Electrolyte Degradation and Interphase Formation Processes in Potassium-Ion Batteries

Freya J. Müller¹, Franziska Allgayer², Sandro Schöner², Andreas Hofmann¹, Fabian Jeschull²

¹ Karlsruhe Institute of Technology (KIT), Institute for Applied Materials – Material Science and Engineering (IAM-WK), 76344 Eggenstein-Leopoldshafen, Germany,
² Karlsruhe Institute of Technology (KIT), Institute for Applied Materials – Energy Storage Systems (IAM-ESS), 76344 Eggenstein-Leopoldshafen, Germany

Inactive materials Matter: How binder amounts affect cycle life of K-graphite half cells

Strong relation between binder content and capacity retention (independent in case of Li-half cells)
Coulombic efficiency is greatly improved with higher binder contents

We aim to find overarching trends between alkali metal batteries along the periodic table and to understand degradation mechanisms at the electrode-electrolyte interface

Comparing the SEI on Graphite in Li- vs. K-half cells

Graphite electrode:
x wt.% binder (PAA-CMC)
1 wt.% SuperC65
99 x wt.% active material
Electrolyte:
EC:DEC (v:v = 1:1)
750 mM KPF₆ or LiPF₆
→ As many process and cell parameters as possible remained the same

Quantitative GC-MS Analysis on soluble degradation products

Steady-state DEDD concentration is an order of magnitude lower than for DMDD.

Reactions in presence of K-metal

- Soluble degradation products rapidly accumulate in liquid electrolytes
- Reaction rates are much faster than for Li and Na (not shown)
- The ethyl groups in DEC appear chemically more stable against degradation

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Contact: fabian.jeschull@kit.edu

Liquid, carbonate-based electrolytes form detrimental degradation products in the electrolyte. At the electrode interface the SEI layer is more ‘organic’ leading to more rapid dissolution and recurrent electrolyte reduction.