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# Design of core-shell nanoparticles as new electrocatalysts for the H<sub>2</sub> production

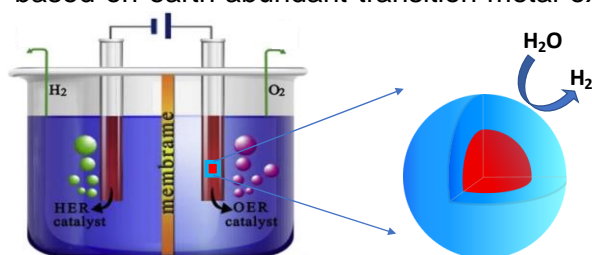
DIRECTEUR DE THESE : PROF. BENOIT P. PICHON

INSTITUT DE PHYSIQUE ET CHIMIE DES MATERIAUX DE STRASBOURG, 23 RUE DU LOESS,  
67 000 STRASBOURG

TEL : 03 88 10 71 33 ; E-MAIL : [BENOIT.PICHON@IPCMS.UNISTRA.FR](mailto:BENOIT.PICHON@IPCMS.UNISTRA.FR)

In the context of global warming and increasing energy consumption, new ways to produce renewable energies with unprecedented performances have to be developed in order to significantly reduce our dependence on fossil energies and greenhouse gas emissions. Considering the intermittent production of energy by windmills and solar panels, hydrogen emerged as a highly efficient fuel and energy carrier. It allows storing electrical energy into chemical energy with efficient restitution thanks to its high-energy density which is three times that of gasoline. Nevertheless, hydrogen is mostly produced by high carbon footprint natural gas reforming processes. Water electrolysis is a very promising environmental friendly alternative way to produce hydrogen. However, it is still hindered by high voltage losses, insufficient durability and noble metals used as electrodes.

This PhD thesis aims at the design of cost-efficient noble metal-free electrocatalytic materials based on earth-abundant transition metal oxides (TMO) for efficient H<sub>2</sub> production via water splitting. The approach will be based on our recent work which consists in the synthesis of nanoparticles combining two different TMO phases into a core-shell structure - a conductive core and a catalytically active shell - with high specific activity. [1-3]



Our [research team](#) is developing cutting edge research in the field of fundamental and applied materials science related to the most urgent challenges such as energy and medicine. We focus on the design of new nanomaterials based on transition metal oxides as substitutes to critical raw materials (noble metal and rare earth elements) for applications in the field of energy and data storage. [IPCMS](#) is affiliated to CNRS and Université de Strasbourg, two prestigious research institutions in France and worldwide.

During three years, the candidate will work in a challenging field of research while acquiring strong skills in synthesis of core-shell nanoparticles, classical / advanced analysis techniques (crystal structure, chemical composition, size and morphology) using the equipment on the IPCMS platforms (TEM, XRD, granulometry ...) and electrochemistry.

The candidate should hold a MSC. Degree in Material Sciences or Chemistry and must have a good knowledge in solid state chemistry and in associated analytical chemistry techniques. Skills in electrochemistry applied to nanomaterials will be appreciated. Send by email a detailed CV and a short cover letter mentioning your interest for the project. Please specify contact information of your previous advisors. Starting date in September / October 2025.

[1] K. Sartori *et al* - ACS Appl. Mater. Interfaces **2021**, 13, 16784–16800 <https://doi.org/10.1021/acsami.0c18310>

[2] L. Royer *et al* - Sustainable Energy & Fuels **2023**, 7, 3239 <https://doi.org/10.1039/d3se00130j>

[3] L. Royer *et al* - ACS Catal. **2023**, 13, 280–286 <https://doi.org/10.1021/acscatal.2c04512>