

# STUDY OF PAPER BATTERY

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**Abstract:** An Electronics have typically been built around their batteries. However, a brand-new battery known as the "paper battery" has recently been created and can now easily adapt to the size and shape of different gadgets. The importance of the paper battery is growing as technology moves towards thinner, more paper-like devices. The technical operation of the paper battery will be covered in this essay. It will examine the benefits of current advancements in the production of paper batteries and evaluate their effectiveness. The paper battery's various uses will then be discussed, along with any ethical concerns that might arise. This presentation will show how the paper battery's design makes use of cellulose and carbon nanotubes to produce a flexible battery while retaining electrifying performance. We'll go into more depth later on regarding how the paper battery combines the elements of a regular battery into a streamlined, paper-thin form. This design's benefits include a wider range of applications and a faster, easier manufacturing procedure.

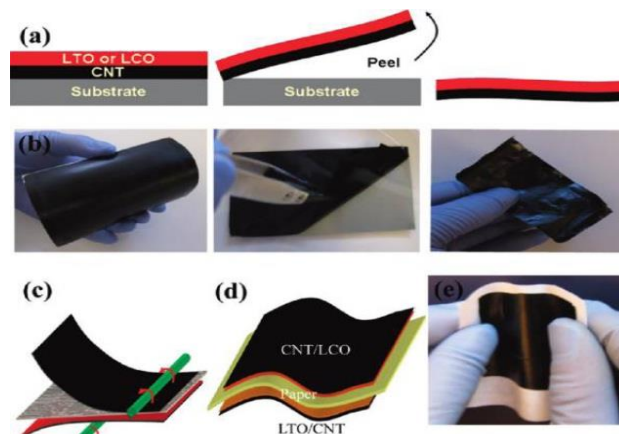
**Keywords:** Paper Battery, nano tubes, capacitors, components, electronics, and capacitors

## I.INTRODUCTION

A power source is necessary since many electronic tools and gadgets depend on electrical energy. The supply can be provided via direct electricity and batteries, which are tools that can store and release electrical energy as needed. Batteries transform chemical energy into electrical energy; they can be either rechargeable or non-rechargeable depending on how they are charged. However, the batteries take a lot of floor space and are very heavy. The development in this technology is the PAPER BATTERY, a thin, flexible energy storage system. It is created by combining cellulose-based nanopaper and carbon nanotubes. As a result, the composition is cheap, and the battery is both disposable and biodegradable. Consequently, a paper battery is a high-energy storage technology. Has a quality similar to a superconductor. Paper batteries are very versatile and environmentally friendly. The paper battery can be used practically anywhere in place of the traditional huge batteries because it is lightweight, thin, and non-corrosive. The paper batteries can be wrapped in any shape, allowing the set to be used in electric cars, greatly reducing the weight of the vehicle. Electron flow is increased by paper batteries, which is crucial for excellent performance

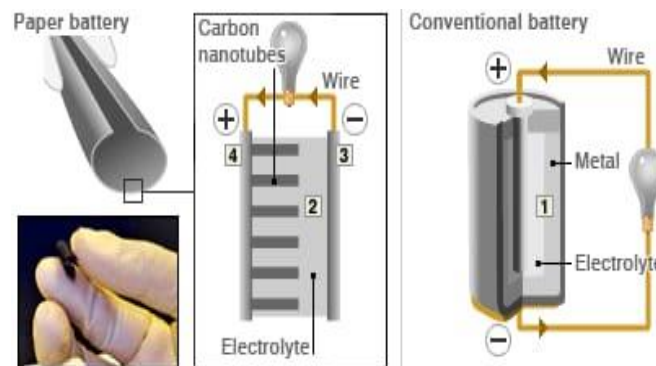
### 1.1 CONSTRUCTION:

Actually, there are many ways to construct paper batteries. Given below are three ways to create paper batteries: The first method involves fabricating zinc and manganese dioxide based cathode and anode. The batteries are printed onto paper using standard silkscreen printing press. This paper is infused with aligned carbon nanotubes which are used as electrode. This paper is dipped in a solution of ionic liquid which acts as the electrolyte. The second method is a bit complex and involves growing nanotubes on a silicon substrate. The gaps in the matrix are then filled with cellulose and once the matrix is dried, the combination of cellulose and nanotubes is peeled off. Thus sheets of paper consisting of layers of carbon nanotubes are created. Two such sheets are combined together to form a super capacitor with a ionic liquid.



The third is a simple method and can be constructed in a laboratory. It involves spreading a specially formulated ink of carbon nanotubes over a rectangular sheet of paper coated with an ionic solution. A thin film of lithium is then laminated on the other side of the paper. Aluminium rods are then connected to carry current between the two electrodes.

**1.2 WORKING:**



Similarly in some paper batteries, carbon nanotubes act as cathode, the metal is the anode and paper is the separator. Chemical reaction between metal and electrolyte results in production of ions whereas chemical reaction between carbon and electrolyte results in production of electrons. These electrons flow from the cathode to the anode through the external circuit. Internal operation of paper batteries is similar to that of conventional batteries with each battery generating about 1.5V. If one can recall traditional batteries work in the manner where positive charged particles called ions and negative charged particles called electrons move between positive electrodes called anode and negative electrode called cathode. Current flows as electrons flow from anode to the cathode through the conductor, since the electrolyte is an insulator and doesn't provide a free path for electrons to travel.

**II. ADVANTAGES & DISADVANTAGES**

**2.1 ADVANTAGES OF PAPER BATTERIES:**

Non-toxic, biodegradable, eco-friendly, biocompatible, easy to recycle, three-year shelf life, works in temperatures ranging from -75 to 150 degrees, rechargeable, no electrolyte leakage, no overheating, light weight, easily moldable into desired shapes, can function as super capacitor, more power in less volume, and adjustable output voltage by staking and slicing.

**2.2 DISADVANTAGES OF PAPER BATTERIES**

Low shear strength makes it easily tearing, expensive CNT production method, nanotoxic for CNT manufacturing employees, can cause fibrosis in lungs, and aquatic like CNT damaged.

### III.NEEDS AND LIMITATIONS OF PAPER BATTERIES

#### 3.1 LIMITATION:

1. Paper batteries have limited strength, making them readily 'ripped'.
2. The methods and configurations used to produce carbon nanotubes are exceedingly pricy and quite ineffective.
3. Their interaction with the lungs' microphages after inhalation is comparable to that of asbestos fibres. Consequently, it could seriously endanger human health

#### 3.2 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.

### IV.APPLICATION



- **IN MEDICAL SCIENCES :**

Paper batteries have various uses in medical sciences such as making pacemakers for heart, artificial tissues using carbon nanotubes, drug delivery systems in cosmetics. These batteries are also used in bio-sensors such as Glucose meters, sugar meters, etc. The paper battery is set in iontophoresis patch, and it helps to deliver drugs, local anesthesia, anodyne, antichloristic, etc into the skin.

- **IN ELECTRONICS:**

In electronics, paper batteries are mainly used in the electronic devices such as mobile phones, calculators, laptop batteries, digital cameras and also in the wireless communication devices like mouse, Bluetooth, keyboard, speakers and headsets. With the replacement of the alkaline batteries with the light-weight paper, there could be a weight reduction of laptop batteries, mobile batteries etc. Paper batteries could also be used in calculators, wrist watch and other low drain devices. Moreover, the paper batteries also have a usage in enhanced Printed Circuit Board (PCB), wherein both the PCB sides: one for the circuit and the other side, having the components, would contain a layer of customized paper battery. This would result in the elimination of heavy step-down transformers and in the need of a separate power supply unit for most electronic circuits. Etc,

### V.FUTURE SCOPE OF PAPER BATTERY

- 1) If paper battery technology is developed at higher rates, then a heavy duty car battery would be a size of a penny.

- 2) For energy storage in medically implanted devices like pacemaker, insulin pump or the implantable radiochip. Etc.

## VI.CONCLUSION

After analysing the paper battery, we can say that CNT is its main constituent. The ineffective CNT production processes raise the cost, making the paper battery more expensive. Batteries will revolutionise the electronics sector if the price is kept low. Glass fibre, resins, polymers, and other materials can be added to paper batteries to boost their shear strength. CNTs must undergo additional Nanotoxicology study to render them safe for human health. Most of the safety problems with Li-ion batteries can be resolved by using lithium as an electrode in paper batteries. With paper batteries, we can see an entirely new universe of opportunities and limitless uses that will one day transform our daily lives.

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