

FINAL MASTER PROJECT PROPOSAL



Title

Fabrication and characterization of nanocomposite Ni/HfO₂ granular multilayers

Supervisor(s)

Pedro A. Algrabel (ICMA)

Jose A. Pardo (INA)

Summary of the project

The main goal of this master project is the preparation and characterization of metal-insulator nanocomposites consisting of nanometer-sized Ni islands embedded in an insulating HfO₂ matrix. These materials find applications in a number of spintronic devices (sensors, contact-less potentiometers, hard-disk read-heads) based on their magnetic-field-dependent electrical resistance.

Pulsed laser deposition (PLD) will be used here to prepare Ni/HfO₂ nanogranular composites following the sequential deposition of alternate continuous HfO₂ and discontinuous Ni layers. The multilayers structure and microstructure will be studied by X-ray diffraction (XRD), X-ray reflectivity (XRR) and transmission electron microscopy (TEM) available at the INA-LMA facilities. The magnetic and magnetoresistive behavior of the films will be characterized at INA and ICMA by VSM and SQUID magnetometries and using a home-made magnetotransport setup.

As a starting point, polycrystalline multilayers will be prepared on glass or silicon substrates. Depending on the results, epitaxial multilayers will be explored. Previous studies of the group in Fe/MgO multilayers proved a substantial improvement of the magnetoresistance properties in epitaxial films relative to the polycrystalline ones.

The student will learn different nanomaterials preparation and characterization techniques. Both supervisors are needed: Dr José A. Pardo will focus on the preparation and structural characterization of the thin films, Prof. Pedro A. Algarabel on the measurement of the magnetic and magnetotransport properties. The researchers have a long experience in similar materials (see DOI: 10.1063/1.3298504, 10.1063/1.3569149, 10.1103/PhysRevMaterials.2.013401).