THE FARADAY INSTITUTION Modelling
MULTI-SCALE MODELLING

Lancaster University

Investigation of compression effects on pouch cells using EIS and P2D modelling.

Project Description

Single-layer pouch cells are widely employed as model systems for prototyping and parametrization. As a rule of thumb, laboratory pouch cell measurements are carried out under a clamped system, using forces chosen arbitrarily based on some empirical indication that electrical contact is sufficiently good whereas resistance is not compromised. Often, this practice is not properly reported or tested exhaustively by the experimenter. We recently developed test rigs that allow us to evenly distribute the pressure on the pouch systems, while accurately measuring the load – at different levels. In addition, although known to impact battery performance and cycle-life, pressure is not a variable explicit in physics-based models. In this work we want to comprehend the role of pressure by identifying the effects on the OCV and different resistances obtained at potentiostatic impedance spectroscopy, using the single-layer cells at different compressed levels. We hope to use our gained understanding on static compression effects to translate pressure dependency into physics-based battery modelling framework, using e.g. Dandeliion and PyBAMM architectures. This is an opportunity for an interested intern to gain experience with battery cyclers and nonintrusive characterisations tests e.g. differential voltage analysis (DVA) and electrochemical impedance spectroscopy (EIS) as well as experience with numerical simulation tools such as PyBAMM and Dandellion.

Project Goal

The overall project splits into three work packages:1) experimental derivation of Nyquist curves for single-layer lithium-ion battery pouch cells compressed and un-compressed, 2) experimental derivation of open circuit voltage curves for single-layer pouch cells compressed and un-compressed and 3) simulation of the compressed and uncompressed systems using Dandellion/PyBAMM. By joining our diverse team at Energy Lancaster, you will be contributing by using our novel pressure test rig to i) develop standardised ways of testing and reporting results and ii) consensus on why optimum pressure levels are beneficial to the battery.

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 £9.50/hour across the UK or £10.85/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 6-8 weeks beginning in June-early July. The funding is provided by The Faraday Institution.

The criteria for selection will be:

Essential: a clear rationale for applying for the position and how it fits with the candidate's career goals.

Essential: evidence of interest and motivation for the research area.

Essential: ability to document work done and flexibility to discuss slides on ongoing results of the project with the supervisor weekly, and update the supervisor promptly on any challenges faced.

Essential: some experience with Python programming language.

Desirable: experience in battery or experimental electrochemical characterisation.

Deadline: please send your CV and a brief cover letter to k.nwanoro@lancaster.ac.uk or a.zulke@lancaster.ac.uk by 7th May 2021.