



PAPER BATTERY

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ABSTRACT

Today the biggest problem faced by the electronics industry is the size of the battery as gadgets gets thinner and smaller day by day. But at certain point the battery size and its weight creates an obstacle. To overcome this 'Paper Battery' present the ultimate solution. The paper battery is literally a conducting paper with a lot of power packed inside it. The various problems faced by the commonly used batteries and how the paper battery offers the solution to all these problems. A detailed construction of paper battery is explained in this paper. A comparison of SWCNT and MWCNT is also shown in this paper. This paper also contains the possible applications which could change our lives. The safety issues of Li-ion batteries, the limitations of NiCad & NiMH and the drawbacks of lead acid battery are discussed in this paper. The advantage of paper battery over these batteries is also described.

Keywords: Paper battery · SWCNT · MWCNT ·

1. INTRODUCTION

In a todays digital life, the portable electronic devices, such as mobile phones, portable camera, notebook computers, PDA etc. are becoming a popular because of their lightweight and small size. Batteries used as a portable power source have also become the focus of public concern and have been an essential element of the various portable electronic devices. Although actual basic problem with traditional batteries such as carbon-zinc batteries, alkaline batteries and secondary batteries, are allegedly environment benign, they in fact largely contain substantial amount of mercury and other heavy metals and also the price of the manufacturing process increasing daily. The paper batteries may meet the energy demands of this next digital generation gadgets. A paper battery may be a versatile, ultra-thin energy storage and production device formed by combining carbon nanotubes with a standard sheet of cellulose-based paper. The Paper batteries will replace the conventional batteries and Li-ion batteries. Anatomy of paper battery is based on the use of a Carbon Nano-tubes tiny cylinder to collect electric charge.



Figure-1 Paper Battery

2. MOTIVATION

After studying the problems associated with the most commonly used batteries, we can conclude that paper batteries along some modifications like Li-ion + CNT paper or some other possible combinations can replace the commonly used batteries. And making them much safer, flexible and light weight. If that happens, we will be able to power a hybrid vehicle with a newspaper sized paper battery or we can have foldable laptops that can fit in our pocket. The possibilities are endless.

3. THEME

Paper Battery either CNT based or Li-ion based provides a better solution for energy storage. The electronic gadgets can get even thinner, smaller and flexible. The Li-ion based paper battery can be recharged efficiently and is much safer than conventional Li-ion batteries. The CNT based paper battery is bio degradable, eco-friendly and can be cycled many times. They have a wide range of operating temperature. The overall efficiency of the paper battery is high.

4. OBJECTIVES

- The use of self-rechargeable thin film batteries, their performance and application.
- The glucose activated paper battery based on glucose oxidized enzyme.
- Ultra-fast all polymer paper-based batteries.

5. CONSTRUCTION

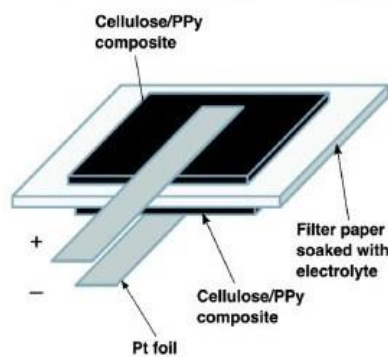


Fig2 construction of paper battery

Step 1: Black carbon ink is applied on a cellulose-based paper. **Step 2:** Black Carbon ink is being spread on a paper spread on the paper.

Step 3: A thin lithium film is laminated over the exposed cellulose surface.

Step 4: The cellulose paper is heated at 80°C for 5 minutes.

Step 5: Next, the film is peeled off from the substrate.

Step 6: The film acts as electrodes of the paper battery. One film is connected to the electrolyte LTO (Li₄Ti₅O₁₂) and another film is pasted to the electrolyte LCO (LiCoO₂).

Step 7: Next, connect a LED on both the ends of the battery and check its functionality.

6. WORKING

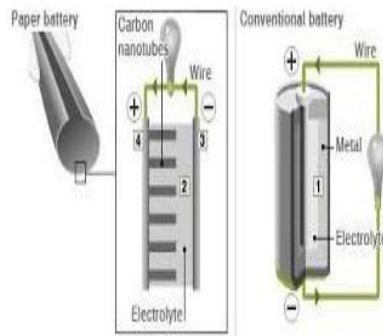


Fig . working of paper battery.

A conventional battery or Rechargeable battery contains a number of separate components that produce electrons through a chemical reaction between the metal and the electrolyte of the battery. The Paper battery works when the paper is dipped in the ion-based liquid solution; next a chemical reaction occurs between the electrodes and liquid. The electrons move from the cathode to anode to generate electricity. The paper electrode stores energy while recharging within 10 seconds because the ions flow through the thin electrode quickly. Figure 4 shows the working of a paper battery. The best method to increase the output of the battery is to stack different paper batteries one over the other.

1. The nano tubes acting as electrodes allow the storage device to conduct electricity.
2. Chemical reaction in battery is occurs between electrolyte and carbon nano tubes.
3. Battery produces electrons through a chemical reaction between electrolyte and metal in the traditional battery.
4. Electrons must flow from the negative to the positive terminal for the chemical reaction to continue. Ionic liquid, essentially a liquid salt, is used as the battery electrolyte.
5. The organic radical materials inside the battery are in an “electrolyte-permeated gel state”, which is about halfway between a solid and a liquid. This helps ions to smooth move, reducing resistance, allowing the batteries to charge faster.
6. We can stack one sheet on top of another to boost the power output. It’s a single, integrated device. The components are molecularly attached to each other: the carbon nano tube print is embedded in the paper and the electrolyte is soaked in to the paper.

7. NEEDS

Limited Life Time:

Primary batteries ‘irreversibly’ transform chemical energy to electrical energy. Secondary batteries can be recharged but they have very short life time, paper batteries overcome both problems.

Leakage:

In case of leakage the chemicals release may be dangerous but no such toxic chemicals are used in paper batteries.

Environmental Concerns:

The wide spread use of batteries has created many environmental concerns, such as toxic metal pollution e.t.c while paper batteries can be easily decomposes without any harm.

8. ADVANTAGES

- Eco friendly, biocompatible
- It is non toxic
- Easy to recycle
- Durable: shelf life of three years

- Works during extreme conditions -75°C to 150 °C
- Rechargeable
- No leakage of electrolyte
- No overheating.

9. APPLICATIONS

In Electronics:

- In laptop batteries, mobile phones, handheld digital cameras: The weight of these devices can be significantly reduced by replacing the alkaline batteries with light-weight Paper Batteries, without compromising with the power requirement. Moreover, the electrical hazards related to recharging will be greatly reduced.
- In calculators, wrist watch and other low drain devices. in wireless communication devices like speakers, mouse, keyboard ,Bluetooth headsets etc.

In Medical Sciences:

- in Pacemakers for the heart
- in Artificial tissues (using Carbon nanotubes)
- in Cosmetics, Drug-delivery systems
- In Biosensors, such as Glucose meters, Sugar meters, etc.

In Automobiles and Aircrafts:

- In Hybrid Car batteries
- In Long Air Flights reducing Refueling
- For Light weight guided missiles
- Powering electronic devices in Satellite programs.

10. CONCLUSION

After analysis of paper battery, we can conclude that the major component of paper battery is CNT. The CNT manufacturing techniques are inefficient which obviously increases the cost, making the paper battery expensive. If the cost is kept economical the batteries will revolutionize the electronics industry.

The shear strength of paper battery can be increased by adding glass fibre, resins, plastics etc.

Further research is needed in Nano toxicology to make CNT's non-hazardous for our health. The use of lithium as an electrode in paper battery can solve most of the safety issues of Li-ion batteries. With paper batteries we can predict a whole a new world of possibilities and endless applications which will one day change our daily lives.

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