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Lithium Distribution in 18650-type Li-ion batteries over its lifetime

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During the electrochemical cycling of lithium-ion batteries, ionic and electron transfer occur simultaneously, i.e., lithium ions and electrons are exchanged between positive and negative electrodes. Besides the material's properties, such an exchange is influenced by cell characteristics, such as electrode dimensions and geometry, current density, temperature, pressure, reaction rate, etc. In cell designs adopting high volumetric and gravimetric densities, these parameters are neither uniformly distributed nor static in general and, therefore, serve as stabilizing factors of heterogeneous state in Li-ion batteries, which is typically reflected in the non-uniform distribution of the intercalated lithium in the electrodes [1, 2].

Previous studies revealed the modification of the lithium-ion distribution in the graphite anode of 18650-type lithium-ion batteries upon increasing cell aging [3]. The current research investigates this effect in detail on quasi-identical commercial cells with different stabilized aging states by applying spatially resolved neutron powder diffraction. Details of lithium distribution over the lifetime of a commercial 18650-type lithium-ion battery were determined.

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.
3. Mühlbauer, M.J., et al., Inhomogeneous distribution of lithium and electrolyte in aged Li-ion cylindrical cells. *Journal of Power Sources*, 2020. 475: p. 228690.

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