

Modelling Li concentration in Li-ion battery material: the case of the promising NMC (811)

Project Description

Fast charging of Li-ion battery, which depends on the dynamics of Li^+ ion in the bulk of electrode materials, is crucial to enable a widespread use of electric vehicles. $\text{LiNi}_{0.8}\text{Mn}_{0.1}\text{Co}_{0.1}\text{O}_2$ (NMC811) and $\text{Nb}_{16}\text{W}_5\text{O}_{55}$ (NWO) have been identified as a promising electrode material but their performance at high charging speed can still be improved by further understanding the charging process, especially the inhomogeneity of the Li concentration inside the particle.

The aim of the project is to model Li concentration in NMC 811 and NWO particles during Li removal/extraction at different speed. The project will start by doing a literature survey of Li-ion battery, Li-ion cathode/anode materials and NMC 811/NWO. Then, the student will extract the required parameters for the modelling such as diffusion coefficient, voltage profile from the literature and existing data set. At last, the supervisor (Dr. Quentin Jacquet – Grey group Cambridge University) will provide a software that models the variation of the Li concentration at a particle scale (Matlab), and the student will perform the simulations, extract and plot the results. The results will help to understand optical characterization that has been performed to visualize Li concentration.

Due to the ongoing COVID-19 situation, the entire project will be running remotely, unless the existing restrictions are removed.

Project Goals

In conducting the project, the student will gain a general knowledge on Li-ion batteries and on the challenges of electrode materials. More specifically, the student will learn how to extract diffusion coefficient from electrochemical experiments and how to model Li diffusion. Throughout the project, the student will interact with experts in different domains from the group.

As part of The Faraday Institution's 2020 intern cohort you will enter an end-of-project poster competition – the winners of which will be invited to present their poster at the Faraday Institution Conference in November 2020.

Eligibility

In order to partake in the project you must be:

- A full-time registered undergraduate student at a UK university
- Undertake the internship within the years of undergraduate study (i.e. not be currently in your final year)

Funding

A salary of £9.30/hour across the UK or £10.75/hour in London will be provided. This will be determined by the working address of the appointee not the universities location. The internship is a full-time role for 8 weeks beginning in early July. The funding is provided by The Faraday Institution.

Deadline

Please send your two page CV and a no more than one page cover letter to sm2383@cam.ac.uk by 8 June.

For project information, please visit <https://faraday.ac.uk/research/lithium-ion/extending-battery-life/>