Design of core-shell nanoparticles as new electrocatalysts for the H_2 production

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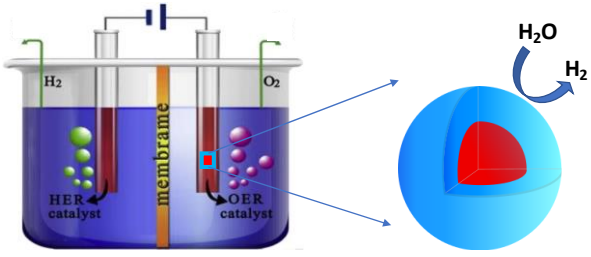
In the context of global warming and increasing energy consumption, new ways to produce renewable energies with unprecedented performances have to be developed in order to significantly reduce our dependence on fossil energies and greenhouse gas emissions. Considering the intermitent production of enrgy 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.However, 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_2 production via water splitiing. 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 aquiring 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 2024.

[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