



Advanced characterisation of functional thin films and interfaces

Doctoral school / Starting date

[IMEP2](#) / Starting date: 01/10/2022

Subject

CONTEXT

In the last decades, advanced thin film technology has enabled a wide range of technological breakthroughs that have transformed entire sectors such as electronics and lighting by the implementation of outstanding nanoscale phenomena in reliable products that involve ultralow contents of critical raw materials. In the future the energy storage sector could be revolutionized by the development of pocket-sized kW-range stacks based on **nano-architected thin film reversible Solid Oxide Cells (TF-rSOCs)** that will be able, using gaseous fuel such as H₂, to efficiently store renewable electricity for applications where the use of batteries is inefficient due to size constraints or long term storage requirements, e.g. off-shore power generation or transportation. This requires the development of TF-rSOCs with low operating temperatures (around 500 °C) and high efficiency to be able to store up to 100 J/cm³.

THESIS PROJECT

Within the framework of the Imperial College-CNRS joint project “Adfun” and the FeT Proactive EU project “Epistore”, the main goal of the PhD thesis is to **develop high performing thin film electrolyte/electrodes stacks for low temperature operation** (T<500 °C) by materials engineering, combined with improved understanding of the electrochemical processes achieved through **advanced characterization**.

RESEARCH ACTIVITIES

Within this very exciting project, the PhD student will:

- focus on the investigation of oxide thin films for low temperature solid oxide cell (SOC) devices such as solid oxide fuel cells and electrolyzers

For this the PhD student will mainly in charge of the:

- Deposition, characterization and tuning of electrolyte and electrode materials
- Integration of thin film electrolytes and electrodes (10-100 nm) in engineered stacks for improved performance
- Development and implementation of advanced *in situ* and *operando* characterization techniques for Nanoionics

To carry out these activities the PhD student will benefit from the quality and impact of Skinner’s and Burriel’s research groups and their broad expertise in oxygen surface exchange, ionic and electronic transport, as well as in advanced structural and ion beam analysis techniques. The PhD student will benefit from the equipment and expertise that LMGP has in thin film deposition by chemical deposition techniques, in electrical conductivity relaxation and *in situ* Raman spectroscopy, which will be complemented with that of Imperial in surface analysis (XPS, LEIS and SIMS) and in characterisation of transport processes (isotopic labelling, diffusion profile analysis).

Scientific Environment

The PhD thesis will begin in Oct. 2022 within the framework of the **Imperial College-CNRS PhD joint project “Adfun”** and the FeT Proactive EU project “[Epistore](#)”, it will be directed by Dr Burriel (LMGP laboratory, Grenoble) and co-directed by Prof. Skinner (Imperial College London).

The PhD student will be based at **LMGP, Materials and Physical Engineering Laboratory**, and will spend 2 months per year at **Imperial College London** to carry out advanced characterisation measurements.

The complementary experience will be combined in this project leading to a unique set of complementary competences for the student.

Within the LMGP the candidate will work within the NanoMat team, and specifically in the [Nanonioncs group](#), led by Dr Burriel. Located in the heart of an exceptional scientific environment, the LMGP offers the applicant a rewarding place to work.

LMGP Web Site: <http://www.lmgp.grenoble-inp.fr/>

Profile & requested skills

Required

- Master Degree (or equivalent) in physics, chemistry, chemical engineering or materials science, preferably with a thesis related to thin films
- Knowledge in materials science, especially in Solid State Ionics and Electrochemistry
- Fast learner, hands on and flexible attitude
- High degree of responsibility and independence, while collaborating with your team and lab mates, and other laboratory staff.
- Good management skills, good presentation skills, excellent written and oral English level (among non-native English speakers, equivalent TOEFL score of 100 or higher).
- Be someone able to and enjoy to solve problems and pushing your research to achieve results

Highly desirable

- Experience in thin film deposition techniques (CVD, MOCVD, ALD, SALD, MBE)
- Experience in processing, developing and characterizing thin films via techniques such as XPS, XRR, XRD, TEM, SEM, SIMS, AFM, ellipsometry, electrical and electrochemical characterization
- Programming skills (labview/python/matlab/etc)
- Experience in building and/or setting up laboratory equipment or simple systems

Salary

2135 € gross/month

Supervisors

Dr Mónica BURRIEL (LMGP): monica.burriel@grenoble-inp.fr

Prof. Stephen Skinner (Imperial College)

Application procedure:

Please send motivation letter, CV, list of publications and contact details of two referees to directly through the following link:

<https://emploi.cnrs.fr/Offres/Doctorant/UMR5628-ANNDUC-004/Default.aspx?lang=EN>

Closing date for applications: 07/06/2022