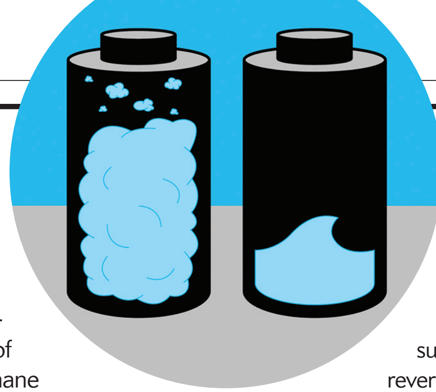
ENGINEERING

Better Batteries

Gas-based electrolytes could be safer and last longer than conventional liquid ones



Some owners of Samsung Galaxy Note7 smartphones learned the hard way last year that lithium-ion batteries, commonly used in many consumer electronics, can be flammable and even explosive. Such batteries typically rely on liquid electrolytes, which are made up of an organic solvent and dissolved salts. These liquids enable ions to flow between electrodes separated by a porous membrane, thus creating a current. But the fluid is prone to forming dendrites—microscopic lithium fibers that can cause batteries to short-circuit and heat up rapidly. Now research suggests that gas-based electrolytes could yield a more powerful and safer battery.

Cyrus Rustomji, a postdoctoral researcher at the University of California, San Diego, and his colleagues recently tested electrolytes composed of liquefied fluoromethane gas solvents, which can absorb lithium salts as well as their conventional liquid-based counterparts do. After the experimental battery was fully charged and drained 400 times, it held a charge nearly as long as it did when new; a conventional lithium-ion battery tends to last nearly 20 percent as long. The condensed-gas battery also generated no dendrites. The findings were published earlier this year in *Science.*

If a standard lithium-ion battery is punctured—and the membrane separating the electrodes is pierced—the electrodes can come into contact and short-circuit. This causes the battery to overheat in the presence of its reactive lithium electrolyte and possibly catch fire (which is exacerbated by oxygen entering from outside). But fluoromethane liquefies only under pressure, so if the new batteries are punctured, the pressure releases, the liquid reverts to a gas and the gas can escape, explains Rustomji, lead author of the *Science* paper. As a result, “there is no electrolyte to create a rush of ion movement” and therefore no fire, he says.

The batteries perform well in temperatures as low as −60 degrees Celsius, unlike standard lithium-ion batteries, so they could power instruments in high-altitude drones and long-range spacecraft, Rustomji says.

Donald Sadoway, a professor of materials chemistry at the Massachusetts Institute of Technology, who was not involved in the study, says the new concept “opens our eyes to a class of liquids that has been understudied.” But, he adds, the researchers need to ensure that excessive heat does not cause the batteries’ liquefied gas to expand rapidly and lead to a dangerous increase in pressure. —*Matthew Sedacca*

Illustration by Thomas Fuchs