Model-Based Investigation of Particle Size and Coating Thickness for Pulse Performance of Automotive Lithium-Ion Batteries

Brian C. Sisk, Zhenli Zhang
Johnson Controls Power Solutions
5757 N. Green Bay Ave, X-67, Milwaukee, WI 53209

Optimization of the performance of Micro-hybrid and Hybrid Electric Vehicles (MHEV, HEV) requires a close match between the demands of the driving profile and the chemical and engineering characteristics of the material. Typical driving patterns present the opportunity for regenerative braking pulses that may be over 30 seconds in some cases. These pulses present challenges for typical power-oriented cells typically found in HEVs.

In this work we have used electrochemical modeling coupled with experimental validation to investigate the effects of particle size and coating thickness on the energy and power capability of lithium ion batteries. Our goal is to provide more opportunity for regenerative braking, particularly for high-speed, long deceleration pulses. We have analyzed NMC 1:1:1 cathode blends with varying particle sizes and electrode thickness (at constant capacity). Dynamics processes are characterized to determine the limiting factors for cell performance and to present options for capturing more regenerative braking energy.