SUCCESS STORY

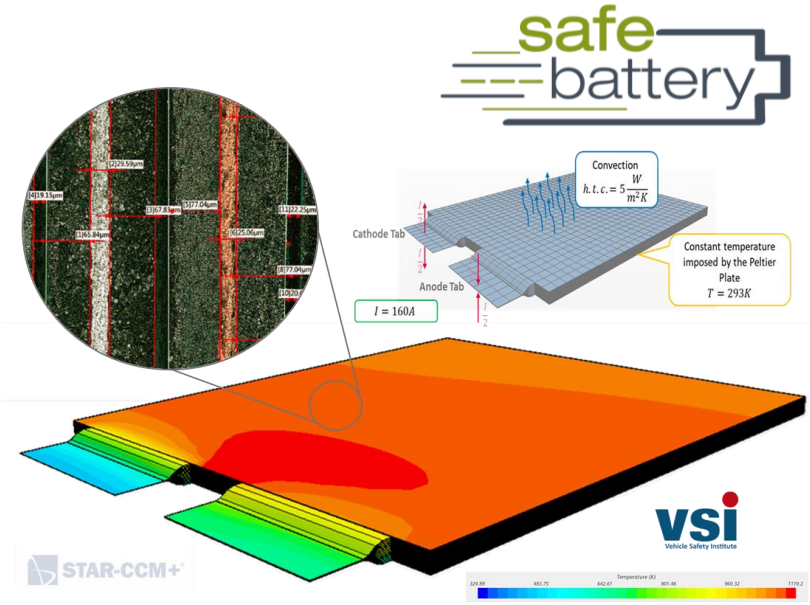
SafeBattery
Safe Lithium-Based Traction Batteries

Sichere Lithiumbasierte Traktionsbatterie

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Project

Type of project: P1 SPECTRUM, 04/2017 – 03/2021 multi-firm



ORTHOTROPIC THERMAL CONDUCTIVITY MEASUREMENT OF POUCH LI-ION BATTERIES

THE DESIGN OF A BATTERY PACK IS MADE IN ORDER TO PROVIDE BEST PERFORMANCES AND SAFETY. LI-ION BATTERIES EXHIBIT BEST PERFORMANCES IN AN OPTIMUM TEMPERATURE WORKING RANGE USUALLY BETWEEN 25 – 45°C. IN ORDER TO KEEP BATTERIES IN BEST TEMPERATURE RANGE, DESIGN PROCESS NEEDS TO BE SUPPORTED BY ACCURATE SIMULATIONS. THE KNOWLEDGE OF ACCURATE THERMAL PROPERTIES OF LI-ION BATTERIES IS OF GREAT IMPORTANCE FOR THE ACHIEVEMENT OF THE BEST PERFORMANCES AND DESIGN.

Thermal management of a Li-ion battery pack

Nowadays a key parameter for electric cars is the driving range. The improvement of this important parameter is certainly depending by design factors and safety requirements. As more batteries are integrated in a battery pack, the more the problems related to safety and thermal management. In facts, during operation, the Li-ion cells are producing heat that needs to be exhausted by the cooling system in order to keep the batteries in the optimal temperature range. Design processes needs to be supported by simulations, here the importance to determine the thermal properties of the materials with high accuracy in order to obtain reliable predictions of the temperature is important. However, batteries are constantly evolving and leading to changes, here the need to develop a fast and practical method for thermal conductivity measurement.

Thermal conductivity of Li-ion batteries

Due to its internal structure and components, a Li-ion battery presents a strong asymmetry of the thermal

Federal Ministry Republic of Austria Transport, Innovation and Technology
Federal Ministry Republic of Austria Digital and Economic Affairs
Version 01/2020

conductivity along different directions: in facts, a battery is a composite material including metals (copper and aluminum), the electrodes materials and the separator (in principle plastic) with laminar orientation and all the components are soaked in electrolyte. Furthermore, the electrolyte is a strongly volatile liquid and it is important for the thermal conductivity itself: a battery dried from its electrolyte would exhibit a different thermal conductivity. Unfortunately, when a battery gets disassembled, the electrolyte quickly vaporizes, compromising the battery thermal conductivity: for this reason it is not recommended to measure thermal conductivity of samples extracted from a Li-ion battery. A realistic measurement of the thermal conductivity should be performed on the battery still sealed and intact. Together with the industrial partners, a new methodology in-situ (without battery disassembly) for the measurement of thermal conductivity has been developed, a concept of a measurement is shown in Figure 1. The realized test bench is extremely compact and the methodology allows to measure the thermal conductivity along the three directions in short time and with low operative costs giving the possibility of a fast, accurate and empirical material characterization. Furthermore, an in-situ methodology gives the possibility to investigate the thermal conductivity changes of the Li-ion batteries in particular conditions, as example, the variation of the thermal conductivity for an aged battery.

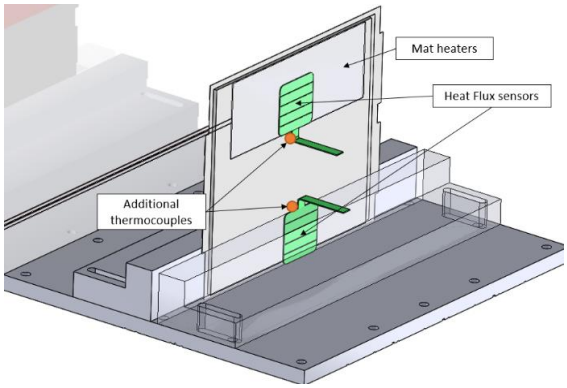


Figure 1 – Test settings for the longitudinal thermal conductivity measurement of a pouch Li-ion battery © SafeBattery

Impact and effects

The developed methodology gives better chances to follow the batteries evolution in terms of material changes. This methodology for fast and precise orthotropic measurement of thermal conductivity can help to keep track of materials changes for better simulation, design and battery pack production. Materials database is an essential support for simulations and design of a Li-ion battery pack. Constant improvement of technology imply changes of chemistry, internal separator material, electrolyte composition, materials thicknesses, etc., those changes are often not communicated by the cells manufacturer to the car producers, highlighting the importance of an independent measurement system.

Project coordination (Story)
Assoc. Prof. Dipl.-Ing. Dr. techn. Wolfgang Sinz
Ass. Prof. Dipl.-Ing. Dr. techn. Christian Ellersdorfer
Institut für Fahrzeugsicherheit, VSI

T +43 (0) 316 873 – 30310 bzw. 30318
wolfgang.sinz@tugraz.at / christian.ellersdorfer@tugraz.at

SafeBattery
Vehicle Safety Institute, VSI
Inffelgasse 23/I
8010 Graz
T +43 (0) 316 873 30301
office.vsi@tugraz.at
www.safebattery.eu

Project partner

- Audi, GER
- AVL List, AUT
- Daimler, GER
- Porsche, GER
- Kreisel Electric, AUT
- Bosch, GER
- SFL engineering, AUT
- TU-Graz (ICTM/VSI), AUT
- VIF, AUT

This success story was provided by the consortium leader and by the mentioned project partners for the purpose of being published on the FFG website. SafeBattery is a COMET Project within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMDW and Province Styria. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet

Federal Ministry Republic of Austria Transport, Innovation and Technology
Federal Ministry Republic of Austria Digital and Economic Affairs

Austrian Research Promotion Agency
Sensengasse 1, A-1090 Vienna
P +43 (0) 5 77 55 - 0
office@ffg.at
www.ffg.at