Paper batteries

Pond scum makes battery production a garage business

(By Derek Hornor - Monday, September 14, 2009)

Cladophora algae *(By: Sea_daddy @ flickr)*
on the rocks

Researchers at Uppsala University in Sweden are reporting on an exciting development in non-metallic batteries based on a new source of cellulose. Cellulose is the material in plants that imparts micro-structure strength to wood and when processed makes paper with a very fine porous surface perfect for holding ink and pencil graphite.

Interestingly "porous" is exactly what is needed for batteries to hold electrons across a potential from the cathode to the anode side and hence store energy. In fact research into paper batteries has continued for some time but with rather dismal results, nothing like what has been accomplished in metallic batteries using materials such as Nickel, Lithium or lead.

Metallic batteries have their drawbacks though; they are dependent on energy intensive mining, processing and complex recycling and disposal, which must be accounted for in the true cost of technology's highest density energy storage mediums.

The cellulose Uppsala researchers have identified as a game changing advancement for nonmetallic batteries comes from Cladophora algae which is the same green pond scum seen on rocks and submerged branches in lakes and streams around the world.

*PROYECTO AGUA** /** WATER PROJECT @ flickr*
Cladophora algae

It is the same algae which periodically blooms at beaches on the great lakes in the US, much to the disappointment of would be bathers.

This alga has a history of use in the pharmaceuticals and cosmetics markets because it is extremely cheap, easy to produce in bulk and can be processed to produce up to 80 square meters of surface area per gram of material.

When this highly porous algal cellulose is covered with a thin layer of the conductive polymer polypyrrole (PPy), the researchers "succeeded in producing a battery that weighs almost nothing and that has set new charge-time and capacity records for polymer-cellulose-based [non-metallic] batteries," according to researcher and doctoral student Gustav Nyström, as reported by gas2.org.

The numbers they have for energy density are basically straight off the lab bench, with no time spent optimizing, even so this PPy-cellulose battery is reported at 25 Wh/kilogram of battery material by weight, or 40 Wh/Liter of battery material by volume. This is approximately 15-25% the density of massively researched and optimized Lithium-ion batteries. It is expected that the PPy-cellulose battery will approach energy storage densities similar to Lithium –Ion batteries after undergoing continued research into optimization.

Perhaps the most exciting aspect of this finding is that the process for making these paper batteries is extremely simple; Professor Maria Strömme, another author of the report states that:

"[This battery] mainly consists of paper and salt water and can theoretically be made in your own kitchen (if you have a strong mixer) without the major energy input needed to create today's batteries. Another benefit is that the batteries can be manufactured without advanced equipment making it possible to build the batteries on site in developing countries."

This development should be considered disruptive, meaning it short-circuits so many losses currently involved in the production of batteries that a complete re-think of how we use and store energy must be undertaken.

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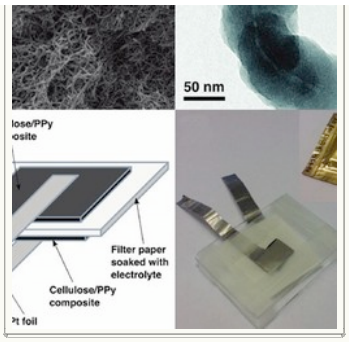
No more earth-moving or mining for a metal wherever that metal is most abundant (like Bolivia for Lithium). Instead sustainability for our energy storage is possible because management of natural, regenerative growth produces the bulk of material for the PPy-cellulose battery.

Even if this battery cannot reach the energy density of top performing Lithium-Ion, the fact that it is largely organic and can be locally produced automatically radically out performs non-organic metal based technologies.

I eagerly await confirmation of Uppsala's findings, and the announcement of the web release of the pdf guide "PPy-cellulose DIY 20 kWh battery".

Via: gas2.org



Battery *gas2.org*

Adapted from Nano Letters journal article

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