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# Computational Modelling of Thermal Runaway Propagation in Lithium-Ion Battery Systems

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While the popularity of lithium-ion batteries (LIB) has increased significantly in recent years, the safety concern is one of the major obstacles that limit large-scale applications in electric vehicles. Of particular interest is a scenario called thermal runaway (TR) in which exothermic chemical chain reactions lead to an uncontrollable and excessive release of heat [1]. While the failure of a single cell leads to a rather limited hazard, the propagation to adjacent cells may release the whole energy stored in the battery pack, leading to severe conditions, such as fire and fierce explosion [2]. Hence, TR propagation must be effectively considered in battery safety design.

In this contribution, TR propagation in LIB modules is modelled applying 3D Finite-Element (FE) simulations in conjunction with Accelerating Rate Calorimetry (ARC) experiments [3]. In more detail, an electro-thermal FE model is combined with an empirical expression for the cell self-heating rate due to exothermic reactions obtained from ARC test data on single reference cells [4]. Thereby, thermal runaway propagation to adjacent cells can be predicted for the battery module at hand consisting of the measured cell chemistry.

This simulation strategy enables a systematic and efficient investigation of the impact of (i) the specific cell and module geometry, (ii) the electrical connection, (iii) thermally resistant layers serving as heat barriers, (iv) different cooling concepts and (v) different scenarios to initially trigger TR, on the probability for TR propagation. These investigations are of significant relevance for developing strategies to prevent or postpone TR propagation as well as to meet safety requirements for LIB modules in electric vehicles [2].

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