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Dynamics of lithium-concentration in 18650-type lithium-ion batteries during electrochemical cycling

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Electrochemical cycling of lithium-ion batteries is supplemented by the active transport of lithium ions and electrons, which are exchanged between the cathode and anode material. Besides material properties, such exchange is facilitated by cell parameters like electrode dimensions and geometry, current density, temperature, pressure, reaction rate etc. Such parameters are neither uniformly distributed nor static in general and, therefore, serve as stabilizing factor of heterogeneous states in Li-ion batteries typically reflected in the lithium concentration distribution in the electrodes [1, 2].
In most studies reported in the literature the lithium distribution was typically probed in the static equilibrium (for example in the fully charged state in the graphite anode), neglecting the evolution of the distribution under real charging conditions, influence of C-rates etc.
In this work, the evolution of the lithium-ion distribution in the graphite anode was studied in operando using spatially-resolved neutron powder diffraction. Neutron data were complemented by diffraction studies using high energy photons; occurrence of lithium inhomogeneities on different length scales and their dynamics was observed and will be presented in current contribution.

1. Senyshyn, A., et al., Homogeneity of lithium distribution in cylinder-type Li-ion batteries. Scientific Reports, 2015. 5(1): p. 18380.
2. Petz, D., et al., Heterogeneity of Graphite Lithiation in State-of-the-Art Cylinder-Type Li-Ion Cells. Batteries & Supercaps, 2021. 4(2): p. 327-335.

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