National Aeronautics and Space Administration

SMALL FRACTIONAL THERMAL RUNAWAY CALORIMETER

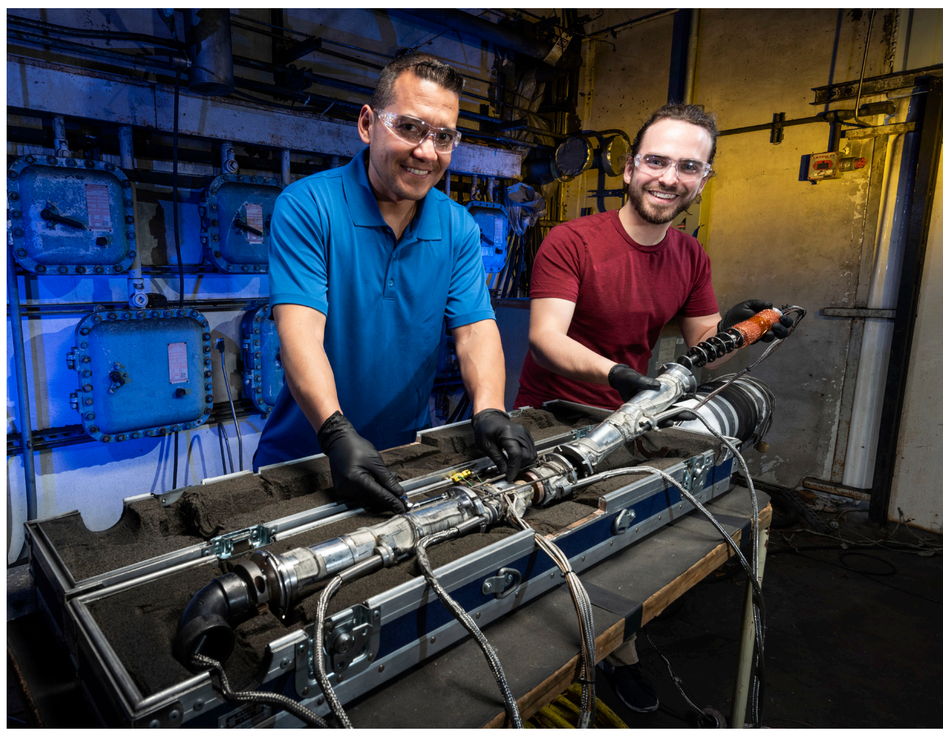
LYNDON B. JOHNSON SPACE CENTER • HOUSTON, TEXAS

OVERVIEW

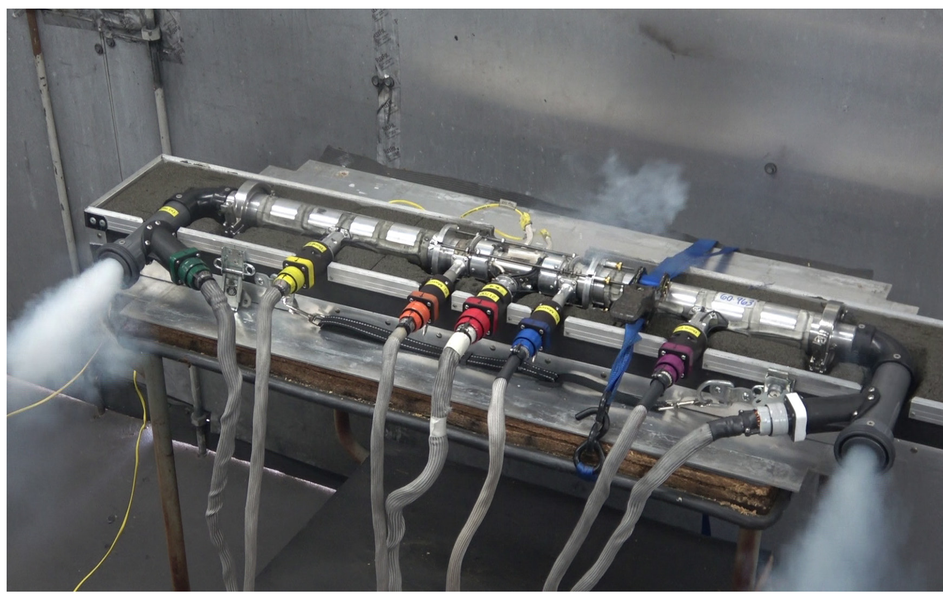
The Small Fractional Thermal Runaway Calorimeter (S-FTRC) is an instrument used to measure and characterize the energy release from lithium-ion cells undergoing thermal runaway.

The instrument quantifies the total and fractional energy outputs, distinguishing between the energy conducted through the cell casing versus energy released via venting and ejected material.

Data collected from the S-FTRC enables informed designs of passively propagation resistant battery systems for human-rated vehicles.



NASA Power Systems Branch team members show the S-FTRC.



The S-FRTC during a battery test with a cell going into thermal runaway with gases ejected from the exhaust.

FUNCTION

During field use, lithium-ion batteries are susceptible to violent thermal runaway due to rare latent manufacturing defects that can be difficult to detect and screen. These defects can induce internal short circuits that generate an unsafe, irreversible reaction. The S-FTRC can be used to then help design propagation-resistant battery systems.

The S-FTRC:

- Is compatible with cylindrical, pouch, and prismatic cells lithium-ion cells <5 Ah.
- Is compatible with various thermal runaway initiation techniques including heaters and nail penetration.
- Is compatible with synchrotron X-ray beamlines, enabling in-situ observation of cell internal structural and material changes during thermal runaway.
- Characterizes the total energy output produced from a cell undergoing thermal runaway.
- Measures the fraction of energy conducted through the cell casing versus the fraction vented via gases and ejecta.
- Has a rapid test turnaround to gather a statistically significant quantity of test runs of each cell configuration in a test series.

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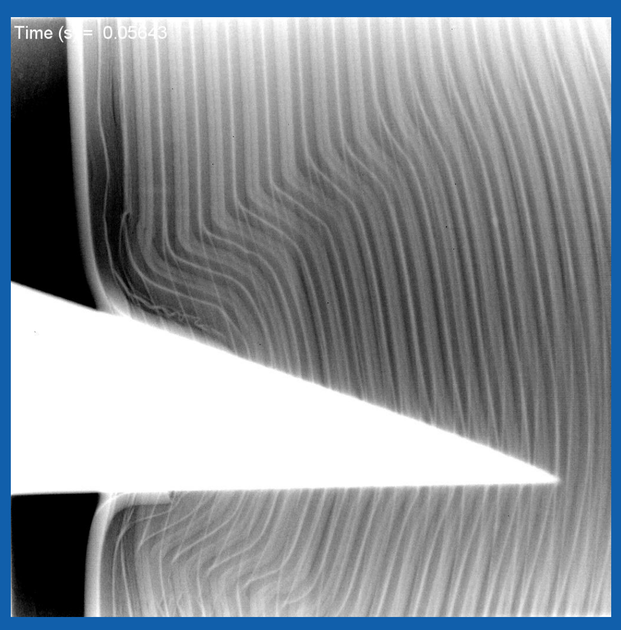
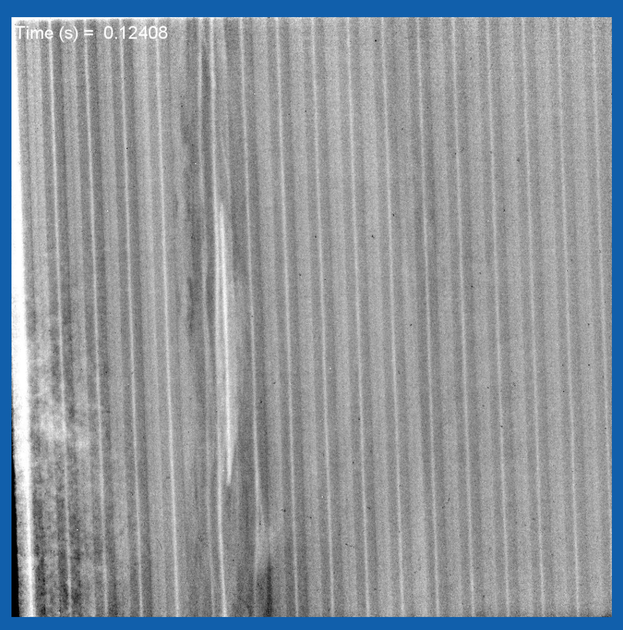
The Small Fractional Thermal Runaway Calorimeter (S-FTRC) was awarded the NASA Commercial Invention of the Year Award in 2023.

A nail (white triangle) entering the cell to start thermal runaway.



A screenshot of an X-ray video of the Internal Short Circuit device activating inside of a cell while undergoing thermal runaway.



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