A new and fast entropy measurement method for lithium-ion cells

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The thermal management is becoming even more important as part of a battery management system, if cell size increases and large battery modules are employed in electrical vehicles (EV). With advancing cell technology, heat dissipation resulting from ohmic losses decreases drastically. As a consequence, especially at elevated temperatures, the heat generated from entropy change becomes the major contribution, depending on the material chemistry [1].
Therefore the measurement of the entropy is essential for optimizing the thermal management.
As a standard technique, entropy is determined from open circuit potential measurements at different cell temperatures [2]. However, this method requires rather long measurement times, as thermal and electrochemical relaxation has to be considered.

We propose a new measurement method, which decreases the required measurement time by a factor of 100. First, this measurement method allows for recording the entropy almost continuously versus state of charge. Second, this measurement method requires only standard-type and non-expensive measurement equipment.
In this contribution, the entropy curve is presented for four commercially available cells, with three different cathode chemistries: LCO/NCA-blend, LCO and two cells with $LiFePO_4$.
The results are in good accordance with the results obtained from potentiometric measurements, as figure 1 shows exemplary for three of the four cells.
As the measurement time is reduced drastically, the entropy can be determined in charge and discharge direction. Comparing both curves show a hysteresis behavior similar to open circuit potential curves.

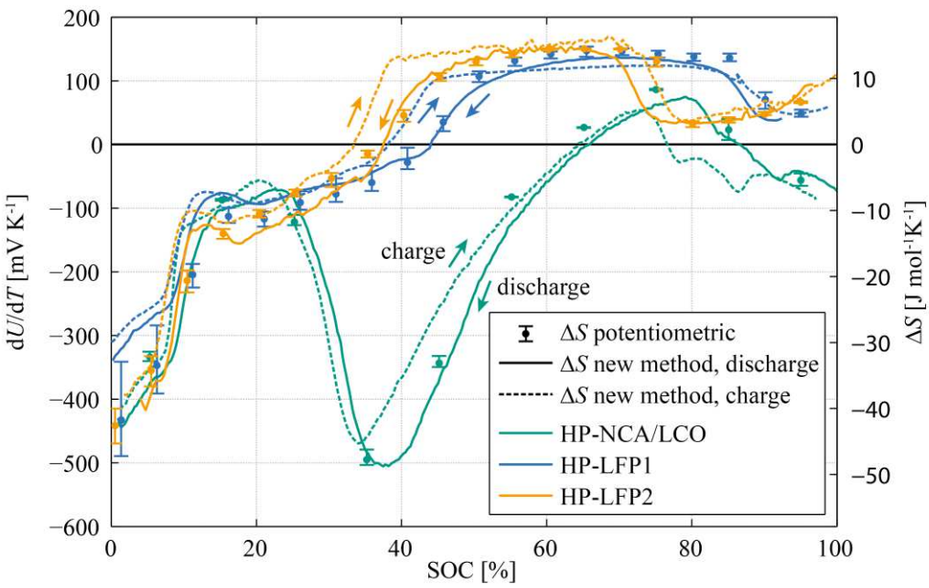

Figure 1: Entropy ΔS determined by potentiometric measurements by discharging the cell in 10% decrements and determined by the new method in charge and discharge direction. A hysteresis can be observed clearly for all three cells.

References:

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