

# Electrolyte Degradation and Interphase Formation Processes in Potassium-Ion Batteries

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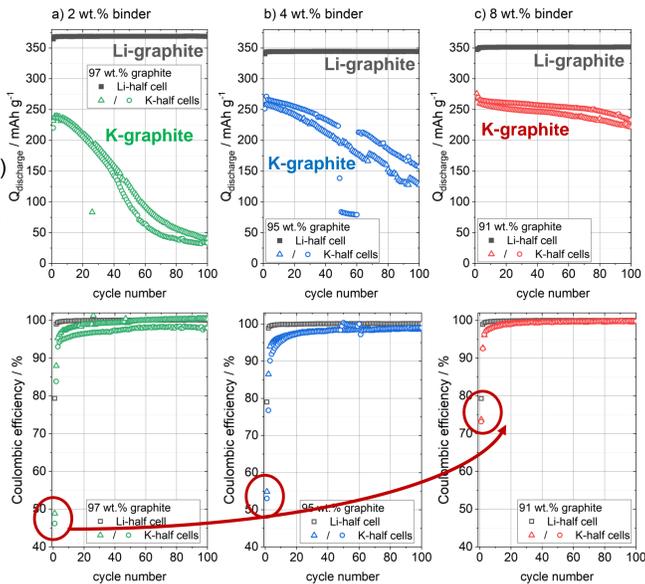
## Inactive materials Matter: How binder amounts affect cycle life of K-graphite half cells

Li-graphite half cells  
versus  
K-graphite 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 KPF<sub>6</sub> or LiPF<sub>6</sub>

→ As many process and cell parameters as possible remained the same



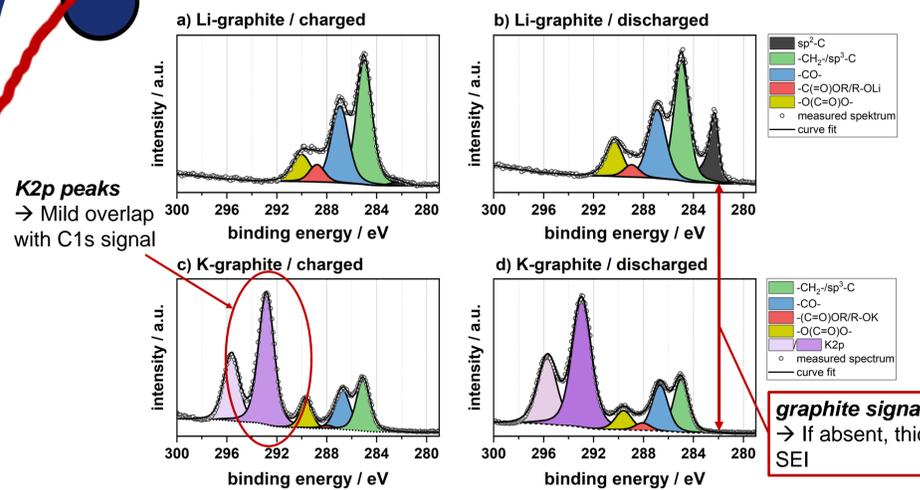
F. Jeschull, J. Maibach, Electrochem. Commun. 121 (2020) 106874.  
<https://doi.org/10.1016/j.elecom.2020.106874>

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

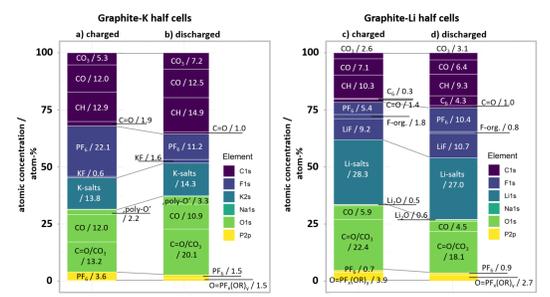
## Comparing the SEI on Graphite in Li- vs. K-half cells



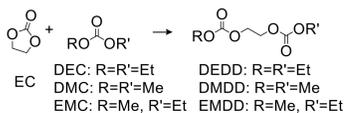
F. Allgayer, J. Maibach, F. Jeschull, ACS Appl. Energy Mater. 5 (2022) 1136–1148.  
<https://doi.org/10.1021/acsaem.1c03491>

The SEI formed in K-half cells:

- is significantly thicker
- contains fewer inorganic salts, particularly KF
- contains more PPF<sub>6</sub> residues (harder to wash off)
- is more 'organic' and undergoes bigger changes

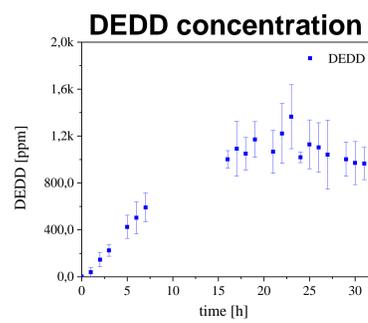
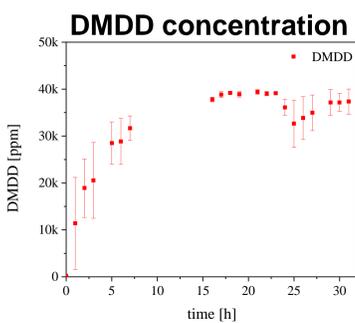
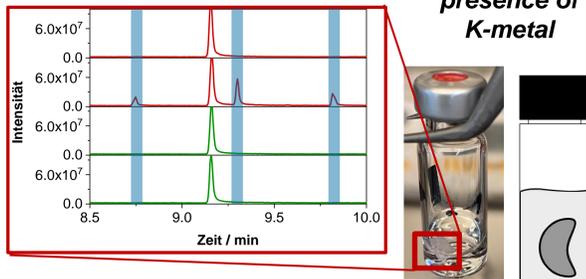


## Quantitative GC-MS Analysis on soluble degradation products



Reactions in presence of K-metal

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



(note the different scaling)

- 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

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.

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