Evaluation of High C Rate Cycle Induced Aging on Low Impedance Lithium-Ion Batteries using In-Situ Electrochemical Impedance Spectroscopy (EIS)

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Lithium-ion batteries which possess an extremely low equivalent series resistance (ESR) have the ability to source high C rate pulsed currents to a wide variety of high power transient loads. While it has been shown that this type of operation is achievable, it has not been shown what impact a pulsed, high C rate discharge has on the cycle induce aging of these types of cells. To better understand how the aging and capacity fade of such devices are impacted in such conditions, the University of Texas at Arlington (UTA) has ongoing experiments in which a 3Ah $LiNi_xCO_yAl_{1-x-y}O_2$ battery, whose ESR is approximately 1.5 mΩ, is being discharged using a high C rate, 100C (300A), pulsed discharge procedure, 10 kHz, and recharged using a 1C constant current (CC) - constant voltage recharge. Similarly, a second identical cell is being discharged at 1C CC and recharged using a 33C (100 A) pulsed recharge procedure in which current is applied in 3 s increments with a 6 s rest period in between. Finally a third identical cell is being cycled using a 1C CC discharge and 1C CC-CV recharge procedure to serve as a control cell. The results of these experiments will enable the impact each respective high rate procedure has on cell aging to be determined. The experiments are being performed using both custom and commercially fabricated experimental test stands and electrochemical impedance spectroscopy (EIS) diagnostics are being used along with conventional current and voltage measurements to understand how the cells are aging and how capacity is affected. The experimental procedures and methods will be discussed in detail and the results of the experiments thus far will be presented.