Growth of Layered Perovskite Superconductor by Pulsed Laser Deposition

Felipe F. Morgado
Instituto de Física de São Carlos (IFSC) - Universidade de São Paulo (USP) / Laboratório Nacional de Luz Síncrotron (LNLS) - Centro Nacional de Pesquisa em Energia e Materiais (CNPEM)

Pedro Caetano Sabino Santos
Instituto de Física Gleb Wataghin (IFGW) - Universidade Estadual de Campinas (Unicamp) / Laboratório Nacional de Luz Síncrotron (LNLS) - Centro Nacional de Pesquisa em Energia e Materiais (CNPEM)

Thiago Mori, Pedro Schio, Júlio C. Cezar
Laboratório Nacional de Luz Síncrotron (LNLS) - Centro Nacional de Pesquisa em Energia e Materiais (CNPEM)

The phase diagrams of complex oxides are very diverse due to the strong interaction between electrons in the electronic structure, named as electronic correlations. Among other mechanisms, the interactions can be explained by the electrons repelling each other by Coulomb’s Law and by Fermi repulsion (Fermi hole) with electrons of same spin. It is possible to probe those interactions by changing electrostatically the carrier density, the main concept behind the Field-Effect Transistors (FET) which is the building blocks of nanoelectronics devices. Basically, in these transistors, it is applied a voltage across a dielectric gate to control the carrier density in the channel between the other two contacts (drain and source). Consequently, the conductivity of the channel is changed as function of the gate voltage. In the case of a strongly correlated oxide channel, it is possible to change the conductivity and the ground state of the material. For example, consider the high-t_c copper oxide $YBa_2Cu_3O_{7-\delta}$, it is possible through an electric field to switch between superconducting and insulator phases.

In this poster we present the proposal and the results of our master work, which deals with the growth by Pulsed Laser Deposition (PLD) of a layered perovskite superconductor. In our case, we aim to find the optimal deposition conditions for the growth of a single layer of $YBa_2Cu_3O_{7-\delta}$ on SrTiO_3 substrates. In that case, we studied the characteristics of the superconductor in order to use it within a field effect device to tune its electrical properties. In other words, we would be able to control the critical temperature of the superconductor using an electric potential.

This project intends to illustrate its proposal by means of preliminary results acquired using several techniques such as X-Ray Diffraction (XRD), Atomic Force Microscope (AFM), X-ray Photoemission Spectroscopy (XPS) and transport measurements (superconductivity) of the single layer above mentioned.