Improving the Energy Density of Li-Ion Pouch Cells using Tapered Electrodes

*C. Cho, C.D. Rahn

In recent years, efforts to alleviate the effects of climate change and global warming have driven the development of lithium-ion (Li-ion) battery technology. Large format cells can have fewer tabs, less packaging material and interconnects, and lower cost but nonuniform material utilization reduces the achievable power and energy densities. The impedance varies across the cell with active material farthest from the tabs having the highest impedance.

As a result, these underutilized parts of the cell do not become fully charged or discharged, especially at high current rates, and the energy storage capability of the cell is not fully realized. The current collector thickness can be increased to increase material utilization, but cost and energy density suffer. In this paper, we linearly taper electrode coatings to decrease thickness (and increase impedance) in low impedance areas, improving the impedance uniformity and material utilization across the cell.

The taper is introduced in the calendering process, by tilting the rollers to change thickness and porosity across the width of the cell. A multiple particle (MP) model is developed and validated in COMSOL to optimize the slope of the taper based on the tab configuration. Higher impedance near the tab balances the higher impedance in the current collector away from the tab. The analysis results show that a small taper (1%) can improve uniformity by 8X.