DSC-like Calorimetry on a coin cell for Lithium-Ion Batteries
&
A new apparatus to determine partial pressure and thermodynamic data by the Knudsen Effusion method

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Research on the thermal behavior of Li-ion batteries fosters the understanding of heat generating effects and the dimensioning of battery thermal management systems (TMS). First comprehensive studies with a DSC-like calorimeter for coin-cells are performed to determine thermal properties of a LiCoO2-graphite cell. The high precision and accuracy of the measurements are obtained by calibrating the signals using melting point standards in properly prepared coin-cell cases. Chemical and physical changes are identified in the measured heat flow signal and are discussed taking into account phase diagram information. Energetic efficiencies are calculated in dependence of temperature and C-rates by integrating the measured electrical power and heat values. The influence of cell aging on heat generation and usable capacity under operating conditions is shown. Considering the measured heat generation in a wide temperature range at different C-rates will make a valuable contribution to the understanding of material properties. This fundamental data is essential to improve thermal models to simulate spatially resolved heat dissipation in the electrodes to prevent over-heating. [1]. Thermal stability of Electrode, electrolyte and separator can be determined for decomposition reactions simultaneously with the quantity of released heat. This will be shown for an induced thermal runaway.

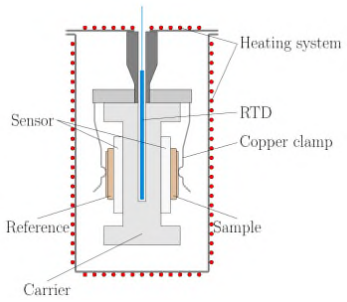

Figure 1 High temperature coin cell module of the multi mode calorimeter (Netzsch Gerätebau GmbH, Germany [1]

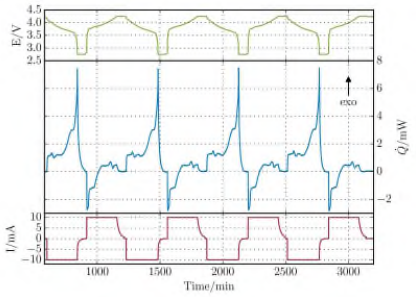

Figure 2 Heat Flow, Cell Voltage, and current curves of a LiCoO2-C coin cell measured at 35 °C and 10 mA (Galvanostatic Cycling with Potential Limitation) [1]

Additionally, a completely new designed apparatus for measuring and comparing vapor pressure and thermodynamic data by mass spectrometry will be shown at a glance. The totally new KEMS apparatus at the University of Applied Sciences in Mannheim (Germany) will exceed the current state of the art of measuring vapor pressure by the method of Knudsen Effusion Mass Spectrometry (KEMS) in sensitivity and usability. New field of applications will be developed in the area of gas analysis and determination of thermodynamic data for new electrode materials and electrolytes for the electromobility.

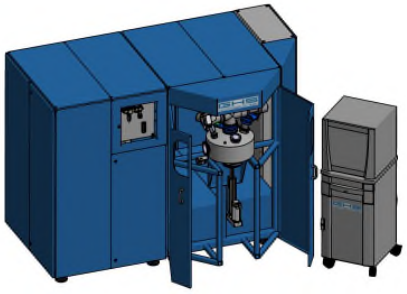

Figure 3 New Knudsen Effusion Mass Spectrometer build up by GHS Vakuumtechnik (Herborn, Germany) and University of Applied Sciences in Mannheim (Germany). Supported by Pfeiffer Vacuum GmbH (Aßlar, Germany)

References

[1] H. Giel, D. Henriques, G. Bourne, T. Markus, Investigation of the heat generation of a commercial 2032 (LiCoO2) coin cell with a novel differential scanning battery calorimeter, Journal of Power Sources 390 (2018) 116–126.