Cognition Energy

Case study: Experimental Chemistry Cell Characterisation

Cognition was asked to undertake a set of characterisation tests over 3 months to generate a dataset that could inform future development by the customer. Cells were an experimental Li-ion chemistry with a 21700 form factor.

Preparation

We agreed a suitable test plan with the customer, including test types, cell connection and cooling methods, reporting periods and data formats. We then wrote the test protocols and automated MATLAB analysis algorithms before testing them on stock cells to ensure that they worked.

Testing

The customer shipped Cognition 24 cells for testing, half of which were for performance testing, the other half of which were for lifetime testing. The cells were barcoded and initial capacity and DC resistance were measured before characterisation and lifetime tests were started. All tests were performed in a forced air cooled chamber with two thermocouples epoxy-bonded to each cell to record cell temperatures, with cells electrically connected using commercial cell holders (see Figure 1).



Figure 1: Cells ready to start testing in a thermal chamber.

Performance Tests

The cells subjected to performance testing and were cycled at a range of power rates up to 40 A to characterise the rate performance of the experimental cell at 25 °C. Subsequently, further tests were carried out to characterise the cell performance at a range of temperatures, and DC resistance and Galvanostatic Intermittent Titration Technique (GITT) measurements were taken to provide further electrochemical characterisation of the cell The data was extracted and analysed in MATLAB before being passed on to the customer (example data is shown in Figures 2 and 3).



Figure 2: Experimental cell voltage versus capacity at a range of power rates (equivalent data from stock cell).



Figure 3: Experimental cell voltage versus capacity at a range of operating temperatures (equivalent data from stock cell).

Life Cycling Tests

The remaining 12 cells were subjected to life cycling at a range of temperatures with breaks to run reference performance tests, including capacity loss, DC resistance and Electrochemical Impedance Spectroscopy (EIS) measurements. Data was again extracted and analysed weekly before being sent to the customer for review. Example data is shown in Figure 4 and 5 (equivalent data is shown).



Figure 4: Cell capacity retention versus cycle number (equivalen data from stock cell).



Figure 5: Nyquist plot of EIS measurements throughout cell life (equivalent data from stock cell).

Completion

On completion of the tests, the cells were packed and returned to the customer. The entire test campaign was equivalent to over 18,000 hours of cell testing and provided valuable information for the customer to further develop and iterate on their cell designs.