Detecting Changes within the Electrolyte of Batteries – a Non-Destructive Method

Sebastian Klick[1,2], Dirk Uwe Sauer[1,2,3]

[1]Chair for Electrochemical Energy Conversion and Storage Systems, Institute for Power Electronics and Electrical Drives (ISEA), RWTH Aachen University, Germany
[2]Juelich Aachen Research Alliance, JARA-Energy, Germany
[3]Helmholtz Institute Münster (HI MS), IEK-12, Forschungszentrum Jülich, Germany

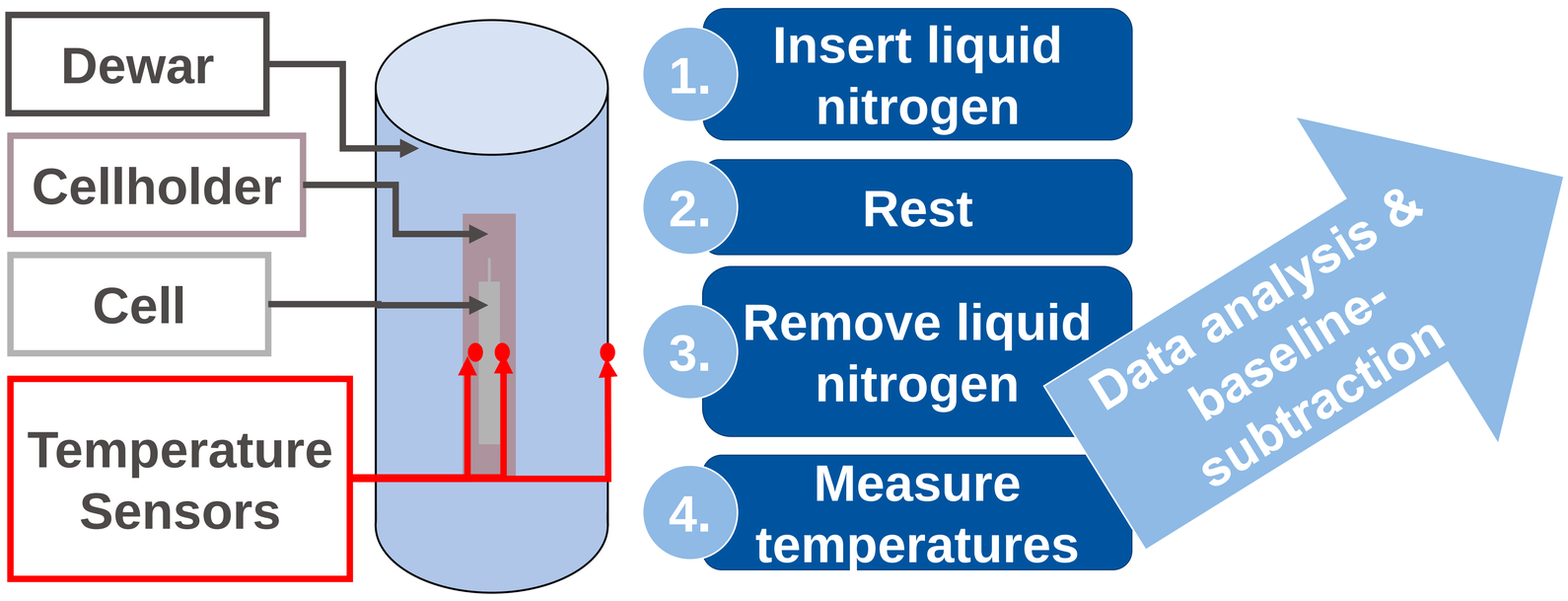
Abstract

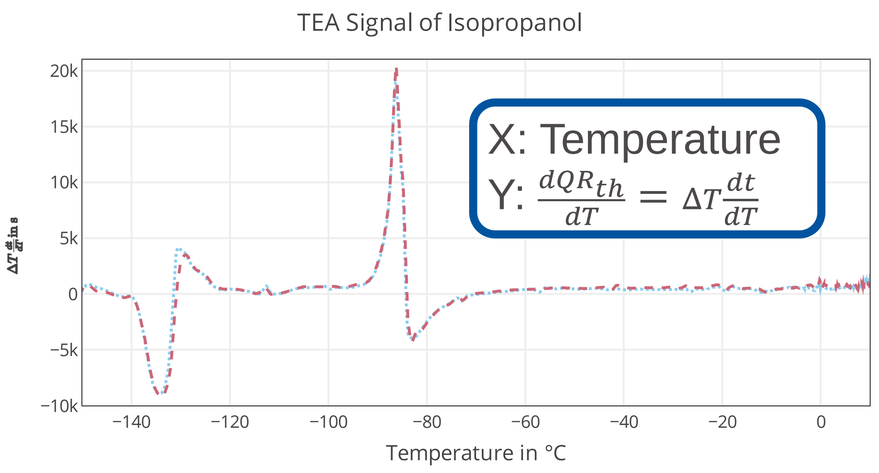
A novel method to analyse the electrolyte of lithium-ion-batteries is presented. Inspired by the Differential Thermal Analysis (DTA) introduced by Day et al. [1], we developed a simpler alternative. The non-destructive method enables new insights into changes to the electrolyte during ageing tests and requires just standard thermocouples, liquid nitrogen and a dewar.

Conclusion

We developed a simple non-destructive method for analysing the liquid phase of the electrolyte and validated its non-destructive nature. By measuring the energy required for certain phase-transitions of the electrolyte we gain information on solvent decomposition, the influence of additives, and formation conditions on the electrolyte. Work on quantification of the results is on-going.

Working Principle of the Thermal Electrolyte Analysis (TEA)

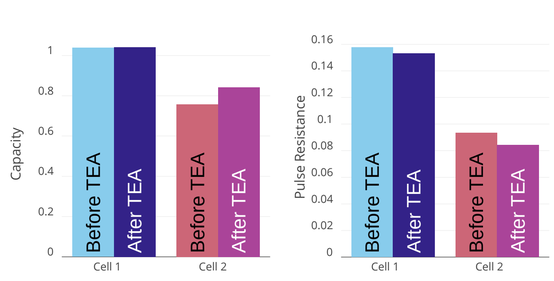


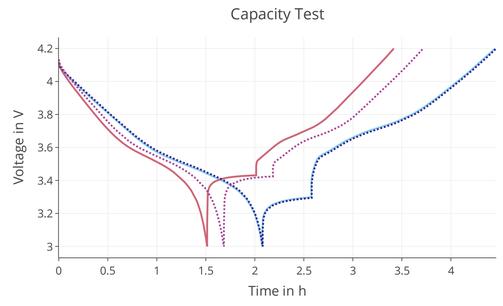


- Area below graph proportional to required energy to heat electrolyte
  - Positive values ➔ endothermic
  - Negative values ➔ exothermic

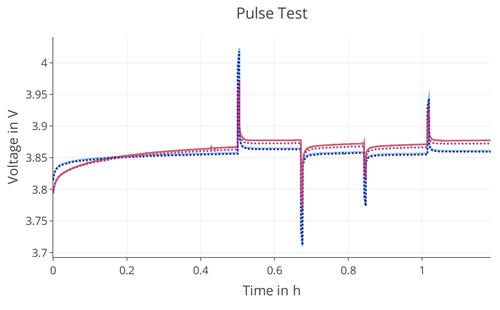
Electrical Measurements before and after TEA

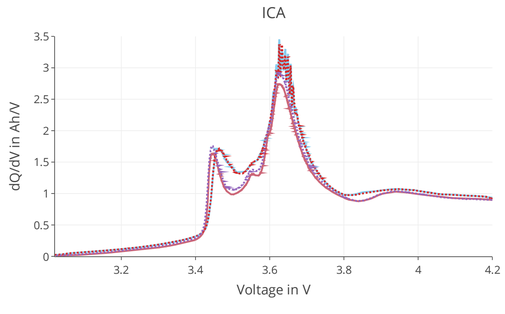
- Cells (1 Ah, NMC622|Gr) were tested before and after TEA-measurements
  - No negative impact on capacity or resistance
  - No substantial change of incremental capacity





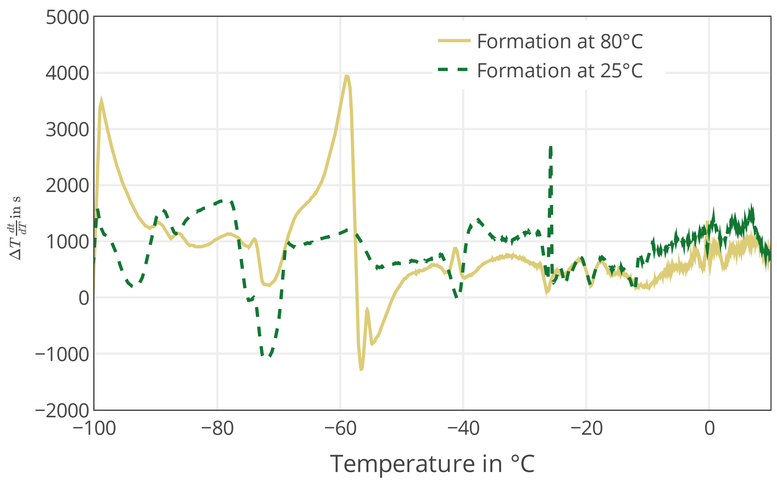
- According to Day et al. [1] temperatures as low as -100 °C have no impact on cyclic ageing

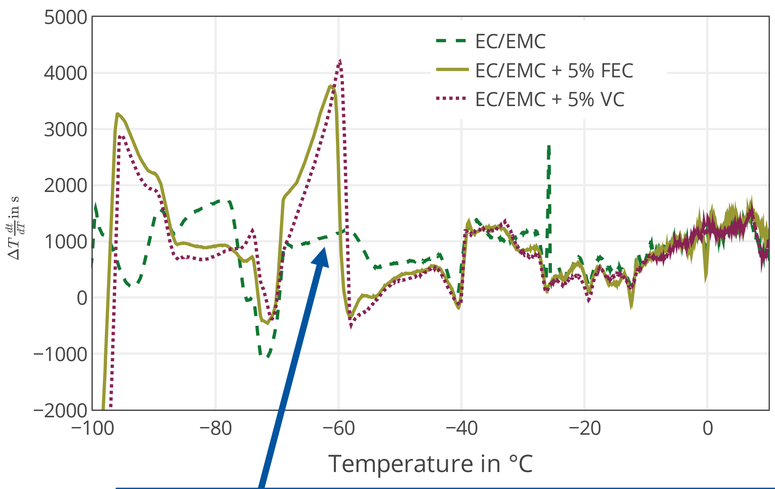


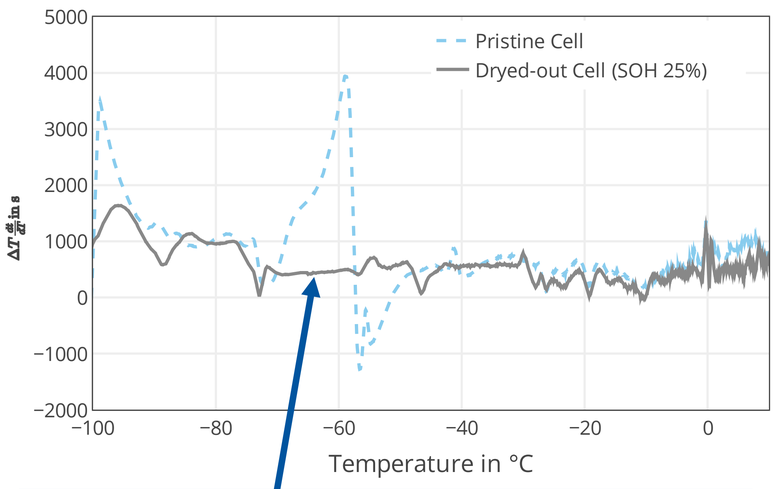


[1] Day, R. P.; Xia, J.; Petibon, R.; Rucska, J.; Wang, H.; Wright, A. T. B.; Dahn, J. R. **Differential Thermal Analysis of Li-Ion Cells as an Effective Probe of Liquid Electrolyte Evolution during Aging.** *J. Electrochem. Soc.* 2015, *162* (14), A2577-A2581. https://doi.org/10.1149/2.0181514jes.

TEA Results







Author

Sebastian Klick
Sebastian.Klick@isea.rwth-aachen.de

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Contact

www.isea.rwth-aachen.de
batteries@isea.rwth-aachen.de