Tech

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IN DETAIL

IS SOLID STATE THE BATTERY HOLY GRAIL?

They're smaller, lighter and more efficient, but solid-state batteries remain just over the horizon – and all the time, lithium-ion tech is advancing. By **Ben Barry**

It's the future! It'll save the EV industry! These are the claims we've heard for years regarding the next big development in battery technology: solid state. But the tech isn't quite arriving as planned.

In (relatively) simple terms, a solid-state battery is a lithium battery with a solid rather than liquid electrolyte. Lithium ions travel through this solid electrolyte (which uses mainly ceramic compounds), flowing from a positive cathode to a negative silicon anode.

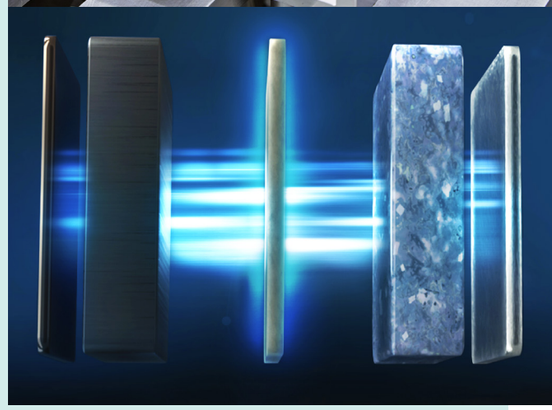
The big win is higher energy densities, because the solid electrolyte can be very thin, allowing it to provide equivalent energy to today's lithium-ion batteries in less space. Advocates promise a reduction in weight, increases in range and vehicle interior space, as well as improved safety, lower prices and faster charging times.

'[Solid-state batteries] represent a real quantum leap over how we currently conceive of batteries,' says VW board member for technology Thomas Schmall. 'The first car maker to bring solid-state batteries to series production will enjoy a crucial competitive advantage.'

But not everyone *CAR* interviewed was so sure, including Doron Myersdorf, CEO of StoreDot, an EV battery specialist working with Volvo among others, and investigating semi-solid-state solutions alongside other alternative technologies. 'Solid state has great potential, but… people are coming to the realisation that there are a lot of challenges, there are many unknowns to this big promise,' he tells *CAR*.

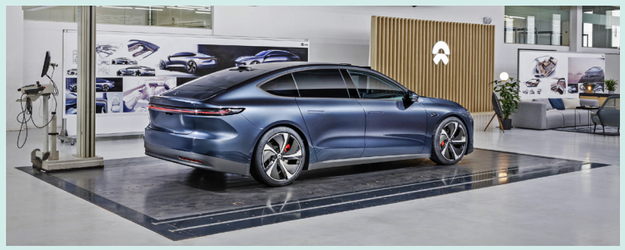
Fast charging is a major hurdle, and currently impossible due to excessive heat build-up, according to Myersdorf.

Nissan aims to open a pilot production line for solid-state batteries in 2024



WHILE SOLID-STATE TECHNOLOGY HAS GREAT POTENTIAL, SIGNIFICANT CHALLENGES REMAIN

SOLID STATE: WHO'S DOING WHAT?



NIO
The Chinese car maker is introducing a semi-solid-state battery with its ET7 saloon (pictured), claiming 620 miles on a single charge. It hits the home market first, towards the end of 2022, and could be fitted to European ET7s in the future.

MERCEDES
Stuttgart has partnered with ProLogium to develop solid-state batteries, but CTO Markus Shäfer admits to *CAR* that 'it'll probably take until the mid-'20s until we see the first battery.'

STELLANTIS
Carlos Tavares, head of the automotive mega group, announced as part of the conglomerate's enormous electrification plans that its first solid-state battery is due in 2026.

TOYOTA
It could bring a solid-state hybrid car to market from 2025, but a full EV using solid-state batteries is some way off. 'It was going to be 2020, then 2022, then 2024 and now they are saying maybe 2028 for mass production,' says StoreDot's Doron Myersdorf.

'When you're trying to move the ions from solid to solid… by definition you have higher friction… more heat, and therefore fast charging is not possible,' he explains. As things stand, customers would potentially gain 10 per cent energy density but trade that against longer charge times. US solid-state specialist QuantumScape claims a charge from zero to 80 per cent in 15 minutes on its prototypes.

Finally, the cost of production is also a consideration – Myersdorf predicts it will take four years from introduction for the technology to reach a reasonable production cost, though Stellantis counters that its solid-state batteries would be 'drop-in compatible for easy integration into existing lithium-ion manufacturing infrastructure'.

Semi-solid-state batteries look set to be a bridging technology, using a gel or liquid electrolyte alongside a solid electrolyte interface. Although Chinese maker Nio originally announced its ET7 electric saloon would debut in 2022 with a solid-state battery, for example, a semi-solid alternative is actually being used for production.

StoreDot offers a lithium-ion battery that replaces graphite normally used for the anode with silicon, marketed as '100in5' – a reference to 100 miles of range after five minutes of charging. Panasonic has developed the 4680 lithium-ion battery for Tesla, said to be 56 per cent cheaper to produce and up to half the size of the 74kWh battery pack in the Model Y, yet developing equivalent energy. It's now one to two years from production.

So while there's a lot of buzz around solid state right now and the technology has great potential, significant challenges remain – not least that conventional lithium-ion technology continues to develop apace.