

# Joint Application of EM FEM and Data-based Modelling for Detection of Small Defect Structures in Batteries

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Lithium-ion batteries (LIBs) are currently the most relevant energy storage solution for a wide field of applications starting from mobile communication and going to high power applications in electric vehicles. Reliable production of the batteries requires measurement techniques and electrochemical models capable to assess possible failures in the production process. Here we will discuss two approaches for LIB quality inspection based on the measurements of the DC self-discharge current and the electrochemical impedance spectroscopy combined - both compared to the respective modelling.

To assess the quality of a LIB either during production or in post-production, its self-discharge rate is an important parameter. Here we present both precise potentiostatic self-discharge measurements (SDMs) on commercial LIBs, and modelling of the SDM which includes the electrochemical processes that are coupled with a 3D temperature FEM and an electric circuit model of the cell self-discharge [1]. Our modelling results in a good overlap with the experimental results and allows us to extract a quantitative value of the LIB self-discharge resistance. Furthermore, we tested a realistic physical self-discharge scenario of the formation of Lithium dendrites by comparing experimental and modelled self-discharge resistance values. Finally, a short overview of our current work on Electrochemical Impedance Spectroscopy (EIS) for following battery's aging processes will be presented [2]. EIS is a potential non-destructive method for characterizing and modelling the dynamic behaviour of electrochemical systems such as batteries. We combine this technique with microscopic and nanoscopic measurements to establish and validate our electrical finite element models of the complex and highly parametrized model of a LIB.

## REFERENCES

[1] Nawfal Al-Zubaidi R-Smith, Georg Gramse, Manuel Moertelmaier, Manuel Kasper, Ferry Kienberger. Advanced Self-Discharge Measurements of Lithium-Ion Cells and Comparison to Modeling. 2020 IEEE International Instrumentation and Measurement Technology Conference (I2MTC), (2020).

[2] Nawfal R-Smith, Mike Leitner, Ivan Alic, David Toth, Manuel Kasper, Ferry Kienberger, Andreas Ebner, Georg Gramse. Assessment of Lithium Ion Batteries aging by combined Impedance Spectroscopy, Functional Microscopy and Finite Element Modelling, in preparation.