**CONTRATOS PREDOCTORALES 2022 SEVERO OCHOA**

**PROJECT TITLE / JOB POSITION TITLE:**

| **Reconfigurable Spintronic Memory Elements Enabled by Solid-State Gating** |
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**JOB POSITION RESEARCH LINE:**

| **RL, General.- FUNCTIONAL OR MULTIFUNCTIONAL NANOSTRUCTURED MATERIALS** |
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**RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:**

Spintronics -the use of electrons' spin information as an active component in electronic circuits- offers innovative solutions for developing energy-efficient data storage platforms. A central challenge in spintronics is to write and read magnetic data by purely electrical means. Current-induced spin-orbit torques (SOT) have recently emerged as a powerful tool to efficiently manipulate magnetization in nanodevices comprising magnetic and nonmagnetic materials. Thus far, most technological efforts have focused on SOT-controlled devices using conducting magnetic materials due to the readily available signal readout schemes based on magnetoresistive effects. Magnetic insulators, on the other hand, although perfectly suitable for SOT-driven magnetic manipulation and offering superior properties, have been concealed from the R&D efforts due to the lack of electrical detection means.

In this project, we will challenge the above common wisdom and create a paradigm shift in spintronics. We will explore novel physical phenomena and material combinations to enable the all-electrical operation of a spintronic device using magnetic insulators as the active material. This will be achieved by combining magnetic insulators and conductors in a single device and actively controlling/configuring their spin transport properties by solid-state gating. At the end of the project, we will develop a first-of-a-kind device prototype with efficient memory functionality. The innovative research proposed here will open up multiple avenues in insulating spintronics and memory/logic device architectures in next-generation data storage technologies.

The successful candidate will work in the *Spintronic Materials and Devices* team of the MULFOX Group. The project will benefit from the state-of-the-art thin film growth and device characterization laboratories recently established by the PI in the framework of an ERC project. The team (currently 2 postdocs and 1 PhD student) readily possesses expertise in developing and characterizing the proposed materials, which will ensure a swift start to the project and increase the chances of success.



**Campus de la Universitat Autònoma de Barcelona**
08193 Bellaterra, Catalunya, Espanya
**Telf.:** +34 935 801 853
**Fax.:** +34 935 805 729

**JOB POSITION DESCRIPTION:**

The successful candidate will

- Grow and optimize magnetic insulator/conductor hybrid heterostructures by means of magnetron sputtering.
- Coordinate the characterization of the above films in shared facilities and establish an efficient feedback loop to reach the desirable properties in the fastest possible timeframe.
- Fabricate micrometer and nanometer-scale devices out of the selected films by standard lithography methods in the NANOQUIM platform.
- Conduct detailed magneto-electrical and magneto-optical measurements to explore the feasibility of the proposed spintronic devices
- Design and demonstrate an all-electrical proof-of-concept memory device based on magnetic insulators.

The candidate is expected to work initially in collaboration with Dr. Silvia Damerio for the parts related to the growth and optimization of the magnetic heterostructures. After optimizing films with suitable properties, the student will work independently under PI's direct supervision. The PI will monitor the scientific progress and the student's performance through weekly meetings and take all the necessary preventive actions to remain focused the project goals. The PI will organize evaluation meetings with the student every three months to discuss the contingency plans for potential problems and make/revise short- and long-term plans accordingly.

The suitable candidate should possess

- A BSc/MSc degree in physics, materials science, electronics engineering or a related discipline.
- Background in condensed matter physics and materials physics.
- Knowledge of magnetic materials and their transport properties.
- Knowledge of device characterization by standard techniques (Hall effect / Magnetoresistance)
- Experience with cleanroom processes
- Knowledge of basic laboratory electronics.
- Knowledge of setup automation and data analysis softwares (e.g., LabVIEW, Matlab, Origin, etc.).
- Excellent writing and communications skills in English and ability to work in team.

**GROUP LEADER:**

**Dr. Can Onur Avci**
**Email:** cavci@icmab.es
**Research project / Research Group website:** https://magnepic.icmab.es/, https://mulfox.icmab.es/



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