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Influence of temperature on the aging behavior of 18650-type lithium ion cells: A comprehensive approach combining electrochemical characterization and *post-mortem* analysis

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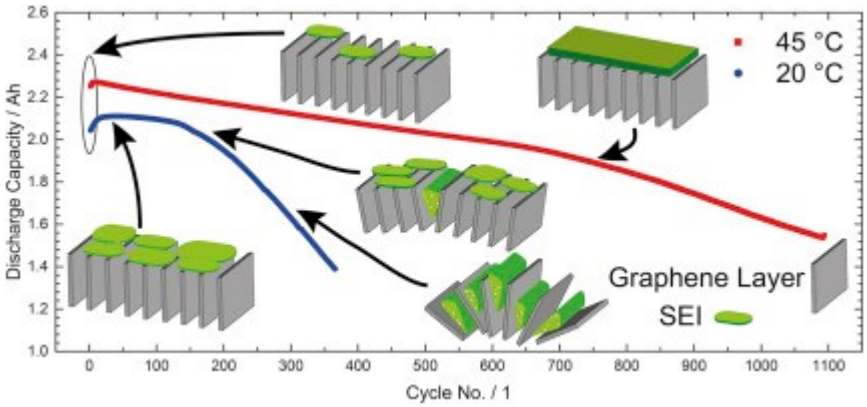
Highlights

- FEC influence on aging and degradation of PC/EC/DMC based electrolyte.
- Complex interaction of electrolyte and electrode in dependency of the temperature.
- Exfoliation of graphite as a result of solvent co-intercalation at 20 °C.
- Exfoliation results into massive electrolyte decomposition and a thick SEI layer.
- Stable and effective SEI at anode enables good electrochemical performance at 45 °C.

Abstract

The understanding of the aging behavior of lithium ion batteries in automotive and energy storage applications is essential for the acceptance of the technology. Therefore, aging experiments were conducted on commercial 18650-type state-of-the-art cells to determine the influence of the temperature during electrochemical cycling on the aging behavior of the different cell components. The cells, based on $Li(Ni_{0.5}Co_{0.2}Mn_{0.3})O_2$ (NCM532)/graphite, were aged at 20 °C and 45 °C to different states of health. The electrochemical performance of the investigated cells shows remarkable differences depending on the cycling temperature. At contrast to the expected behavior, the cells cycled at 45 °C show a better electrochemical performance over lifetime than the cells cycled at 20 °C. Comprehensive *post-mortem* analyses revealed the main aging mechanisms, showing a complex interaction between electrodes and electrolyte. The main aging mechanisms of the cells cycled at 45 °C differ strongly at contrast to cells cycled at 20 °C. A strong correlation between the formed SEI, the electrolyte composition and the electrochemical performance over lifetime was observed.

Graphical abstract



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Keywords

18650-type; Lithium ion cells; Aging mechanisms; Electrolyte aging; Graphite exfoliation; Temperature dependency

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