diplomawork for master of science degree

Simulation of thermal runaway in Li-ion batteries for enhanced battery safety

### About ABB

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels. With a history stretching back more than 130 years, ABB is currently employing 110,000 talented people in over 100 countries.

### Background

ABB provides various Li-ion battery solutions for electrified shipping and trains. It is important to have detailed knowledge of the various safety aspects of these types of batteries, as they are known to come with safety concerns. If a battery is exposed to abuse e.g. overcharging, short circuiting or external heat (e.g. an onboard fire), exothermal reactions inside the battery cell may be triggered. The heat from the exothermal reactions can initiate new reactions and the battery then goes into a self-heating stage. Eventually the self-heating may reach the onset of extremely rapid temperature rise, so called thermal runaway, at which the temperature rise is no longer stoppable and will continue until the battery burns out, in worst case it may explode.

The effect of a potentially harmful abuse situation can be influenced on different levels, e.g. by choice of cell chemistry, by cell/module/rack design, and by various system level protection devices. The actions may either hinder the thermal runaway event to happen or prevent it to spread.

The aim of this diploma work is to build a model to simulate thermal runaway in Li-ion batteries on cell- module level, with the main target to describe propagation behavior at module level. The work has already started with a model implemented in COMSOL (so some experience from COMSOL work is advantageous). The work will be focused on developping the model further based on real applications and conditions and to study the effect of specific design parameters on TR evolution. The model will be validated against available experimental data from previous thermal runaway experiments. Also new experimets will be planned and work on th simulation tool can provide input to this plan.

### Work

1. Literature search thermal runaway models
2. Adapt and develop current simple thermal runaway model to relevant module- and cell designs
3. Validate the model, and simulated thermal runaway event, against experimental data (available)
4. Perform parameter study using new model
5. Create a work plan for further work

### Further information

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