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Peltier Heats in Lithium-Ion Batteries

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Temperature is known to be of importance for the ageing, performance, and safety of lithium-ion batteries. The heat released or absorbed inside a battery has therefore been a topic of much interest. The heat released or absorbed with the cell reaction, the reversible heat effect, is commonly included in thermal models through the entropy change of the reaction. The total reversible heat is then distributed evenly over the cell. However, the cell reactions are occurring at the two electrode interfaces resulting in two local effects known as the Peltier heats. [1]

An anodic electrode surface reaction with a positive Peltier heat will be cooling down, while a negative Peltier heat means it is heating up. For lithium-ion batteries this means that an electrode which heats during discharge, will cool during charging. The two local Peltier heats combine under the assumption of isothermal conditions to give the entropy change of the reaction. [2] If the entropy change is small, the Peltier heat of the individual electrode surfaces may still be large. [1,2] In such a situation one electrode surface would cool while the other heats. To distribute the reversible heat effect uniformly, would therefore give an inaccurate temperature profile.

We will show how entropy measurements of lithium-ion batteries with a lithium metal counter electrode can be used to predict the Peltier heats of electrode materials of various chemistries and lithium content if the Peltier heat of Li-metal is known. These data are already available in literature [3,4] and has heretofore been unexploited. We will see that one electrode surface will cool while the other releases heat. [5] The importance of these local effects will be for the temperature profile on a single-cell level and a stack will shown. [1]

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References

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