Modeling Thermal Effects of Battery Cells Inside Electric Vehicle Battery Packs

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Abstract

The paper presents a methodology to account for thermal effects on battery cells to improve the typical thermal performances in a pack through heating calculations generally performed under the operating condition assumption for Electrical Vehicle (EV) application. The aim is to analyze the issues based on battery thermo-physical characteristics and their impact on the electrical state of battery cells. Based on this analysis, the thermal management strategies are derived in achieving the temperature uniformity goal, and then propose a battery thermal management system (BTMS) with cell-level thermal controls. To achieve this, a 3D FEM model of a simplified battery pack is solved in COMSOL Multiphysics with the time varying heat source with different flow rates and in two different cell orientations. The Heat equation is used to model the pack and the classical cooling media e.g. Air and Liquid for the battery pack is implemented. The BTMS ability to represent local mean-flow effects and the impact on the different liquids and their flow rate is then evaluated comparing the results with those provided by an in-house zero-D code for resolving to get the heating rate and also the temperature evolution in terms in the presence of a mean flow.

Reference

1. COMSOL Version 5.1, Reference Manual

2. Jos van Schijndel, Integrated Modeling using MATLAB, Simulink and COMSOL with heat, air and moisture applications for building physics and systems

3. Ahmad A. Pesaran, Battery thermal models for hybrid vehicle simulations, Journal of Power Sources 110 (2002) 377–382

Figures used in the abstract

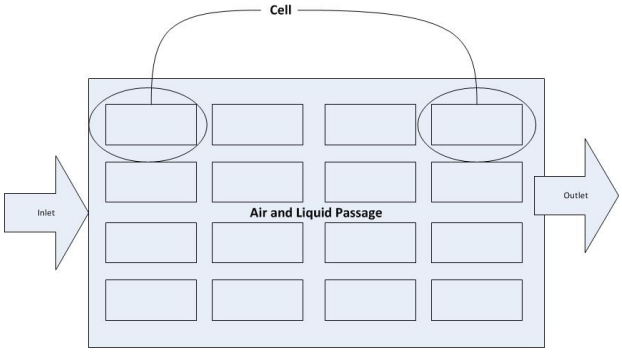

Figure 1: Battry thermal Management systems