A Single Particle Thermal Model for Lithium Ion Batteries

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Abstract

COMSOL® "Single Particle Model for Lithium-Ion Batteries" (Model ID: 14527) is generalized to include an energy balance. This is accomplished by approximating the solution phase polarization as a function of current and temperature. The theoretical approach for this work is similar to Guo et al. [Journal of the Electrochemical Society, 158, (2) A122-A132 (2011)] for modeling lithium ion cells. The COMSOL isothermal model run at 0.1 A provided the baseline for the open circuit potentials (OCPs). The temperature dependence of the (OCPs) and reaction entropies was determined by subsequent runs of the mass balance model at Temperatures ranging from 298-348 K. The discharge profile for the thermal model is shown in Figure 1 for 35.0 A/m² and the heat generation for the adiabatic case for a 17.5 A/m² discharge is shown in Figure 2.

Reference

1. Meng Guo, Godfrey Sikha, and Ralph E. White, Single-Particle Model for a Lithium-Ion Cell: Thermal Behavior J. Electrochem. Soc. 2011 158(2): A122-A132; doi:10.1149/1.3521314.

2. L Cai, RE White , Mathematical modeling of a lithium ion battery with thermal effects in COMSOL Inc. Multiphysics (MP) software, Journal of Power Sources, 2011.

Figures used in the abstract

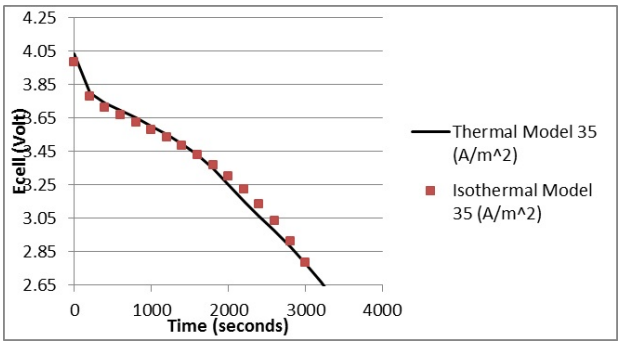

Figure 1: Discharge Profile for 35 A/m².

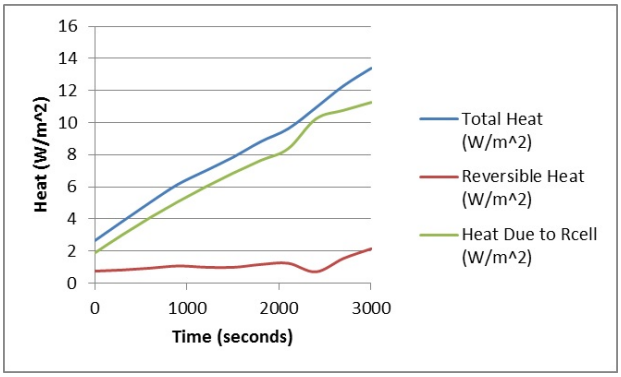

Figure 2: Heat Generation for Adiabatic Case for 17.5 A/m² Discharge.