Investigation of degradation in lithium-ion batteries during drive cycle operation using electrochemical simulations

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The performance and durability of lithium-ion batteries can be heavily impacted by different degradation mechanisms. One of the most prominent during low temperature or high current charging is the deposition of metallic lithium on the surface of the negative electrode. These conditions are often met during the charging or driving of EVs. To allow for a longer battery life the understanding of lithium plating is vital. The experimental approaches towards detection of lithium plating are difficult or not applicable in consumer devices. The utilization of electrochemical simulations to investigate degradation mechanism and predict possible design optimizations is therefore crucial to the advance of lithium-ion batteries.

Postmortem studies on degraded electrodes showed a inhomogeneous distribution of lithium plating [1]. The impact of spatial variations in the electrode porosity on the plating onset [2] and spatial distribution of lithium plating is investigated using the framework BEST [3], [4]. A pouch cell geometry consisting of NMC and graphite electrodes is selected as model system [5]. Special attention is given to the degradation susceptibility of lithium-ion batteries during drive cycles such as the WLTP [6]. Regions of local inhomogeneity show a different behavior than the bulk regions.

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