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Many aspects of an electric vehicle are the same as a gas-powered one: the seats are seats, tires are tires, the steering wheel still turns right and left. The biggest difference, and the one that will make or break mass EV adoption, is the battery.

That"s why some of the most exciting research in the modern automotive landscape centers on battery technology—and "solid state" batteries are one area being explored. This alternative to the lithium-ion batteries used today promises to improve vehicle range, decrease charging times, and eliminate risk of battery fires.

You can"t yet drive a solid state battery-based EV off the lot, but they"re in the works. Toyota signed a manufacturing deal to commercialize its technology by 2028, which could eventually achieve over 900 miles of range. Honda is also working on them in its Tokyo-based lab, with plans to launch a vehicle with a solid-state battery in the latter part of the decade. Nearly all major EV brands are conducting similar research, such as Mercedes, Volkswagen, and China-based Nio.

In the future, trains, planes, and trucks may also use solid state batteries, setting the stage for much wider electrification of transportation than we can visualize today. Here"s what you need to know about this potentially game-changing technology.

Solid state batteries operate the same way as any other battery. They take energy in, store it, and release the power to devices—from Walkmen to watches and, now, vehicle motors. The difference is the materials inside.

Solid state batteries already exist, just in much smaller devices likesmartwatches, pacemakers, and RFID tags. The barrier to using them in EVs is primarily that they"re expensive and difficult to produce in a larger size at scale, Voxexplains. With battery-powered vehicles already more expensive than gas-powered ones, consumers have little appetite for even pricier vehicles.

Certain aspects of the technology have yet to be figured out, such as longevity, but Honda says it has a solution. The solid electrolytes can degrade over time, so Honda plans to protect it by wrapping it in a new polymer fabric, Ars Technicareports. This is just one of many R& D efforts going toward this breakthrough chemistry from a slew of battery manufacturers and OEMs.

With a solid state battery, EVs should be able to go just as far as a gas-powered car does before refueling. Take a 15-gallon gas tank that goes 30 miles per gallon, for example. That car can go 450 miles before filling up.

Most EVs today have ranges of 200 to 300 miles, although the Rivian R1T with a max pack battery goes 410 miles on a single charge, and the super-luxeLucid, already on the road today, boasts a 516-mile range on the 2024 model.

Multiplying those ranges by around 50% (or as much as 80%, CarBuzzreports), and solid state batteries are ready to play ball on road trips. An EV with a 300-mile range now has 450 miles. Plus, solid state batteries will charge faster than lithium ion with less degradation to the battery itself.

With frightening reports of battery fires in the wake of flooding, EVs have developed a bad rep for being rolling matchsticks. But in reality, that honor should go to the lithium-ion battery. Swap it out for a solid state equivalent, and the EV has a very low risk of fire.

Fires from lithium-ion batteries are rare, and automakers include casing and protective measures to avoid them, but when they happen they are powerful and difficult to extinguish, sometimes taking thousands of gallons of water. Building EVs that are not flammable is a big win for drivers, citizens, and fire departments.

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