6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

A COMPUTATIONAL FLUID DYNAMICS MODEL OF A 21700 CYLINDRICAL LITHIUM ION BATTERY CELL WITH SOLID-ELECTROLYTE INTERPHASE GROWTH

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Key Words: *Battery Ageing, CFD, 21700 Cylindrical Battery Cell, Electrochemistry, Heat Transfer, Lithium-Ion Battery, Solid-Electrolyte Interphase.*

Traditional experiments cannot precisely measure temperature distributions inside battery cells. An accurate prediction of internal temperatures in battery cells is important for their safe operation, good performance and extended life expectancy [1, 2, 3].
This work presents a coupled one dimensional electrochemical and three dimensional thermal computational fluid dynamics (CFD) model in order to accurately predict temperature profiles of commercially available 21700 format cylindrical lithium ion battery cells. Since an operating temperature has a significant effect on battery ageing, the CFD model is also coupled with the solid-electrolyte interphase (SEI) formation on the negative electrode. The SEI formation and growth is one of the main contributors to ageing of lithium-ion batteries that shortens their life expectancy and needs to be adequately addressed. The CFD model is based on charge, discharge and rest duty cycle periods of the 21700 format cylindrical lithium ion battery cell established on experimental test protocols for a specific application. In the future, the surface temperature and voltage profiles from the CFD model will be validated against experimental results. This model thus represents a computational framework to potentially decrease the cost and number of battery cell experiments with different duty cycle scenarios and optimise a cooling/heating system of battery modules and packs.

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