INTERNSHIP OFFERING – Master 2

Electrochemistry of protic ionic liquids

Location & labs: Laboratoire de Réactivité de Surface (LRS) at Sorbonne Université – Paris

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Research project

For new, efficient, durable and safe electrochemical storage systems, the choice of the charge carrier is fundamental. It must be an abundant element with an efficient ionic conduction in the accumulator. The proton/hydrogen couple fulfills these conditions in aqueous media but has limitations related to electrode corrosion and the electrochemical window of water. In the framework of an ANR project involving the ICMPE laboratory in Thiais, we recently develop a new concept of proton batteries using protic ionic liquids (PILs) as non-corrosive electrolytes. Such electrolytes associated with high-capacity negative electrodes used for metal hydride batteries will allow to improve the overall performances of the system. However, this fundamental project faces a key point that is little or not studied in the literature. How do ionic liquids degrade? What are the products formed when repeatedly cycling on the oxidation and reduction walls of the solvent?

In order to better understand the reactivity of these liquids and their degradation, we wish to undertake a detailed analysis of their electrochemical behavior by coupling electrochemistry to other analytical techniques, in particular NMR. First, we want to study the degradation products generated during an electrolysis performed on an inert metal. In a second step, a similar analysis will be carried out on solutions having undergone several ten cycles independently with the materials of the negative and positive electrode. Finally, a mechanistic approach coupling electrochemistry to different spectroscopic techniques will be implemented to identify the proton donor and proton acceptor groups during the successive charge/discharge cycles. In fine, the objective of this work is to understand how the proton is exchanged and if this exchange is accompanied by the degradation of the solvent in order to orientate our choice towards the most stable electrolyte.

Applicant profile

- Student in 2nd year of Master or 3rd year of engineering school with a good background in electrochemistry and/or analytical chemistry
- Autonomous, meticulous, rigorous
- A good level of English is required

Internship period: Ideally from mid-January 2022 for 5 or 6 months