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Lithiation dynamics of graphite anodes investigated by in operando neutron diffraction

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In lithium ion batteries the most commonly used anode material is graphite. The lithiation dynamics of graphite anodes is of crucial importance in respect to fast charging or low temperature charging of the cells, as well as aging processes can depend on the intrinsic lithiation properties. Commonly known issues have recently shown that even small effects can cause detrimental lithium plating and can impose a huge security issue.

A fine understanding of the dynamic lithiation processes in commercial type cells is important to optimize the cell design and material properties in order to avoid security issues as well as unexpected performance deterioration due to fast aging.

We have studied the lithiation dynamics at low and high temperature in commonly used 18650-type cells with in operando neutron diffraction and could show for the first time that intermittent Li plating can be observed even under not too harsh conditions. The Li plating has been elusive for a long time as our studies also reveal that the majority of the intermittently plated lithium is dissolved during very short relaxation times at room temperature and only remains for many hours at low temperature. The relaxation time is strongly dependent on temperature.

[1] Zinth, V., C. von Lüders, M. Hofmann, J. Hattendorff, I. Buchberger, S. Erhard, J. Rebelo-Kornmeier, A. Jossen and R. Gilles, 2014, Journal of Power Sources, 271, 152-159.

[2] Zinth, V., C. von Lüders, J. Wilhelm, S. V. Erhard, M. Hofmann, S. Seidlmayer, J. Rebelo-Kornmeier, W. M. Gan, A. Jossen and R. Gilles, 2017, Journal of Power Sources, 361, 54-60.

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