Marie-Skłodowska-Curie Actions – Individual Fellowships 2020

ICN2 Expression of Interest

Group leader:

Aitor Mugarza

Scientist in charge of the fellow:

Aitor Mugarza

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Brief description of the research group:

Our research is focused on the atomic-scale engineering of the quantum properties of novel nanomaterials. At the nanoscale, the properties of materials are dominated by quantum effects and interfacial phenomena, which impose strong limitations on the control and reproducibility of device performances, but also open up avenues for engineering new physical properties. The aim of our group is to understand and control quantum phenomena with atomic precision by chemical and structural manipulation, nanostructuring and interfacing materials that are identified as strategic in the roadmap for new technologies (hybrid metal-organic heterostructures, graphene-based 2D materials, topological insulators...).

Our methodology is based on the in-situ synthesis and characterization in ultra-high vacuum conditions, combining scanning probe microscopy (STM) with electron (XPS/ARPES) and photon (XAS/XMCD) spectroscopies.

We are also exploring different optoelectronic and sensing device concepts with the materials we synthesize.

Title of project:

Atomically precise graphene nanostructures

Project description:

Nanostructuring graphene confers multiple functionalities to this material, making it attractive to very diverse applications in electronics, molecular sensing and filtering. For instance, semiconducting gaps can be induced by reducing its dimensions to the nanometer scale, whereas introducing pores of similar sizes turns impermeable graphene into the most efficient molecular sieve membrane. But having homogeneous

semiconducting gaps and sieving selectivity requires atomically precise nanostructures, a condition that can only be achieved by bottom-up synthesis.

This project aims at synthesizing atomically precise 2D graphene-based nanostructures. The on-surface synthesis method our group recently demonstrated (C. Moreno et al., Science 360, 199 (2018)) will be employed to synthesize nanoporous graphene of different pore size and geometry, and chemical composition. The study will be extended to hybrid lateral heterostructures combining graphene nanostructures with covalent molecular structures of different functionalities.

The candidate will synthesize the graphene nanomaterials in ultra-high vacuum conditions and characterized them by combining scanning tunnelling microscopy and spectroscopy (STM/STS), and X-ray photoelectron spectroscopy (XPS). The optical and transport properties will be tested in three-terminal devices that will be fabricated by transferring the nanomaterials onto dielectric substrates.

Research area:

Chemistry	CHE	x
Social Sciences and Humanities	SOC	
Economic Sciences	ECO	
Information Science and Engineering	ENG	
Environmental Sciences and Geology	ENV	
Life Sciences	LIF	
Mathematics	MAT	
Physics	PHY	x

ICN2 HR will request a letter of motivation, CV (max. 4 pages) and two referees.