Material Characterization of Lithium-ion Batteries for Crash Safety

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The safety of lithium-ion batteries is extremely important due to their widespread use in consumer products such as laptops and cell phones and more recently in vehicles. Several cases of thermal runaway in lithium ion batteries that resulted in fires have been reported recently. And in the case of vehicle batteries, deformation during a crash event could cause an internal short circuit, leading to thermal runaway, fires, or toxic gas release. While much is understood about lithium-ion batteries, no comprehensive computational models exist to test and optimize these batteries before manufacture.

The objective of this research is to characterize the mechanical properties of lithium-ion batteries to aid in the development of a comprehensive computational model. Prismatic, Elliptic, and Pouch cells, as well as their interior components, were obtained from Impact and Crashworthiness (ICL) sponsors and tested. The full cell tests included flat plate compression and hemispherical punch. Tests on interior component materials included uniaxial stress, biaxial punch, and compression tests. The results of these tests were used in the development of computational models that will be combined to fully describe the behavior of lithium-ion batteries in various crash scenarios and determine point of short circuit.

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