**Exciting PhD opportunity with the** [**Faraday Institution**](https://faraday.ac.uk/)**.**

Looking for a battery related career that contributes to creating a sustainable future? Keen to join a dynamic community of pioneering battery researchers seeking to find solutions to support a fully electric future?

The Faraday Institution Cluster PhD researchers receive an enhanced stipend over and above the standard EPSRC offer. The total annual stipend is approximately £20,000 (plus London weighting where applicable) plus an additional training and consumables package worth £7,000. Recipients will have access to multiple networking opportunities, industry visits, mentorship, internships, as well as quality experiences that will further develop knowledge, skills, and aspirations. [Read more](https://faraday.ac.uk/education-skills/phd-researchers/).

Take a look at the bespoke [training programme](https://www.faraday.ac.uk/wp-content/uploads/2021/11/Faraday-Institution-PhD-Training-Guide-2021-22-1.pdf) on offer.

**University:** The University of Sheffield (UoS) and ISIS Neutron and Muon Source (ISIS)

**Project title:** Developing a complementary set of *in-operando* Small Angle Neutron Scattering and Neutron Reflectometry cells to study the dynamic behaviour of the SEI in ion batteries.

**Project description:**

**Broader context**

The ion battery (IB) is a revolutionary device that has played a key role in humanity’s most recent technological leap by enabling the portable electronic era. Now that a clear path towards a more sustainable future had been defined through the [UN’s seventeen Sustainable Development Goals](https://www.un.org/sustainabledevelopment/sustainable-development-goals/), the IB has been globally chosen as one of the main technologies that is needed to achieve the highly ambitious, but crucial [net-zero](https://www.iea.org/reports/net-zero-by-2050) energy supply. Despite being on the verge of making the [full electrification of the transportation sector](https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030) possible, IBs still face several performance challenges before they can realise their full potential. Increasing the capacity, charge/discharge rates, and lifetime are at the core of IB optimisation, and understanding the mechanisms behind the phenomena occurring within the device during charge and discharge is paramount to achieve it.

**Research question**

One of the main challenges towards improving the performance (capacity, rate, and cyclability) of ion batteries is understanding andmanipulating the electrolyte-electrode interface. As soon as the electrolyte is put in contact with the electrodes, a passivation layer starts to form whose dynamic composition, size, and characteristics depend on the operating conditions of the battery. This layer is commonly known as the [solid electrolyte interface (SEI)](https://iopscience.iop.org/article/10.1149/2.1441707jes) and serves as an ion-permeable barrier that blocks electrons allowing it to prevent the further reaction between the electrolyte and the electrodes. However, the SEI also consumes active electrolyte and electrode materials resulting in reduced battery performance, and in some cases, battery failure. Due to the crucial function and complex nature of the SEI it is widely recognised as ‘the most important and the least understood component in ion batteries’. One of the main reasons for such poor understanding is the limited capability of most characterisation techniques to accurately probe and describe the SEI dynamics as the battery is cycled. In this regard, small angle neutron scattering (SANS) and neutron reflectometry (NR) are excellent complementary techniques capable of tracking the change in composition, size, and shape of light-element containing buried surfaces and interfaces such as the SEI. However, while SANS and NR are ideal to study the SEI, the main challenge is to design cells that that can perform well electrochemically during characterisation, commonly referred to as an *in-operando* experiment, and allow the collection of meaningful data.

**Scientific aims:** The primary aim of the project is todevelop a complementary set of *in-operando* cells for SANS and NR experiments initially tailored to the materials developed by the supervisory team and partner collaborators. It is expected that the design of the cells will evolve as more findings about the investigated battery systems are obtained and respective specific research needs change. The secondary aim of the project is to provide new knowledge and understanding about the SEI dynamics in at least one Li-based and one Na-based battery systems.

**Start date:** 3rd October 2022

**Supervisor:** Dr Alisyn J. Nedoma (UoS, [a.nedoma@sheffield.ac.uk](mailto:a.nedoma@sheffield.ac.uk)), Gabriel E. Pérez (ISIS, [gabriel.perez-garcia@stfc.ac.uk](mailto:gabriel.perez-garcia@stfc.ac.uk)), Emily Reynolds (ISIS), Venkateswarlu Daramalla (University of Cambridge)

**Eligibility:**

Applications are welcome from home and international students (although places for international students are limited. Please see [[UKRI guidance](https://www.ukri.org/wp-content/uploads/2021/03/UKRI-170321-InternationalEligibilityImplementationGuidance.pdf)](https://www.ukri.org/wp-content/uploads/2021/02/UKRI-030221-Guidance-International-Eligibility-Implementation-training-grant-holders-V2.pdf) for more details).

We are looking for a highly motivated individual looking to build a research and development career profile in specialist advanced materials characterisation techniques that offer solutions to some of the main technological challenged faced by society. You should have or be close to completing a BSc/Masters in Mechanical Engineering, Materials Science, Chemistry, Physics or a related STEM discipline. Mature students and candidates with equivalent industry experience are welcome to apply. The project will require dissemination of results both nationally and internationally so you will have multiple of opportunities to travel both nationally and internationally. The highly collaborative nature of the project would also require you to have good interpersonal skills and a cooperative work ethic. If English is not your first language then you must have an International English Language Testing System (IELTS) average of 6.5 or above with at least 6.0 in each component, or equivalent.

The successful candidate will work on a well-defined project with clear goals, deliverables, and schedules, and will be mainly based at the top 100 ranked [University of Sheffield](https://www.sheffield.ac.uk/cbe) where most of the cells assembly and electrochemical testing will be carried out. One year will be spent at the world-class central facility [ISIS Neutron and Muon Source](https://www.isis.stfc.ac.uk/Pages/home.aspx) to work on the cell design and to perform tests in the neutron beam. Some short-term visits to collaborating universities will also be required to work on different specialist processing techniques for the materials used in this project. The duration and frequency of the research visits will be dependent on research needs, project circumstances, and travel restrictions. It is also highly likely that non-UK based neutron sources will need to be visited for this project or to support partner collaborators with their experiments. This includes the writing or supporting for writing of proposals for beamtime.

**Application:**

In order to apply for a Faraday Institution PhD position, you need to do both of the following:

1. Complete a Faraday Institution [expression of interest form](https://www.surveymonkey.co.uk/r/7ZVPYRB)
2. Follow the instructions to apply in the University of Sheffield’s website, [https://www.sheffield.ac.uk/cbe/postgraduate/phd/how-apply](https://www.findaphd.com/common/clickCount.aspx?theid=133642&type=184&DID=1390&url=https%3a%2f%2fwww.sheffield.ac.uk%2fcbe%2fpostgraduate%2fphd%2fhow-apply). Please include the name of your proposed supervisor and the title of the PhD project within your application.

**Diversity**

**The Faraday Institution**

The Faraday Institution is committed to creating a dynamic and diverse pool of talent for the fields of battery technology and energy storage.

**The University of Sheffield**

The University of Sheffield is committed to equality of opportunity and to fostering good relations, for students and prospective students.

It is the University's policy to treat all students with dignity and respect, irrespective of protected characteristics, as defined by the Equality Act 2010. The University aims to enact this in all its functions:

* Access and recruitment.
* Admissions and retention.
* Assessments and progression.
* Provision of student services and related facilities.
* Teaching, learning, examining, curriculum development and quality assurance.
* Research.
* Community links and partnerships.

The aim of the policy is to ensure that all students and prospective students are treated equally, irrespective of race, colour, nationality, ethnic origin, sex, gender reassignment, sexual orientation, marital (including civil partnerships) or parental status, pregnancy and maternity, age, disability, religion and belief or socio-economic class or spent criminal convictions.

The University's Equality, Diversity and Inclusion Policy for students is augmented by specific policies on personal harassment and the support of students with disabilities.

It reflects and complements the University's Equality and Diversity Policy and Code of Practice for Staff. It operates within the context of relevant equalities legislation.

**ISIS Neutron and Muon Source (STFC, UKRI)**

How we support EDI in the workforce

At UKRI, we believe that everyone has a right to be treated with dignity and respect, and to be provided with equal opportunities to thrive and succeed in an environment that enables them to do so. We also value diversity of thought and experience within inclusive groups, organisations and the wider community. For further information, please visit ‘How we support EDI in the workforce’.

Disability Confident Employer

As users of the disability confident scheme, we guarantee to interview all disabled applicants who meet the minimum criteria for the vacancy/ies. We will ensure that individuals with disabilities are provided reasonable accommodation to participate in the job application or interview process, to perform essential job functions, and to receive other benefits and privileges of employment. Please contact us to request accommodation.