Following internal resistance changes in batteries with a versatile intermittent current interruption technique

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Determination of the internal resistance of a battery is valuable as an indicator of performance (power capability) and state-of-health. Internal resistance is also dependent on state-of-charge (SoC) for many battery systems and may also be useful in SoC determination methods. While there are a number of established electrochemical techniques for determining internal resistance, the most commonly employed is electrochemical impedance spectroscopy (EIS), which is a powerful technique allowing for the probing of the various resistive and reactive processes in the battery over a wide timescale. However, practical application of EIS is complicated by the requirement for specialist equipment and particularly specialist interpretation of data, especially if equivalent circuit modelling is desired. This complexity is even more the case if one wishes to follow the change in resistance over long-term testing. In many cases, a simpler method may suffice.

Galvanostatic cycling combined with an intermittent current interruption (ICI) resistance determination method[1,2] is presented as such method for following resistance changes in batteries over long-term cycling. By comparison with EIS, the method gives a single time-independent value of resistance, is fast, accurate, simple to interpret and can be implemented with most conventional battery testing instruments. The method is also readily applied to three-electrode measurements. This presentation will give an overview of the technique and some examples of its application, particularly to the analysis of lithium-sulfur batteries but also recent application to three-electrode measurements in Li-ion batteries.

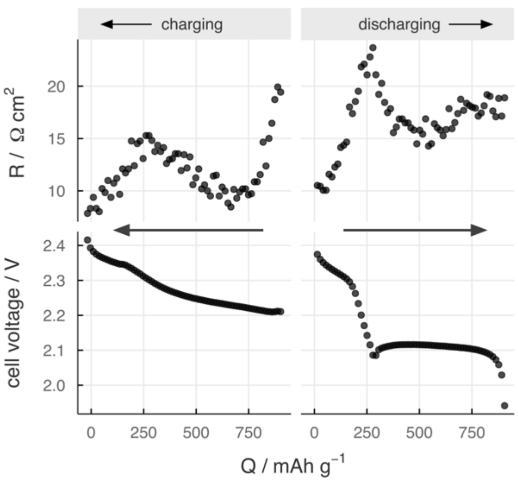

Figure: Cell voltage and internal resistance vs capacity for a single cycle of a lithium-sulfur battery at a slow (C/10) charge/discharge rate. Arrows indicate direction of charge/discharge.

References:
[1] M. J. Lacey, ChemElectroChem 4, 8 (2017) 1997-2004.
[2] M. J. Lacey, K. Edström, D. Brandell, Chem. Commun. 51 (2015), 16502-16505.