CONTRATOS PREDOCTORALES – MATRANS24 (CEX2023-001263-S)

RESEARCH CHALLENGE:

CHLG5: Superconducting materials for new high-power gaps

PROJECT TITLE / JOB POSITION TITLE:

Correlation between microstructure and properties of competitive high temperature superconductors

RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:
(Max. 2.000 characters – including spaces)

Superconductivity is a macroscopic quantum phenomenon with remarkable properties and wide-ranging applications. Since the discovery of high-temperature superconducting (HTS) cuprates over 30 years ago, researchers have faced both scientific unknowns and complex materials challenges [1]. HTS are strongly correlated systems with unconventional superconductivity, and their microscopic theory remains incomplete. They require doping to become superconducting and exhibit novel vortex phases. Although disorder typically degrades superconductivity, if properly engineered, it can serve as a powerful vortex pinning source, as shown in our previous work [2,3], which makes microstructure understanding very relevant and powerful.

Despite unresolved fundamental questions, HTS tapes are now fabricated for high-current, energy-efficient technologies (power cables, wind turbines, and electric aviation), as well as large-scale infrastructures like fusion reactors, circular colliders, and NMR systems above 1 GHz; magnetic fusion currently driving most HTS tape development. However, high throughput production and reducing cost/performance ratios remain key challenges.

At ICMAB, we have developed a novel high-throughput method—Transient Liquid Assisted Growth (TLAG) [4]—which enables epitaxial growth of HTS films over three orders of magnitude faster than conventional methods [5], maintaining high superconducting performance [6, 7]. The PhD project will focus on understanding how TLAG growth mechanisms influence the superconductivity of this material and vortex pinning. Advanced tools, including an in-situ growth platform at ALBA synchrotron, transmission electron microscopes, and high magnetic field (9 and 16T) cryogenic systems, will support this research and the goal of pushing HTS performance further for real-world applications.

[1] X. Obradors and T. Puig, Superconductor Science and Technology 27, 044003 (2014)
[2] J. Gutierrez et al, Nat Mat 6, 367 (2007)
[3] A. Llordes et al, Nature Materials, 11, 329 (2012)
[4] L. Soler et al, Nature Communications 11, 344, (2020
[5] S. Rasi et al, Advance Science, 2203834 (2022)
[6] T. Puig, J. Gutierrez, X. Obradors Nat Rev Phy 6, 132 (2024)
[7] X. Obradors, T. Puig New & Views Nat. Mat. 23, 1311 (2024)

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JOB POSITION DESCRIPTION:
(Max. 2.000 characters – including spaces)
Include all the relevant information about the position, role, responsibilities and skills required within the project/group

The project aims to engage talent young students for a doctorate in the field of High Temperature Superconductors (HTS), by investigating the correlation between superconductivity in HTS, microstructure and growth by ultrafast TLAG approach. She/he will be integrated in a large interdisciplinary and international group, with different background expertise in the field of HTS materials developing cutting-edge research in the synthesis, microstructural, physical understanding of HTS and their integration in devices. The goal is to bring new knowledge on the superconductivity of TLAG films at extreme conditions of high magnetic fields, cryogenic temperatures and high transport currents, and correlated it with nanoscale microstructure analysis and growth reactions paths. Therefore, a 7-class clean room facility, a 9 and 16 T magnetic system, Transmission Electron Microscopes and an in-situ growth platform at ALBA synchrotron will be available. This research was initiated with an ERC-Advanced Grant which was followed by two ERC-Proof-of-Concepts.
The position requires:
–Bachelor and master in physics, material science, chemistry, chemical engineering, nanoscience or related fields.
–Good knowledge in Condensed Matter Physics
–A high level of English. All working meeting are held in English
–High motivation to experimental research.
–Working aptitudes in a collaborative group.
ICMAB Institute offers excellent conditions for PhD students, including:

- a creative, world-class interdisciplinary research environment for fundamental and applied nanoscience state-of-the-art infrastructure for the preparation and characterization of nanostructured materials.
- a highly regarded scientific education.
- a strong international nanoscience network.

Experience and knowledge on superconductivity, superconducting materials will be valuable.

PhD CO-DIRECTORS:

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RELATED LINKS TO THE POSITION (optional)
URL: https://suman.icmab.es/predoctoral-open-position-in-correlation-between-microstructure-and-properties-of-competitive-high-temperature-superconductors/
Title link: SEARCH CANDIDATES