Battery Thermal Characterization

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RELEVANCE
Life, cost, performance, and safety of energy storage systems are strongly impacted by temperature.

OBJECTIVES
- To thermally characterize cell and battery hardware and provide technical assistance and modeling support to DOE\(\text{U.S. DRIVE, USABC, and battery developers for improved designs.}
- Identify how changes to the battery chemistry and cell design affect the cells' efficiency and performance.
- To quantify the impacts of temperature and duty cycle on energy storage system life and cost.
- Work with the cell manufacturers to identify new thermal management strategies that are cost effective.

SUMMARY
- NREL collaborated with U.S. DRIVE and USABC battery developers to obtain thermal properties of their batteries.
- We obtained heat capacity and heat generation of cells under various power profiles.
- We obtained thermal images of the cells under various drive cycles.
- We used the measured results to validate our thermal models.
- The data has been shared with the battery developers to improve their designs.
- We identified additives and cell architecture that improved the high and low temperature performance of the cell.
- Thermal properties are used for the thermal analysis and design of improved battery thermal management systems to support life and performance targets.

Cell Thermal Studies

- Efficiency Comparison as a Function of Anode Type
- Improving Efficiency of Successive Generations of Cells
- Efficiency Varies as a Function of State-of-Charge (SOC)

Heat generation, heat capacity, spatial temperature distribution, cell-to-cell temperature imbalance, cooling system effectiveness.

Pack Thermal Test Studies

- Thermal Management System Performance
- Advanced Algorithms Decrease Charge Time

Cell-Level Testing

- Thermal Imaging
- Temperature variation across cell, pack, modules, and packs; in this section, we’ll look at the results of the characterization efforts.
- Heat generation, heat capacity, and efficiency.
- Temperature variation across cell, module, and pack; in this section, we’ll look at the results of the characterization efforts.

Infrared Imaging Studies

- Infrared Imaging of Cell Connections
- Infrared Imaging of Battery Module

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