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## Journal of Power Sources

Volume 342, 28 February 2017, Pages 88-97

# 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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<https://doi.org/10.1016/j.jpowsour.2016.12.040>

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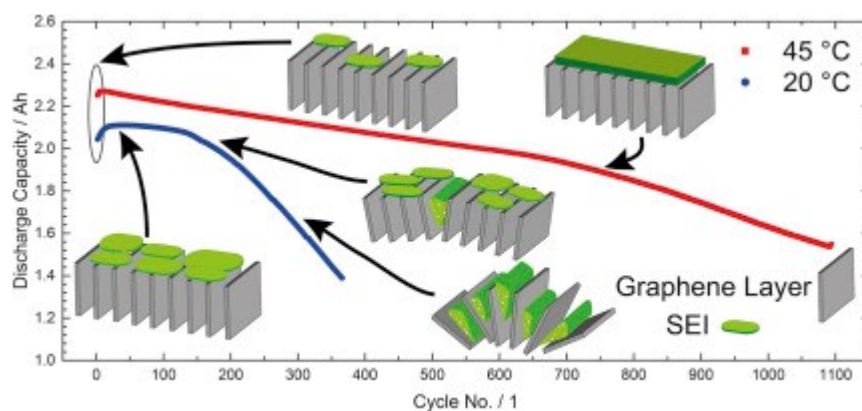
## Highlights

- 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  $\text{Li}(\text{Ni}_{0.5}\text{Co}_{0.2}\text{Mn}_{0.3})\text{O}_2$  (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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