

# Graphite for K-ion Batteries: Stability and Formation of SEI layer

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Despite Li-ion battery (LIB) technology dominating the global market for portable energy storage, the increased use of portable electronic devices and electric vehicles has directed the scientific research to explore other chemistries such as Na-ion batteries (NIBs) and K-ion batteries (KIBs) [1]. Although Li has the lowest metal atomic mass, the higher abundance of Na and K in the Earth's crust could play a crucial role to lower cost of rechargeable batteries. The advantage with K-ion compared to Na-ion batteries is a lower redox potential of K<sup>+</sup>/K compared to Na<sup>+</sup>/Na. Carbon-based materials such as graphite, hard or soft carbon have been reported to be suitable as anode in KIBs [2]. Graphite has shown to form KC<sub>8</sub> with a stage-1 structure [3], reaching a reversible capacity of 244 mA h g<sup>-1</sup> [4].

In this study, electrochemical performances of graphite cycled vs. K metal were widely investigated by means of voltammetry and galvanostatic techniques. Half-cell configuration provided high capacities and good capacity retention upon cycling using K metal as counter electrode, 0.8 M KPF<sub>6</sub> in EC:DEC (1:1) as the electrolyte, and graphite (SLP30, TIMCAL)/PVDF (4:1) as the working electrode. In particular, 345 mA h g<sup>-1</sup> was reached after the first discharge with a capacity retention of around 63 %. The capacity density, however, decreased to 250 mA h g<sup>-1</sup> in the following cycles, which is lower than the theoretical capacity of KC<sub>8</sub> (278 mA h g<sup>-1</sup>) [3]. Upon cycling, a moderate capacity degradation was shown, maintaining a value higher than 150 and 100 mA h g<sup>-1</sup> up to 125 and 200 galvanostatic cycles, respectively (figure 1).

To understand the mechanism of capacity fading, synchrotron-based hard X-ray photoelectron spectroscopy (HAXPES) and Raman spectroscopy were used to characterize the composition of the solid electrolyte interphase (SEI) at various stages of the first galvanostatic cycle.

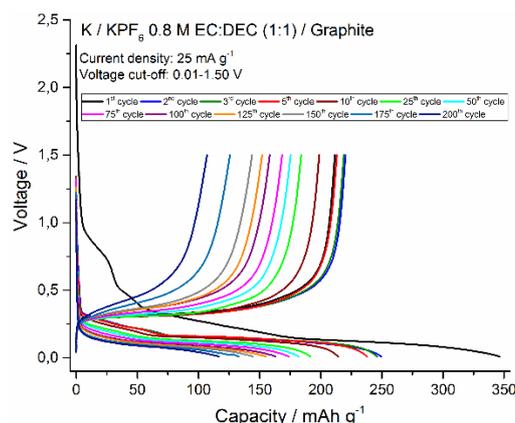


Figure 1. Galvanostatic cycles of graphite vs. K metal in half-cell configuration.

## References:

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