POWER MANAGEMENT SYSTEMS

LINCAD'S RESEARCH & QUALITY MANAGER, GAVIN DURHAM, TALKS ABOUT BATTERY CHEMISTRY

Q. Lithium-ion seems to be the dominant battery chemistry at the moment. Is that a fair assessment?

A. Yes, lithium-ion is the dominant battery chemistry at the moment. There is a massive amount of research and development into lithium-ion pushing it further ahead of alternative chemistries. It has been estimated that the manufacture of lithium-ion batteries is set to increase at least five-fold in the next three years. However, work is taking place into other battery chemistries. Lithium is a relatively abundant element with significant deposits found mainly in Argentina, Chile, China, Australia and Mexico, but other components of lithium-ion batteries, such as cobalt, are rarer.

Q. Why are we expecting such a big growth in battery production? Is it because of electric cars?

A. It's partly because of electric cars but it's also because of domestic and large scale energy storage systems and our ever increasing demand for portable electronic devices.

There's a massive new requirement for energy storage through batteries and there's probably more research and development into lithium-ion batteries than all of the other different chemistries put together. Overall, I think that the big steps forward in the future are still going to come from lithium-ion.

Also, a lot of research is being done into special materials which may improve the performance of lithium-ion batteries such as graphene and nanomaterials. Graphene is a form of carbon with very specific properties which is being applied to lithium-ion batteries to improve charge and discharge rates. Nanomaterials enable the engineering of new properties into the electrode materials such as improved electrical conductivity and reduced diffusion path lengths.

Q. So, is lithium-ion the whole story now?

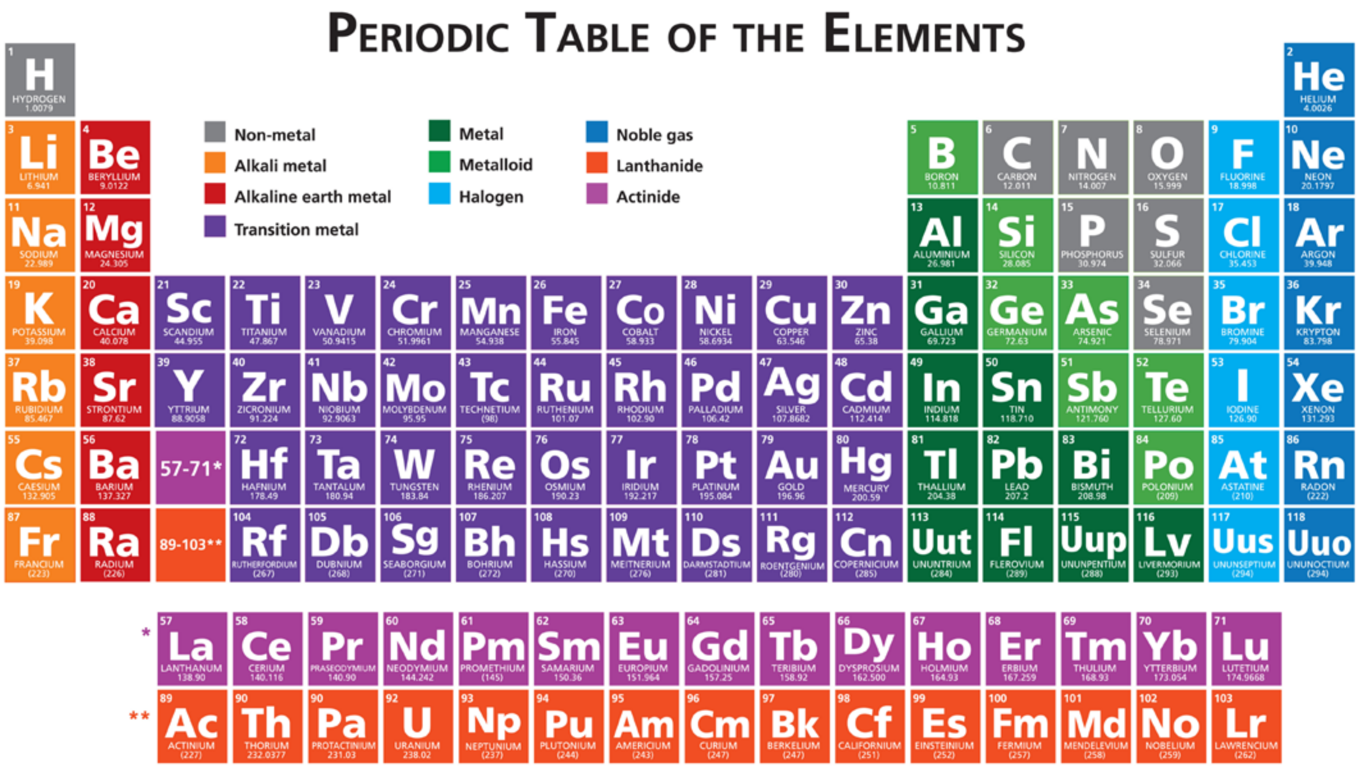
A. Not entirely, sodium is the next element down from lithium in the Periodic Table and sodium ions are similar to lithium ions. But there are issues with sodium-ion batteries, largely from the chemistry point of view. Sodium ions are bigger and heavier than lithium ions. In a lithium-ion battery, the reaction taking place is basically an intercalation reaction where the lithium ions are transferred from the anode to the cathode and inserted into the structure of graphite in the anode. Because sodium ions are larger, that process doesn't occur so readily.

Due to the fact that sodium ions are heavier, you cannot get such a high energy density in a sodium-ion battery compared to a lithium-ion battery. So, you're unlikely to see sodium-ion laptop and mobile phone batteries because they'd be a lot heavier and bulkier. They're also lower voltage. However, what you might see is sodium-ion batteries being used in domestic and large scale energy storage systems where size and weight don't matter so much.

The major advantage for sodium-ion is the abundancy of sodium. It is more abundant than lithium and therefore offers potential cost savings

Q. Is it an area that Lincad will be looking at?

A. Lincad is always open to new developments in cell technology. Our current focus is on high energy density, high power, lightweight batteries and sodium-ion can't compete with lithium-ion at all in that area. But as we diversify across a range of sectors, in the future we may well incorporate sodium-ion cells into our battery products.



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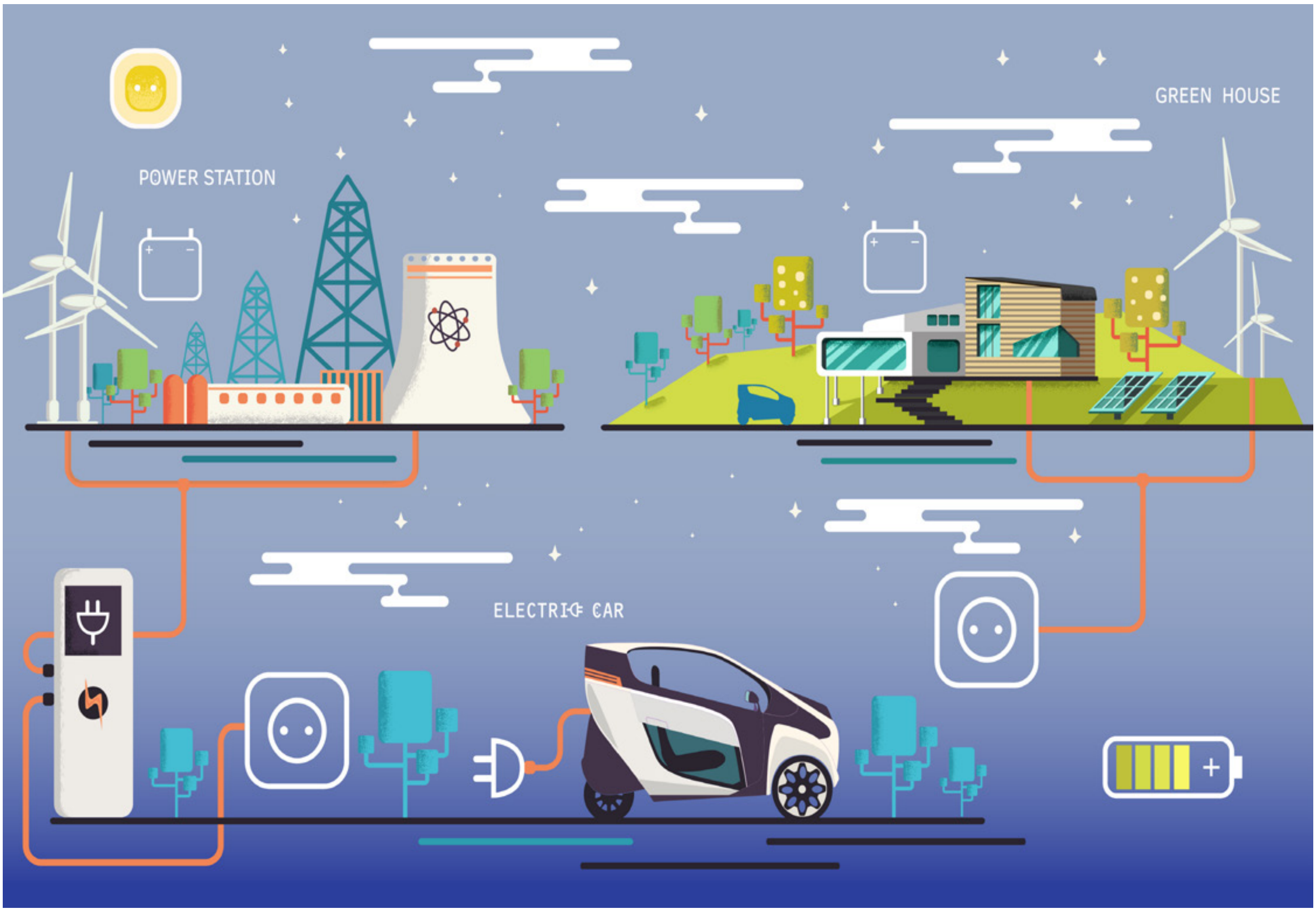

Q. And what about aluminium-ion batteries?

A. It's a similar picture with aluminium. Aluminium ions have the advantage that for every ion that crosses the membrane from anode to cathode, you get three electrons. But there are a lot of technical issues with aluminium.

Q. Is that because aluminium is heavy?

A. Yes, it is. If you look at the Periodic Table, you've got hydrogen and then helium. But unfortunately, they're both gases. The first solid element is lithium. So, it's the ideal one. It's got high voltage and, in my opinion, it's going to be the leader in the field for many years to come. There's nothing to touch it really whether it's for non-rechargeable primary or rechargeable secondary batteries.

Q. What about the use of silicon?

A. Research has been done into using a silicon anode with a lithium-ion battery. By replacing some of the graphite in the anode with silicon, increases in cell capacity can and have been achieved. However, there are technical problems due to mechanical stresses from swelling which are limiting the amount of silicon that can be incorporated into the anode. But the technology looks promising.

Q. How does all this affect Lincad going forward?

A. Lincad's business is split into design and manufacture on the one hand and distribution on the other. The design and manufacture aspect is where we use lithium-ion technology the most. As this technology develops, we are able to design and manufacture higher energy density products with higher power which is what our customers require, especially military customers. This can also afford significant weight reduction, imperative for the soldier in the field.