

A Review on Paper Batteries

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ABSTRACT – with the advancement in technologies, the interest has been shifting towards using paper as substrates for batteries or as some other energy storing devices. Due to some intrinsic properties paper like batteries show overwhelming performance when it comes to cost, cross functionality, adaptability etc. Here we will be giving a brief overview about the overall past achievement of paper batteries and their various uses. We will also be discussing about multiple types of power devices like electro chemical batteries, lithium ion batteries and biofuel cells. We will also give a brief note of the various technical as well as scientific snags faced.

Key Words: Substrates, Conventional, Conation

INTRODUCTION

A paper battery can be an adaptable, very-thin energy storage as well as energy producing device made by the combination of fullerene with conventional sheet of cellulose-built paper. It could act both as a high energy battery as well a capacitor. Paper battery is an electrical device designed to use splitter made from long chains of carbohydrate molecules containing nano scale structures which act as electrodes and hence increasing the rate of conation. Irrespective of being very thin they are eco-friendly too and hence giving a free hand to use at multiple places. They have similar functions if compared to conventional batteries. The better part about them is that they are non-corrosive in nature and hence don't need housing around them.

HISTORY

The first prototype of paper battery was developed in the month of December 2009 at Stanford University by YUI CUI and his fellow research team. That prototype had a terminal voltage of 1.5V. That battery could also work as a super capacitor as well as a high energy battery.

A BRIEF INTRODUCTION TO CONVENTIONAL BATTERIES

The French physicist invented the lead acid battery way back in 1859. It has high energy to weight ratio and low energy to volume ration but has the tendency to supply high surge currents, taking us to a conclusion that it has large power to weight ratio. An important point here is that they are less expensive if compared with their counterparts and hence widely used in motor vehicles.

The battery has two plates positive and a negative one. During the discharged state both the plates positive and negative becomes lead (II)sulphate and the electrolyte after loosing most of its dissolved sulphuric acid becomes water. In charged state the negative and positive plate consist of lead and lead oxide. The concentration of sulphuric acid in the electrolyte is at its peak and hence stores most of the chemical energy.

DISADVANTAGES OF CONVENTIONAL BATTERIES

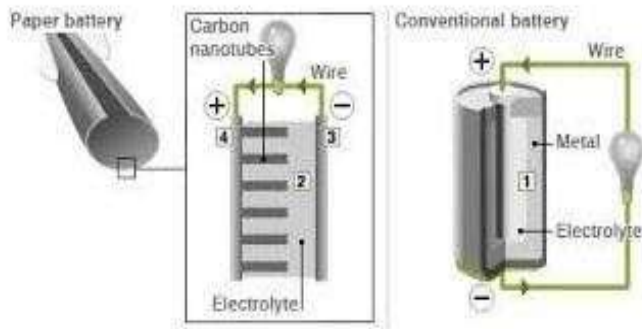
The overall life of the battery is limited since it generates its energy by means of chemical reactions and hence the components loose their capacity with time.

The have high energy to weight ratio and hence takes lump of space and contributes much to the overall weight of the object.

Due to freezing point depression there are chances that the electrolyte may freeze under harsh cold conditions.

WORKING OF PAPER BATTERIES

Like conventional batteries paper battery too houses a pair of electrodes, a solution and charge collectors. However, in paper batteries one conductor product is of semi conductance carbon tubes and second one is formed by coating paper centrifuge with lithium compound. For keeping the supply of solution, the paper is kept saturated with ionic liquid. As we are using the ionic liquid therefore, we have an assurance that it won't freeze or evaporate as no water is present here and thus enables them to work under extreme temperatures ranging between -78 degree Celsius to 177 degree Celsius. Since paper batteries are dry hence, they don't require any protective casing. A paper battery of size equivalent to a stamp can generate up to 2.5V. Similar to the conventional batteries a chemical reaction is must for the generation of electrons, leading towards the formation of cathode and anode. Lithium metal is used as anode and carbon nanotubes are chosen for cathode, for separator cellulose is used. And when the electrons start moving from anode to cathode a potential difference is created and we get voltage output.



ADVANTAGES

- Can be recycled and reused.
- It is lightweight and thin and hence could be used in smart watches.
- It can be manufactured in desired shape and size.
- It is operational under wide range of temperatures.

DISADVANTAGES

- It is expensive to manufacture.
- It has low efficiency. ○ It has low shear strength.

CONCLUSION

A device manufactured by combining carbon nanotubes with a conventional sheet of cellulose based paper and results is the formation of very-thin and flexible device which could be used as an energy storing medium. It is functional under wide range of temperature. Now if compared with conventional batteries they consume very less space and have very high energy to weight ratio. They have a very long life if compared with conventional batteries because there is no cathode, anode, electrolyte used. Though the cost of paper battery is bit high but the places where it can be used is totally its monopoly. Some time back google launched one of its products which was "Google Glass" now this was a very small electronic device and to power it a small source was required so paper battery was chosen. So, they can be used at every compact location. Paper battery is environment friendly in as well as human friendly as it is both biodegradable and non-toxic, as these days recycling is a major challenge and this paper battery fulfills that stance also. An interesting point about these paper batteries are that they act both as energy storing device and as super capacitor. With the ever-advancing technologies we are making smaller and smaller electronic devices and in future paper batteries will have a monopoly in powering them as it is a technology of future.

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