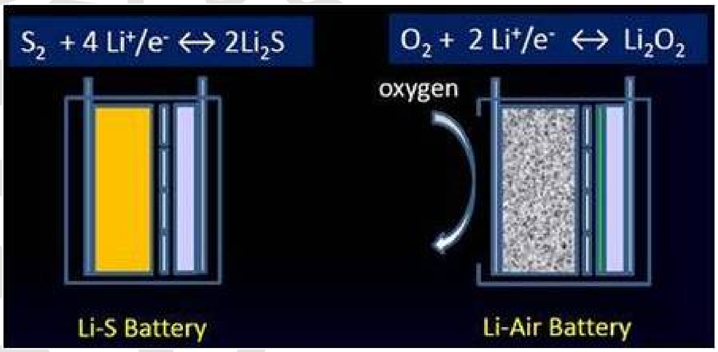

BUILDING BETTER BATTERIES

Professor Linda Nazar,

Canada Research Chair

Plug-in hybrid electric vehicles and pure electric vehicles are better for the planet. They generate less pollution and less greenhouse gas emissions.

So why don't we see more of them on the roads? Blame the battery. The lithium-ion versions currently used simply don't have the capacity that drivers want. A Nissan Leaf, for example, can travel only 100 miles on a single charge.

At UW, Canada Research Chair Linda Nazar is turning her attention to lithium-sulfur (Li-S) and lithium-oxygen (Li-O2) batteries. Because of their energy density, they have the potential to achieve a far higher energy density than their lithium-ion counterparts.

In Li-S batteries, the electrons and lithium are stored at the positive electrode by reacting them with sulfur to form lithium sulfide (Li2S). The process is reversible, so directing the flow of electrons the other way regenerates the sulfur, creating a rechargeable cell. Li-O2 batteries rely on similar chemistry, except that storage is in the form of Li2O2.

Although Li-S cells are further along in development, there are two main hurdles to commercialization. One is keeping the sulfur - or the discharge product, Li2S - in intimate contact with a conductive material in the cathode. The other is preventing the soluble polysulfide intermediates from getting "lost" into the electrolyte, thus reducing the capacity of the batteries with each cycle.

According to Nazar, the solution could lie in nanoporous carbon, a form of carbon riddled with tiny pores or channels 2-20 nm in diameter. Incorporating of sulfur into these pores forms a network of sulfur nanofibres surrounded by conductive carbon walls, creating that all-important contact to "wire up" the sulfur. The carbon framework also acts as a mini-reaction chamber, encouraging a more complete reaction.

Meanwhile, adding a polymer coating to the surface reduces the diffusion of the polysulfide ions. This minimizes the capacity fade, extending the life of the battery. As a result, the composite boasts three times the energy density of a lithium-ion cathode. In theory, a five-fold increase is possible, while the Li-O2 cell has even greater potential.

Nazar's work thus paves the way for a new generation of batteries that can power a car for several hundred kilometers on a single charge - and cost far less than today's lithium-batteries.

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