Innolith Battery Strikes at ‘Flammable’ Lithium-Ion: BNEF Q&A

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Swiss startup Innolith AG has designed a non-flammable battery with high energy density that could take the place of conventional lithium-ion batteries on the market today, and potentially make electric vehicles “cheaper than internal combustion engines”, Markus Borck, chief engineer at the company, told BloombergNEF in an interview.

Lithium-ion battery technology is “reaching its limits” due to its flammability, high costs and dependence on certain materials like cobalt that can be difficult to source, said Sergey Buchin, chief executive at Innolith. In contrast, the company’s inorganic electrolyte technology contains no cobalt and is proven in laboratories to have a higher energy density than batteries currently on the market.

Innolith deployed its first utility-scale battery on the Pennsylvania New Jersey Maryland interconnection grid in the U.S. almost two years ago and is now developing an electric vehicle battery. An Innolith EV battery would have energy density of “1,000 watt-hours per kilogram” – treble the energy density of a Tesla vehicle battery – which would reduce the cost to $50 per kilowatt-hour, Borck said.

“Increasing battery material energy density will be crucial to further reducing the cost of lithium-ion batteries” because a more energy-dense material spreads manufacturing and operational costs over more kilowatt-hours, said James Frith, energy storage associate at BNEF.

Innolith aims to “partner with a larger company to secure its place in the market” and targets delivery of its EV battery in the next four to five years. Since inception, Innolith has raised “tens of millions of dollars” from an unnamed strategic investor, the company said.

Read the Q&A below for more..

Q: What makes Innolith’s inorganic battery chemistry different?

Borck: In lithium-ion batteries, electrolytes bring basic stability to the cells. The inorganic electrolyte has a different composition [to an organic electrolyte used in batteries today], and uses different conductive salts and solvents.

Our electrolyte doesn’t contain combustible components, so we remove the risk of ignition and fire. A conventional lithium-ion electrolyte is composed of conductive materials like conductive salts and organic solvents – which are combustible. So if there is a hot spot within the cell, they could easily ignite, or in the case of malfunction – if there is a release of evaporated electrolyte -- they could ignite simply because of contact with hot metals.

This is one of the big risks associated with conventional li-on batteries – once a cell starts to burn, the energy generated is so high that other cells take part in the reaction too. It takes one cell to start a chain reaction, which can spread to an entire battery system. In an extreme case, the fire could even jump to other battery systems if they are close by.

This is causing most of the headaches for conventional lithium-ion systems, because there are many potential failures that could lead to this.

Q: How does Innolith replace the combustible components with non-flammable components?

Borck: We exchange both components – the conductive salts and the solvent – to materials that are non-flammable. The solvent we use also dissolves a higher proportion of salts compared to conventional electrolyte, which contributes to the electrolyte's high conductivity and supports the high power capability of the battery. The absence of organic materials also removes a major source of chemical degradation.

Q: Apart from the non-flammability, how else have you proven that your batteries have longer lifetime and better energy density?

Borck: Conventional lithium-ion batteries lose lithium through side reactions, which reduces the capability over time of the electrolyte to provide the same current and there is also accelerated ageing because of the change in the electrodes themselves – meaning that more capacity is lost through the cycles compared to the initial phases.

Side reactions do not occur within an inorganic electrolyte – so our technology has a very predictable capacity and we have shown that acceleration in ageing does not occur for our cells.

Q: Does your technology reduce the amount of valuable metals like cobalt and lithium that are currently used in batteries?

Borck: Our battery system is lithium-based but there is no cobalt, either in our grid-scale battery – which has already been manufactured and deployed, or in the battery designed for electric vehicles, which we announced on April 4 and plan to bring to market over the next few years.

Q: What are the challenges in bringing the Innolith battery to market?

Buchin: The battery world is now dominated by conventional lithium-ion batteries. It's a proven technology and is available at large scale, but there are downsides because the system is flammable, the cost is too high to deploy in certain locations and some of the materials [like cobalt and lithium can be problematic to source]. Overall, conventional lithium-ion is reaching its limits, and a number of competing technologies could take its place.

Solid-state battery technology is the most well-known alternative – it's non-flammable and more stable – but it's still an unproven platform with lower power density. Many scientists believe that it won't be commercially available before 2030.

Then there are lithium-sulfur and lithium-air technologies, which promise extremely high energy densities, but they are unlikely to be available before 2030 to 2040.

We are bringing a new electrolyte to the mix that can compete with conventional lithium-ion. It has a high energy density, and is stable, but it is still a new technology and has yet to make its way to the market.

Our manufacturing processes are no more complex than those of conventional batteries. Currently, the world is focused on one technology, but at some point it will move to a different technology – just as was the case with lead acid batteries.

Fundamentally, our cell design is the same as lithium-ion, it's just a set of different materials that is required for inside the cell. But in principal, it uses the same anode, cathode, electrolyte separator and housing.

Q: What are the details of your grid-connected battery project in the U.S.?

Buchin: We have a 2 megawatt / 1 megawatt-hour system that was installed in the PJM grid in the U.S. in August 2017. Since then, it has been delivering frequency management services to the grid – where the battery gives and absorbs energy throughout the day from the grid, in about ten to 12 discharge cycles.

Being part of the PJM grid has been a good test of the economics of an Innolith battery. PJM has a very demanding signal and most of the batteries will wear out within 12 to 24 months, whereas we know that our battery can function there for ten to 15 years.

Q: Do you plan to expand upon this grid-scale battery project soon?

Buchin: First, we intend to expand our project in PJM and then we plan similar deployments elsewhere in the U.S. We have about a 100-megawatt pipeline of projects.

Q: Where does your funding come from?

Buchin: We have raised hundreds of millions of dollars throughout the lifespan of this technology. [Innolith acquired the German and Swiss assets of Alevo after it went into administration]. Our funding for Innolith comes from a strategic investment, backed by a family office that has multi-million dollars' worth of assets under management.

We intend to partner with a larger company to secure our place in the market, either through licensing, joint ventures or mutual investments.

Q: Tell us about your newest battery technology launch for electric vehicles…

Borck: We made a breakthrough invention about 18 months ago, to allow us to create a battery with 1,000 watt-hours per kilogram energy density, and bring the price level to $50 per kWh. It's a great battery for electric vehicles and would make them cheaper than internal combustion engines. It works well as energy storage on the grid, to make renewable energy economically viable and opens up new applications for batteries in the marine sector for electric ships.

In comparison, the Tesla battery is 280wh/kg and the practical limit for lithium-ion is in the range of 350 to 400wh/kg.

Q: How does it compare on cost to make a conventional lithium-ion battery?

Buchin: The cost for commercially-available lithium-ion batteries is between $150 and $400 per kWh. We expect that when we bring this high-energy cell into production, it will cost less than $100 at the start and with economies of scale, the cost would reduce to below $50 per kWh for an EV application.

Q: What is the $50 per kWh based upon?

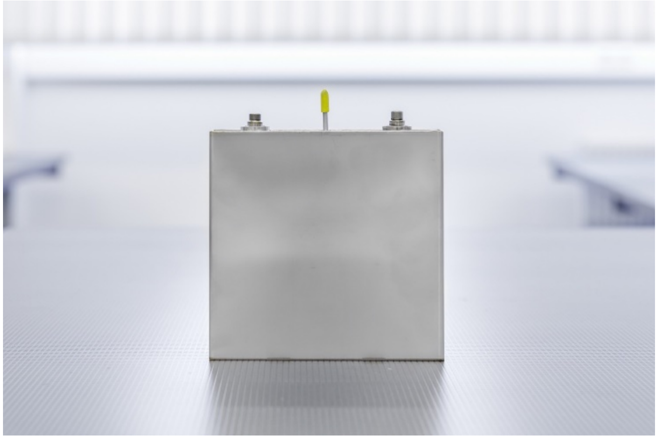
Buchin: It's based on the material estimates because when you treble the energy density – you need one-third of the components to build a battery. So it significantly reduces the billable materials because of the improved energy density and is beneficial to cost and range for an electric vehicle.

Q: When could you commercialize this by?

Borck: The prototype is already working in the lab – it will take us another couple of years to design the cell to go into production and then we will focus on production processes and bringing it to the market. So altogether, we expect it to be in the range of four to five years.

Q: What markets do you seek to enter as the company scales up?

Buchin: We are looking at all mainstream battery applications – our first phase would be in the grid ancillary services for frequency and voltage regulation; the second phase would be in electric vehicles; and longer-term, we aim to look into marine applications where there is a lot of pressure to reduce emissions, together with markets like aviation.



Above: Innolith battery cell

Source all photos: Innolith. First photo is Markus Borck, second photo is Sergey Buchin.

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