Graphene and recent energy storage developments

When you hear energy storage and graphene mentioned in the same sentence this usually refers to electrical energy. Let’s take a brief look at some of the research that has been coming out of the labs recently…

Batteries

Energy storage is of critical interest in road transport because you have to carry the energy you need around with you. Electric vehicles (EVs) run on batteries.

Batteries work by storing electrical energy in a chemical reaction. When the battery is connected and circuit is made, the pathway for the reaction is opened and electricity is released in a controlled way.

There are two problems with the technology. Firstly the batteries take a long time to charge. Secondly they don’t store a lot of energy in comparison with liquid fuels like diesel.

This means you cannot travel long distances without recharging. Then when you connect to the power grid you have to wait quite some time for the batteries to recharge.

Improving batteries with graphene

Recent work reveals that graphene could help with the charging time. Samsung claim to have developed a graphene coating for the electrodes that can make batteries recharge faster.

The secret seems to be that they have made a graphene powder from graphite with a sophisticated milling technique developed by the Hosokawa Micron Corporation in Japan. This machine is

called the Nobilta. It grinds up solid graphite to create an exfoliated graphene nanoplatelet powder that looks a bit like microscopic popcorn.

This form of graphene is coated on the battery electrodes. It has a high surface area, which means there are more sites for the chemical reaction to operate. This is why the reaction can go faster and this speeds up the charging time. However it is hard to see how this development can increase the energy density of the battery.

Supercapacitors

Supercapacitors also store electrical energy. Instead of a chemical reaction they store a charge on the surface of conductive plates that are separated by a very narrow gap filled with an electrolyte. Large charges can build up on these plates and when a circuit is made between the plates, electrons flow to equalise the charge difference.

This means that supercapacitors are very good at charging quickly. They also discharge quickly, but you get everything at once, unlike batteries that release the current gradually.

Improving supercapacitors with graphene

Because the charge is stored on the surface of the plates, electrodes with a high surface area are essential to the performance of a supercapacitor. Activated carbon has been used in the past but since graphene nanoplatelets were developed commercially these have started to find use as electrode material. Graphene has an extremely high surface area and nanoplatelets help increase the operational voltage. It will not surprise you, dear InvestorIntel reader, to learn that this is an area of intense research activity.

To take one example of a recent R&D project done jointly by teams in China and Australia. A mixture of carbon nanotubes

and graphene nanoplatelets (in a 1:3 proportion) was wet spun to make a fibre. The fibre was then coated with polyaniline (a polymer that conducts electricity very well)

The researchers found they could make a material that was suitable for use in supercapacitors and was very flexible. Coiled springs made from this fibre had an extraordinary 800% strain capability.

Making stretchy graphene fibres that conduct electricity and can hold an electrical charge could be the basis for incorporating electrical devices in to clothing. The polyaniline coating is a well-understood material and is already in use as a component in supercapacitors. So the adoption of this technology by the energy storage industry is likely to be easier because it is built on known technology

In summary

Batteries for transport applications might not be improving much in terms of the amount of energy that can be squeezed into a given space. However graphene could improve the time spent charging so at least we can get moving again faster. Supercapacitors might not be ideal for transport applications but adding graphene can improve their performance too and also enable the development of flexible power packs that could find novel applications such as textiles that can store and release power.