

Master thesis project in:

Feasibility study on the cycling of organic materials using SEM operando

Background and objective of the project

The massive electrification of our mobility and daily environment induces a booming interest for the battery field and so an exponential growth of batteries production. The electroactive materials forming the electrodes are mainly composed of metals, extracted from exhaustible minerals, whose world transport and transformation leads to significant energy and environmental costs. Their recycling processes are still in development and the actual recovered quantities will not be able to meet the demand. So, new materials, eco-friendlier, reliable and composed on earth-abundant elements, have to be developed to release pressure on critical raw materials.

A promising solution lies in the use of organic compounds derived from inedible agro-resources and green synthesis process to create sustainable storage energy systems. However, many questions remain about their reactivity and degradation mechanisms (formation of solid electrolyte interphases (CEI, SEI), dissolution, precipitation, ...). A thorough understanding of the electrochemical reactivity mechanisms of organic materials at the micro-scale will enable major advances in the development of organic batteries.

Description of the project

As the observation of micro to nano-scale evolution such as formation of SEI, CEI, dissolution, precipitation processes can be done by Scanning electron Microscopy (SEM) due to its good special resolution, we plan to perform ***in-situ* SEM operando cycling** using home-made electrochemical cells to perform real-time morphological (dissolution, crack formation, SEI ...) and chemical investigation.

However, such type of experiments is a challenge to be done on organic materials due to their possible reactivity under the electron beam and in liquid electrolyte as the SEM chamber is under high vacuum and classical electrolyte (EC/DMC ...) tend to be too volatile. The master student will have to test different electrolytes (EC/PC, glyme, ionic liquid ...) to find a suitable and representative one for *in-situ* experiments as well as test the reactivity of the organic materials in order to perform the first SEM-operando cycling for organic compounds.

For this project, you should have an interest in material chemistry, molecular materials, electrochemistry and electron microscopy. Previous experience of material synthesis and characterisation by spectroscopy would be beneficial. English language skills as well as writing and speaking skills and team working abilities are highly recommended.

How to apply ?

Apply by sending a CV, motivation letter and name of two previous advisors (if possible) to the following email address: carine.davoisne@u-picardie.fr (LRCS) and gregory.gachot@u-picardie.fr (LRCS)

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