Cleantech energy storage with graphene heat battery

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Clean technology such as solar has an obvious problem. As long as the sun shines we can have power, but what happens at night? The answer is some kind of energy storage during the day that can release power whenever we need it. It looks like graphene may be solving this problem too…

Storing power in a battery

Solar power can be captured during the day in one of two forms, electricity and heat.

A team in Hong Kong had reported a design for a graphene-based battery that could harvest heat energy directly from the surrounding environment and turn it into electricity. This work was done back in 2012 and seems not to have been continued since then. So let's assume there was some flaw in the work that halted the development.

This time I'd like to look at what is being developed with graphene for heat storage.

How heat storage batteries work

The simplest form is to heat up a solid, liquid or a gas. Keep it hot and then use a heat exchanger to transfer the heat to make steam to drive a turbine that generates electricity.

The problem with heat batteries is that you have to keep them very well insulated to stop the heat from leaking away until you need it. No insulation is perfect and this means an energy loss

that reduces the efficiency of the system.

Salt hydrate technology

This idea draws on the fact that some inorganic salts are hydrates. The term hydrate can take us deep into chemistry but for our purposes it means water stored in the salt in a chemical bond.

Those of you who studied science at school might remember copper sulphate. It starts out a lovely bright blue colour but if you heat it, it turns white. This is the dehydrated salt (water has been removed). Let the white solid cool. Then add some cold water and the white solid turns back to the original bright blue colour – and it gets hot. You can find the details at the RSC website.

There are two points to note about this. The first is you can handle the white powder and it needs no insulation. The heat is stored in chemical bonds and is released when you add water back again with almost no energy losses. The second point is that it is reversible; you can put heat in and take it out as many times as you like.

Salt hydrate heat battery development

Modern salt hydrate heat batteries use cheaper salts than copper sulphate. A project called MERITS by TNO, the Dutch technology developer, found that their heat battery could store 1 gigajoule per cubic metre. This is about the same energy density as a lithium ion battery or one sixth of the energy released by burning a barrel of oil.

Graphene in salt hydrate heat batteries

A Swedish company called SaltX Technology has developed a

graphene-enhanced system by coating salt crystals with graphene nanoplates. As well as improving heat transfer the graphene stops the crystals from aggregating during the heating and cooling cycles. The solar power grid storage product is called EnerStore and the company claims to be three times more volume effective than their competitors with a two-year return on investment for the installation.

SaltX has also this month announced a strategic collaboration with specialty paper producer Ahlstrom-Munksjö. The two companies are working on a new development to spray the graphene-enhanced salt on to graphene-coated paper. They believe this development will reduce the cost by up to 80%. We can make some educated guesses about how they could actually achieve this. However that, dear reader will have to wait for a future column entry.

If this new graphene enhanced heat battery works as well as expected this will definitely be a cleantech project to watch out for when the development matures in two years' time.