

## Electrode meets Electrolyte: Studying the Solid Electrolyte Interphase in Batteries using Photoelectron Spectroscopy

Julia Maibach

Institute for Applied Materials – Energy Storage Systems, Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, julia.maibach@kit.edu

The performance of rechargeable ion batteries such as lithium- and sodium-ion batteries largely depends on the chemistry developed at the electrode/electrolyte interface. At the negative electrode, the solid electrolyte interphase (SEI) forms from electrolyte decomposition products. This interphase is crucial for safe and stable battery operation. Therefore, significant research efforts have been focused on understanding SEI composition and functionality. However, almost 40 years after the first SEI model was described, we still do not have a complete picture of its formation and aging processes. This is a testament to both the complexity of the electrode/electrolyte interactions and the scarcity of suitable characterization tools.

In this talk, we will present photoelectron spectroscopy approaches for battery interface characterizations showcasing key challenges when analyzing electrodes and electrolytes.

Starting from so called post-mortem SEI studies for Li-ion batteries, we will show how we have to rethink our experimental approach for Na-ion batteries [1] as well as for all solid-state batteries [2]. Finally, we will discuss our findings on using near-ambient pressure photoelectron spectroscopy to study liquid battery electrolytes and approach the solid/liquid interface [3,4].

[1] K. Pfeifer, S. Arnold, J. Becherer, C. Das, J. Maibach, H. Ehrenberg, S. Dsoke, *ChemSusChem* (2019), 12, 3312-3319.

[2] F. Strauss, J. H. Teo, J. Maibach, A-Y. Kim, A. Mazilkin, J. Janek, Torsten Brezesinski, *ACS Appl. Mater. Interfaces* (2020), 12, 51, 57146–57154.

[3] J. Maibach, I. Källquist, M. Andersson, S. Urpelainen, K. Edström, H. Rensmo, H. Siegbahn, and M. Hahlin, *Nature Communications* (2019), 10, 1-7.

[4] P.M. Dietrich, L. Gehrlein, J. Maibach, A. Thissen, *Crystals* (2020), 10, 1056.