

Sensitivity Analysis of Material and Design Parameters  
on Performance of Lithium Ion Battery Using  
Electrochemical Modeling

Zhenli Zhang, Brian Sisk

Johnson Controls Inc., Power Solutions, Global  
Technology & Innovation  
5757 N Green Bay Ave, Milwaukee, WI 53209, USA

A variety of materials and engineering variables affect the performance of an automotive lithium ion battery. Some of the most important materials parameters include dynamic transport properties of electrolyte and solid material - including ionic conductivity, electronic conductivity, and lithium diffusivity. Understanding the relationship between changes to these materials parameters and performance of the battery is critical to battery design. Additionally, the sensitivity of these parameters is affected by the intended application, as well as the choice of engineering parameters, such as particle size and porosity.

In this work, we consider the impact of the sensitivity of these fundamental parameters within the context of two different systems: a power cell for hybrid-electric vehicles (HEV) applications, and an energy cell for electric vehicle (EV) applications. These applications are simulated using high-pulse power capability (HPPC) and constant-current discharge tests. The range of variance, as well as sensitivity of key electrochemical parameters, are presented.