NPL PROJECTS FOR THE CFM-PHD RECRUITMENT FAIR 2021

The Center for Materials Physics (CFM) in Donostia / San Sebastián (the Basque Country, Spain) is currently seeking for bright, highly motivated PhD candidates. All details about the call can be found at https://cfm.ehu.es/education/phd-recruitment-fair/.

The **Nanophysics Laboratory** offers **4 PhD projects** on this call. Do not hesitate in contact us for information about the project and the call. The description of the project and responsible are listed bellow:

Project S8. Synthesis of Functional Materials for Chemical Synthesis

Contact people: Martina Corso (martina.corso@ehu.eus) and Dimas G. de Oteyza (d_g_oteyza@ehu.eus)

We are looking for highly motivated candidates, physicists or chemists, with a background in solid state physics, surface science or physical chemistry to take up an experimental PhD position in the area of functional carbon-based nanomaterials.

In this challenging PhD project, several strategies will be explored to create atomically precise carbon-based nanostructures with specific functionalities to detect toxic gases and air contaminants. The ultimate goal is to create materials with enhanced sensitivity and selectivity to specific analytes. The specific functionalities in the graphenic nanoscale materials, as graphene nanoribbons, will be included in the materials during their growth by means of on-surface synthesis in ultra-high vacuum conditions. The electronic response to different analytes of the functionalized materials will be tested with surface sensitive characterization tools such as scanning tunneling microscopy/spectroscopy (STM/STS), X-ray photoelectron spectroscopy (XPS) and Angle-resolved photoemission (ARPES).

The successful candidate will be integrated in a multidisciplinary national collaborative project and in the international working environment of the NanoPhysics Laboratory.

Project S14. Synthesis and Electronic Structure of One-Atom-Thick Hexagonal Boron Nitride on Curved Crystals: Toward Boron Nitride Nanostripes

Contact person: Frederick Schiller (frederikmichael.schiller@ehu.eus)

Two-dimensional and one-dimensional materials are attracting strong interest due to their promising electronic, magnetic, or mechanical properties. Among them the heavily investigated graphene, a material that was once supposed to replace silicon in device fabrication. Graphene devices have been realized in certain applications (Sensoring, Biomedicine), but it cannot be

used in electronics because it lacks a semiconducting band gap. Hexagonal boron nitride (hBN) is the isostructural semiconducting counterpart of graphene, and hence of fundamental importance in the development of nanolectronics applications. Yet the synthesis and electronic characterization of 2D hBN monolayers and 1D nanostructures, such as nanostripes, is poorly developed, requiring intensive search of appropriate growth substrates and fine characterization using surface science techniques.

We have recently demonstrated that hBN and graphene can be grown on curved Ni and Rh crystals, leading to homogenous coating and one-dimensional nanostripe arrangement [1]. The candidate will focus on the exploration of the structure and the electronic properties of pure and mixed hBN and graphene nanostructures on nanopatterned substrates, using Scanning Tunneling Microscopy, Low-Energy Electron-Diffraction, X-ray and Angle-Resolved Photoemission in our laboratory, as well as X-ray absorption and core-level photoemission in European Synchrotron radiation facilities.

[1] L. Fernandez et al, 2D Mater. 6 (2019) 2025013; arXiv: http://arxiv.org/abs/1811.09291

Project S16. Unveiling the Structure-Activity Relationships for Water Electrolysis

Contact people: Sara Barja (sara.barja@ehu.eus) and Enrique Ortega (enrique.ortega@ehu.eus)

Development of optimized catalyst requires a comprehensive atomic scale picture of the chemical and physical properties of surfaces, in connection to their macroscopic catalytic performance. Operando imaging and spectroscopy has become a cornerstone in the development of novel catalyst systems.

We combine ultra-high-vacuum characterization (scanning tunnelling microscopy, X-Ray photoemission spectroscopy), and parallel electrochemical test on the very same sample. The described experimental approach allows unique quasi-in situ studies to understand the electrode-electrolyte interface at the atomic-scale.

This project focuses on relevant metal-oxide surfaces for water electrolysis, and proposes to bridge the gap between model studies and real electrocatalytic systems. The PhD-student will become party of the above project and will during his/her PhD obtain extended experience in surface science and fundamentals of catalysis.

The experimental results obtained in the project together with theoretical models and materials synthesis will form a circular development loop aimed at optimizing catalyst performance. The multidisciplinary character of project will support active collaboration with worldwide research groups in surface science and catalysis. Such comprehensive characterization will provide the fundamental understanding of the structure-functionality relationships needed to develop new and improved electrocatalyst for clean water electrolysis.

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Project S22. Exploring Materials for Quantum Technologies

Contact people: Celia Rogero (celia.rogero@csic.es) and Maxim Ilyn (maxim.ilin@ehu.eus)

We propose a challenging experimental PhD project devoted to the development and application of materials for quantum-enabled technologies and devices. We are right now on the second quantum revolution where materials science will be key to unlocking novel technologies based on quantum properties. In this context, the aim of the PhD position will be to grow and study the properties of novel materials with potential application on quantum technologies into the future. The novel materials will cover from thin layers of inorganic materials [1, 2], monolayers of 2D Van der Waals materials [3] and organic materials [4].This fundamental study will combine the most atomically precise growth techniques with the most sophisticated, structural, spectroscopic, magnetic characterization techniques operating under ultra-high vacuum (UHV) conditions, such as low temperature scanning tunneling microscopy and spectroscopy (STM, STS), or X-ray photoemission and Magnetic Dichroism spectroscopy (XPS, XMCD). It will be an exciting work at the interface between materials science, chemistry, condensed matter physics and quantum science.

We are looking for highly motivated PhD students with background in solid state physics or chemistry to work in the framework of a multidisciplinary European Collaborative Projects. Daily work will be conducted at NanoPhysics Laboratory, with frequent visits to synchrotron installations as well as to Nanogune.

[1] Nano Letters 20, 6815-6823 (2020)
[2] arXiv:2012. 15549
[3] J. Phys. Chem. C 2019, 123, 45, 27802-27810
[4] Nature 583, 48-54 (2020)