Ph D position at Institut des Sciences Chimiques de Rennes.

Duration 3 years – Starting Octobre, 1st, 2022
Keywords: surface functionalization, nanoparticles, electrocatalysis, plasmonics

O_2 and CO_2 as sustainable energy sources: to boost the performances of hybrid nanomaterials by coupling electrocatalysis and plasmonics

The activation of O_2 and CO_2 through electrochemical reduction (ORR and CO_2RR) is highly promising for developing sustainable and alternative energy conversion technologies. The electrochemical reduction of these abundant feedstock requires strong electrocatalysts in terms of i) efficiency, ii) selectivity and iii) durability.

We have recently demonstrated that metallic nanoparticles (Au, Ag, Pt) functionalized wit a covalently-bound monolayer of molecular cavities exhibit better performances toward ORR and MOR as nanocatalysts, with, notably, better selectivity and durability. The immobilized organic ligands allow a tuning of the interfacial reactivity which has positive impact on the selectivity of the reaction while increasing the stability of the catalysts under operation (*Adv. Mat. Interf. 2020 DOI 10.1002/admi.202001557, ChemElectroChem, 2020, DOI 10.1002/celc.202000132).*

The goals of this PhD project will be to even enhance the efficiency and selectivity of the target reactions, namely comcerning the CO_2RR reaction which is highly challengin nowadays. In addition to a specific design of the organic cavities inspired from metalloenzymes for the development of nanohybrid catalysts, we will also take benefit from the properties of the nanoparticles (Ag, Au, Cu) by coupling electrocatalysis with plasmonics. We will then evaluate the synergy of such an approach through a plasmon-mediated electrocatalysis (*Adv. Mat. 2020, doi.org/10.1002/adma.202000086)*.

The research work will be run at Institut des Sciences Chimiques de Rennes in the framework of a collaborative project funded by the french national research agency (project MARCEL, ANR 2021). The nanomaterials will be synthesized and characterized in the host laboratory by employing a combination of available techniques (IR, Raman, XPS spectroscopies, SEM, TEM, ATG, etc). The electrochemical performances will be evaluated by using the state-of-the-art techniques (RDE, RRDE) and electrochemical microscopy (SECM). Complementary techniques such as gas chromatography will help in the products identification. All facilities are available in the host laboratory.

Required skills
The recruited PhD will be in charge of the preparation, characterization of the hybrid nanoparticles and of the evaluation of their electrochemical performances toward ORR and CO_2RR. The recruited PhD will analyze the data and will monitor bibliographic literature.
The applicant should complete or hold a Master's degree. The candidate should be enthusiastic and has interest in at least one of the following fields: electrochemistry, physical chemistry of surfaces, synthesis and characterization of nano-objects.

Funding : 36-months contract from CNRS (french scientific research organism) with gross monthly salary of 2135 € (netto 1715 €).

Interested applicants are invited to send a CV and a letter of motivation **before June, 15, 2022**.

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