

CONTRATOS PREDOCTORALES 2022 SEVERO OCHOA

PROJECT TITLE / JOB POSITION TITLE:

Hybrid Molecular Graphene Devices

JOB POSITION RESEARCH LINE:

RL4 - Tuneable and Low Cost Molecular Electronics

RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:

This project develop hybrid molecule-graphene materials that explores combinations of photoswitchable molecules with advanced graphene based devices. Graphene's superior electrical and thermal conductivity results in low resistance losses and better heat dissipation than traditional semiconductor materials. The electronic properties of graphene can be tailored by positioning dopants onto graphene devices – augmenting the intrinsic properties. Common for traditional dopants are that they introduce a static shift in the electronic states of the material that is doped.

In this project, we will introduce a new class of dynamic, photoswitchable dopants onto graphene based field effect transistor devices (G-FET). The photoswitchable dopants will change the local doping of graphene using stimuli in the form of light.

The group of Kasper Moth-Poulsen, has a long tradition of developing molecules for electronic devices, (ERC StG grant SIMONE), as well as dopants for graphene devices. The group is also working with developing photoswitchable materials (ERC CoG Photherm).

The Group of Nuria Aliaga, is also well versed in design and synthesis of molecular systems, and has through recent years established a unique platform for the study of electronic properties of graphene based devices (ERC CoG Tmol4TRANS).

A first part of the project will involve the synthesis of molecular photoswitch systems that enable electronic changes in the local environment of graphene. Molecular designs can be based on photo-acid concepts or photo-induced spin cross-over compounds targeting magnetic switching. A second part of the project focus on hybrid Molecular G-FETs (graphene field effect transistors), among others, whose fabrication technology is already established in the group of Aliaga. The I-V response (e.g., the shift-induced resistance change and the Dirac point shift in G-FETs) as well as their electronic response with and without light to achieve efficient and responsive hybrid systems.

JOB POSITION DESCRIPTION:

The ideal candidate will have a background in chemistry, and an interest in organic synthesis, physical chemistry and nanoscience.

During PhD training, the ability to perform both the synthesis of the molecules and their measurement enables re-evaluation of the designs for the creation of new generations of molecules (e.g., different functional groups), as well as for G-FETS (e.g., variations in the nature of the gate/insulator, etc.), and thus improve the molecule+device association.

Molecular systems will initially be synthesized by the candidate and characterized using a combination of physical chemistry tools such as optical photoswitching properties, magnetic susceptibility and electrochemistry.

The candidate will also be trained in the insertion of these molecules into substrates/nanodevices, for use as active components in electronic devices. Knowledge of molecular properties will allow the best approach to molecular deposition to be found, i.e., whether it is possible by sublimation or in solution, with comparative studies of both situations. The student will participate in

The candidate will work on a multidisciplinary project covering different topics. On the device side, he/she will perform deposition studies first on graphene substrates with later characterization of this arrangement by Raman, confocal, SEM and XPS, among others. The student will be trained in activities related to the design and fabrication of G-FETs, including microfabrication processes and cleanroom use, as well as in the measurements of the prototypes, by means of a probe station.

GROUP LEADER:

Prof. Nuria Aliaga (ICREA) & Prof. Kasper Moth-Poulsen (ICREA)

Email: naliaga@icmab.es, kmothpoulsen@icmab.es

Research project / Research Group website

www.moth-poulsen.com & <https://icmab.es/aliaga-alcalde-nuria-permanent-researchers>