Ecole Doctorale - 104

Sciences de la Matière, du Rayonnement et de l'Environnement

EDSMRE

ESTABLISHMENT :

Laboratory(ies) of affiliation : Unité de Catalyse et Chimie du Solide, UMR CNRS 8181

Scientific field, Speciality: **DS4 | Materials chemistry**

Thesis director: Vannier, Rose-Noëlle, Professeur, rose-noelle.vannier@centralelille.fr

Co-director:

Co-supervisor (non HDR): Rolle, Aurélie, Maître de Conférences, aurelie.rolle@centralelille.fr

Affiliate programme(s):

Planned (co)-funding : Région Hauts de France/Centrale Lille

Title of the thesis : Research and development of air electrode materials for fuel cells or proton-conduction ceramic electrolysers

THESIS SUBJECT (ABOUT 1/2 PAGE)

With the development of nuclear micro-reactors capable of generating steam at 550°C and electricity, proton conduction ceramic electrolysers are emerging as a technology of choice for hydrogen production. This technology is similar to SOFCs, with the difference that the current in the electrolyte is not carried by oxide ions but by protons. It is less mature than SOFCs but has the advantage of producing dry hydrogen and, above all, of operating at lower temperatures, typically between 400 and 600°C. Their development is the subject of the PROTEC project, funded by PERP-H2, in which a number of obstacles remain to be overcome, in particular the research and development of sustainable air electrode materials. In this context, with thermal expansion coefficients close to those of electrolytes, the phases derived from $Ca_3Co_4O_{9+\delta}$, studied for some fifteen years at UCCS as SOFC electrode materials, are promising. The aim here is to extend the study carried out at UCCS to proton conduction systems, relying on the results of the PROTEC project for the choice of electrolyte and possibility of integrating these materials into whole cells, with particular emphasis on understanding the mechanisms involved in the oxygen reduction reaction in fuel cell mode and water oxidation in electrolysis mode.

The thesis work will be carried out on the Energy Platform at the Chevreul Institute.

With a master's degree or an engineering diploma in chemistry, the candidate should have skills in solid state chemistry (synthesis, X-ray diffraction) and ceramic shaping (sintering, screen printing). Additional experience in electrochemistry would be particularly welcome.

Expected date of recruitment : 01/10/2025
Contact (e-mail address): rose-noelle.vannier@centralelille.fr, aurelie.rolle@centralelille.fr
Additional remarks/comments: sent CV, cover letter, bachelor and master grades to the previous email addresses - deadline to apply: 08/05/2025

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