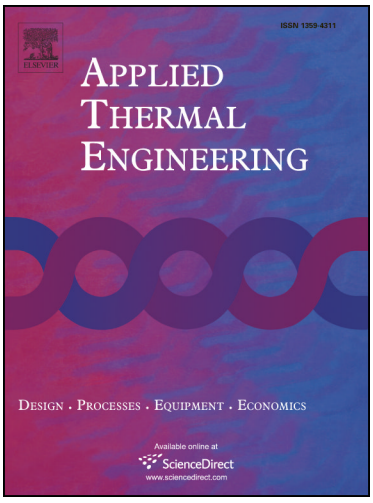

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Wenxin Mei, Haodong Chen, Jinhua Sun, Qingsong Wang

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Numerical study on tab dimension optimization of lithium-ion battery from the thermal safety perspective

Wenxin Mei[a], Haodong Chen[a], Jinhua Sun[a], Qingsong Wang[a,b,*]

[a]*State Key Laboratory of Fire Science, University of Science and Technology of China, Hefei 230026, China*

[b]*CAS Key Laboratory of Materials for Energy Conversion, University of Science and Technology of China, Hefei 230026, P.R. China*

Abstract

Tab is related to the safety of the whole battery, it is crucial to optimize the tab dimension to reduce the battery temperature and improve the safety performance. An electrochemical-thermal coupling model for an 18.5 Ah pouch cell is proposed and the model is validated with experimental data. Using this model, the temperature distribution is investigated at four discharge rates of 0.5, 1, 2 and 4 C, respectively. It is found that heat will be accumulated at the positive tab at high discharge rate. Then the thermal behavior is analyzed with different tab dimensions for 4 C discharge rate to determine an optimized tab dimension. The results indicate that widening and thickening the tab appropriately can significantly reduce the battery temperature and lead to more uniform temperature distribution. Eventually the tab with thickness of 0.2 mm, width of 35 mm and height of 20 mm are selected as the optimized tab design for this battery. Afterwards, the heat generation mechanism and characteristics are discussed at the optimized tab dimension, which indicates that the irreversible heat, especially the positive irreversible heat occupies an increasingly dominant position in the total heat generation rate with the increase of the discharge rate.

Key words: Lithium ion battery safety; Electrochemical-thermal coupling model; Tab dimension optimization; Discharge rate; Thermal behavior

Nomenclature

A_{tab}	Cross section of the tab (m^2)
c_1	Concentration of lithium in the active material (mol/m^3)
c_2	Concentration of lithium in the electrolyte (mol/m^3)
C_{dl}	Electrical double layer capacitance (F/m^2)

* Corresponding authors: Tel.: +86 551 6360 6455; fax: +86 551 6360 1669.
E-mail: pinew@ustc.edu.cn (Q.S. Wang)