Why do batteries explode

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Our two departments provide fundamental and applied studies of an outstanding caliber. The remarkable breadth and depth of resources available to our students readies them as chemists and chemical engineers to address society"s most urgent 21st-century issues.

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The College of Chemistry is consistently ranked as one of the best places on earth to learn, teach, and create new tools in the chemical sciences. This is no accident. It"s the direct result of exceptional scholarship as well as thousands and thousands of donations from our loyal alumni and friends.

How likely would an electric vehicle battery self-combust and explode? The chances of that happening are actually pretty slim: Some analysts say that gasoline vehicles are nearly 30 times more likely to catch fire than electric vehicles. But recent news of EVs catching fire while parked have left many consumers - and researchers - scratching their heads over how these rare events could possibly happen.

Researchers have long known that high electric currents can lead to "thermal runaway" - a chain reaction that can cause a battery to overheat, catch fire, and explode. But without a reliable method to measure currents inside a resting battery, it has not been clear why some batteries go into thermal runaway, even when an EV is parked.

Now, by using an imaging technique called "operando X-ray microtomography," scientists at Lawrence Berkeley National Laboratory (Berkeley Lab) and UC Berkeley have shown that the presence of large local currents inside batteries at rest after fast charging could be one of the causes behind thermal runaway. Their findings were reported in the journal ACS Nano.

"We are the first to capture real-time 3D images that measure changes in the state of charge at the particle level inside a lithium-ion battery after it"s been charged," said Nitash P. Balsara, the senior author on the study. Balsara is a faculty senior scientist in Berkeley Lab"s Materials Sciences Division and a UC Berkeley professor of chemical and biomolecular engineering.

"What"s exciting about this work is that Nitash Balsara"s group isn"t just looking at images - They"re using the images to determine how batteries work and change in a time-dependent way. This study is a culmination of

many years of work," said co-author Dilworth Y. Parkinson, staff scientist and deputy for photon science operations at Berkeley Lab"s Advanced Light Source (ALS).

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Lithium-ion batteries, or "Li-ion" for short, are one of the most ubiquitous forms of portable power in the world today. Most handheld devices like smartphones use Li-ion batteries, though scaled-up Li-ion batteries have also been used in various electrical vehicles. The fact that they"re rechargeable makes them much more efficient than traditional, disposable batteries, and for the most part, they"re a very safe technology. However, they do have one major flaw that"s been made more apparent in recent years.

In certain circumstances, Li-ion batteries have been known to suddenly catch fire. While not a common occurrence, instances of lithium fires have been frequent enough in the last few years that firefighting and rescue agencies have started putting together specialized procedures for detecting and containing such fires. (It"s why EVs catch fire too.) Of course, the best option is to prevent a fire from sparking up in the first place. So, what exactly causes a Li-ion battery to catch fire?