PhD call offer:

"Ultrafast growth for competitive high temperature superconductors"

Superconductivity is a macroscopic quantum phenomenon with outstanding properties and impact in many applications. Since high temperature superconducting (HTS) cuprate materials were discovered 30 years ago, they had to face unknown science and new materials engineering complexities [1]. HTS are strongly correlated systems, showing unconventional superconductivity and their microscopic theory is still unidentified. In addition, they need to be doped to be superconductors and exhibit novel vortex phases. Disorder is a strong enemy for the superconducting state of HTS, but if properly designed, it can be used as an outstanding source for vortex pinning, as we showed in [2,3]. Beyond the still unsolved questions about HTS, nowadays, the international community is able to fabricate HTS tapes for high current energy efficient applications (high power cables, wind generators, electrical aviation) and large scale infrastructures (fusion, circular colliders, NMR beyond 1 GHz), one of the remaining issues being the need to reduce the cost/performance ratio of the fabrication process. We have developed a novel high throughput process, called Transient Liquid Assisted Growth (TLAG) process [4], which is able to grow epitaxial superconducting films at 100 times faster than standard methods [5] with high performances, and therefore overcoming the market obstacles.

The PhD project is addressed towards the understanding of the TLAG growth mechanisms, tuning of material microstructure to boost the superconducting properties and understanding of vortex physics in TLAG films. Advanced growth facilities (including in-situ XRD synchrotron), last generation Transmission Electron Microscopes and ultrahigh magnetic field installations 16T at cryogenic temperatures will be available for this project.

[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)

Job positions description:

The project aims to engage talent young students for a Materials Science doctorate in the field of High Temperature Superconductors (HTS), by investigating the novel high-throughput TLAG growth process. They 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 and physical understanding of high temperature superconductors. The goal is to unravel the growth mechanisms of TLAG and boost the superconducting properties at high magnetic fields by designing the material microstructure landscape. This research was initiated with an ERC-Advanced Grant which was followed by two ERC-Proof-of-Concepts.

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We offer **3 positions** with the following **requirements**:

- Bachelor and master in material science, physics, chemistry, chemical engineering, nanoscience or related fields.
- Good knowledge in Condensed Matter Physics, nanomaterials or metal-organic synthesis.
- 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 and electron microscopy characterization techniques will be valuable.
- The PhD will be integrated in a very international group of PhD students and Postdocs with backgrounds in chemistry, materials science and physics of superconducting materials.

Group leader: Prof. Teresa Puig
Contact: teresa.puig@icmab.es, hr_suman@icmab.es
Website: https://suman.icmab.es/

Interested candidates should send their CV, academic grades certificate and reference letters to:

erc-ultrasupertape@icmab.es

The recruitment process will be closed when a suitable candidate is found, but strong effort will be done to finish it before end of January 2023.

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