

Introduction of a Test Bench – Localized pressure analysis to optimize lithium-ion battery lifetime

Hendrik Laufen^{1,3,4}, Sascha Berg^{2,3}, Julian Engeser^{2,5}, Fabian Frie^{1,3,4}, Dirk Uwe Sauer^{1,3,4}

¹Chair for Electrochemical Energy Conversion and Storage Systems, Institute for Power Electronics and Electrical Drives (ISEA), RWTH Aachen University, Germany

²Chair for Aging and Lifetime Prediction of Batteries Institute for Power Electronics and Electrical Drives (ISEA), RWTH Aachen University, Germany

³Juelich Aachen Research Alliance, JARA-Energy, Germany

⁴Helmholtz Institute Münster (HI MS), IEK-12, Forschungszentrum Jülich, Germany

⁵Fraunhofer Institute for Solar Energy Systems ISE, Freiburg, Germany

Abstract

The pressure acting on a lithium-ion battery cell is an important parameter in battery design. Analyzing local pressure distributions aim to homogenize cell degradation. A rigid plate structure using resistive pressure sensors and a cushioning pad is presented.

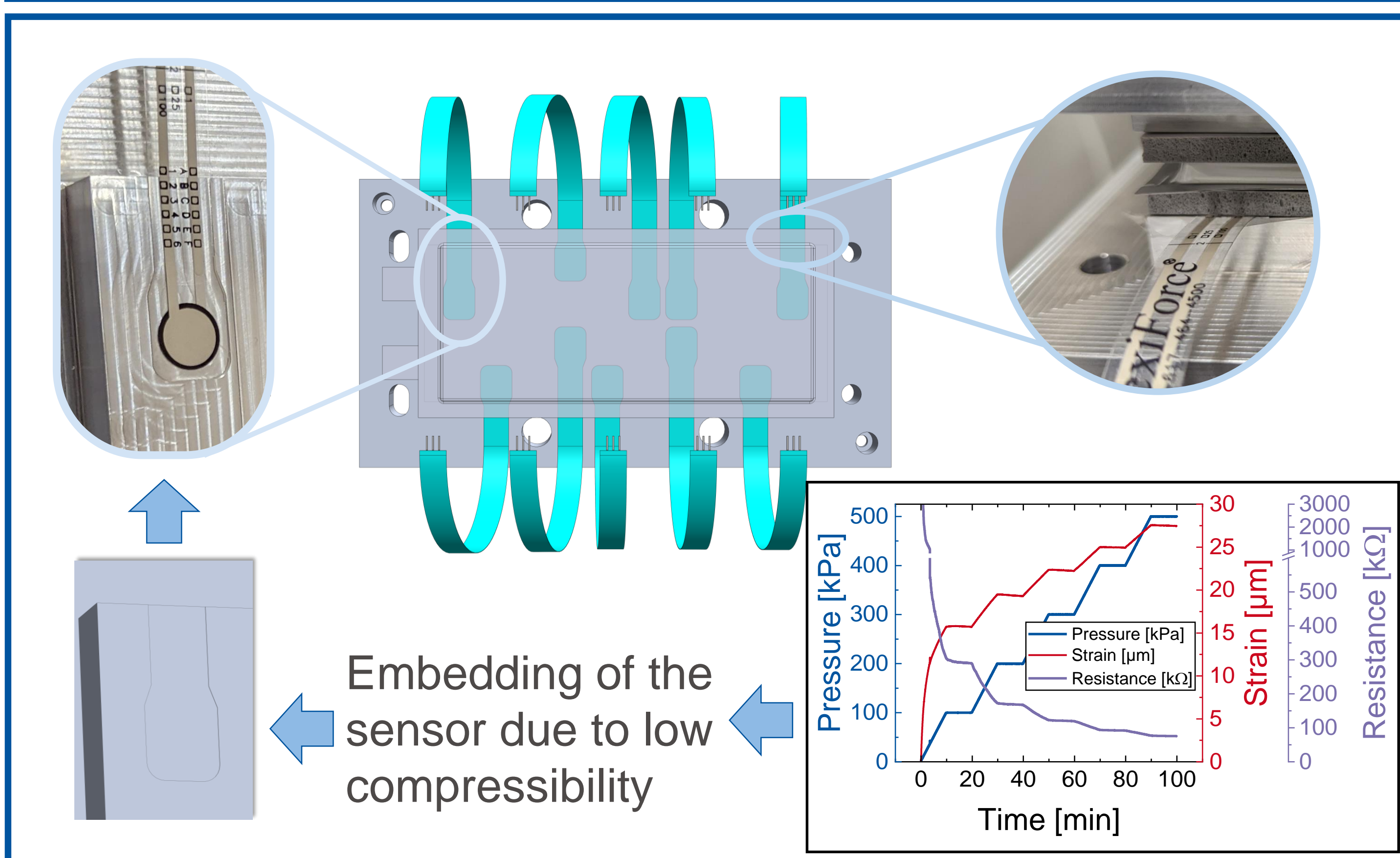
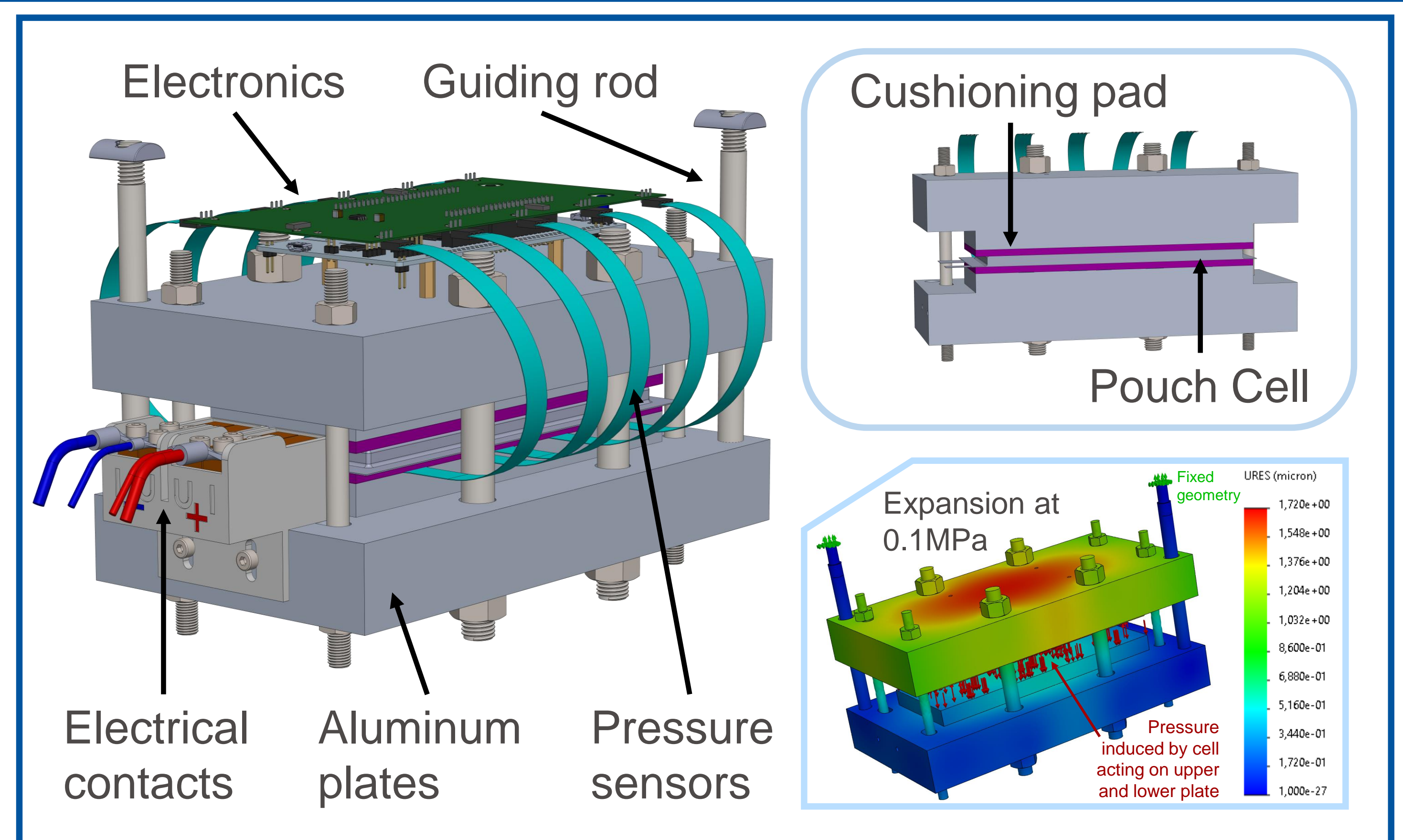
Conclusion

This test bench is designed for localized pressure analysis using embedded resistive pressure sensors enabling detection of pressure change during cell cycling and cell's irreversible expansion. The cushioning pads used as buffer layers provide a spatially resolved pressure deflection characteristic and a semi-linear behavior over cell's expected irreversible expansion.

Experimental Setup for Pouch Cells

- Cell (Kokam 11.6Ah SLPB065070180) is centered between aluminum (2618-T61) plates
- Maximum expansion:
1.72 μ m (0.1MPa) - 17.2 μ m (1MPa)
- Two cushioning pads (CPD) are used as buffer layers (BISCO® HT-840 Silicone Foam 4.8mm)
- Pressure sensors (Tekscan FlexiForce A201) are embedded in lower aluminum plate
- Electronic for sensor data measurement [1]

[1] S. Berg, H. Laufen, et al.; Session 3C-3; Advanced Battery Power Conference; 2022



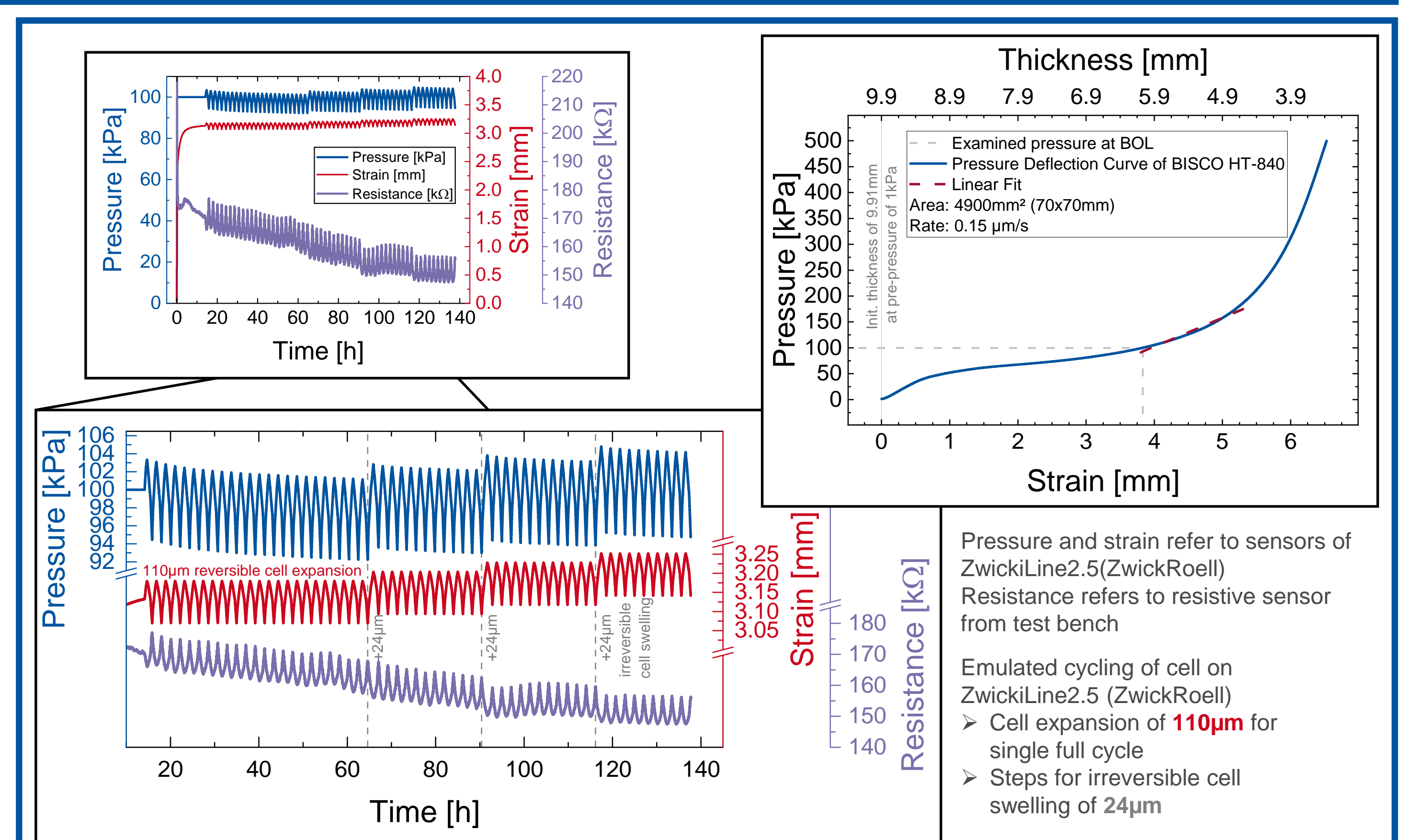
Embedding of resistive Pressure Sensors

- Sensors are embedded into lower aluminum plate due to low compressibility of sensor's material
- Avoiding pressure peaks on cell
- Sensors are distributed on lower aluminum plate to measure pressure distribution of cell during operation
- Localized pressure analysis to investigate pressure patterns regarding homogenized degradation

Examined pressure range

- Medium pressure is reported to improve cell performance [2]
- Examined pressure at begin of life (BOL): 100kPa
- Maximum expected irreversible cell swelling until end of life (EOL) of 1.5mm
- Cushioning pad shows semi-linear behavior
- Cycling of cell leads to change of approximately 10kPa in pressure and approximately 10kΩ in resistance

[2] S. Hahn et al.; Journal of Energy Storage (2021); doi: 10.1016/j.est.2021.102517



Author

Hendrik Laufen
hendrik.laufen@isea.rwth-aachen.de



Acknowledgements

Federal Ministry of Education and Research (BMBF)
Funding Code 03XP0312A-B



Contact

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

