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Effect of Si content within Silicon-Graphite anodes on performance and Li concentration profiles using NDP and conventional electrochemical techniques

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Although addition of silicon to a conventional pure graphite anode leads to a large increase in energy densities, profound morphological changes associated with it, due to repeated (de-)lithiation, may lead to rapid degradation in cell performance. A reversible (de-)lithiation of Li-ions and the formation of a homogenous SEI layer in the initial cycles is therefore crucial.

In this work, we use conventional electrochemical techniques to quantify in-situ the amount of active Li-ions. The electrochemical analysis was conducted using coin-half-cells out of different silicon-graphite (SiG) combinations against lithium chip, as the counter electrode.

Furthermore, we utilized neutron depth profiling (NDP) for an ex situ technique to quantify lithium content, accumulated in SEI as inactive lithium, in different electrode combinations. Here, the coin-half-cells were brought to the desired depth-of-discharges (DODs), using constant current rate of 0.05 h⁻¹. Moreover, the electrodes were extracted and dried under argon atmosphere before conducting the NDP measurements.

The focus lies on the delithiation phase after fully lithiating the electrode samples. Finally, a comparison of Li contents extracted from the two methods is represented. The results show the Li density profiles across the electrode coatings (surface and bulk) for each SiG combination.

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