ESRF | The European Synchrotron

Master student traineeship proposal

Title:

Understanding Cation Effects on Electrochemical Lithium Plating

Abstract:

Electrochemical lithium (Li) plating is a key process in emerging technologies like Li-metal batteries and the lithium mediated nitrogen reduction reaction (Li-NRR). Li-metal batteries have the highest theoretical capacity of any Li based battery and the Li-NRR provides a potential alternative to the energy intensive Haber-Bosch process. In both systems Li is electrochemically deposited from an organic electrolyte. Reactions of the deposited Li with the electrolyte lead to the formation of the solid electrolyte interphase (SEI) which is critical for the overall performance of the system.

A recent study has shown that the addition of small amounts of different cations (Na^+, K^+, Cs^+, etc.) to the electrolyte has a strong impact on Li-NRR performance. Dependent on the cation ammonia production is either enhanced or almost completely prevented [1]. These effects are likely related to differences in the SEI layer caused by the addition of different cations. Initial grazing incidence wide angle X-ray scattering measurements also indicate that the addition of different cations impacts the Li plating behaviour as a much larger number of Li-crystallites was observed throughout the whole experiment when a cation additive had been added to the electrolyte.

Therefore, the aim of the project is to systematically study different cation additives and their impact on Li-metal batteries and the Li-NRR. The project will consist of the electrochemical characterization of Li plating from electrolytes containing different cation additives and the characterization of the resulting deposits with (operando) WAXS and SAXS at ID31 [2].

References:

[1] S. Zhai, N. H. Deissler et al., manuscript submitted, 2026

[2] N. H. Deissler et al., Energy Environ. Sci., 2024, 17, 3482–3492.

Scientist in charge:
Jakub Drnec

Beamline(s)/Host Group:
ID31

Traineeship supervisor(s):
Niklas H. Deissler

Access to Instruments/labs/computing/software: Electrochemistry Lab

Starting date and Duration:
Flexible

Contact : jakub.drnec@esrf.fr - niklas.deissler@esrf.fr