



Test Rigs for Thermal Cell- / Module-Evaluation of Lithium-Ion Batteries for E- & Hybrid Vehicles



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Motivation

To increase life-time, reliability and safety of Lithium-Ion Batteries (LIBs), the following circumstances have to be considered:

- life-time / aging = $f(\vartheta, \dots)$
- safe operation = $f(\vartheta, \dots)$
- reliability = $f(\vartheta, \dots)$

For each of this temperature relations an upper and lower limit exist, which is not allowed to be exceeded or underrun, respectively.

⇒ **Where and how to cool or heat the LIB cell best ?**

Thermal Cell Evaluation

For sufficient thermal management system design local heat flux as well as surface temperature distribution of the considered LIB cell under realistic operation condition are required. At NTB Buchs a Cell-Test-Rig (CTR) has been build, to measure these values in-situ at 87 individually controlled measuring points, which are uniformly arranged around the cell.

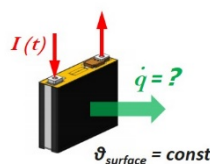


Unique Measurement Modes

With the new Cell-Test-Rig (CTR) at NTB Buchs unique thermal evaluations can be executed:

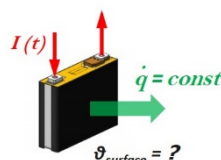
Detection of local heat flux distribution (Mode: Const. Surface Temp.)

- ⇒ Measurement of required cooling power ?
- ⇒ Where to cool or heat the battery best ?



Detection of local surface temperature distribution (Mode: Const. Heat Flux)

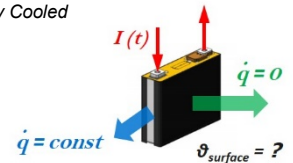
- ⇒ Localization of thermal hot spots ?



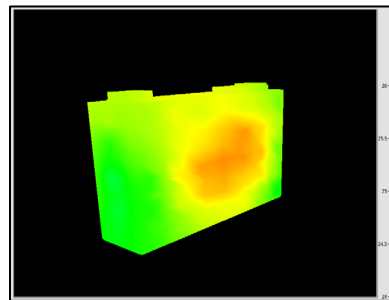
Analysis of a discrete cooling strategy

(Mode: Partial Ideal Isolated with Locally Cooled Areas)

- ⇒ Verification of cooling methods ?
- ⇒ Determination of cooling power ?
- ⇒ Recording of engaged temperature distribution ?



Outcome / Result



Temperature Distribution
of a 60 Ah lithium-ion cell after 3 hours of 1 C cycling at isolated surface setting.

Thermal Module Evaluation

With the knowledge of the cool or heat strategy for a single cell, an adequate thermal management system for modules can be designed. To validate such systems an Module-Test-Rig (MTR) is available at NTB Buchs, where tests can be performed under realistic operating conditions, i.e. electrical and environmental.

Electrical Operating Cond.

- max. charge current 365 A
- max. discharge current 365 A
- max. voltage 65 V

Thermal Operating Cond.

- max. chamber temperature 100 °C
- min. chamber temperature -40 °C
- max. chamber heat load 2.85 kW

