MADAM4Life

Mechanical aging diagnostics with strain gauges, dilation, pressure, acoustics and modal analysis for lifetime prediction

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Motivation of the Project

- Can we achieve an extended battery life by detecting mechanical changes and their effects on cell aging and cell states?
- Can we derive a mechanical end-of-life criteria and thereby improve the operation life prognosis?
- Is it possible to transfer these findings to new cell chemistries and thus optimize cell design at an early stage?

State of Research

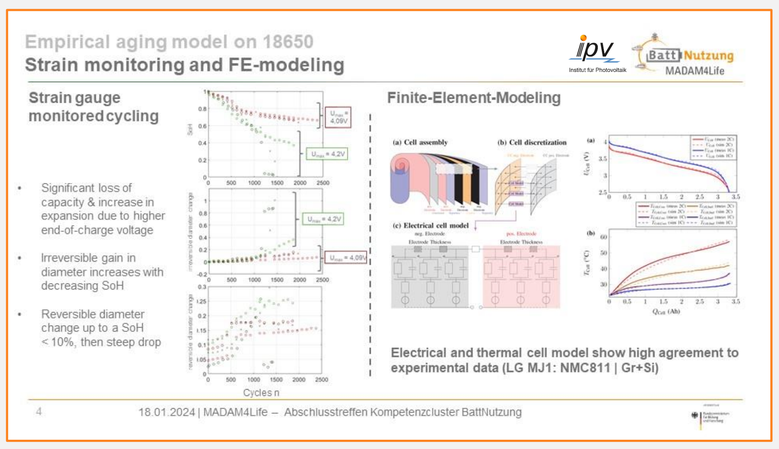
- Different mechanical operando diagnostic methods were examined during aging of jelly-roll and pouch cells
- Development and qualification of new test benches
- Creation of mechanical models and derivation of aging functions to evaluate the RUL

In progress:

- Final aging tests and identification of suitable measurement method(s) for possible integration into a BMS

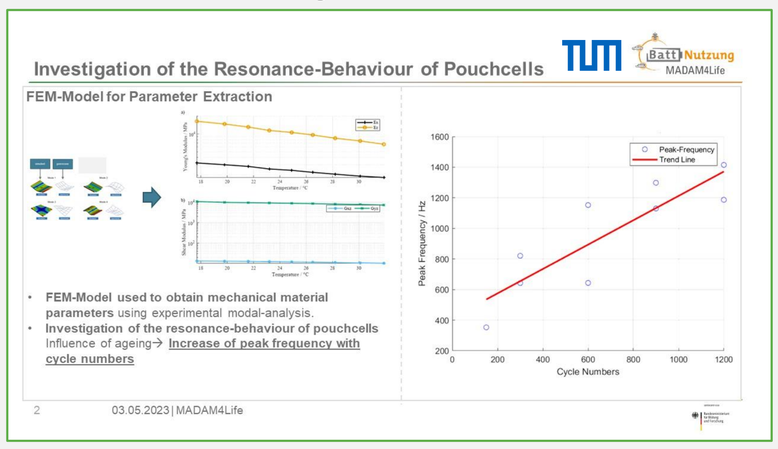
Results

Aging model of 18650 Cells



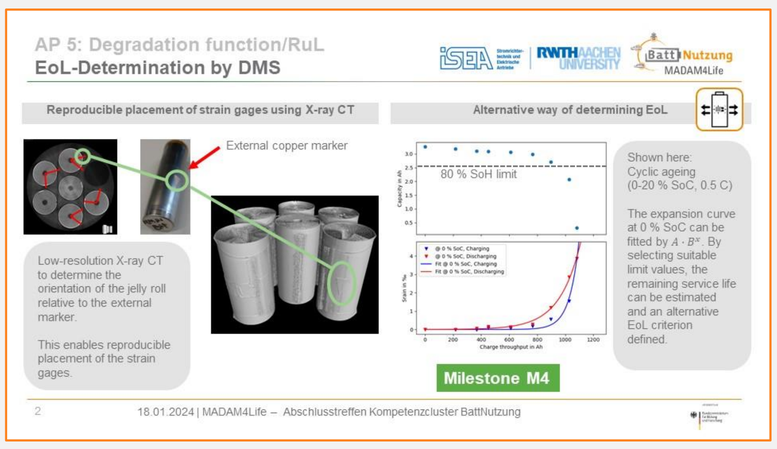
- Electrical and thermal model agrees well with experimental data

Modal Analysis on Pouch Cells

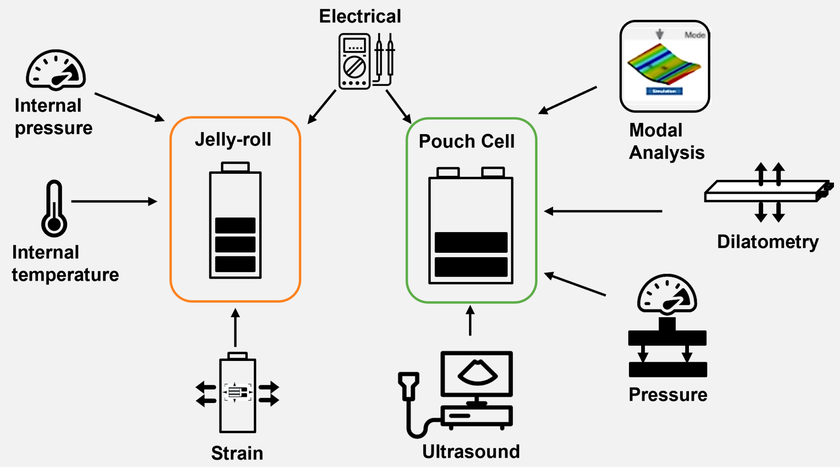


- Extraction of mechanical parameters from FEM

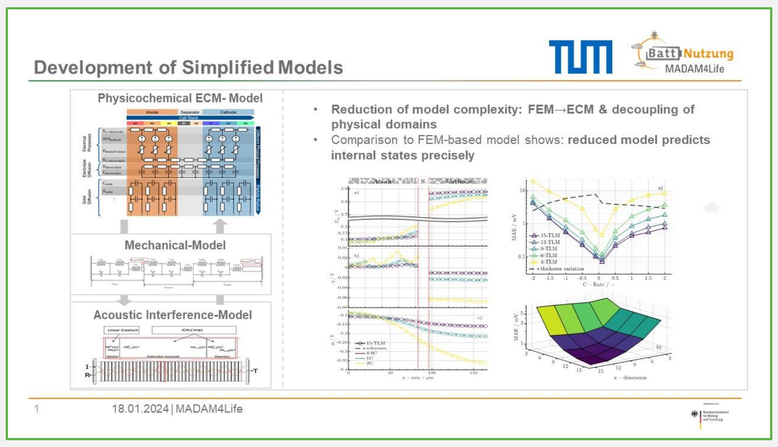
Alternative End-of-Life Criterion for 18650



- From the cell's expansion curve the RuL and an alternative EoL criterion can be derived

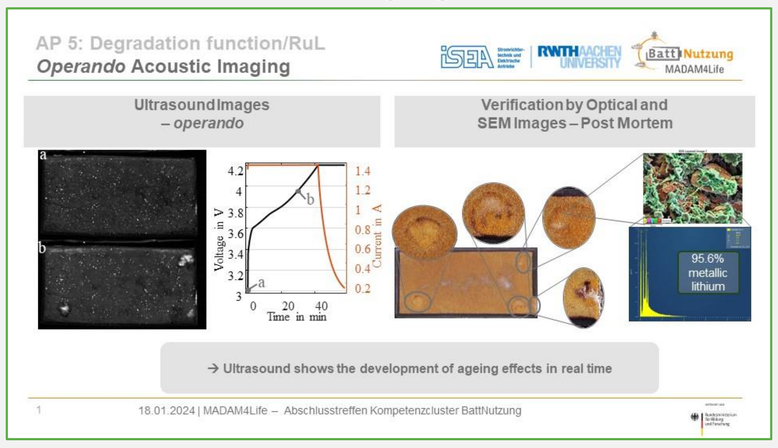


Simplified Models on Pouch Cells



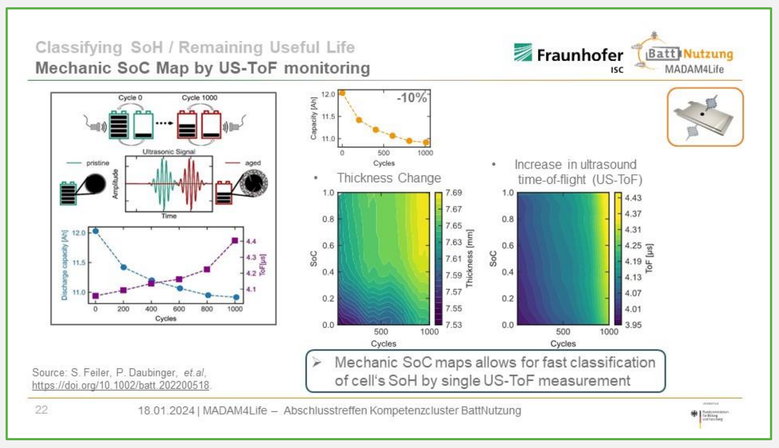
- Physicochemical ECM: Precise depiction of cell behavior including internal states and plating criteria

Real-time Visualization of Aging Effects in Pouch Cells



- US acoustic imaging allows *operando* monitoring of aging effects

Ultrasound for Classifying SoH of Pouch Cells



- Mechanic SoC mapping enables classifiying cell's SoH from individual US-ToF measurement

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