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Thermal &Toxic-Fume Hazards: Lithium-Ion Batteries

Assessment & Analysis
System Engineering and Experimentation

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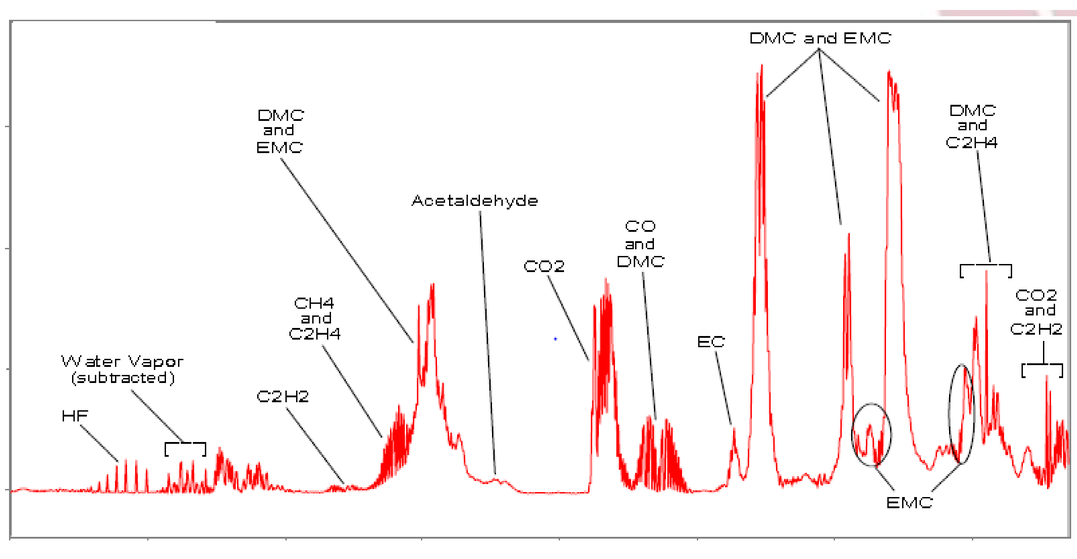
Research Objective

- Assess thermal & toxic-fume hazards generated during ballistic or crash events
- Use experimental results to drive design and fielding decisions
- Incorporate vulnerability-reduction techniques to mitigate thermal and toxic-fume hazards

Battery pack destroyed by uncontrolled thermal runaway

Challenges

- Designing lightweight, energy-dense power sources for military applications.
- Achieving reduced toxic-fume hazards associated with damaged batteries.
- Developing thermally stable battery chemistries without a weight penalty.



Sample FTIR spectrum for toxic-fume analysis

ARL Facilities and Capabilities Available to Support Collaborative Research

ARL facilities provide unique test/experimentation capabilities enabling real-time remote test execution of electrically-loaded test articles ranging from single cells, modules, or entire battery packs. If actual containment structures/vehicles cannot be provided, our on-site fabrication facilities allow for construction of representative vehicle mock-ups to house battery packs for testing in operationally-realistic environments.

Containment structures should prevent build-up of flammable mixtures

- Toxic fumes produced from damaged lithium-ion batteries using unstable cathodes and flammable electrolytes can be lethal within seconds after inhalation.
- Tightly-packed battery modules and packs contribute to thermal runaway.
- Vulnerability-reduction techniques, such as directed venting, can be effective at mitigating the toxic-fume hazard.

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Expertise in battery chemistries.
- Suggestions for innovative new research approaches to address battery designs and configurations to reduce personnel vulnerability.

Reference:

Allen, Jan and Lowry, David; *Reaction of a Lithium-Ion Battery Containment Structure to Ballistic Impacts*; 83rd Lithium Battery Technical Safety Group Meeting; Key West, FL; February 2011 (U)

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