Bosch acquisition of Seeo highlights NMC vs. NCA chemistries and safety

Steve Taranovich - September 20, 2015

Bosch, is one of the top automotive suppliers in the industry, and on August 28, 2015 had strategically acquired Seeo, a solid-state battery developer of next-generation energy storage. There was not much notice in the industry, but I believe this could be a significant boost to Seeo with the financial power backing of Bosch. This is the first instance of a major automotive player outright acquiring a next-generation battery developer, highlighting the strategic importance of advanced energy storage for the automotive value chain.

More range and improved safety

The potential is there for a significant increase in the range of electric vehicles (EV) as well as a safer technology in EVs and hybrid electric vehicles (HEVs). Lithium nickel manganese cobalt oxide (NMC) and lithium nickel cobalt aluminum oxide (NCA) are two standard Li-ion chemistries for the cathode makeup in those batteries.

Addressing the critical factor of safety, Reference 1 outlines electrical abuse tests such as short circuit, overcharge and over-discharge performed on these batteries with the two different cathode chemistries. The tests showed that Lithium Iron Phosphate technology (LiFePO4/C or LFP) cells have higher thermal stability and would be safer against thermal or electrical abuse where heat generation is the critical point. The problem is that LFP cells are overcharged, its cathode does not have an overcharge reserve like NMC and NMA cells do such that the LFP will be irreversibly damaged earlier than NMC and NMA cells.

In addition, LFP cells showed occasional electrical leakage when short circuited.

So there is certainly more research and development to be done regarding the NCA cathode chemistry, but it is beginning to look promising.
Reference 1 also discussed the Current Interrupt Device (CID) which protects a battery from over-charge. See Figure 1.

![CID diagram](Image courtesy of Reference 1)

**Figure 1: Typically a CID is located at the top of a cylindrical battery. Here it is shown before and after opening**

Before the acquisition Seeo had been trying to move from lower-energy LFP (lithium iron phosphate) cathodes towards higher-energy NCA (nickel cobalt aluminum) cathodes to keep ahead of the competition. It was also looking to set up joint ventures to help it scale up production of cells capable of 350 Wh/kg, a crucial step in proving its new technology.

With the Bosch acquisition and financial backing, technical issues like low ionic conductivity (which limit power and require the battery be heated to about 80 °C) can be possibly be overcome with advances in technology.

I believe that the acquisition price may have been low enough (terms were undisclosed) to make it a move worth making. Seeo’s technology will require quite a bit more investment and time before it is ready for a commercial debut, but the acquisition is an almost a necessary one for a supplier like Bosch that has ambitions to be a key battery player in a crowded, competitive space.

Bosch’s CEO commented earlier this year, that the supplier is hoping its batteries reach the 300 Wh/kg to 400 Wh/kg mark by 2020, and that at the same time costs fall by 50% in that timeframe. Such ambitions are well-matched to taking a risk on next-generation batteries beyond existing present lithium-ion (Li-ion) technology, like Seeo’s. Seeo's advanced lithium polymer cells have the potential of an energy density of 350 watt-hours per kilogram, roughly twice the level of batteries used in today's electric vehicles.

**A pure Lithium anode**

By using solid-state technology, the battery anode can be made from pure lithium, which
considerably increases storage capacity. In addition, the new cells function without ionic liquid, which means they are not flammable. With the acquisition of Seeo Inc., Bosch now possesses the first sample cells which have the potential to meet the high standards of the automotive industry where durability and safety are concerned.

Seeo’s battery technology may help to increase energy density by 50 to 100 percent, which could significantly increase the operating range of an electric vehicle. I would buy one if they could increase the range like that.

The company also has an exclusive license to core patents from Lawrence Berkeley National Laboratory that could help Bosch produce lightweight batteries on an industrial scale.

I spoke to Cosmin Laslau, Lux Research senior analyst and he provided some good insights:

*Apple is also rumored to have acquired distressed thin-film battery developer Infinite Power Solutions at the end of 2014. GM has made investments into Sakti3 and SolidEnergy, and VW is investing into Quantumscape and working with Oxis Energy, two other beyond-Li-ion players.*

*As these OEMs and their suppliers look to appeal to more buyers, the pressure for longer driving ranges for less money will push Li-ion to the breaking point, necessitating next-generation technology. For now, solid-state batteries are the best positioned to take that crown, but other families like lithium-sulfur, high-voltage cathodes, and alternative ions are worth watching, too.*

*Automotive players and their supply chains should continue to watch this space closely for acquisition opportunities, while also doubling down on internal research and development efforts to push beyond Li-ion. Expectations should be managed, however. Despite the growing hype around solid-state batteries, do not expect Li-ion to lose its crown in the next decade. It will be surpassed eventually, and those that prepare now by securing key IP and leading researchers, will be the best positioned to prevail in the future of transportation drivetrains.*

Laslau said that Apple views transportation as the ultimate mobile device and questions whether Google may want to purchase Tesla. He said that the infotainment market companies want better batteries as well. 80°C is needed in EV battery technology (I live in Arizona and that would help us here where we need to buy automobile batteries every 3 years or less)

Let’s keep watch on this technology growth and innovation and especially watch Bosch because I think we will see some interesting developments in taking this mid-pack company Seeo and using
Bosch’s financial power and automotive connections to make a major breakthrough in EV battery technology.

References

1 Electrical safety of commercial Li-ion cells based on NMC and NCA technology compared to LFP technology, Martin Brand, Simon Gläser, Jan Geder, Stefan Menacher, Sebastian Obpacher, Andreas Jossen, Daniel Quinger; presented at the Electric Vehicle Symposium (EVS27) Nov. 2013