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Super Charger with Paper Battery

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Abstract: ***The battery forms an important part of many electronic devices. Typical electrochemical batteries or cells convert chemical energy into electrical energy. Batteries based on the charging facility are classified into primary and secondary cells. secondary cells are usually used because of their rechargeable nature. presently, the battery takes up a massive quantity of space and contributes to a large part of the device's weight. There is a strong new awareness in ultrathin, flexible, safe energy storage devices to meet the many design and power needs of modern gadgets. A new investigation recommends that carbon nanotubes may finally provide the best hope of implementing stretchy batteries which can shrink our gadgets even more. A paper battery is flexible, ultra-thin energy storage and manufacture device designed by compounding two components that are separate in traditional electronics.***

Keywords: Li-ion (Lithium-ion batteries), Carbon Nano Tubes (CNT), Paper (cellulose), Paper Battery

I. INTRODUCTION

There has been a mounting request for solvent and lesser electronic devices. To complete those demands "Paper Battery" offers the best solution. A paper battery is essentially a fibre-based „paper" with CNT dropped on either side of the paper. A load of such papers makes a paper battery. Some batteries use Silvery Nano Wires as a replacement for CNT. It is enormously thin, stretchy, light weightiness, and stores much power in less space. Recently established paper battery associations the Li-ion based chemicals to make a grouping of Li-ion and paper battery.

Recent growth in the field of moveable apparatus has been the main driven force behind the examination with the high energy density and form elasticity. There are variabilities of batteries presented, the most well identify is lithium batteries because it has low discharge potential, high energy density, and the highest theoretical charge capacity of all commercial rechargeable batteries. Due to this silicon is a good-looking anode material for lithium batteries. Si majority film and micrometre-sized particle were used as the electrode in lithium batteries have shown size fading and short battery lifetime due to maceration and loss of electrical constant between the active material and the current collector, product in the poor transport of electron.

A laptop is a device that is moveable and appropriate for use while traveling or a laptop is often called a notebook which is small and moveable. A laptop contains a display screen, speakers, a keyboard, a processor, and so on. Along with these, every Laptop is given with battery charger, the battery charger must be effective and steadfast with high power density, low cost, low volume, and weight. The charging time and battery life are related to the individual of the battery charger.

The average lifetime of a laptop battery can be anywhere between one to six-hour dependent on the battery usage. The three main types of batteries used in recent laptops are NiMH, Li-ion, LiPo.

The problem arises when the laptop must be charged while traveling, where there is no availability of socket to charge, or if there is no electricity which results in the shutdown of the system. To overcome this problem, knowledge is to create a moveable power bank for laptops using a paper battery.

Figure 1: Paper Battery

The first and primary method of constructing paper batteries was projected and introduced by Robert Linhardt, a chemist at Rensselaer Polytechnic Institute in Troy, New York. Cellulose (paper) was layered upon conductive carbon nanotubes. Though the combination would be a strong material to construct a battery, however, the problem arose when the materials would fall apart when moved. A solution was found by Yi Cui, a materials scientist at Stanford University, Palo Alto (California).

He and his team of scholars formed an ink of carbon nanotube by overhanging them in water and a carbon-based surfactant. This ink was evenly spread on a piece of paper. As the inked paper was heated in the oven to drive off the water, the nanotubes attached tightly to the paper fibers, and a highly conductive sheet of paper was formed.

Scientists at Stanford University in Golden State have successfully turned paper covered with ink made of silver and carbon Nanomaterial into a "paper battery".

A. *Necessity*

There are many details to study a battery that is harmless, thin, & stretchy. Let us study some of the problems of the most normally used lithium-ion battery.

1) *Li-ion (Lithium-ion Batteries):* Li-ion battery is the most regularly used battery for smartphones, laptops, digital cameras, and all types of home appliances. It is essentially a rechargeable battery with lithium as an undesirable electrode. It is known for its low self-discharge, high productivity. But it is exclusive, it has security issues. The electrolyte wants to be reserved under pressure. It also needs an electronic monitoring system to avoid overcharging, overheating, overvoltage, etc. So, it wants a temperature sensor, voltage regulator, etc. which raises the cost. The electrolyte is highly flammable, responsive, and dangerous. In September 2016, Samsung remembered 2.5 million galaxies Note 7 since the battery strategy caused both the electrodes to touch which caused a short circuit and they smashed into combustions. In January 2013 Boeing 787 Dreamliner of Japan Air Company wedged excitement at Beantown airport. The batteries remained accountable. Luckily, no one got offended but had it immovable fire while flying the results would have remained best. Today greatest of smartphone users do not know how unsafe the Li-ion batteries are. New studies have suggested using Li-ion along with CNT to get a better, much harmless battery.

II. LIMITATIONS OF Li-ION BATTERY

1) Requires safety circuit to keep voltage and current within harmless parameters.
2) Topic to aging, even if not in use - storage in a cool place at 40% responsibility decreases the aging effect.
3) Transportation limitations - shipment of larger extents may be subject to supervisory control.
4) This limit does not apply to personal carry-on batteries.
5) Exclusive to manufacture - about 40 percent higher in cost than nickel- cadmium Class 9 miscellaneous hazardous material.

A. *Why to use Paper Battery?*

1) *Ultra-thin size& flexible structure.*
2) *Exhibits property of super- capacitor (22F-36F per gram)*
3) *Operating temperature (-75 to 100 degree Celsius)*
4) *Provide* both long-term, steady power production and bursts of energy.
5) Cost-effective.

III. PAPER BATTERY

A paper battery is a stretchy, ultra- thin energy storing and manufacture device designed by grouping carbon nanotube with a conventional sheet of cellulose-created paper as shown in fig.2. A paper battery performance as both a high energy battery and supercapacitor, compounding two components that are isolated in traditional electronics.

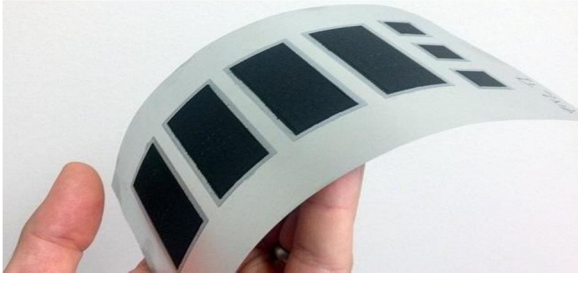

Figure 2: Paper Battery

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IV. COMPONENTS

1) *Cathode:* Carbon Nanotube (CNT)
2) *Anode:* Lithium metal (Li+)
3) *Electrolyte:* All electrolytes (incl. bio electrolytes like blood, sweat and urine)
4) *Separator:* Paper (Cellulose) Paper battery = cellulose paper + carbon nanotube.

V. CARBON NANO TUBES (CNT)

The carbon nanotube is an allotrope of carbon. Allotropy is nothing but different structural modifications of an element. CNTs exhibition strange strong points and exclusive electrical properties, and are effective thermal conductors.
The paper battery based on carbon nanotube provides both long-term steady power production as well as bursts of energy. Because the paper battery based on carbon nanotube can function both as a high-energy battery and supercapacitor. Carbon nanotubes can be used as an anode for lithium-ion battery.

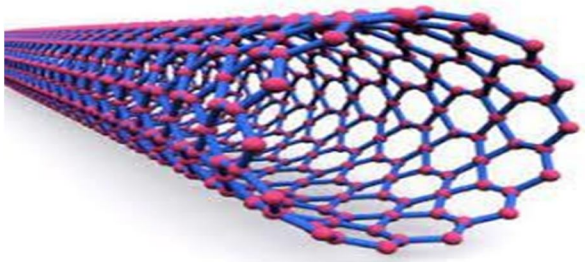

Figure-3: Carbon Nano tubes

VI. PAPER (CELLULOSE)

A cellulose-based paper is layered with black carbon ink and laminate thin film over the cellulose surface. Heat the cellulose paper for 5mins at 800C, then shell off the film from the substrate. The electrode of the paper battery is designed by the film. The electrolyte LTO and LCO are associated with changed films.
Cellulose is a compound biological substance create in a paper, which is not eatable by humans. The carbon nanotube is a very tiny cylinder formed from a single sheet of carbon atom rolled into a tiny cylinder. These are sturdier than steel and more leading than the best semiconductor. This grouping allows the battery to afford both long-term, steady power making and the burst of energy. A paper battery may be crumpled, cut, or shaped for different applications without any loss of integrity or efficiency.

Figure-4: Paper(Cellulose)

VII. CONTRUCTION

The major section used for the construction of paper battery contains:

1) *Step 1:* Black carbon ink is practical on cellulose-based paper.
2) *Step 2:* Black Carbon ink is animation spread on a paper spread on paper.
3) *Step 3:* A thin lithium film is covered over the uncovered cellulose surface.
4) *Step 4:* The cellulose paper is heated at 80oC for 5 minutes.
5) *Step 5:* Next, the film is skinned off from the substrate.
6) *Step 6:* The film acts as electrodes of the paper battery. One film is related to the electrolyte LTO (Li4Ti5012) and another film is pasted to the electrolyte LCO (LiCo02).
7) *Step 7:* Next, connect a LED on both ends of the battery and check its functionality.

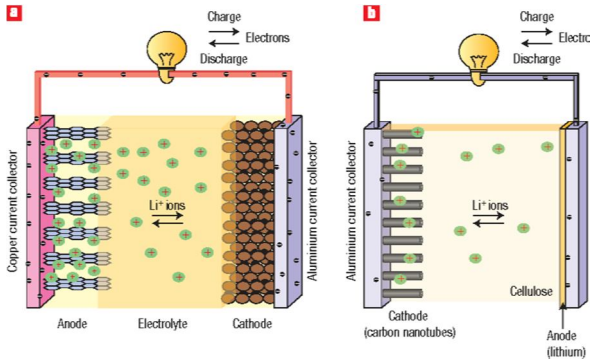

Figure-5: Schematic diagram of a paper battery

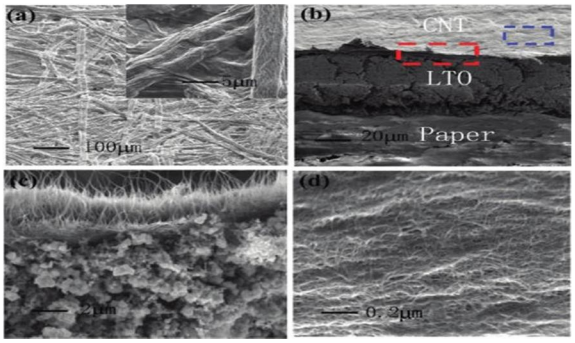

Figure-6: Microscopic View of the Layers

VIII. WORKING

The conservative rechargeable batteries which used in our day-to-day life contain several separating mechanisms which are used for making electron with the chemical reaction of a metal and electrolyte. If once the paper of the battery is curved in ion-based liquid, then the battery starts working i.e, electricity is generated by the program of the electron from cathode terminal to anode terminal. This is due to the chemical reaction between the electrodes of the paper battery and liquid, due to the fast flow of ions within the paper electrode throughout the recharging. If the anode terminal comes in contact with the cathode terminal, there will be no flow of current in the peripheral circuit. Thus, to avoid the short circuit between anode and cathode a barrier or centrifuge is wanted, which can be contented by the paper separator.

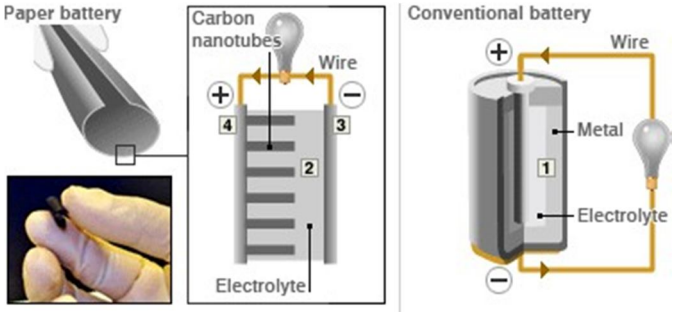

Figure-7: Working of paper battery

Six Important reasons how Paper Batteries are better than their Conventional Counterparts:

1) Paper batteries have a long-lasting time. They are non-toxic as they do not contain harmful chemical reactions.
2) They are stretchy and can be gathered or cut without any effect on their productivities.
3) This is because they are made up of materials like cellulose and carbon nanotubes which have a high tensile strong point.
4) They are not reusable as they are made up of cellulose which is biodegradable and non-toxic.
5) They can be used in exacting climate conditions like heat and cold. This is because the electrolyte does not involve water which makes the battery operation in the range of -73 to 149 degrees Celsius.
6) They operate carbon nanotubes, which are one of the most highly efficient conductors of electricity.

IX. APPLICATIONS

A. Smart cards and tags
B. Enhanced Printed Circuit Board (PCB)
C. Electronic games and entertainment devices
D. 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.
E. Automobiles and Aircraft: In Hybrid Car batteries, in Long Air Flights reducing Refueling, for Lightweight guided missiles, for powering electronic devices in Satellite programs.

X. ADVANTAGES OF PAPER BATTERY

A. Cell constituent of paper battery: cathode- carbon nanotube and anode- Li-ion while extra battery covers some hazardous components.
B. Specific heat of paper battery is low compared to other batteries.
C. It has a ledge life of three years under the dangerous condition it can operate within -750 C to +1500C.
D. Charging time of a battery is less associated to other.
E. Since it is very light in weight, it is moveable.
F. It's not exclusive compare to other batteries.
G. Important advantage of paper battery is, it can be recycled.

XI. DISADVANTAGES OF PAPER BATTERY

A. Due to low shear strong point these batteries can be uncertain easily.
B. Exclusive and less effective methods are used in the manufacturing of carbon nanotubes.
C. If panted it can also harm a human being.

XII. CONCLUSION

Science and knowledge create smart devices that have reduced human work. In those smart researches, Laptop plays the main role in day-to-day life. Thus, there is a need of studying moveable power banks for laptops. A paper battery is a kind of power source, which is good energy storage and manufacturing device, since, it is biodegradable, non-toxic, and recyclable, it can be used as a power bank for the laptop which is more flexible, low cost, and moveable.

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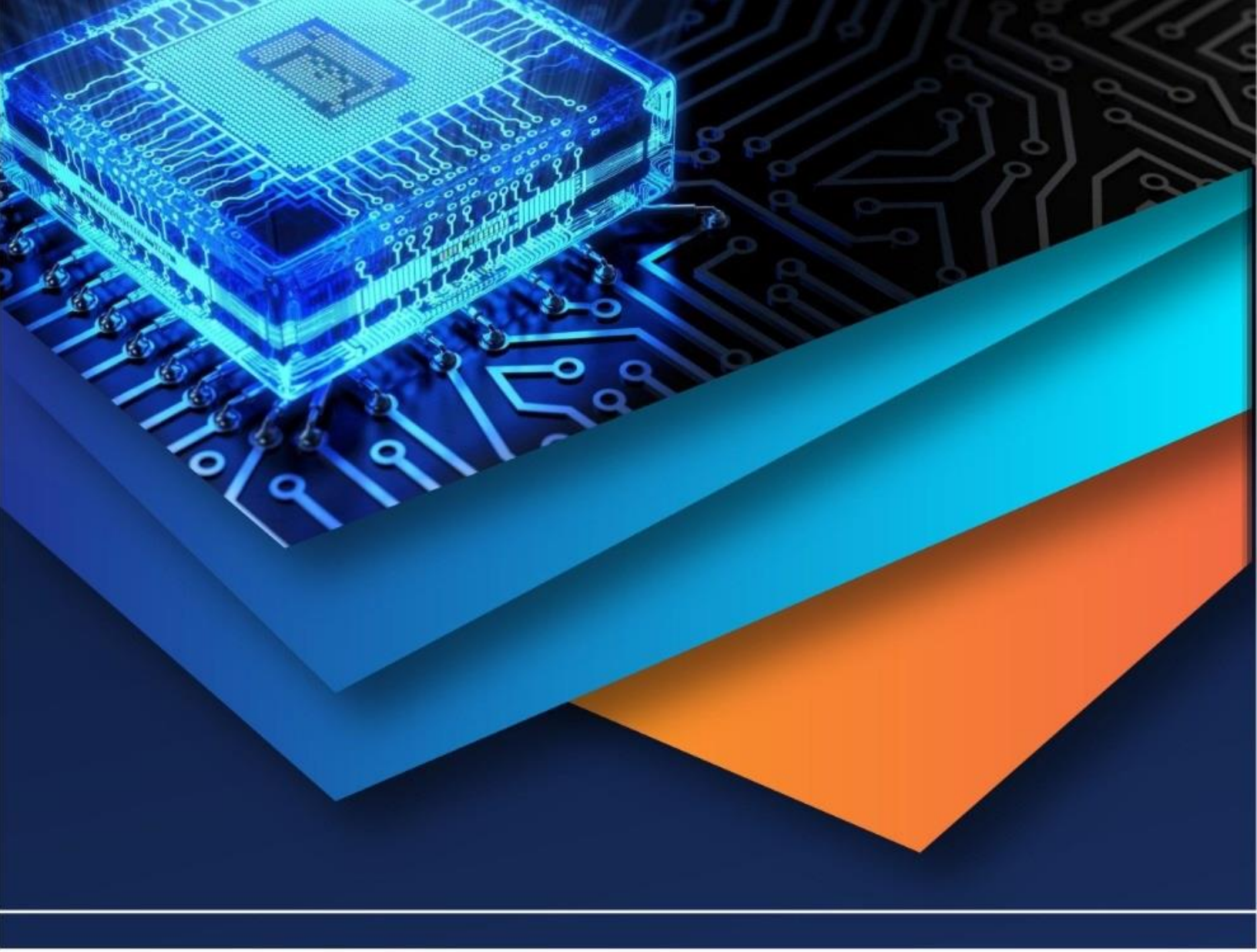

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