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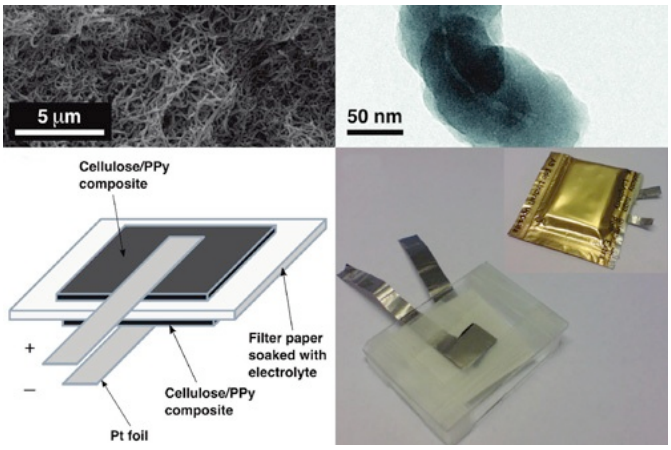
Algae-Based, Non-Metallic Batteries Could Revolutionize Energy Storage Industry

By Nick Chambers
A group of researchers at Uppsala University in Sweden have discovered that a particular type of algae — with a bad reputation for causing damaging algal blooms in oceans throughout the world — produces a substance that can be used to make inexpensive, non-toxic, simple-to-build, flexible, thin and durable batteries that, after optimization, are expected to perform on par with today's most advanced lithium-ion batteries.



The key to the discovery lies in the way in which the algae, Cladophora, produce a unique type of cellulose with a very large surface area (approximately 80 square meters of surface area per gram of material).

By coating this algal cellulose material with a thin layer of a well-known, conductive polymer, called polypyrrole (PPy), the team has "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 Gustav Nystrom, a doctoral student in nanotechnology and one of the main researchers.

The battery they created during the course of their experiment was completely unoptimized, yet even so they managed to obtain storage capacities of approximately 25 Wh/kilogram of battery material by weight, or 40 Wh/Liter of battery material by volume. To get an idea of what that means, lithium-ion batteries (which have been being optimized for a long time now) have a range of 100-160 Wh/kg or 250-360 Wh/Liter. After optimization, the research team expects the PPy-Cellulose batteries to have roughly the same energy storage characteristics as lithium-ion.

Up until now, no one has been able to make an organic-based battery perform anywhere close to what you expect from the best lithium-ion inorganic batteries. What's the big deal with having an organic-based battery you ask? From ease of manufacture, to the low degree of toxicity, to the flexible nature of the material, organic-based batteries have several key advantages over inorganic ones such as lithium-ion.

According to an email from Professor Maria Stromme, one of Gustav Nystrom's advisors and another author on the paper, the battery would be very easy and cheap to make because it "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." In a separate email, Mr. Nystrom also added that the manufacture of the battery is "based on an easy, all-chemical batch wise fabrication process using inexpensive and abundant materials."

Although the battery can be made with ease and is quite non-toxic, it has some impressive characteristics relating to charge times and durability. Again, keeping in mind that their experimental battery was completely unoptimized, it already shows an impressive ability to be quickly charged and discharged at high Amperages over and over without losing much of its storage capacity.

The research team is not focusing directly on car applications as of yet, choosing instead to direct their energies on taking advantage of the battery's unique properties of flexibility and low toxicity.

"We anticipate that the new batteries may open up entirely new possibilities when it comes to battery applications," said Professor Stromme in an email. "Because of the potential cost efficiency and light weight, the batteries can be used in smart textiles (clothes, e.g. for sensors that monitors pollutants or UV irradiation or alternatively monitors our sweat for diagnostic purposes) in packaging, in diagnostic devices in developing countries, etc.. Another benefit is that the batteries can be manufactured without advanced equipment making it possible to build the batteries on site in developing countries."

However, because the batteries are expected to perform on par with lithium-ion, and may potentially be much cheaper and less-toxic,

there is no reason that they couldn't outright replace lithium-ion as the battery of choice for all applications, including electric and extended-range vehicles.

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