

## **Lithium plating - a critical side reaction in lithium ion cells**

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Lithium deposition on graphite anodes is an unwanted side reaction in lithium ion batteries, which significantly contributes to accelerated ageing of the cells. Lithium deposition is connected not only to a drastic decrease of life-time, but also limits fast-charging capability and can cause severe safety issues due to increased exothermic reactions [1]. The reason for lithium deposition are polarization effects, which lead to negative anode potentials vs.  $\text{Li/Li}^+$ , which can be determined by reference electrode measurements [2]. Lithium plating is promoted by charging at high rates, high SOCs and low temperature. Local variations of the anode potential can for example be caused by temperature gradients, differences in current density or by local inhomogeneity in lithium ion cells. These local differences of the anode potential can lead to non uniform lithium deposition.

The presentation will summarize results from different types of lithium ion cells, which have been cycled using various operation conditions and have been analysed by post mortem analysis using complimentary analytical methods. The presentation will discuss causes, hints and proofs for lithium deposition, the morphology of lithium deposition/plating, the impact of lithium plating on ageing mechanisms and shapes of capacity fade curves and the influence of lithium plating on safety. Although often discussed, safety issues regarding Li deposition are not only limited to dendrite growth and internal short circuits, but also to exothermic reactions and other properties of Li metal. Furthermore, routes to predict and reduce lithium plating in cells will be discussed including strategies for optimized electrode microstructure, cell design and optimized charging profiles.

### References:

- [1] M. Fleischhammer et al., J. Power Sources. 274 (2015) 432–439.
- [2] T. Waldmann et al., J. Electrochem. Soc. 163 (2016) A1232–A1238.

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