AVL DITEST

FH JOANNEUM
Elektronik und
Computer Engineering

BA Seminar

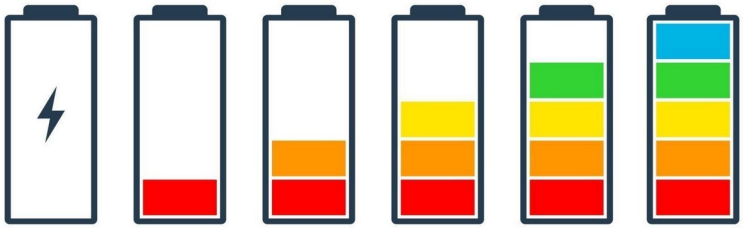
SS 2022

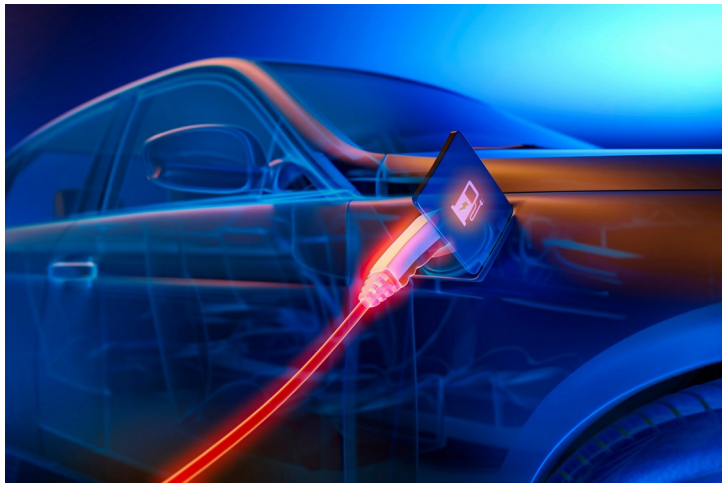
Elektronik und Computer Engineering
Florian Zwittnigg

Determining the internal resistance of a lithium ion battery

Motivation

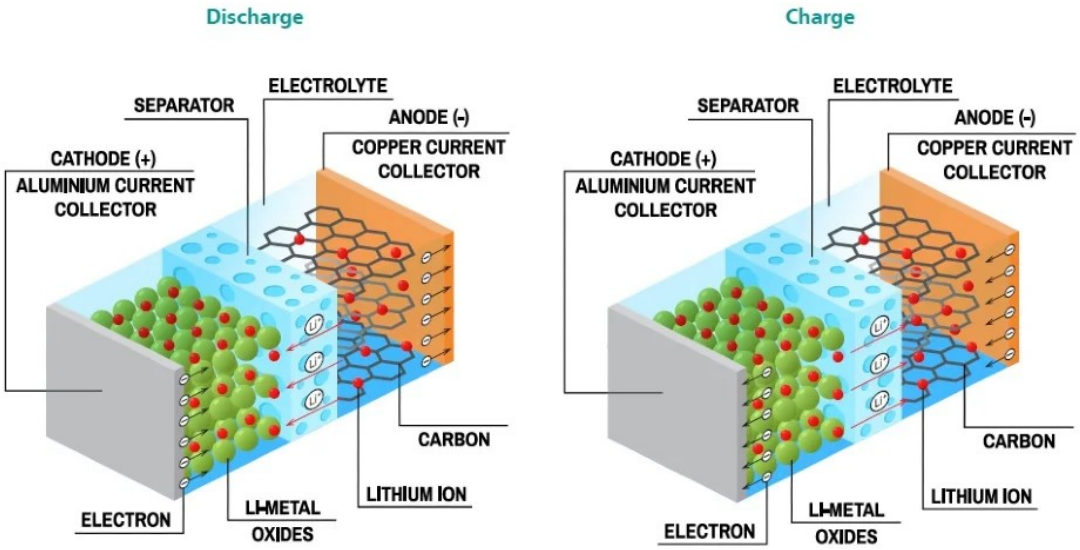
- Condition of a Lithium Ion Battery
- Information about durability of the Battery
- Simple and fast measurement





Lithium Ion Battery general information

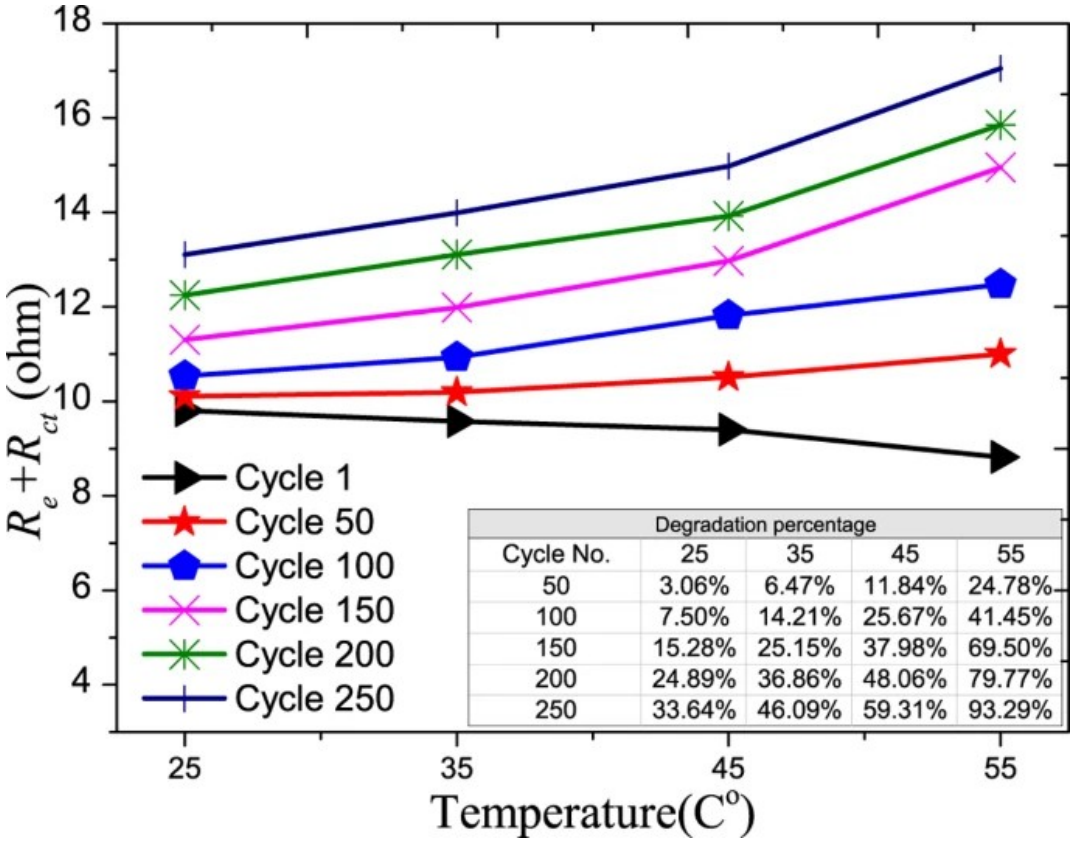
- Build of a Lithium Ion Battery
- Aging Process
- Meaning of the internal resistance



https://www.azom.com/article.aspx?ArticleID=19013

Lithium Ion Battery general information

Aging Process

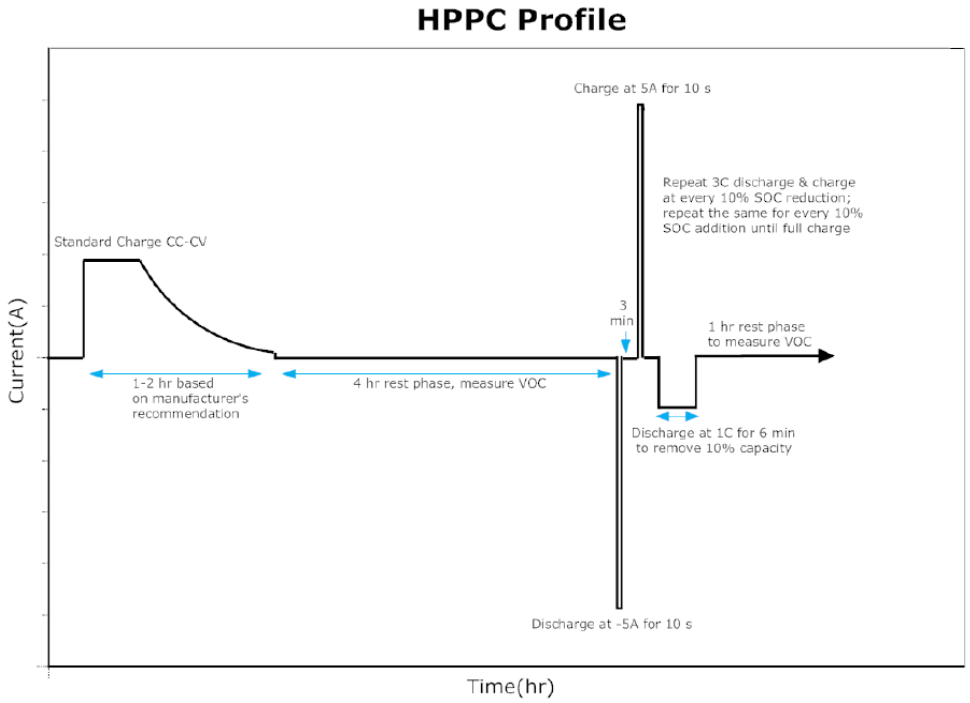


Degradation percentage				
Cycle No.	25	35	45	55
50	3.06%	6.47%	11.84%	24.78%
100	7.50%	14.21%	25.67%	41.45%
150	15.28%	25.15%	37.98%	69.50%
200	24.89%	36.86%	48.06%	79.77%
250	33.64%	46.09%	59.31%	93.29%

https://www.nature.com/articles/srep12967

Methods to determine the internal resistance of a Lithium Ion battery

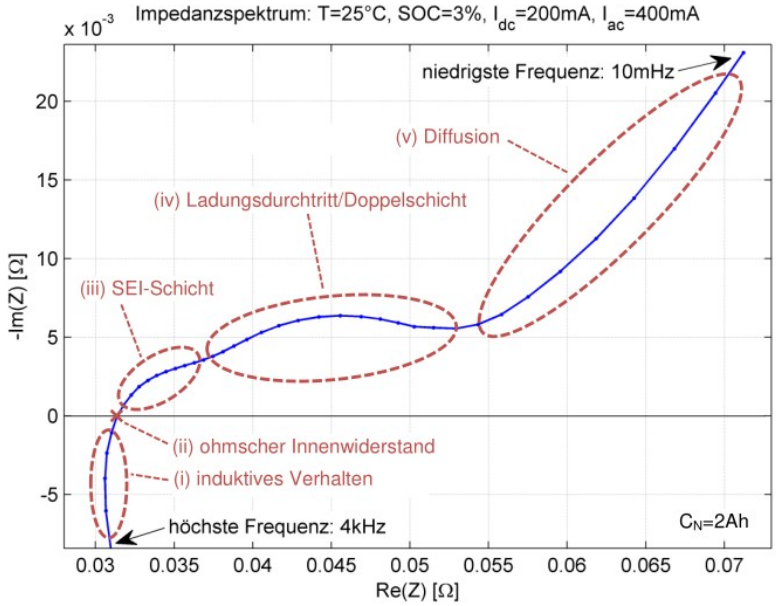
- Hybrid Pulse Power Characterization (HPPC)



https://www.researchgate.net/figure/Hybrid-Pulse-Power-Characterization-HPPC-test-profile_fig2_235602059

Methods to determine the internal resistance of a Lithium Ion battery

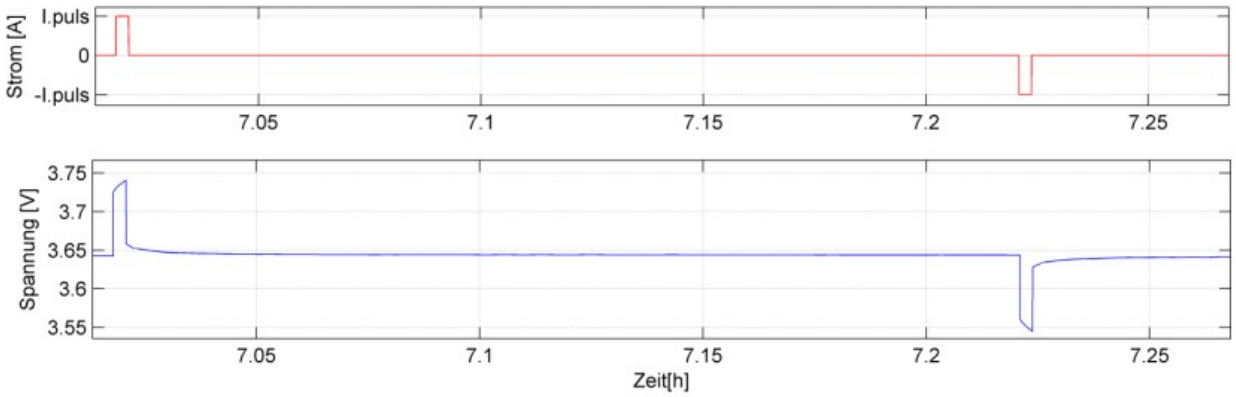
- Galvanostatic Intermittent Titration Technique (GITT)
- Electrochemical Impedance Spectroscopy (EIS)

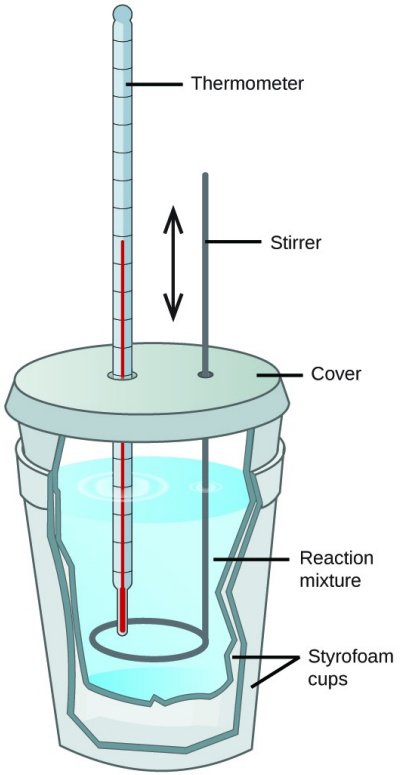


https://mediatum.ub.tum.de/doc/1162416/

Methods to determine the internal resistance of a Lithium Ion battery

- Calorimetric Measurement
- DC Charging Method
- Parameterization using current pulses





https://mediatum.ub.tum.de/doc/1162416/1162416.pdf

https://opentextbc.ca/chemistry/chapter/5-2-calorimetry/

Findings

- *„The internal total resistance represents the sum of the individual resistances in the SEI-layer, the charge passage and the diffusion in equilibrium“* (https://mediatum.ub.tum.de/doc/1162416/1162416.pdf, Page 9)
- And determines the ability how much current can be delivered by the battery
- Battery is aging → resistance is increasing (https://www.nature.com/articles/srep12967)

AVL DITEST

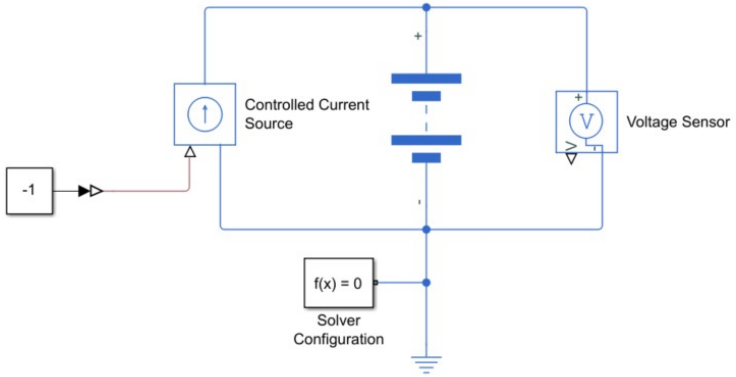
FH JOANNEUM
Elektronik und
Computer Engineering

Findings

- Chosen method is the parameterization using current pulses
  - Already used with the existing device from the company
  - In comparison to other methods not time consuming
- Advantage: fast and easy measurement
- Disadvantage: not as accurate as the other methods
- Other measurements are much more complex or take to much time respectively need expensive measuring devices

Outlook

- Model building in Simulink
- Equivalent electric circuit to reality
- Data Evaluation of the system response
- Comparison of the results with the findings from the literature



Outlook

- Measurements with available hardware
- Device IRP120
- Measurement of 400V System
- Measurement of single cells
- Comparison between Matlab results and measurement results