Contrato predoctoral Severo Ochoa para la formación de doctores, ICMAB-CSIC (Barcelona)

Tuning of the electronic structure in High Temperature Superconducting films at nanometric scale

Contacto: Dr. Anna Palau (palau@icmab.es) and Dr. Narcís Mestres (narcis.mestres@icmab.es). http://departments.icmab.es/suman/

High temperature superconductivity (HTS) is one of the key technologies of the 21st century, which will bring new breakthroughs in the fields of electric power technology, medicine, fusion energy, environmental control, information technology and others.

A unique feature of HTS is that their properties strongly depend on the carrier concentration. In cuprates, one of the most studied families of HTS, a metal insulating transition (MIT) occurs by hole doping the strongly interacting electrons present in their CuO_2 planes.

In this project we will study the reversible modulation of the carrier density induced in $YBa_2Cu_3O_{7-d}$ (YBCO) films by means of electric field, "resistive switching (RS) effect" [1]. The mechanism underlying the generation of a MIT in these materials is still unclear though oxygen vacancies is believed to have a key role. Therefore, the oxygen mobility at the interfaces between oxides as well as with different metal electrodes is believed to have a significant impact. Especially relevant will be the intrinsic anisotropy of cuprates in the oxygen diffusion through the material.

We will evaluate new opportunities to induce switchable manipulation of flux quanta for novel devices in digital applications. The idea is to locally modulate the superconducting order parameter by using a nanometric non-homogeneous electric field profile in order to induce reconfigurable pinning potentials (Figure 1). The potentiality of nano-engineering the doping level in YBCO films will also be undertaken to investigate on novel concepts and devices minimizing energy consumption. These include fluxtronic devices based on the controlled motion of flux quanta [2].

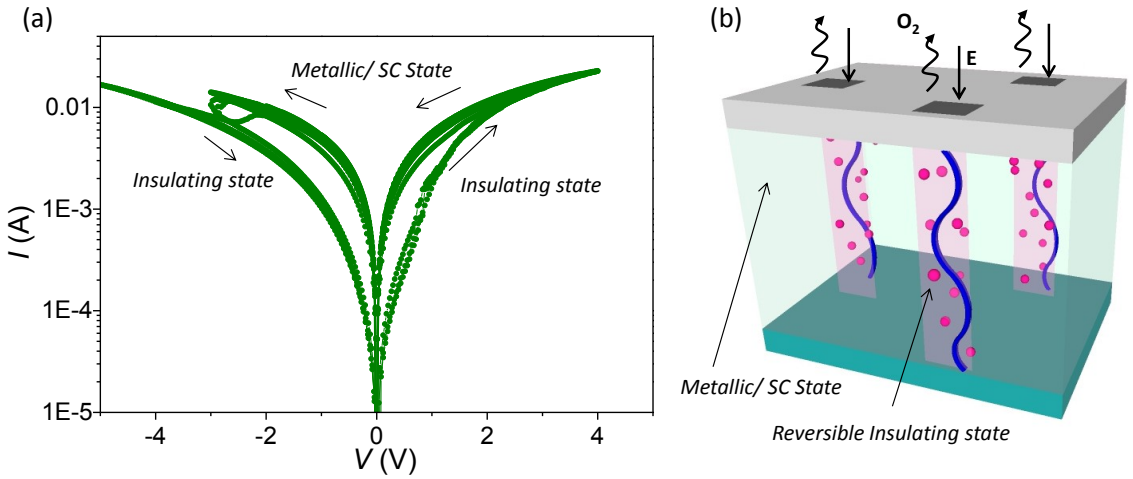

Figure 1- (a) Bipolar resistive switching measured in a YBCO layer with silver contacts. (b) Schematic representation of the creation of reversible pinning potentials in a YBCO film based on the local modulation of the oxygen content by means of an electric field.

[1] C. H. Ahn et al. Nature 424, 1015 (2003)
[2] V. Rouco et al. New Journal of Physics 17, 073022 (2015)