Cell testing to determine OCV

- We first discuss experiments to determine OCV relationship
  - The cell is very slowly discharged, then very slowly charged between cutoff voltages $v_{\max}$ and $v_{\min}$, specified by manufaturer
  - Voltage, accumulated ampere-hours discharged, and accumulated ampere-hours charged are recorded regularly (*e.g.*, once per second)
  - Tests are run at a number of temperatures spread over cell's operational range
- Because very low current rate is used, there is negligible heat generation, and we can consider all data to be collected at ambient test temperature
- This lesson teaches the procedure conducted for each temperature

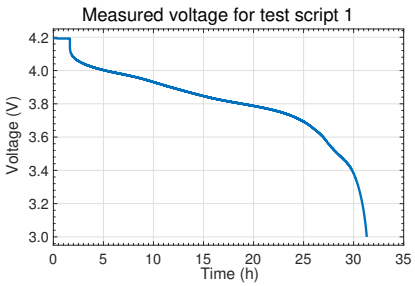
Discharge portion of test

OCV test script #1 (at test temperature)

1. Soak fully charged cell at test temperature for at least two hours to ensure uniform temperature
2. Discharge cell at constant-current C/30 rate until terminal voltage equals $v_{\min}$

OCV test script #2 (at 25 °C)

3. Soak cell at 25 °C for at least two hours to ensure uniform temperature throughout
4. Bring cell terminal voltage to $v_{\min}$ by dis/charging at C/30 rate



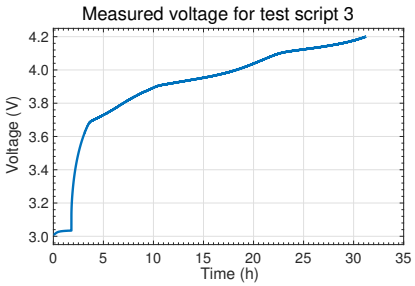
Charge portion of test

OCV test script #3 (at test temperature)

5. Soak cell at test temperature for at least two hours to ensure uniform temperature throughout
6. Charge the cell at constant-current rate of C/30 until cell terminal voltage equals $v_{\max}$

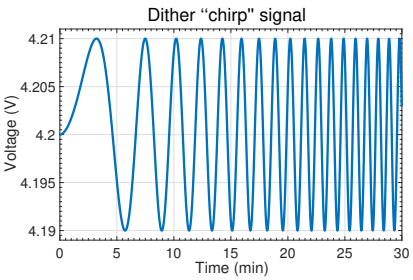
OCV test script #4 (at 25 °C)

7. Soak cell at 25 °C for at least two hours to ensure uniform temperature throughout the cell
8. Bring cell terminal voltage to $v_{\max}$ by dis/charging at C/30 rate



Optional: Add dithering to end of steps 4, 8

- Purpose of step 4: calibrate by reaching 0 % SOC by dis/charging cell to $v_{\min}$ (OCV $= v_{\min}$ at 0 % SOC)
- Purpose of step 8: calibrate by reaching 100 % SOC by dis/charging cell to $v_{\max}$ (OCV $= v_{\max}$ at 100 % SOC)
- However, OCV is different from equilibrium terminal voltage due to hysteresis, so setpoint SOC is not truly achieved!
- Can (optionally) counteract using method, sometimes used in demagnetization, subjecting cell to a forced dithering input voltage
- Causes hysteresis loops to collapse toward zero



Summary

- To determine OCV relationship, we generally want to average discharge and charge curves
- Calibrate tests by starting with fully charged cell and ensuring that SOC is 0 % after discharge and is 100 % after charge
- Further calibrate by ensuring that temperature is 25 °C at calibration points
- Record of accumulated ampere hours dis/charged will be used to determine total capacity, coulombic efficiency, and dis/charge voltage at every point in the test
- These voltages will be processed to compute OCV