Master thesis project in:

Organic batteries with solid-state electrolytes

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, from the production to the recycling of electrode materials and organic batteries. 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. The interest toward this family is constantly growing and important progresses were achieved these last five years by the scientific community. However, there is still some challenges to be overcome to make the organic alternative comes true. One aspect that limits performances of OIB is the solubility in the liquid electrolyte of the most efficient molecular compounds (i.e. benzoquinone, nitroxide…). Usually, this drawback is overcome by the adjunction of an ionic fragment or by the use of a polymer backbone both bringing an important contribution to the molecular weight and causing a decrease of the specific capacity of the material. One promising option, which is presently strongly investigated to solve safety issue of battery based on inorganic materials, is the replacement of the liquid electrolyte by a solid-state material able to drive ion quickly between both electrodes. Few studies in this field associate organic materials (positive electrode) with metallic anode using organic polymers, hybrid material including ionic liquid or even thiophosphate.

Description of the project

The research project aims at building and test full organic solid-state battery composed of low-molecular weight organic electrode materials with liquid-free electrolytes. First step will consist in formulating electrodes (active material, conductive additive and liquid-free electrolyte) and investigate chemical stability using different characterization tools available in the laboratory. Secondly, electrochemical characterization of formulated electrodes will be realized in order to select best composite electrode for the cell building, finality of the project

For this project you should have an interest in battery assembly and electrode formulation. Prior experience in electrochemistry, electrode formulation and cell assembly are beneficial.

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