A lithium-ion battery inspired by safety glass

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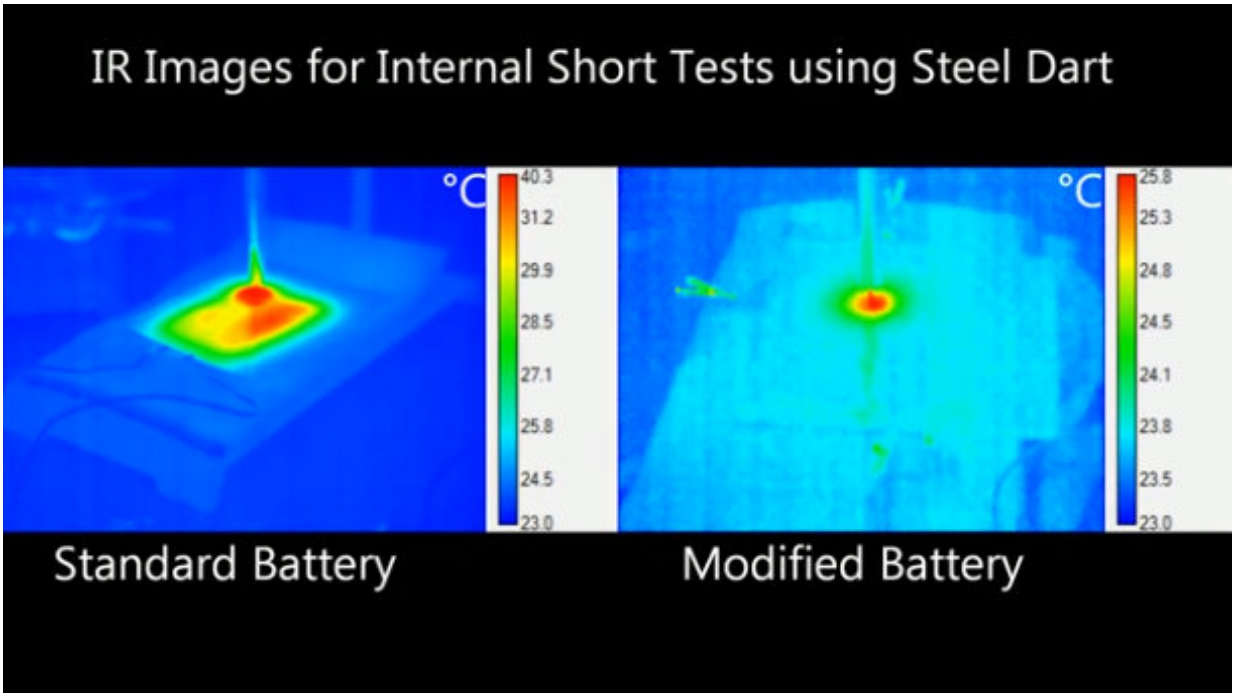

Researchers in the United States have modified the design of lithium-ion batteries to include slits along the electrodes, a feature which may mitigate the risk of battery failure during automobile accidents. The prototype, presented December 13 in the journal *Joule*, could allow manufacturers to scale down the housing materials that commonly protect batteries in electric cars from mechanical damage, improving the overall energy density and cost.

"Small batteries pose a much smaller hazard when they are accidently shorted than do very large batteries," says Nancy Dudney, an author on the study and an energy storage researcher at the Materials Science and Technology Division of Oak Ridge National Laboratory. "Our innovation may allow the large batteries used in most vehicles to fragment into many small batteries if damaged in a collision. With such an innovation, device manufacturers can reduce the weight and expense of heavy-duty containers that are normally needed to protect their batteries from mechanical abuse."

Many electric and hybrid cars use lithium-ion batteries, which are known to be exceptionally safe, but occasionally, an impact may disrupt the battery's function, creating an electrical short. Dudney and her team lowered the risk of a battery failing during an accident by adding slits as perforations along the electrodes. These slits are designed to break the electrodes into tiny fragments during an impact, dividing the battery's energy into smaller components so it is more difficult for the temperature to rise beyond a level the battery can handle. In the event that a short does still occur, the fragments limit the current and heating around the short.

"Safety glass was our inspiration," says Dudney. "Sometimes the best way to help protect against a dangerous failure is to allow a component to fail or break gracefully and safely under mechanical abuse." The team tested their model against a standard lithium-ion battery by pressing a large metal ball into each. The modified battery was distorted like a potato chip but continued to function at 93% of its original capacity. Similar damage to a standard battery causes a full discharge and failure.

Since the electrode slits only added a minimal cost to the production of their redesigned lithium-ion battery and didn't call for significant changes in how the battery was made, the team believes this technology could be scaled up in the future. However, there are still many more tests

to run.

"We only tested a handful of cells, and this impressive performance needs to be replicated 100 or 1,000 times for good statistics under a wide range of duty cycles," says Dudney.

More information: *Joule*, Naguib et al.: "Limiting Internal Short-Circuit Damage by Electrode Partition for Impact-Tolerant Li-Ion Batteries" www.cell.com/joule/fulltext/S2542-4351(17)30147-2 , DOI: 10.1016/j.joule.2017.11.003

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