Engineers develop new method to spot lithium-ion battery problems

December 14 2023

Credit: Pixabay/CC0 Public Domain

Mechanical engineers at the University of Sheffield have developed a new way of determining the internal structure and health of batteries that power many of the electronic devices and vehicles at the center of our

everyday lives.

The technique, published as part of a study in the *Journal of Energy Storage*, could be used to identify battery problems much earlier, before they reach the point of no repair, helping to extend their life cycles, reduce electronic waste and the demand for new batteries that use critical raw materials.

The new method could be used by manufacturers to help them spot battery defects during production—reducing the number of faulty batteries reaching consumers—and be used during servicing to provide a more accurate assessment of a battery's health.

Researchers from the University of Sheffield's Department of Mechanical Engineering developed the technique by using a single ultrasonic wave to reverse engineer a lithium-ion battery cell for the first time. Lithium-ion batteries are used in electronic devices such as mobile phones and laptops, and are also used to power electric vehicles.

Currently, the main way to accurately assess the internal condition of a lithium-ion battery is by using an X-ray machine, which is expensive and impractical for businesses, manufacturers and consumers. This means defects can be missed and not identified until the battery shows visible damage, such as swelling, which is often when the battery is beyond repair.

The breakthrough from Sheffield signals a promising direction towards the development of a new low-cost but effective system for assessing the health of lithium-ion batteries, though it is still in the early stages and requires further development to be widely accessible to industry.

The technique also opens up the possibility of developing small sensors that could be fitted onto the battery to provide real-time monitoring of

its condition. This could be a significant development for monitoring the health of batteries in electric vehicles, but it could also be developed to be used in smaller consumer electronics such as laptops and mobile phones.

Royce Copley, a Research Associate at the University of Sheffield and lead author of the study, said, "Lithium-ion batteries are essential components of so many of the electronic devices we all rely on everyday, in so many aspects of our lives. They power electric vehicles and their health is key to how far an electric car can travel before needing to be charged.

"We've all been in that situation when we've noticed that the battery in our phone doesn't seem to be lasting as long, or our phone suddenly dies when we are out and need it the most. It is even more frustrating when the battery in a new device seems to be running out of charge quickly, even though you only recently bought it.

"The technique we've developed at Sheffield could help to put an end to these problems. It could form the basis of a cheap, but incredibly effective way of spotting battery problems before they reach the consumer."

Professor Rob Dwyer-Joyce, Professor of Lubrication Engineering at the University of Sheffield and also a researcher in the study, said, "This method has the potential to make the batteries in our electronic devices much more reliable. While currently limited in precision under certain test conditions, with further research and development, it could be used in the production phase, so manufacturers can spot issues before they ship. It could also be used during servicing to help our electric vehicles, but also small consumer electronics, last longer."

After publishing the research, the Sheffield engineers are now looking

for an industrial partner to help develop the technology.

Professor Dwyer-Joyce added, "The research we have done is at the fundamental stage. We have shown what is possible in the laboratory—how we can determine the internal structure of a battery—and now we are looking to take it to the next level with a partner from industry. We are really excited about this breakthrough and are looking forward to progressing the technology and seeing where it will lead."

More information: R.J. Copley et al, Prediction of the internal structure of a lithium-ion battery using a single ultrasound wave response, *Journal of Energy Storage* (2023). DOI: 10.1016/j.est.2023.108778

Provided by University of Sheffield