

POWER BANK FOR LAPTOP USING PAPER BATTERY

RASHMI RAGHAVENDRA GUDI¹

*1,Final year, Department of Electronic and Instrumentation Engineering
Basaveshwar Engineering College, Bagalkot, Karnataka, India - 587102*

Abstract - In fast growing technologies, research is made on smart portable devices such as smart phone, laptop, life saving equipment, aerospace and satellite. Smart phone and laptop made our life easy and comfortable. Now, the world without these device can not be imagined. Basic need of these device is battery, problem begins when their is need of recharging the battery. Recent research, made on portable charger for smart phone i.e. power bank which can be carried along with us to any location. To contribute more to science and technology, research on portable charger for all smart devices using paper battery. In this paper, research is made on power bank for the laptop using paper battery.

Key Words: Paper battery, Carbon nanotube, Cellulose.

1.INTRODUCTION

Recent development in the field of portable equipment have been the main driven force behind the search with the high energy density and form flexibility. There are varieties of batteries available, the most well know is lithium batteries because of it has low discharge potential, high energy density and the highest theoretical charge capacity of all commercial rechargeable batteries. Due to this silicon is an attractive anode material for lithium batteries. Si bulk film and micrometer sized particle were used as the electrode in lithium batteries have shown capacity fading and short battery life time due to pulverization and loss of electrical constant between the active material and the current collector, result in the poor transport of electron[1]. Cellulose whiskers, a name that refers to the needle like structure of the crystallite, were separated from various source such as wheat straw and tunicin, and were used as reinforcement in polymer matrices. Cellulose are the most abundant renewable polymer in the world, using these crystallites as a reinforcement in Nano-composite has a numerous advantages. Several studies have been reported where cellulose crystallites were identified and separated from various source[2]. Carbon nanotube, originally discovered as the by-product of fullerene research, are attracting increasing interest as constituents of nanoscale material and device structure. Mechanical, electrical and magnetic properties that are in the principle tunable by varying the diameter, number of concentric shell and chirality of the tube, the use of the nanotube as practical material will require the

elimination of defect and other reaction products, production in high yield and synthetic control of tube diameter and length[3]. Even thou the lithium batteries are most used in commercial, there are some disadvantages that need to be balanced against the benefits, firstly, protection required - lithium icon cells and batteries are not robust as some other rechargeable technologies, they require protection from being over charged and discharged too far. Secondly, they need to have the current maintained within safe limits. Thirdly, they suffer from ageing. In 1991, the discovery of carbon nanotube opened up a new era in materials science. A carbon nanotube(CNT) is a tube shaped material, made up of carbon, having a diameter measuring on the nanometer scale. Carbon nanostructure are tremendous interest from both a fundamental and an applied perspective. The application investigated include using carbon nanotube as an anode for lithium batteries, however, limited research work has been done on fabrication and evaluation of a "free standing" carbon nanotube paper electrode without any electrode substrate that is produced with simple filtration method via positive pressure[4]. They are normally categorized as single walled nanotube(SWNT), double walled nanotube(DWNT) and multi walled nanotube(MWNT). Single walled nanotube are paper have been synthesized by simple filtration method via positive pressure. Despite all the research done on CNT, scientist still don't understand exactly how it work and the process is relatively to produce the nanotubes. Composite material consisting of carbon nanotube combined with cellulose paper have been developed. Because of their excellent electrical and anti-corrosive properties, CNT's are useful particularly in electrical and electronic application. CNT is mixed with cellulose to form paper, as an alternative of making the CNT based sheets, were also reported. Incorporating CNTs was also found to strengthen physical properties of the cellulose paper such as its tensile strength and stiffness. Large sheets of the CNT/cellulose paper with the thickness of 0.45mm and width of 50cm were produced using a mass production line[5].

Laptop is device that is portable and suitable for use while travelling or laptop is often called a notebook which is small and portable. Laptop includes 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 efficient and reliable with high power density, low cost, low volume and weight. The charging time and battery life are linked to the characteristic of the battery charger. The average life of a laptop battery can be anywhere between one to six hour depending on the batter usage. The three main type of batteries used in modern laptop are NiMH, Li-ion, LiPo[6]. Problem arises when laptop must be charged while travelling, where their is no availability of socket to charge or if their is no electricity which results in shut down of system. To over come this problem, idea is to invent the portable power bank for laptops using paper battery. Scientist at Stanford university in California have successfully turned paper coated with ink made of silver and carbon Nano material into a “paper battery”. The creation of the paper battery drew from a diverse pool of disciplines, requiring expertise in materials science, energy storage and chemistry[7].

2. PAPER BATTERY

A paper battery is a flexible, ultra thin energy storage and production device formed by combination carbon nanotube with a conventional sheet of cellulose based paper as shown in fig.1. A paper battery act as both a high energy battery and super capacitor, combining two component that are separate in traditional electronics.



Fig-1: Paper battery

3. COMPONENTS

Various component required for the power bank for laptop:

Paper battery: As discussed above it is a flexible, ultra thin energy storage and production device. Each sheet of paper battery generate about 2.4V with a power density of about 0.6mA/cm². The sheet can be expanded to larger area. For higher voltage, paper can be stacked.

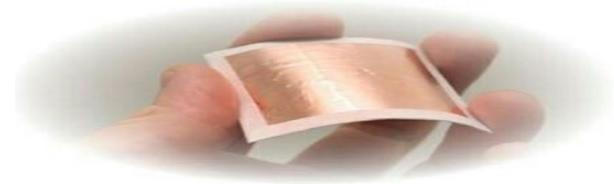


Fig-2: Paper battery

IC-7806: 7806 is a voltage regulator integrated circuit. It provide +6V regulated power supply. Capacitor of suitable values can be connected at input and output pins depending upon the respective voltage level.

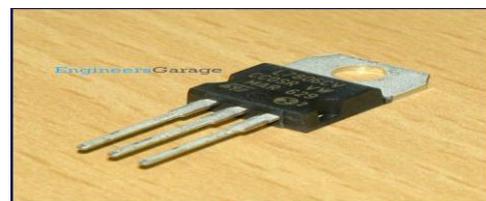
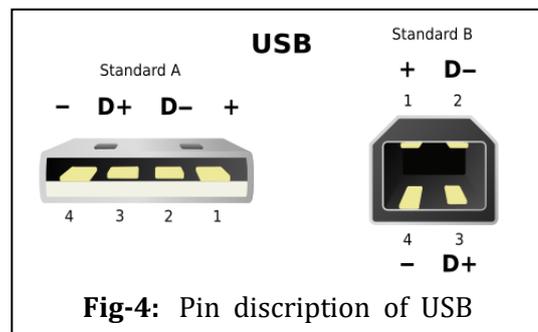
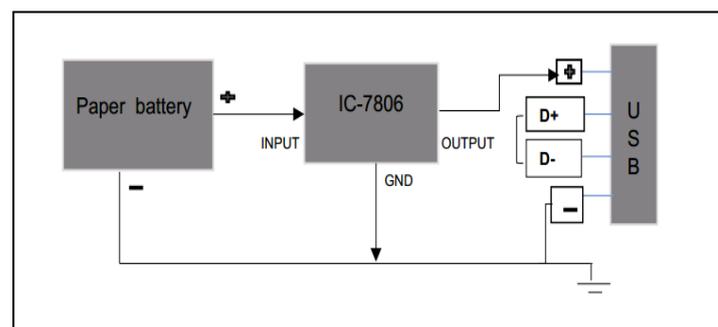


Fig-3: IC-7806

Universal serial bus(USB): It is an industrial standard that defines cables, connector, and communication protocols for connection, communication and power supply between devices .



4. BLOCK DIAGRAM OF POWER BANK FOR LAPTOP



5. CONSTRUCTION

The major component used for the construction of paper battery include:

1. Carbon nanotube used for cathode terminal
2. Lithium metal(Li+) used for anode terminal
3. Different type of electrolyte that include blood, urine, and sweat(which are termed as bio electrolytes)
4. Paper(cellulose separator)

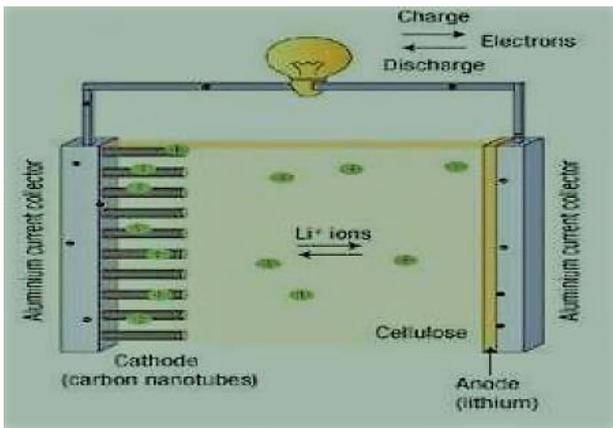


Fig-5: schematic of a paper battery

A cellulose based paper is coated with the black carbon ink and laminate thin film over the cellulose surface. Heat the cellulose paper for 5mins at 80°C, then peel off the film from the substrate. The electrode of paper battery are formed by film. The electrolyte LTO and LCO are connected to different films.

6. WORKING

The conventional rechargeable batteries which use in our day-to-day life consist of various separating components which are used for producing electron with the chemical reaction of a metal and electrolyte. If once the paper of the battery is dipped in ion-based liquid, then the battery starts working i.e, electricity is generated by the movement of electron from cathode terminal to anode terminal. This is due to the chemical reaction between the electrodes of paper battery and liquid. Due to the quick flow of ions within the paper electrode during the recharging. If the anode terminal comes in contact with the cathode terminal, there will be no flow of current in the external circuit. Thus, to avoid the short circuit between anode and cathode a barrier or separator is needed, which can be fulfilled by the paper separator.

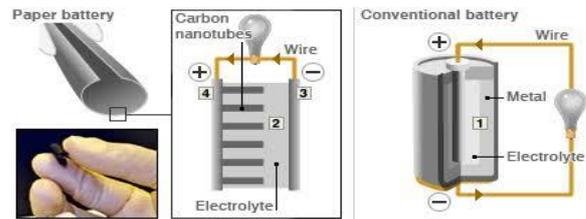


Fig-6: working of paper battery

Paper battery = cellulose paper + carbon nanotube

Cellulose is complex organic substance found in the paper, which is not digestible by human. Carbon nanotube is very tiny cylinder formed from a single sheet of carbon atom rolled into tiny cylinder. These are stronger than steel and more conducting than the best semiconductor. This combination allows the battery to provide both long term, steady power production and burst of energy. Paper battery may be folded, cut or shaped for different application without any loss of integrity or efficiency.

7. ADVANTAGES OF POWER BANK

- 1] Cell component of paper battery: cathode- carbon nanotube and anode- Li-ion whereas other battery contain some hazardous components
- 2] Specific heat of paper battery is low compare to other batteries
- 3] It has a shelf life of three years, under extreme condition it can operate within -75°C to +150°C
- 4] Charging time of battery is less compared to other
- 5] Since it is very light in weight, it is portable
- 6] Its not expensive compare to other batteries
- 7] Important advantage of paper battery is, it can be recycled

8. CONCLUSION

Science and technology found smart devices that has reduced human work. In those smart researches, Laptop play major role in day-to-day life. Thus, their is necessity of researching on portable power bank for laptop. Paper battery is kind of power source, which is good energy storage and production device, Since, it is biodegradable, non-toxic and recyclable, it can be used as power bank for laptop which is more flexible, low cost and portable.

ACKNOWLEDGEMENT

I thank all the members who helped directly and indirectly for the completion of this technical paper.

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BIOGRAPHY

Rashmi Raghavendra Gudi is pursuing B.E Degree in Electronics and instrumentation engineering at Basaveshwar Engineering College, Bagalkot, Karnataka, India. Interested area- embedded system, control system, sensors and linear integrated circuits.