



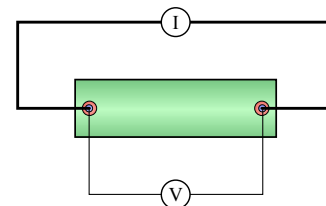
Characterizing a cell

- Our focus now turns to how to find ESC model parameter values to describe a specific lithium-ion cell
- To do so, we must collect data from the cell using carefully defined procedures, and then process that data to generate the parameter values
- A cell's OCV is a static function of SOC and temperature; all other aspects of a cell's performance are dynamic in some sense
 - Separate cell tests are performed to collect data for the OCV versus SOC relationship and for the dynamic relationship
- This week, we look at the tests required to collect data for the OCV relationship, and how to process that data



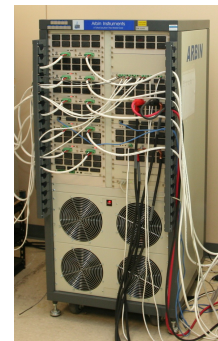
Physical test setup: 4-wire connection

- It is critical to use a 4-wire or *Kelvin* connection in test setup
- Test equipment will source/sink current through two wires
- Test equipment then measures voltage response through two different wires
- Large currents can be sourced by test equipment, so there can be large voltage drop over the current-supply wires leading to large measurement errors if only two wires are used
- Voltage sensing draws essentially zero current, so there is no voltage drop over the voltage sense wires, leading to an accurate voltage measurement



Equipment

- Cell data are collected with aid of lab equipment known as *battery-cell cyclers* or *battery-cell test equipment*
- An example, manufactured by Arbin Instruments, is shown
- This computer-controlled cycler can perform independent experiments on up to 12 different cells simultaneously, controlling each cell's current according to a user-specified profile and recording actual cell current, voltage, and temperature
- Each of the 4-wire cables shown in the figure corresponds to a single *test channel*—the power electronics designed to conduct an independent test; 2-wire cables measure temperature
- Battery-cell test equipment is generally custom designed to the user's specifications, so this example is representative only





Controlling ambient temperature

- In addition, most tests must be conducted in controlled temperature settings
- The figure shows an *environmental chamber* manufactured by Cincinnati Sub-Zero
- This particular unit has 8 ft³ of interior space and is capable of maintaining constant temperatures between -45°C and 190°C and commanding profiles of temperature versus time
- Systems can be configured with humidity control, wider temperature ranges, rapid cooling for thermal-shock testing, and more



Summary

- This week, we begin to look at how to identify ESC-model parameter values to characterize a particular battery cell
- Importantly, the cell must be configured in a 4-wire measurement setup for accurate voltage measurements
- Cell-test equipment will supply a profile of demanded current (or power) versus time, and measure actual current, voltage, and temperature
- Thermal chambers will maintain a constant ambient temperature



Credits

Credits for photos in this lesson

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