Effect of Tab Design on Large-Format Li-Ion Cell Performance

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Effect of Tab Design on Large-Format Li-Ion Cell Performance

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Abstract

Large-format Li-ion batteries are essential for vehicle and grid energy storage. Today, scale-up of Li-ion cells has not maximized the potential of available battery materials, leading to much lower energy density than their coin cell benchmarks. In this work, a 3D computational methodology based on physical and electrochemical principles underlying Li-ion cells is developed for the design of large cells. We show a significant increase in the cell's usable energy density by minimizing voltage losses and maximizing the utilization of active materials in a large cell. Specifically, a class of designs using multiple current-collecting tabs are presented to minimize in-plane electron transport losses through long electrodes, thereby achieving nearly the same energy density in large-capacity cells as would be expected from battery materials used. We also develop a quantitative relation between the current density non-uniformity in a large-format cell and the cell's usable energy density, for the first time, in the literature.

Key words: Li-ion cell; Energy density; Tabs; 3D; Model

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