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High Power Battery Characterization for Parameterization of Battery Management Systems

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This work focuses on parameterizing performance of lithium-ion cells in 21-70 form factor when charged at ultra high charge rates between 5 and 20 minutes in isothermal, air chamber, and in active battery thermal control system (BTMS) mechanisms. Molicel P45B cells are dissected and geometry of internal components such as electrode, current collector, and tab geometry are measured. Electrode chemical composition of active materials analysed using ICP, SEM, and CT techniques. Cells are cycled at high charge rate in traditional air chamber and in isothermal conditions to identify differences in parameterization results. Internal cell temperature gradients are evaluated in air chamber and isothermal condition using an internal temperature sensor probing technique. A novel isothermal cell holder and high-rate cell cycler are used to cycle cells in a range of temperatures and rates to parameterize properties and identify an optimal operational window. Charge time, charge capacity, and charge efficiency are mapped various temperature and charge rates. New cell performance metrics which describe fast charge performance to support comparing different charge profiles. The affect of asymmetric temperature modulation (ATM) (commonly referred to as preheating) on charge performance is presented. Internal temperature and maximum temperature of cells are compared to isothermal conditions when charged in a novel active oil immersion heat transfer mechanism. In summary, this seminar presents various techniques for physically, chemically, and potentiometrically evaluating cells with the intention of characterizing cell performance in fast charging applications.