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Commercial single cell testing: understanding the degradation mechanisms

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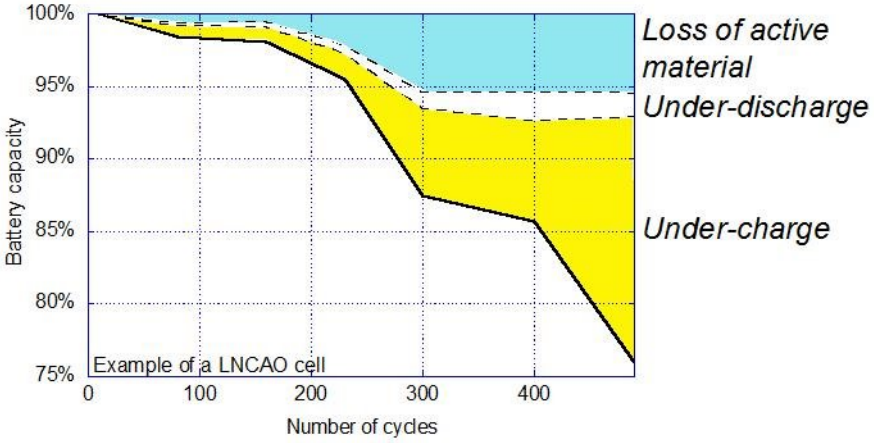
Focused Areas Main List [1]

Other Areas: Understanding Real Life Data [2] - Driving Cycle Analysis [3] - Cell Modeling [4] - Battery Pack Simulation [5]

Determining state-of-charge (SOC) in a battery has been an important subject for the industry for decades. Despite significant efforts in the past focusing on methodologies to accurately estimate SOC in a battery, the fundamental understanding of the SOC issue has not been clear, at least in the industry where testing, control, and operation are concerned. Recently, we have been working on developing reliable techniques to identify capacity loss mechanism in rechargeable lithium batteries and to quantify contributions to capacity loss from different origins. That prompted us to re-visit the SOC issue. Strictly speaking, SOC is a static thermodynamic property of battery chemistry, which should be determined at equilibrium. On the other hand, cell capacity is a quantity of practical interest often determined by kinetics; thus, it is rate dependent. We conducted a few experiments to illustrate the accurate estimate of SOC through proper measurements. We also explained the proper correlation between SOC and rate capacity. A better understanding of the charge and discharge behavior in a battery under different rates in relation to the SOC is therefore derived.

A quantitative approach is then used to identify sources of contribution to capacity fade in commercial rechargeable lithium battery cells in laboratory evaluations. Our approach comprises measurements of close-to-equilibrium open-circuit voltage of the cell after relaxation at the end of the charging and discharging regimes and an incremental capacity analysis, in addition to conventional cycle-life test protocols using the dynamic stress test schedule. This approach allows us to separate attributes to capacity fade due to intrinsic and extrinsic origins.



More details? 3 publications:

Incremental Capacity Analysis and Close-to-Equilibrium OCV Measurements to Quantify Capacity Fade in Commercial Rechargeable Lithium Batteries. [6]
M. Dubarry, V. Svoboda, R. Hwu and B.L. Liaw, Electrochem. Solid State Lett., 9(10), p. A454 (2006).

Capacity and Power Fading Mechanism Identification From a Commercial Cell Evaluation. [7]
M. Dubarry, V. Svoboda, R. Hwu and B.Y. Liaw, J. Power Sources, 165(2), p. 566 (2007).

Capacity Loss in Rechargeable Lithium Cells During Cycle Life Testing: The Importance of Determining State Of Charge. [8]
M. Dubarry, V. Svoboda, R. Hwu and B.Y. Liaw, J. Power Sources, 174(2), p. 1121 (2007).

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