FINAL MASTER PROJECT PROPOSAL

Title

Nanopatterning of molecules on devices by Atomic Force Microscopy

Supervisor(s)

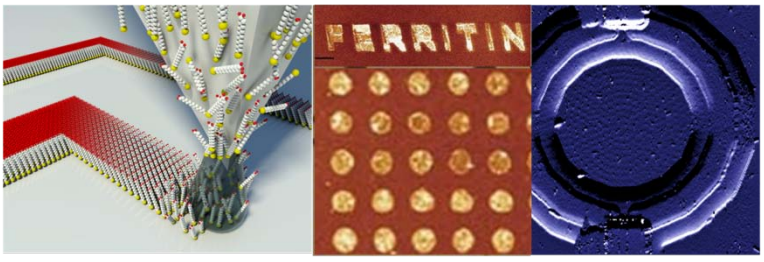
Ana Isabel Gracia Lostao

Summary of the project

Dip-pen nanolithography (DPN) is the only lithography approach able to organize soft materials with nanometer resolution at environmental conditions. DPN is a direct-write method based on atomic force microscopy (AFM) able to design, create and image patterns. Our Group has the only DPN5000 system available in Spain to develop high performance DPN. We have several projects under development: a) the integration of new nanomagnets (qubits & qugates) and radicals, preserving their properties, on selected regions of devices such as superconducting coplanar waveguide resonators. The application of single molecule magnets in quantum information technologies (ICT) necessarily involves a rational integration of these molecules into solid state devices; b) the organization of proteins on silicon and gold surfaces for different purposes; c) the fabrication of graphene micro and nanoribbons using polystyrene as mask to fabricate devices; and d) deposition of metallic nanoparticles on devices.

The aim of the TFM is the integration of molecules on surfaces and devices using DPN and AFM. The work plan consists of:
a- Nanomagnets or radicals solutions will be deposited by DPN/AFM onto marked silicon substrates to optimize the nanopatterns, that will be replicated on selected areas in the device, as the nanoscopic constrictions of a superconducting coplanar waveguide resonator. Physical measurements (funded by MAT project MIRT from MICINN and Quant-ERA SUMO from UE projects)
b- Nanoestructuration of flavoproteins on gold substrates. Exploration of the conductivity properties by scanning tunneling microscopy (funded by a BIO project from MICINN)
c- Fabrication of micro/nanoribbons on graphene using polystyrene

The samples will be prepared in the biochemistry lab, and the measurements performed in the DPN5000 and the ambient AFMs of the ICTS Laboratory of Advanced Microscopies, at INA, of which A.I.G.Lostao is responsible.



Left: Scheme representing the DPN deposition process using a functionalized AFM probe. Middle: Nanoarrays of protein ferritin and word fabricated on gold with DPN. Right: Circular pattern of nanomagnets integrated on a μSQUID device with DPN.