IMPROVING BATTERY MODELS USING UNCERTAINTY ANALYSIS

Estimating experimental error and investigating propagation in models.

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1. ABSTRACT

Battery models are increasingly desirable for automotive companies, motorsport and cell manufacturers to design control systems based on a particular cell. Models are as reliable as their input parameters, which are obtained from physical measurements made by tearing down a cell. Quantifying the uncertainty in these measurements and propagating through the model has a threefold impact:

1. The reported data is more trustworthy for the customer.
2. The level of uncertainty may affect decisions such as amount of billing materials or manufacturing route used.
3. The sources of uncertainty in the measurement method are identified and the method can be improved.

2. UNCERTAINTY BUDGETING

Uncertainty is the quantification of doubt in a measurement1.

The expanded uncertainty is quoted to 95% confidence; there is a 95% probability the true value lies within this interval.

3. TEARDOWN PROCESS

4. SOURCES OF UNCERTAINTY

5. MONTE CARLO METHOD

The standard (not expanded) uncertainty of mass loading and thickness found in the gravimetric budget was set to be the standard deviation of the input values.

6. EQUATIONS

7. CONCLUSIONS

8. IMPACT / NEXT STEPS

- In both figures the mean of B is greater than the mean of A. However, the conclusion that B > A cannot be drawn for (1) due to significant overlap.
- Hence, uncertainty analysis enables quantitative comparison between measurements under different conditions.

Future steps:

- Improve equipment + setup
- Electrochemical measurement uncertainties
- Uncertainty in supply chain

REFERENCES


INTERN BIO

Siddhi is a 3rd year Materials Science student at the University of Cambridge. She hopes to pursue a PhD in the battery sector and transition to industry to make a positive, sustainable impact! She would love to establish a start-up in the future within the energy storage industry.