THE FUTURE OF ENERGY STORAGE

BATTERIES WITH 10 TIMES THE ENERGY STORAGE

To meet the rising global demand for electric vehicles, we need new and improved batteries. Researchers from Western University are studying a promising new candidate: solid-state lithium sulfur batteries. According to the researchers, these batteries can store nearly 10 times the amount of energy as traditional lithium-ion batteries. Using sulfur also makes these batteries more environmentally friendly, affordable, and safe. The researchers used the CLS to analyze what happens inside these batteries when they are operating, key information for designing longer-lasting, high-energy density batteries.

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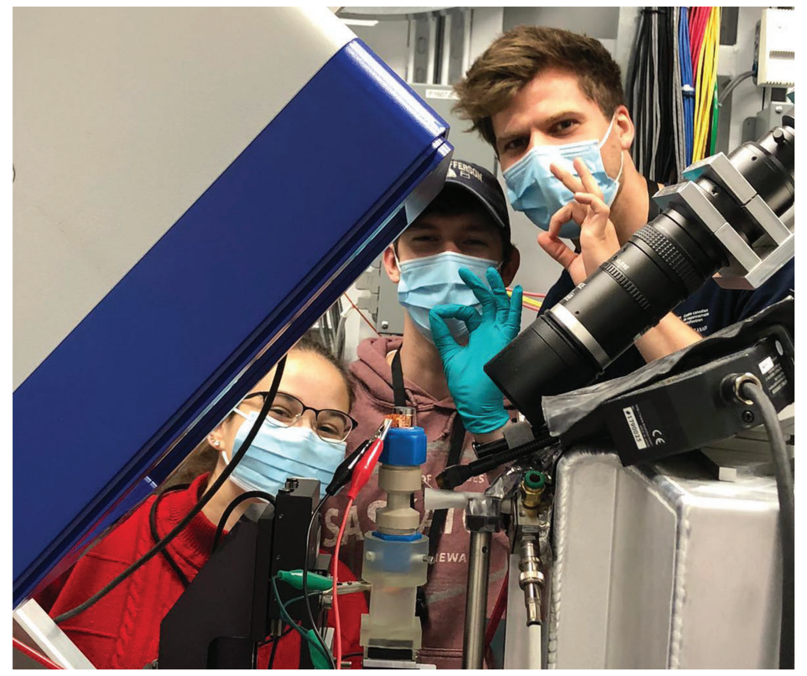

From left to right: Brittany Pelletier-Villeneuve (UQAM), Jeremy Dawkins (McGill), and Bastian Krueger (UQAM).

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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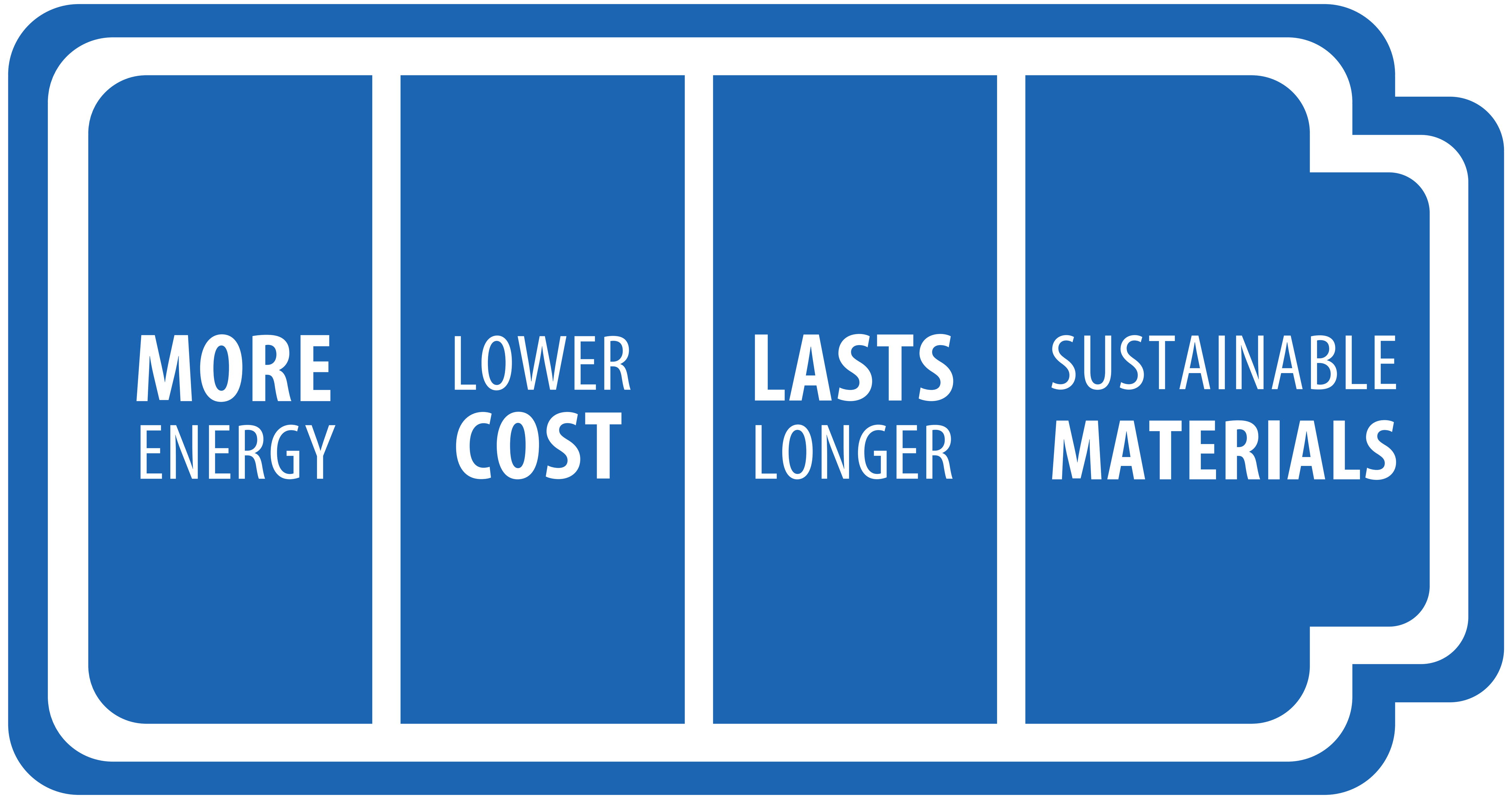

WHY BATTERIES STOP HOLDING A CHARGE

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.

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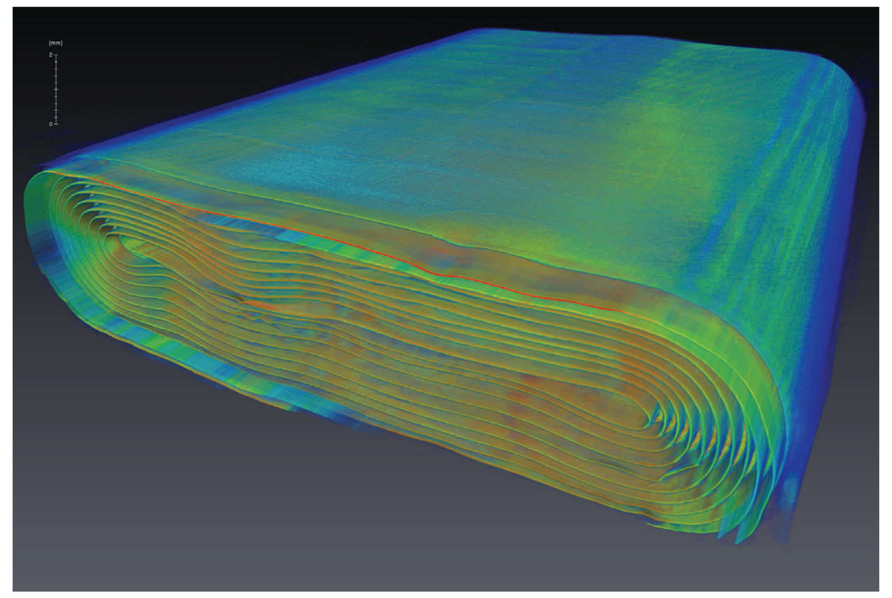

PEERING INSIDE BLOWN-UP BATTERIES

When a lithium-ion battery– like the ones in our laptops and smart phones– is overheated or overcharged, internal components can chemically react with each other, generating gas inside the battery. The trapped gas is what produces a "pillowing" effect, which can decrease performance, or worse: the battery can leak, cause damage, or even explode. To understand how this happens, and to get some insight into battery safety, CLS scientists performed highly detailed CT scans on lithium-ion batteries before and after pillowing. The resulting images are helping battery companies better understand the role that small manufacturing defects play when it comes to performance and safety, ultimately leading to better, safer batteries.

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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.

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Yaser Abu-Lebdeh, National Research Council of Canada

DESIGNING EV BATTERIES THAT CAN LAST OVER A MILLION MILES

Making new electric vehicle (EV) batteries requires important minerals such as lithium, cobalt, nickel, and manganese. As EV adoption ramps up globally, there is concern that the long-term supply of these minerals may not be able to keep up with demand. An important way to make the most of the supply that we have is to ensure that batteries can operate for as long as possible before they need to be replaced. CLS and Dalhousie researchers used the BMIT beamline to investigate how to reduce degradation and improve the service lifetime of EV batteries. The researchers looked at different ways of draining and charging EV batteries, as well as the materials those batteries are made of. The team was able to show how a new type of battery material – called "single-crystal" electrodes – showed no signs of mechanical degradation. After cycling batteries made from these materials for over two years, they project that an EV battery made from these materials could be driven as far as 1,000,000 miles (over 20 years) before losing the ability to hold a charge.

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DISCOVERY AT THE SPEED OF LIGHT