Institut Charles Gerhardt Montpellier
UMR 5253 CNRS-UM-ENSCM
Pôle Chimie Balard Recherche
1919, route de Mende
34293 Montpellier cedex 5 - France

Lorenzo Stievano, Professor
lorenzo.stievano@umontpellier.fr
Tel: +33 (0)4-48 79-21 00
http://www.icgm.fr

Master 2 Internship – Université de Montpellier

Optimization of an all-solid-state monomaterial battery based on Li_6PS_5Cl (LPSC)

Project description: All-solid-state batteries (ASSBs) are currently attracting growing interest as next-generation energy storage devices due to their thermal stability and improved safety compared to conventional liquid electrolyte-based batteries. In this context, the solid electrolyte Li_6PS_5Cl (LPSC) has gained significant attention in recent years thanks to its exceptional Li^+ conductivity, comparable to that of traditional liquid electrolytes.

This material, however, suffers from limited electrochemical stability at the operating potentials of conventional active materials (both anodic and cathodic) used in Li-ion batteries. Beyond its good ionic conductivity, LPSC also exhibits an intrinsic ability to store and release lithium ions, which makes it a promising candidate for developing an "all-solid monomaterial" battery.

Our recent work has demonstrated that the ion exchange capacity of LPSC strongly depends on the electrode preparation method. Within this project, the student will be responsible for optimizing the ball milling parameters used to prepare LPSC-carbon composites, evaluating the type of carbon additive, and tuning the electrochemical cycling conditions to enhance the reversible capacity of the battery over multiple cycles.

The internship will include:

i) Preparation of LPSC/carbon mixtures using various ball milling procedures and carbon types;
ii) Characterization of the resulting LPSC-C composites (XRD, SEM, MAS-NMR, EIS) to correlate their structure and morphology with electrochemical performance;
iii) Assembly and galvanostatic testing of symmetric LPSC–C | LPSC | LPSC–C cells;
iv) (If time permits), *post mortem* analysis of cycled cells.

By the end of the internship, the student will have gained hands-on experience in materials synthesis and characterization, as well as in electrochemistry, particularly in the field of ASSBs.

Candidate profile: The internship is intended for a highly motivated Master 2 student interested in an innovative project with strong fundamental research aspects and potential industrial applications. A strong curiosity for learning and enthusiasm for experimental work are essential. No advanced prior knowledge in physical chemistry or electrochemistry is required, although previous laboratory experience, particularly in materials chemistry, would be an advantage.

Duration: 6 months (February - July 2025)

Supervisors: Lorenzo Stievano, lorenzo.stievano@umontpellier.fr
Gabriele D'Aiuto, gabriele.d-aiuto@umontpellier.fr