FINAL MASTER PROJECT PROPOSAL

Title

Fabrication of superconducting $YBa_2Cu_3O_7$ quasi-monodimensional microwires by a Chemical solution Method.

Supervisor(s)

Irene Lucas del Pozo
Antonio Badía Majos

Summary of the project

This master project is devoted to the preparation and characterization of $YBa_2Cu_3O_7$ (YBCO) patterned nanowires fabricated by a chemical solution method (Polymer Assisted Deposition-PAD). This superconducting material is of great interest in applications since its critical operation parameters (temperature, current density, magnetic field) reach the highest values known to date. Monocrystalline YBCO thin films are usually fabricated by using physical techniques such as PLD (pulse laser deposition) or sputtering. Chemical methods considerably reduce the cost of fabrication and this makes them attractive when thinking about final applications. Therefore, fabricating YBCO by PAD becomes interesting not only for the simplicity of the method but also when thinking about a scalability of the results.

Firstly, YBCO thin films of a few nanometers will be prepared by PAD on $SrTiO_3$ (STO) and $LaAlO_3$ (LAO) substrates and characterized in order to confirm their structural and superconducting properties. Then, selected YBCO thin films will be nanostructured by optical lithography to fabricate thin-film microwires. In order to facilitate the theoretical interpretation of the physical properties, the fabrication of the wires should attain some geometrical criteria. Their three dimensions (width, length and thickness) must differ orders of magnitude one from each other. The length will be in the range of mm, the width will be of the order of micrometers and the thickness will be in the range of nanometers. This is imposed by a characteristic length scale: λ^2/d, λ being the London penetration depth and d the thickness of the wire. When possible the wires will be characterized to study their response under applied fields at different temperatures applied across different directions of the sample.

As a benefit of this master project, the student will learn a chemical nanomaterials preparation route as well as several physical characterization techniques and will get in touch with nanostructuration techniques such as optical lithography. Both supervisors are needed: Dr Irene Lucas will focus on the preparation and structural characterization of the thin films, Prof. Antonio Badia on the measurement of the magnetic and magnetotransport properties. The researchers have a long experience in this material and have supervised previous MSc and final BSc project theses on YBCO microwires fabricated by physical methods.