2019-2020

Internship proposal at LMGP Lab.

Development of advanced in situ Raman spectroscopy for micro-Solid Oxide Fuel Cells

Abstract

A breakthrough in micro-energy harvesting and storage technologies is required to cover the increasing demand of autonomous wireless sensor nodes (WSN) for the future Internet of Things (IoT), which is considered one of the five technologies that will change the world by connecting 27 billion devices and generating €2 trillion market by 2025. The FeTOpen European HARVESTORE project (http://www.harvestore.eu/) in which the LMGP participates aims to power these IoT nodes from ubiquitous heat and light sources by using nano-enabled micro-energy systems with a footprint below 1cm^3. A radically new family of all-solid state micro-energy sources able to harvest and store energy at the same time will be developed.

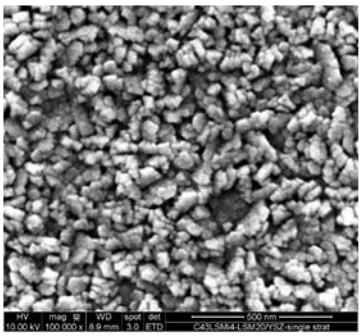
Mass transport of key ions such as O^{2-} are at the core of the performance of these solid state energy devices. However, fundamental study of these complex systems is not easy with state of the art characterisation techniques due to problems with combined sensitivity, resolution and in situ analysis. **The goal of this project is to characterize electrodes and micro-devices by *in situ* Raman spectroscopy measurements under operation conditions (temperature, current flow, atmosphere, etc.).**

Project description

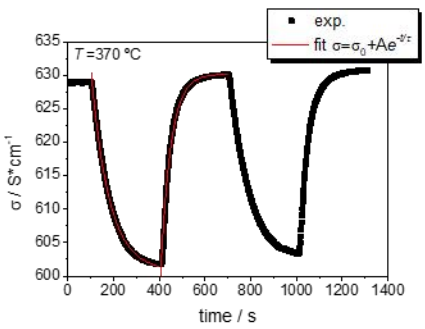
This project will focus on the advanced characterization of cathode materials and electrode/electrolyte bilayers for the development of micro-Solid Oxide Fuel Cells (µ-SOFC) and will be carried out within the framework of FeTOpen European HARVESTORE project.

The Masters student will focus on the **structural and microstructural characterization** of thin films such as $La_{0.8}Sr_{0.2}MnO_3$ with perovskite structure and La_2NiO_4 with K_2NiF_4-type structure deposited by Metal Organic Chemical Vapour Deposition (MOCVD). MOCVD will be used as the deposition technique for its precise control and reproducibility. The obtained films will be fully analyzed: X-ray diffraction (Theta-2theta, GIXRD, and Reflectometry), atomic force microscopy and electron microscopy (FEG-SEM, TEM) will be routinely used for the physical characterization. The LMGP houses state of the art experimental equipment for investigating such properties.

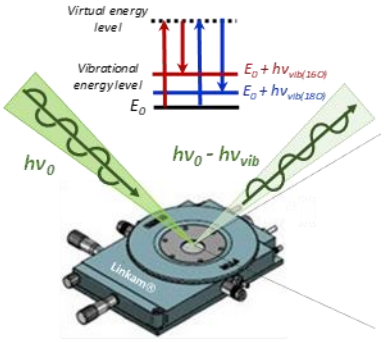
The electrical and electrochemical properties of the selected cathode materials will be measured at intermediate temperatures (up to 750 °C). The structural changes occurring at high temperature, at different oxygen partial pressures and under operation will be studied by ***ex-situ*** **(before and after measurements) and *in-situ* (during measurements) Raman spectroscopy, and will help us relate the functional and structural properties of the materials and systems.**



Top surface of an electrode



Electrical measurements changing the pO_2



In-situ Raman setup

Laboratoire des Matériaux et du Génie Physique/LMGP : 3 Parvis Louis Néel, Grenoble INP, MINATEC, CS 50257, 38 016 Grenoble cedex 1

Scientific environment:

The candidate will work within the LMGP, Materials and Physical Engineering Laboratory. Located in the heart of an exceptional scientific environment, the LMGP offers the applicant a rewarding place to work. She/he will work in the NanoMat team (i.e. *Nanomaterials and advanced nanostructures*), particularly, in the *Oxides for Nanoionic Devices group* http://www.lmgp.grenoble-inp.fr/en/research/oxides-for-nanoionic-devices

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

Profile & requested skills:

We are looking for a highly-motivated Engineering School or M2 Masters student with a strong interest in experimental physics and materials science. Interpersonal skills, dynamism, rigor and teamwork abilities will be appreciated. Candidates should be fluent in English and/or in French and have good English writing skills.

Subject could be continued with a PhD thesis: Potentially in related topic

Allowance: Internship allowance will be provided

CONTACT

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