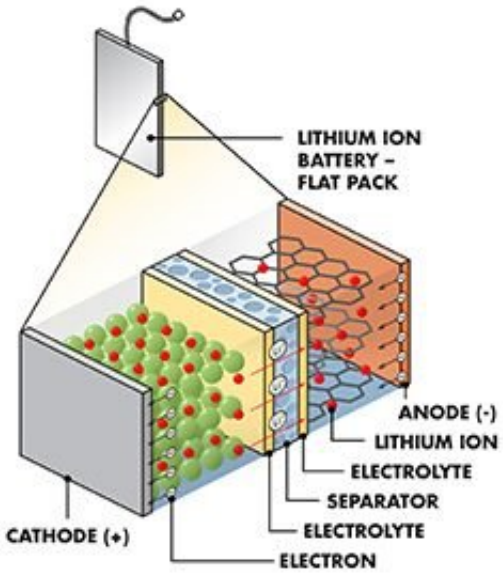
Research could help electric cars beat the cold

January 29 2018, by Laura Otto



Lithium-ion batteries consist of a short stack of metal and plastic layers, with the positive electrode (cathode) on one side and the negative (anode) on the back. Add the electrolyte between the electrodes and you have a lithium-ion battery in a flat pouch. The electrolyte carries positively charged lithium ions from the anode to the cathode and vice versa during charging or discharging, causing electrons to accumulate at the anode. These “free” electrons will to return to the cathode along a wire that connects the electrodes, creating a current. Credit: UWM Graphic/Allie Kilmer

Leave a car overnight in extreme cold and you might get an unpleasant

surprise in the morning.

All car batteries labor to start an engine during a deep freeze. That's because chemical reactions needed to produce a current happen more readily when it's warm.

But researchers in Deyang Qu's lab have found a fix for the cold-car start – at least for electric vehicles, which use rechargeable lithium-ion batteries to spark ignition.

Qu, the Johnson Controls Endowed Professor in Energy Storage Research at UWM, and his researchers have come up with the right "recipe" for a part of the battery – the electrolyte. This liquid induces a chemical reaction to move lithium ions around, necessary for generating a current.

"It isn't the conductivity or the melting or freezing point of the electrolyte that has the largest effect on battery performance," said researcher Joshua Harris. "It really all depends on the electrolyte's components."

From the electrolyte's reactions with the anode, a layer of oxidation builds up. Called the SEI layer, it governs the performance of the battery.

If it grows too thick, it restricts movement of ions in the electrolyte, hindering the power. But if it's too thin, it allows the electrolyte to continuously react with the electrodes, and that reduces battery life.

Researcher Joshua Harris loads a flat lithium-ion battery into equipment that will test its chemistry at different temperatures. Credit: UWM Photo/Pete Amland

The research team tested 46 combinations of electrolyte components to find the ideal mix, said Harris.

Temperature plays a role in how the electrolyte affects the SEI layer, he says. "The best conditions are actually cold temperatures, but not cold enough to decrease the battery's cycle life."

The research was done in collaboration with industry so whether it will morph into a commercial product is still uncertain.

"This is one instance where we have developed the technology to solve

the problem," says Qu. "Now it's up to companies to decide whether they want to invest to commercialize it."

Provided by University of Wisconsin - Milwaukee