CHEM205

BATTERIES

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Researchers at MTU are working on designing a lighter, greener, longer-lasting battery. In order to do so they designed an electrical storage device that’s half capacitor half battery and all of this is thanks to their key ingredient, carbon foam. The question now is why carbon foam?

The principle behind this innovation is the replacement of nickel, which is the base for most batteries, with carbon foam. The reason behind this switch is that carbon foam is that it’s lighter and cheaper. The main role of carbon foam, will be then, is scaffolding, filling its holes with nickel oxyhydroxide.

In 1600, a British scientist named William Gilbert established the study of electrochemistry, which led several years later, 202 years later to be specific, into the invention of the first electric battery capable of mass production by another British scientist called William Cruickshank. Since then chemists and physicists are trying their best to improve the battery in capacity, ecologically, and in recharge capability. Before we begin talking about batteries there are a few things that we should know. Electricity, as you probably already know, is the flow of electrons through a conductive path like a wire. This path is called a circuit*.* Batteries have three parts, an anode(-), a cathode(+), and the electrolyte. The cathode and anode (the positive and negative sides at either end of a traditional battery) are hooked up to an electrical circuit. The chemical reactions in the battery cause a buildup of electrons at the anode. This results in an electrical difference between the anode and the cathode. You can think of this difference as an unstable build-up of the electrons. The electrons want to rearrange themselves to get rid of this difference. But they do this in a certain way. Electrons repel each other and try to go to a place with fewer electrons. In a battery, the only place to go is to the cathode.

But, the electrolyte keeps the electrons from going straight from the anode to the cathode within the battery. When the circuit is closed (a wire connects the cathode and the anode) the electrons will be able to get to the cathode. In the picture above, the electrons go through the wire, lighting the light bulb along the way. This is one way of describing how electrical potential causes electrons to flow through the circuit. However, these electrochemical processes change the chemicals in anode and cathode to make them stop supplying electrons. So there is a limited amount of power available in a battery. When you recharge a battery, you change the direction of the flow of electrons using another power source, such as solar panels. The electrochemical processes happen in reverse, and the anode and cathode are restored to their original state and can again provide full power. Capacitors store an electrical charge physically and have important advantages: they are lightweight and can be recharged (and discharged) rapidly and almost indefinitely. Plus, they generate very little heat, an important issue for electronic devices. However, they can only make use of about half of their storage. Batteries, on the other hand, store electrical energy chemically and can release it over longer periods at a steady voltage. And they can usually store more energy than a capacitor. But batteries are heavy and take time to charge up, and even the best can’t be recharged forever.

Enter asymmetric capacitors, which bring together the best of both worlds. On the capacitor side, energy is stored by electrolyte ions that are physically attracted to the charged surface of a carbon anode. Combined with a battery-style cathode, this design delivers nearly double the energy of a standard capacitor.

MTU researchers have incorporated a novel material on the battery side in order to improve their creation. Their cathode used to rely on nickel-cadmium or nickel-metal hydride batteries before changing it to carbon foam. Carbon foam, as we mentioned earlier is lighter and cheaper. The carbon foam used by the MTU researchers has 72 percent porosity which means 72 percent of its volume is empty space, so there is plenty of room for the nickel oxyhydroxide. With this high percentage of the presence of nickel oxyhydroxide we can expect a big lifespan. Actually the researchers achieved more than 200,000 cycles and haven’t worn it out yet. The carbon foam can also be made of renewable biomass, which is attractive in an ecological point of view.

We can conclude finally that carbon foam holds the key for better batteries. Its light weight, high capacity of holding nickel oxyhydroxide which extends battery’s life, and its ability to be fabricated by renewable biomass, makes it the best thing that ever happened for batteries.