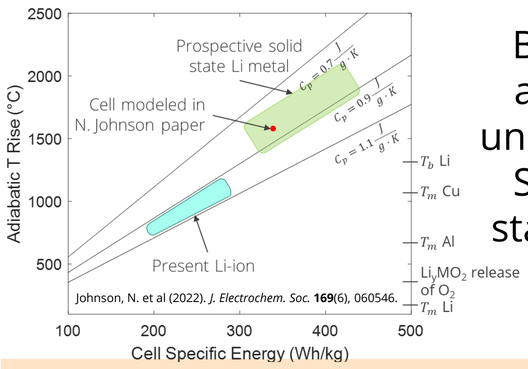
Sandia National Laboratories

QUANTIFYING VARIABILITY FROM KEY FACTORS IN MATERIALS-SCALE BATTERY SAFETY TESTING

Nathan Brenner Johnson, Alex M. Bates, Loraine Torres-Castro, Bhuvsmita Bhargava, Megan Diaz, Yuliya Preger, Paul Albertus

Motivation



Johnson, N. et al (2022). *J. Electrochem. Soc.* **169**(6), 060546.

Battery safety testing is often completed at the end of the battery development cycle after $100s of millions and years of labor have been invested. This makes costs from unexpected safety issues immensely expensive in both money and time lost. Differential Scanning Calorimetry offers a viable option for predicting safety issues from an early stage in development, but variability exists in the literature from a lack of standards for testing battery materials making cross-institutional comparison difficult.

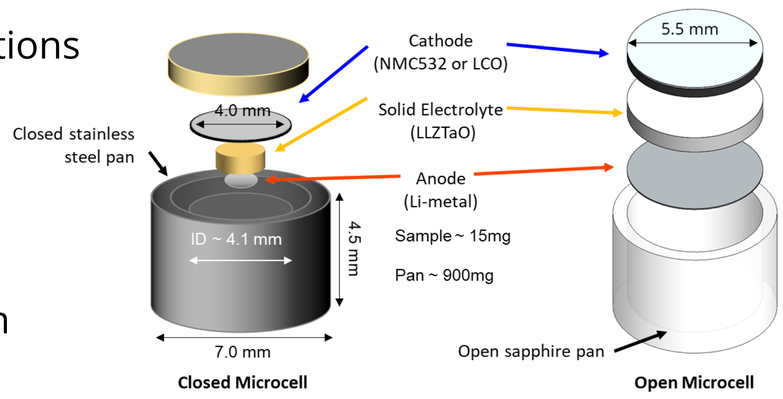

Chen et al. (2020) *Joule* **4**(4) 812-821

Microcell Assembly and Testing

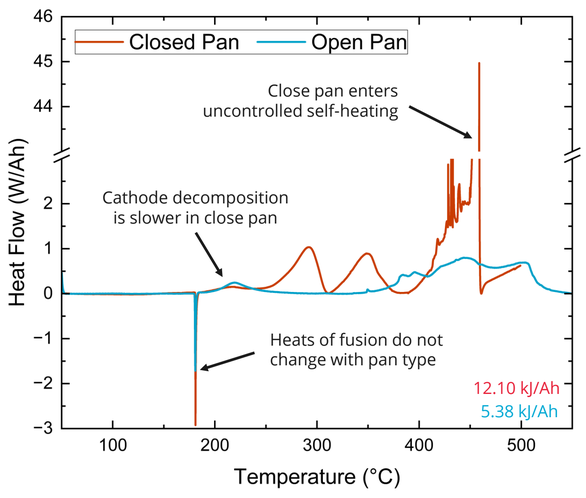
1) Exchange materials between institutions for DSC testing

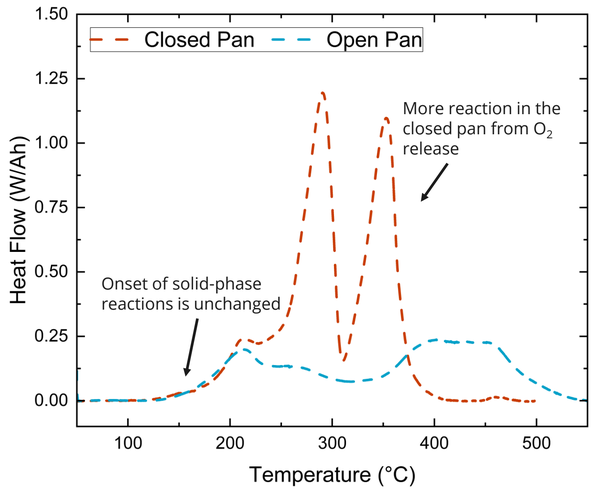
2) Identify sources of discrepancy for identical samples and materials

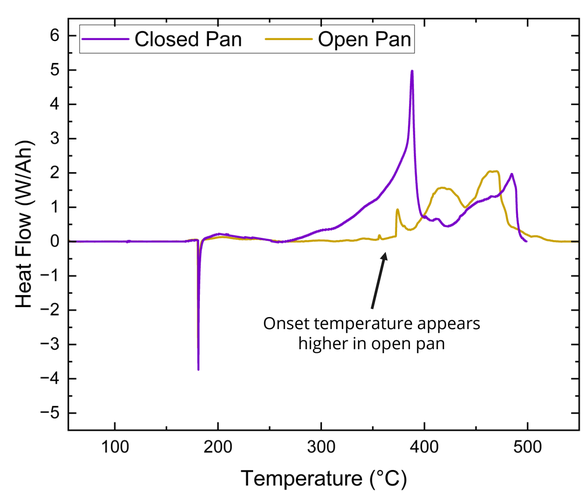
3) Quantify impact on safety prediction

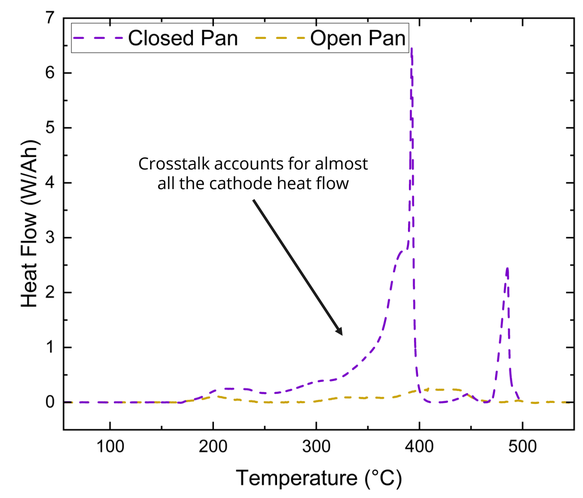


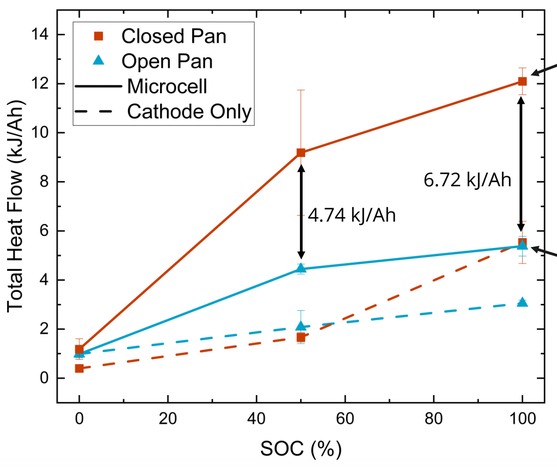
NMC532/LLZTO/Li Microcells









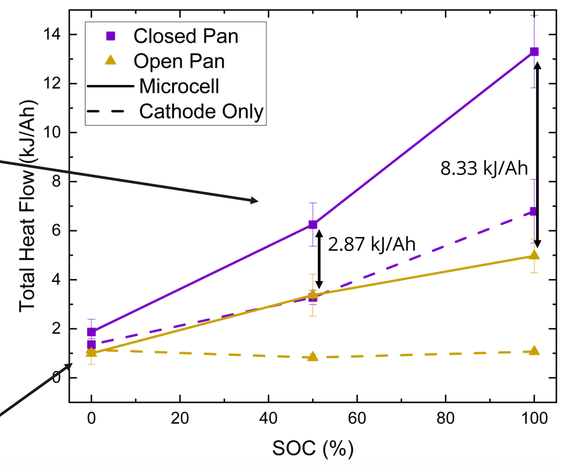


The inclusion of lithium metal significantly increases heat flow – Crosstalk is critical

Discrepancy grows larger as materials become more energetic

High pressure pans encourage more reactions involving gaseous reactants. Open pans encourage more reactions involving gaseous products.

Little difference in heat flow at 0% SOC



6.72 kJ/Ah is a difference in adiabatic temperature rise of >700°C

8.33 kJ/Ah is a difference in adiabatic temperature rise of >800°C

Key Takeaways and Future Work

- Sample design and pan type are critical for accurate heat flow measurements
- Open pans represent lower enthalpy bound and closed pans represent upper bound
- Modeled thermal response can vary drastically depending on pan type (100s of °C difference)
- Critical details need to be reported for accurate data interpretation and modeling

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