THE FUTURE OF ENERGY STORAGE

TURNING SEAWATER INTO STORED ENERGY

Batteries that use seawater as an electrolyte can be safer, cheaper, and more environmentally friendly to make and dispose of than conventional lithium-ion batteries. However, their development has been limited by a lack of a suitable material for the anode – the part of the battery from which electricity flows. Researchers from the University of Alberta developed a composite material that can store many types of ions, including those found in seawater. Since the new anodes are thicker than previous ones, they can store a lot of energy, last a long time, and operate under extreme conditions.

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FASTER-CHARGING BATTERIES

Researchers from McGill University and Université du Québec à Montreal have found a new approach to making inexpensive batteries that can not only hold large amounts of charge but also recharge quickly. They focused on improving lithium ion batteries, rechargeable cells that are used in electric vehicles, power tools, and phones. The research team mixed a known fast-charging material with a high-capacity one and experimented with different ways to combine them. Using the CLS enabled them to image the lithium ions–which act as a bottleneck for fast charging–so that they could monitor the battery chemistry while it was being charged. It turned out that a layered, sandwich-like design worked best.

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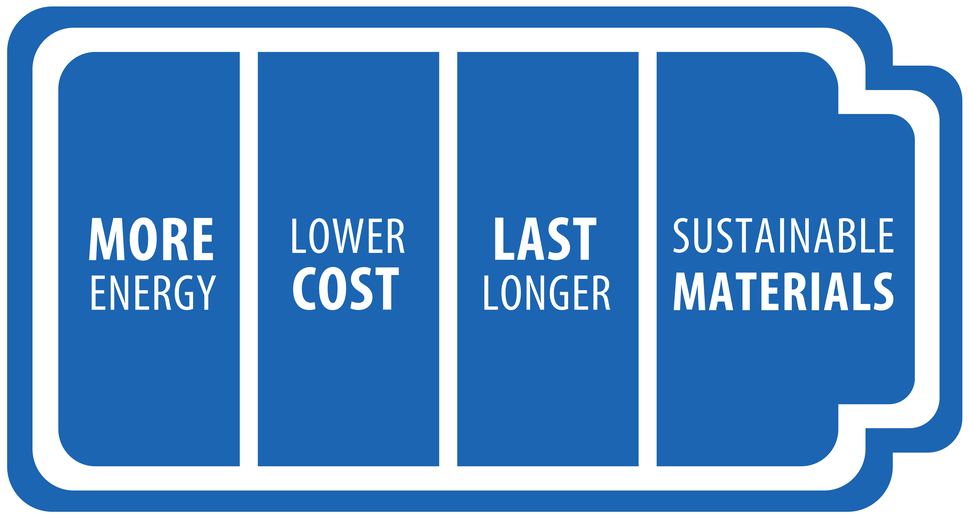

WHY BATTERIES STOP HOLDING A CHARGE

All batteries eventually degrade, losing the ability to store energy. There are many ways this degradation can occur, but one issue faced by all lithium-ion batteries is that they undergo a lot of mechanical stress as the battery is charged and discharged. This repeated expansion and contraction – or "breathing" – of the material can cause fatigue, resulting in microcracks that form slowly over time. For the first time ever, researchers from Dalhousie University and the CLS used our BMIT beamline to see inside a commercial battery without taking it apart. The team hopes this will provide a new way to assess the durability of long-lived, sustainable lithium-ion batteries.

DOI: 10.1149/1945-7111/ada0d2

A THIN SHIELD FOR BETTER BATTERIES

One significant shortcoming of conventional lithium-ion batteries is that they're prone to short-circuiting. A leading cause is the rough, tree-like crystal structures called dendrites that can form on the surface of one of the electrodes. Researchers from the University of Alberta discovered that adding a thin layer of tin between the electrode and the electrolyte helps spread the lithium around when it's being deposited on the battery, creating a smooth surface that suppresses dendrite formation. Cells modified with the tin-rich layer can also operate at a much higher current and withstand many more charging-discharging cycles than a regular cell.

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PAVING THE WAY FOR SOLID-STATE BATTERIES

Lithium-ion batteries contain flammable materials that could pose a safety risk under certain conditions. Researchers from the National Research Council of Canada used the CLS to develop a safer alternative: solid-state batteries. These batteries replace the flammable liquid electrolyte in conventional batteries with a solid ceramic-based material to pass charge through the battery. Solid-state batteries have another advantage: because they can be made with lithium metal, they're able to hold a great deal of charge in a small space, making them powerful energy storage devices. The new insights gained will help the researchers improve the mix of solid and liquid parts and how these batteries are put together.

DOI: 10.1021/acs.jpcc.3c05419

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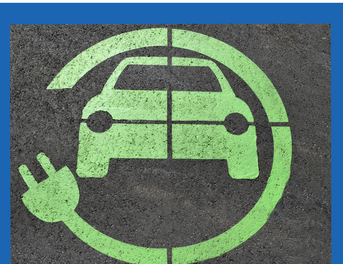
NEW EV BATTERY LASTS FOR EIGHT MILLION KILOMETERS



The push is on for batteries that can power electric vehicles (EV) for decades, then be put to use for grid energy storage afterwards. Researchers from Dalhousie University showed that a new type of lithium-ion battery called a single crystal electrode can be cycled more than 20,000 times – the equivalent of 8 million kms – without showing any discernible signs of internal damage. Regular lithium-ion batteries develop severe microscopic cracking from repeated charging and discharging. The findings suggest we're nearing the point where EV batteries outlast the rest of the car and should give the companies building them the confidence to plan for the long term.

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DISCOVERY AT THE SPEED OF LIGHT