UNC Pembroke

Lithium-Ion Battery Hazards

Lithium-ion battery fire hazards are associated with the high energy densities coupled with the flammable organic electrolyte. This creates new challenges for use, storage, and handling. Studies have shown that physical damage, electrical abuse, such as short circuits and overcharging, and exposures to elevated temperature can cause a thermal runaway. This refers to rapid self-heating from an exothermic chemical reaction resulting in a chain reaction thermal runaway of adjacent cells.

Manufacturer's defects, such as imperfections and contaminants in the manufacturing process, can also lead to thermal runaway. The reaction vaporizes the organic electrolyte and pressurizes the cell casting. If (or when) the case fails, the flammable and toxic gases within the cell are released. The severity of a runaway battery reaction is related to the buildup and release of pressure from inside the cell. Cells with a means of releasing this pressure (i.e., pressure relief vents or soft cases) typically produce less severe reactions than cells that serve to contain the pressure and rupture due to high pressure (i.e., unvented cylindrical cells). As a result, cell construction can be a significant variable in the severity of a battery incident.

The resulting reaction can look anywhere from a rapid venting of thick smoke (i.e., smoke bomb/smoker), to a road flare, to a steady burn, to a fireball to an explosion. See Figure 1.

Figure 1: General Battery Reactions

Best Storage Practices

Procurement

- Purchase batteries from a reputable manufacturer or supplier.
- Avoid batteries shipped without protective packaging (i.e., hard plastic or equal).
- Inspect batteries upon receipt and safely dispose of damaged batteries.

Storage

- Store batteries away from combustible materials.
- Remove batteries from the device for long-term storage.

- Store the batteries at temperatures between (41°F and 68°F).
- Separate fresh and depleted cells (or keep a log).
- If practical, store batteries in a metal storage cabinet.
- Avoid bulk-storage in non-laboratory areas such as offices.
- Visually inspect battery storage areas at least weekly.

Charger and Charging Practice

- Disconnect batteries immediately if, during operation or charging, they emit an unusual smell, develop heat, change shape/geometry, or behave abnormally. Call EHS for disposal of damaged batteries.

Handling and Use

- Handle batteries and or battery-powered devices cautiously not to damage the battery casing or connections.
- Keep batteries from contacting conductive materials, water, seawater, strong oxidizers, and strong acids.
- Do not place batteries in direct sunlight, on hot surfaces, or in hot locations.
- Inspect batteries for signs of damage before use. Never use and promptly dispose of damaged or puffy batteries.
- Keep all flammable materials away from the operating area.
- Allow time for cooling before charging a battery that is still warm from usage and using a battery that is still warm from charging.

Disposal

- Dispose of damaged cells and cells that no longer hold a substantial charge.
- Batteries that can be recycled need to go to UNC – Pembroke Surplus/Asset Relocation 910.521.6346.
- Please coordinate disposal of damaged batteries with the Environmental, Health, and Safety Office (EHS) at 910.521.6792 or 910.775.4772. The office can also be reached by email: safety@uncp.edu.

Emergencies

Follow these steps if there is evidence of a battery malfunction (e.g., swelling, heating, or distinctive odors). Use personal protective equipment, such as gloves, goggles/safety glasses, and lab coat.

- If batteries are showing evidence of thermal runaway failure, be very cautious because the gases may be flammable, and toxic and failure modes can be hazardous.
- Disconnect the battery (if possible).
- Remove the battery from the equipment/device (if possible).
- Place the battery in a metal or other container away from combustibles.

- Contact EHS at **910.521.6792** or **910.775.4772,** and the office will provide further assistance.
- If a lithium battery fire occurs, use a CO2 (Class BC) or dry chemical (Class ABC) fire extinguisher, only if trained and safe to do so. Please identify the location of the fire extinguishers located in your building. Call Campus Police at 910.521.6235 or the Fire Department by dialing 9 x 911 on a campus phone or 911 on any other phone.

Additional Information

Publications:

Battery University: Safety Concerns with Li-ion

Consumer Product Safety Commission: Battery Safety Alerts

Training:

NASA: Short Course on Lithium-ion Batteries