

PhD position

Réseau sur le stockage électrochimique de l'énergie

Synthesis and study of Li-rich solid solution alloys as anode for solid state batteries

Co-supervised research :

Lab #1: LRCS**Supervisor : Dominique LARCHER****e-mail : dominique.larcher@u-picardie.fr****Lab #2: CSE – CdF****Supervisor : Jean-Marie TARASCON****e-mail : jean-marie.tarascon@college-de-france.fr**

The topic of this PhD relies on the synthesis and study of Li-based solid-solution alloys as negative electrodes for Li batteries, with the goal of improving their electrochemical reversibility. We will focus on the control of the Li dendritic growth, which largely impedes its use, either with organic liquid electrolyte or in “all solid state” inorganic configurations.

These binary alloys (Li-Mg) alloys will be prepared via 1) metallurgical means, by melting of the elemental metals, 2) electrochemical means, by reacting Li with Mg in lab cells, and 3) by chemical means using, for instance, metathesis reaction between Li_3N and Mg. The as-produced materials will be analysed with various techniques in order to check their chemical purity (AA, ICP, DSC), their structure (XRD) and their morphology (optical and electronic microscopies). Their evolution upon cycling will be monitored via electrochemical means (Galvano, GITT, CV ...) and different in-situ techniques, in classical and also in specifically designed cells, in both « liquid » and « all solid-state » configurations. For the “all solid-state” versions, the shaping and processing of the alloy electrodes will represent an essential point to be mastered.

Along that track, this survey will also take advantage of the structural specificities of the Li-Mg phase diagram (wide solid-solution domains) to 1) study some kinetic issues such as the time required for a return to equilibrium (i.e. homogeneous alloy) after a fast charge/discharge, and 2) determine the individual impact of the electrode/particles swelling, of the unit cell dimensions, and of the phase transitions onto the overall reversibility of such metallic electrodes. Here, also, a close comparison between the “liquid” and “solid” electrolytes configurations will potentially be teaching a lot.

This PhD, funded by the RS2E network, will be co-supervised by LRCS (Dominique Larcher, Mathieu Morcrette) and Collège de France (Jean-Marie Tarascon), with a strong contribution of the Prototyping Unit (Amiens, RS2E), for the cell design for instance.

In addition to curiosity and to a solid background in materials sciences, the PhD student should have skills in experimental creativity, a deep team spirit, and be naturally prone to ideas/knowledge sharing. These are mandatory pre-requests.