

# Preliminary demonstration of the early stage detection of lithium plating for cell blocks based on charge curve analysis data

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The National Traffic Safety and Environment Laboratory (NTSEL) has confirmed in laboratory tests that lithium plating in lithium-ion secondary batteries leads to a decrease in thermal stability, and we consider that such reduced thermal stability can be a contributing factor to the occurrence of fires in electric vehicles and the escalation of damage during use.<sup>[1,2]</sup> In addition, NTSEL has investigated and examined nondestructive techniques for estimating a battery's internal state—including lithium plating—and in our previous report we described a method for detecting lithium-plated cells (i.e., cells with reduced thermal stability) within a module using charge curve analysis, one of the nondestructive diagnostic techniques.<sup>[3,4]</sup> However the targets of detection in previous reports have been lithium plated cells with risk stage only (Fig. 1).

In this paper, detecting the early stage of lithium plating for cell blocks was demonstrated with charge curve analysis data and laboratory level experiments. The early stage of lithium plating was estimated based on the charge curve analysis data, such as, negative electrode capacity and Shift of operating window (SOW) capacity. Disassembly inspections of the negative electrode and thermal runaway tests on cells were conducted to confirm the early stage of lithium plating within cell blocks.

The following results were obtained:

- Charge curve analysis was conducted every 50 cycles on the cell block subjected to repeated charge–discharge cycling, and its internal state was estimated.
- The early stage of lithium plating (Level 1) was detected by using the rate of change in negative-electrode capacity retention as an index, which is one of the estimated internal-state parameters.
- Feasibility of detecting early-stage lithium plating using charge curve analysis data was demonstrated by the results from laser irradiation thermal runaway tests and the negative electrode surface observation on the target cells.

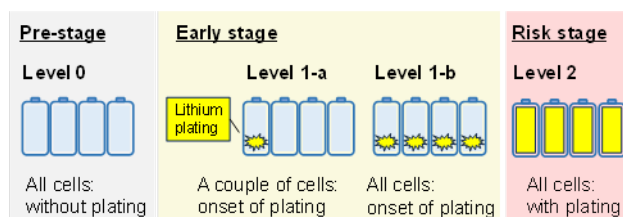


Fig. 1. Schematic image of lithium plating levels for cell blocks

## Reference

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