# Lithium-Ion Battery Failure Experiments and Hazard Analysis

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## 1 Abstract

Lithium-ion batteries (LIBs) have been widely adopted for power supply of modern electronics. However, these batteries are prone to failure via thermal runaway (TR) and pose a variety of hazards including significant energy release; production of jet flames; ejection of micro- and nano-particulates; and emission of toxic and combustible vent gasses. A state-of-the-art battery failure experiment has been designed and built at Texas A&M to evaluate these hazards for standard and new battery systems. The experiment consists of a constant-volume bomb that is optically accessible; a thermal failure initiation system; plumbing for atmospheric control and gas capture; and various diagnostics. These diagnostics include thermocouples for control, battery surface, and headspace temperature measurements; pressure transducers; open-cell voltage measurement; and optical diagnostics (e.g., high-speed video, etc.). Battery failure experiments are supplemented with post-failure analyses via complimentary techniques including gas chromatography-mass spectrometry (GC-MS), scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS), X-ray diffraction (XRD) analysis, and X-ray photoelectron spectroscopy (XPS). This presentation provides an overview of the experimental design and approach, a series of representative experimental results, and a discussion of novel techniques implemented in the experiment.

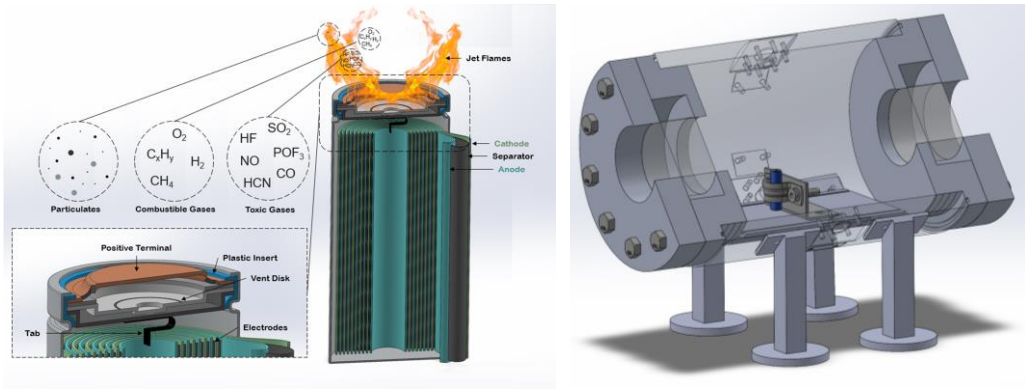


Figure 1: (left) Battery failure hazards. (right) CAD representation of the battery failure experiment.