability (required for diffusion of reagents and products). With the aim of accomplishing these goals, we propose the use of dendritic polymers that thanks to a rigid multivalent structure are designed to facilitate the encapsulation of macromolecular structures within vesicles of superior stability. The candidate should have experience on organic/polymer synthesis and the evaluation of nanostructures for drug delivery/diagnostic applications.

External stimuli self-sorting in amphiphilic supramolecular aggregates

Supervisors: Luis García-Rio

Description: Exchange of solubilized species in micelles/vesicles between the inner core/palisade layer and the Stern layer usually do not occur, but in the case of sulfonatocalixarenes based micelles the guest can, in principle, exchange between the cavity and the other solubilisation sites (Chem. Eur. J. 2016, 22, 6466-6470). This particular property allows the study of molecular recognition and self-sorting events within the micellar aggregates where local concentrations can be exceptionally high, and the active species are compartmentalized in specific locations.

Functionalization of molecule magnets for the integration into carbon nanostructures

Supervisors: Maria Giménez López, Miguel Vázquez López and M. Eugenio Vázquez Sentís

Description: Next-generation spintronic devices will be based on molecule magnets. The key challenge is the coupling of these functional nanoscale units to the macroscopic world, which is essential for read and write purposes. Carbon nanotubes can provide an excellent means to achieve this coupling. The goal of this project is to explore the functionalization of molecule magnets enabling the integration into carbon nanostructures with peptide mediators. The candidate will be working in a dynamic environment within the NANOCOMP ERC Starting Grant framework. Experience in inorganic and organic synthesis and knowledge in molecular magnetism will be highly desirable.

Helical Polymers: Sensors and nanostructures

Supervisors: Ricardo Riguera, Emilio Quiñoá and Félix Freire

Description: The target goal of this interdisciplinary research is the design, synthesis and evaluation of smart polymers and nanostructures with stimuli-responsive properties. More precisely: the generation of size- and helically-controlled nanostructures from helical polymers and their applications for reversible chiral recognition; Asymmetric catalysis and processes related to their helicity such as optical sensors. Required experience: Organic and supramolecular chemistry, asymmetric synthesis and catalysis, smart polymers, nanoaggregates and solid state techniques.

Metal catalysis in synthesis and in chemical Biology

Supervisors: José Luis Mascareñas

Description: The candidate could work in interdisciplinary projects at the frontier between coordination and organometallic chemistry and catalysis, or in projects with a higher focus in chemical biology (see metbiocat.eu). In particular we aim at discovering and developing new catalytic transformations of synthetic potential, as well as discover new synthetic probes and catalytic methods for cellular and biological intervention. The candidate should have either a strong experience in synthesis and organometallic chemistry or multidisciplinary knowledge in chemistry and biology.

Nanotechnology for the protection of cultural heritage

Supervisors: Massimo Lazzari and Francisco Rivadulla

Description: Development of 3D nanostructured Surface-Enhanced Raman Scattering spectroscopy (SERS)-active substrates with modulable surface polarity for the detection of art materials and degradation products. Professors Rivadulla (former ERC-Starting Grant and actually ERC-Proof of Concept "ANTS" grant holder) and Lazzari (European Commission projects holder) will promote this interdisciplinary research line. Self-reliance of the candidate is strongly encouraged.

Organometallic Catalysis: Design, Synthesis and Catalytic Applications

Supervisors: Carlos Saá and Jesús Varela

Description: Our research is devoted to the discover of new catalytic reactions for the synthetic application to bioactive/pharmacological drugs and advanced organic materials. The candidate will work on the design, preparation and development of highly efficient organometallic catalysts for exploring applied synthetic chemistry (C-H activation, electrophilic and nucleophilic carbenes/vinyl carbenes, etc.). A strong knowledge in synthesis, manipulation and structural determination of organometallic complexes is highly recommended.

Supramolecular and microfluidic chemistry

Supervisors: Juan Granja and Javier Montenegro

Description: Supramolecular polimerization processes inside confined spaces might bring new insights about shape regulation machinery. There is a clear demand of new simple and functional materials that could mimic the hierarchical self-assembly of the natural cytoskeleton. At this respect the manipulation of fluids in channels with micrometric dimensions — microfluidics — has emerged as a distinct new field that allows the preparation of vesicles with high reproducibility and fine-tuned control over size, shape, and hierarchical structure. This project will be carried out within the framework of the HFSP and Spanish government grants.

Santiago de Compostela, October 20th, 2017