

CONTRATOS PREDOCTORALES 2022 SEVERO OCHOA

PROJECT TITLE / JOB POSITION TITLE:

Functional Oxide Nanostructures for Spin-Charge interconversion

JOB POSITION RESEARCH LINE:

RL, General: Functional or Multifunctional Nanostructured Materials

RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:

The increasing worldwide demand for higher performance electronic devices has become a major challenge as we approach the physical limits of the current technology (complementary metal oxide semiconductor, CMOS). Moreover, the power consumption of microelectronic chips is a major issue. In recent years, to overcome these limitations the emerging field of spintronics aims to exploit the electron spins as elementary units in computing and highly efficient electronics because of spintronics minimal energy use.

In this context, the proposed research is centred at two basic objectives. The first consists on studying spin pumping processes using oxide thin films as spin current source, collector or both. Spin pumping takes place when the magnetization of a ferromagnetic material (FM), in close contact with a high spin-orbit coupling non-magnetic metal (NM), is brought to a dynamical state (usually by means of ferromagnetic resonance). The magnetization dynamics induces a spin current in the normal metal that can be detected by different means like the inverse spin Hall effect, which converts the spin current into an electrical current and a DC voltage.

The second is the creation of AFM based magnetic memories in which the reading/writing of the information is based on spin orbit torque (SOT). This phenomenon is based on the dynamics induced by a spin current that arrives to a FM or to a AFM. This dynamic is induced by the torque that the spin current exerts on the magnetic moments that is able to align them. Ways to test the effect of the SOT on magnetic materials include anomalous Hall effect, magnetoresistance MR, or spin Hall MR.

The candidate will join a pioneer and dynamic group (ACNM, formed by four permanent researchers, a visitor researcher and a Phd student) actively involved in preparing advanced functional oxide thin films for spintronic applications in the framework of the research project: *Spin-charge interconversion in oxide heterostructures for SOT devices*.

JOB POSITION DESCRIPTION:

Achieving the two goals of the current project will require the growth and optimization of diverse thin films and multilayered nanostructures, both by chemical (polymer assisted deposition) and physical (sputtering) methods (or even a combination of both for multilayers). Different oxide materials ($\text{La}_{1-x}\text{MnO}_3$, $\text{La}_{1-x}\text{Sr}_x\text{MnO}_3$, $\text{Pr}_{1-x}\text{Sr}_x\text{MnO}_3$, $\text{Nd}_{1-x}\text{Sr}_x\text{MnO}_3$, LaCrO_3 , $\text{LaFe}_{0.5}\text{Cr}_{0.5}\text{O}_3$, SrRuO_3 , SrIrO_3) and metals (Pt, Au) will be used. For some of them our group has experience in their preparation, but for some other it will be the candidate's responsibility to prepare the appropriate precursors (solutions for chemical methods or solid state targets for sputtering), and to explore the routes of preparation and optimization. Characterization of the prepared systems, including magnetometry, microscopy (AFM, SEM), X-ray diffraction, FMR/ISHE, and magnetotransport, will be candidate's responsibility, including, in some cases, device preparation at ICMAB's clean room facility.

The candidate will actively participate in using other techniques beyond our research group: HR-STEM, in collaboration with other researchers at ICMAB (Dr. J. Gázquez) or abroad (Dr. C. Magén, ICMA) for the detailed characterization of the films and interfaces; XAS/XLD/XMCD in collaboration with ALBA synchrotron (Dr. J. Herrero) for the characterization of the valence state and magnetic and/or orbital ordering in the films; and PEEM, in collaboration with BESSY synchrotron (Dr. S. Valencia) for further surface characterization. In addition, the candidate might travel to other European countries to develop the project in the framework of established scientific collaborations or to present the results of his/her/theirs/hirs research in conferences and schools.

For this, we search a person with a degree in Chemistry or Physics, complemented by nanoscience knowledge and a related master degree with high qualifications, willing to actively form him/her/them/hir/self, gaining knowledge in the field of Materials Science.

GROUP LEADER:

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Research project / Research Group website <https://acnm.icmab.es/>