SOLID STATE BATTERIES

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INTRODUCTION

Solid state with regard to batteries means that a solid electrolyte is used. For the last decade, developers of solid state battery systems have promised products that are vastly safer, lighter and more powerful. Battery packs for EVs, Electrical Vehicles can account for 50 percent of the total weight of an EV and 30 percent of its cost. Manufacturers are working on decreasing not only the cost of packs, but also the mass, which can lead to longer ranges per charge.

Electric vehicles have never been cooler, faster or cleaner, yet they still account for only around one in 25 cars sold around the world. A global survey of 10,000 drivers in 2020 by Castrol delivered the same perennial complaints that EVs are too expensive, too slow to charge and have too short a range.

SOLID STATE BATTERIES

Solid state batteries will represent a $6 billion industry by 2030. Many of the recent promises in battery development - making them lighter, safer and more powerful, have largely evaporated. Solid state batteries lack a liquid electrolyte for moving electrons between the battery's positive (cathode) and negative (anode) electrodes, making them less flammable and quicker to charge than the Li-ion batteries.

If you run the calculations, you can get reasonable numbers and they are very exciting. It is just that making it happen in practice is very difficult. So far, no large auto manufacturers have found success in developing solid-state batteries for EVs.

BATTERIES NEEDS

A successful vision of batteries in electrical vehicles is:
1) The distance a single charge will go is equivalent to a full tank of gasoline at 30mpg (or better)
2) It takes the same amount of time to recharge as it does to refill a gas tank does today.

Another alternative would be to have the ability to swap out batteries on a long trip and have a way to recharge the expired battery using the car's axle motion to recharge it rather than electricity. It sounds simple enough and but nobody seems to be doing that.

If the governments of the world and the USA are going to dictate EVs, then the technology has leaps and bounds to make. That just does not seem to be happening despite many brilliant minds working on the problems.

People cannot go more than 300 miles at a time in one long trip without stopping for a while to charge. EVs are only good for local use, and that is not acceptable.

RECENT DEVELOPMENTS

Samsung has developed a silver carbide solid state battery which is half the size of a lithium ion battery which they claim can power a vehicle 500 miles on a single charge and be charged

faster than a lithium ion battery. It can also be charged a thousand times over its life. You will only have to buy one or two cars over a life-time since the car will last 500,000 miles.

A new wave of companies and technologies are maturing and attracting the funding necessary to feed batteries' biggest market: transportation. Electric vehicles account for about 60% of all lithium-ion batteries made today, and IDTechEx predicts that solid state batteries will represent a $6 billion industry by 2030.

Three tipping points that EVs would need to drive a decisive shift away from their internal combustion rivals: a range of at least 300 miles, charging in just half an hour and costing no more than $36,000. Theoretically, solid state batteries (SSB) could deliver all three.

TYPES OF SOLID STATE BATTERIES, SSBs

There are many different kinds of SSBs but they all lack a liquid electrolyte for moving electrons between the battery's positive (cathode) and negative (anode) electrodes. The liquid electrolytes in lithium-ion batteries limit the materials the electrodes can be made from, and the shape and size of the battery. Because liquid electrolytes are usually flammable, lithium-ion batteries are also prone to runaway heating and even explosion. SSBs are much less flammable and can use metal electrodes or complex internal designs to store more energy and move it faster, giving higher power and faster charging.

In 2015 alone, Dyson acquired Ann Arbor startup Sakti3 and Bosch bought Berkeley Lab spin-off SEEO in separate automotive development projects. Both efforts failed, and Dyson has since abandoned some of Sakti3's patents.

Prieto Battery, whose strategic investors include Stout Street Capital and Stanley Ventures, venture arm of toolmaker Stanley Black & Decker, pioneered an SSB with a 3D internal architecture that should enable high power and good energy density. Prieto aiming to scale up production for automotive battery packs. The first customer for these is likely to be electric pickup maker Hercules, whose debut vehicle, called Alpha, is due in 2022. Fisker also says that it is developing a 3D SSB for its debut Ocean SUV.

A Colorado SSB company Solid Power, had investments from auto OEMs including BMV, Hyundai, Samsung and Ford, following a $20 million Series A in 2018. Solid Power has no ambitions to make battery packs or even cells, according to CEO Doug Campbell, and is doing its best to use only standard lithium-ion tooling and processes. Once the company has completed cell development in 2023 or 2024, it would hand over full-scale production to its commercialization partners.

QuantumScape is the highest profile SSB maker on the scene today. Spun out from Stanford University a decade ago, the secretive QuantumScape attracted funding from Bill Gates and $300 million from Volkswagen. In November, QuantumScape went public via a special purpose acquisition company at a $3.3 billion valuation. It then soared in value over 10 times after CEO Jagdeep Singh claimed to have solved the short lifetime and slow charging problems that have plagued SSBs.