Master thesis project in:

Synthesis and characterization of aromatic heterocyclic compounds for positive electrode materials

Background and objective of the project

The field of organic ion-batteries (OIBs) capitalizes today more than ten years of research to open up many opportunities, essentially focused on the reduction of their weight, of their cost and especially of the environmental footprint they induce.[1] The structural richness of organic compounds endows them with a great capacity of adaptation, making them suitable for the conception of positive and/or negative electrode materials.[2] The interest toward this family is constantly growing and important progresses were achieved these last five years by the scientific community. This is all the more the case as these materials offer specific reactivities such as the insertion of anions into p-type materials.[3] This type of material can then be used in new-generation dual-ion or anionic batteries.[4,5]

Description of the project

As part of a national project, we are aiming to develop new molecular materials based on aromatic heterocycles with tuneable redox properties (e.g. phenothiazine). To this end, we are seeking for a motivated and dynamic trainee who will be tasked with i) synthesising new electroactive molecules, ii) studying their physico-chemical properties and ii) determining their electrochemical properties with a view to their use as positive electrodes. For this project, you should have an interest in organic chemistry, molecular materials and electrochemistry. Previous experience of organic synthesis and characterisation by spectroscopy is essential. In addition, English language skills as well as writing and speaking skills are highly recommended.

References

1. Poizot, P. *et al.* Opportunities and Challenges for Organic Electrodes in Electrochemical Energy Storage. *Chem. Rev.* **120**, 6490–6557 (2020).
2. Schon, T. B., McAllister, B. T., Li, P.-F. & Seferos, D. S. The rise of organic electrode materials for energy storage. *Chem. Soc. Rev.* **45**, 6345–6404 (2016).
3. Murugesan, Rajesh, Becuwe Matthieu & Dolhem, F. Reversible Anion Insertion in Molecular Phenothiazine-Based Redox-Active Positive Material for Organic Ion Batteries. *ChemSusChem* **13**, 2364–2370 (2020).
4. Russo, R. *et al.* High-Output-Voltage and -Energy-Density All-Organic Dual-Ion Battery Using Molecular Thianthrene. *ACS Energy Lett.* 4597–4607 (2023) doi:10.1021/acsenergylett.3c01456.
5. Poizot, P., Dolhem, F. & Gaubicher, J. Progress in all-organic rechargeable batteries using cationic and anionic configurations: Toward low-cost and greener storage solutions? *Current Opinion in Electrochemistry* **9**, 70–80 (2018).

How to apply

Send CV, motivation letter and name of two previous advisors (if possible) to the following email address: matthieu.becuwe@u-picardie.fr (LRCS)

For more information about the hosting laboratory: https://www.lrcs.u-picardie.fr/