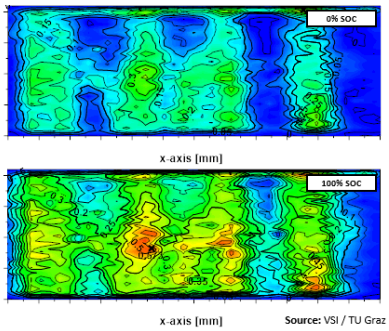
Vehicle Safety Insitute

Simulation of heat transfer in Li-ion batteries considering breathing and swelling mechanisms

Background

Managing the heat transfer within Li-ion batteries is crucial for safety and performance of (hybrid) electric vehicles. Li-ion cell volume will change due to reversible ("**breathing**") and non-reversible ("**swelling**") effects. In the battery module, cells are stacked side-by-side. Here, cell thickness change will causes a **non-uniform pressure distribution** that possibly degrades the **heat-transfer characteristics**. This may have a significant influence on **safety** of a Li-ion battery module.

Change in cell surface heat transfer?



Source: VSI / TU Graz

Goal

Your goal is to investigate the heat transfer between components in a battery module under consideration of breathing & swelling mechanisms. You will develop a theoretical model, implement it using numerical methods (Abaqus) and validate your results against experimental data. You will get insight into an up-to-date automotive research topic and you will gain hands-on experience on your particular problem. In the end, you will have improved your skills both as an engineer and as a team player.

Tasks

- **Familiarize** with the basics in battery design and safety development
- **Understand** the influence of breathing & swelling on heat transfer
- **Develop** a heat transfer model that accounts for the main influence factors
- **Implement** a numerical simulation of the heat transfer within a battery cell
- **Cooperate** with the VSI project and testing teams and renowned industry partners

Literature

- Grandjean, T. et al. (2017): *Large format lithium ion pouch cell full thermal characterisation for improved electric vehicle thermal management*. In: *Journal of Power Sources* 359, S. 215–225. http://dx.doi.org/10.1016/j.jpowsour.2017.05.016
- Maleki, H. et al. (2014): *Li-Ion polymer cells thermal property changes as a function of cycle-life*. In: *Journal of Power Sources* 263, S. 223–230. https://doi.org/10.1016/j.jpowsour.2014.04.033
- Veth, C. et al. (2014): *Thermal characterizations of a large-format lithium ion cell focused on high current discharges*. In: Journal of Power Sources 267, S. 760-769. https://doi.org/10.1016/j.jpowsour.2014.05.139

This topic is recommended as

- Master's thesis for Mechanical Engineers

Organizational

- Start: anytime
- Scholarship: min. € 2.500 at successful completion of the thesis
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