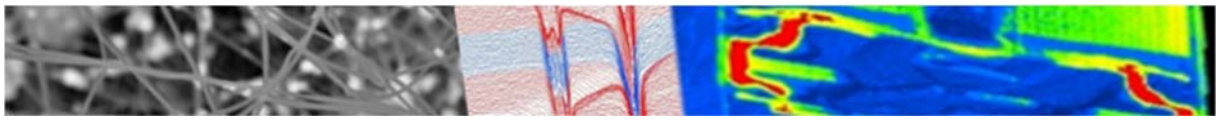
Karlsruher Institut für Technologie Institut für Angewandte Materialien

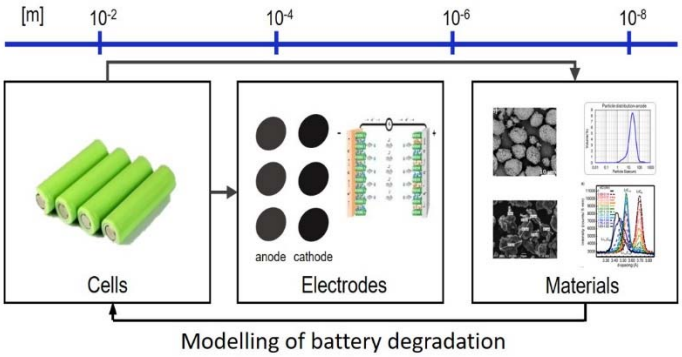


Masterarbeit

"Degradation investigation of commercial 18650 cells for Electric Vehicle (EV) application by post mortem analysis "

Starting date: Aug 2018

Suitable for: Master thesis



Background

Representatives of China, Germany, Japan, and USA provided an overview of the current and future battery research activities [1], depicting that the Lithium-ion batteries (LIBs) are a promising technology of choice for replacing the fossil “energy storage” in modern transportation modes due to their outstanding energy and power density. Though the capacity and the power fading of LIBs may not be considered as a severe problem for portable electronics, it becomes a critical issue for Electric Vehicle (EV) and other Electrical Energy Storage System (EESS) applications [2]. Furthermore, for practical applications in EV, it is important to determine the state of health (SoH) of the LIBs. However, the SoH prediction is still a challenging task because it requires a comprehensive understanding of the degradation mechanism of the LIBs. The aim of the master thesis work is to reveal the degradation mechanism of the commercial LIBs.

In our institute, 64 commercials 18650 cells have been cycled as a function of cycling temperature, State of Charge (SoC) and Depth of Discharge (DoD) for over 700 cycles. The cell impedance (EIS), capacity retention and coulombic efficiency have also been monitored periodically.

The context of your task

A *post mortem* study; by disassembling the degraded cell and performing the structural, morphological and chemical analysis on each component (cathode, anode, electrolyte, separator, current collector); is conducted in order to get a more detailed description on the cell degradation mechanism.

Your task is to disassemble selected degraded cells and perform a thorough *post mortem* analysis using several methods such as X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Electrochemical Technique (e.g. galvanostatic cycling, cyclic voltammetry). The underlying causes of the degradation are investigated. The influence of the cycling temperature, state of charge and depth of discharge on the cell degradation will be determined.

The *post mortem* analysis of the degraded cells, together with the Electrochemical Impedance Spectroscopy (EIS) and electrochemical analysis during cycling will shade more lights on the degradation process. Which are the critical cycling parameters that accelerate the cathode and anode degradation? Do the cathode degradation and loss of the active lithium occur simultaneously or sequentially? Is the degradation rate always constant over hundreds of cycling? Additionally, based on the results, the operating parameters to prolong the cycle life of the LIBs will be recommended.

The experimental results that you obtained will be used further to validate the electro-thermal-fatigue modelling work on the battery degradation which has been developed in our institute.

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References

[1] D. Bresser, K. Hosoi, D. Howell, H. Li, H. Zeisel, K. Amine, S. Passerini, Journal of Power Sources, 382 (2018) 176-178.
[2] K. Jalkanen, J. Karppinen, L. Skogström, T. Laurila, M. Nisula, K. Vuorilehto, Applied energy, 154 (2015) 160-172.