SUCCESS STORY

BattLab
High-performance battery systems based on polymer science and virtual materials engineering

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Module

Type of project: Project 2- Virtual Cell, 01/2024-12/2027, multi-firm

SMART SOLUTION FOR CALORIMETRICAL EXAMINATION OF BATTERY CELLS

HIGHLY SENSITIVE METHOD FOR MEASURING HEAT FLOW ENABLES MORE ACCURATE ANALYSES UNDER IN-SITU CONDITIONS

Assessing and predicting the long-term performance of battery cells and systems in electric vehicles is resource-intensive with currently available technologies. Within the COMET module "BattLab," a calorimetric method for investigating thermal processes in batteries was developed. This method represents a comparatively cost-effective yet highly sensitive approach to measuring heat flows, refining the analysis of aging mechanisms using electrochemical impedance spectroscopy. This allows predictions about battery lifespan and performance without the need for destructive battery testing.

Measurement of heat flow

Heat flow sensors were attached to the surfaces of lithium-ion cells, and a specially designed thermal insulation was developed for the measurements (see Figure 1). This enabled the recording of the thermal processes during charging and discharging with an accuracy of 0.01 mW and 0.01 °C. The thermal data obtained in this way show that specific electrochemical reactions, which influence the lifespan and performance of the cell, can be detected with high precision (see Figure 2). Such data cannot be acquired, or can only be acquired to a limited extent, using currently available non-destructive methods. The combination of electrochemical impedance spectroscopy with the new calorimetric method opens up new possibilities for the detailed

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analysis of aging and degradation processes in battery cells.

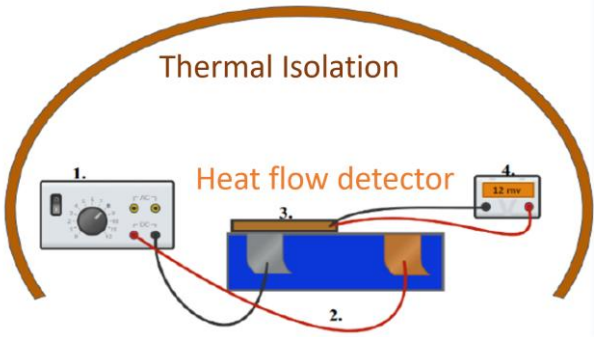

Figure 1: Schematic representation of the heat flow spectroscopy method.

Impact and effects

The newly developed calorimetric analysis of battery cells significantly reduces the experimental time required for aging investigations, as lengthy long-term tests can be partially replaced by more readily available thermal indicators. Simultaneously, a deeper understanding of the underlying degradation processes enables a more precise assessment of the cell's condition. This allows for a sustained improvement in predicting the lifespan and operational reliability of battery cells and systems.

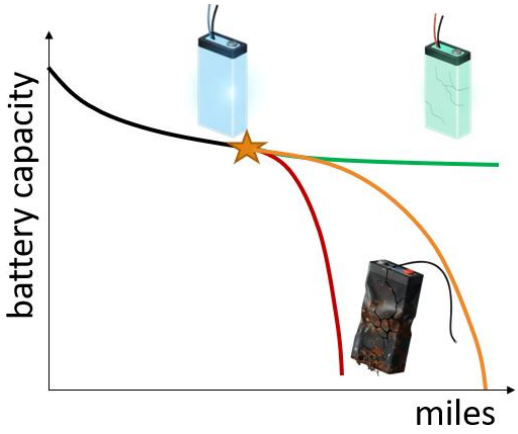

Figure 2: The lifespan of batteries depends on the underlying aging mechanisms.

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