

A REVIEW PAPER ON Li-ION BATTERY

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Abstract – Lithium ion batteries are the most efficient batteries of modern world. They use Li-ions to work. Lithium ions move from cathode to anode and vice versa. Their movement creates free electrons. Movement of free electrons creates electric current at current collector. Stanley Whittingham of Exxon mobile discovered lithium batteries. Akira Yoshino of Meijo University in Nagoya proposed first prototype of Li-ion battery. As energy density of batteries increases these batteries require more safety mechanism. Li-ion battery requires low maintenance. At high voltage these batteries can be damaged and if we try to limit their voltage then their performance will be reduced. There are some limitations in Li-ion batteries which can be overcome by advancement in future technology.

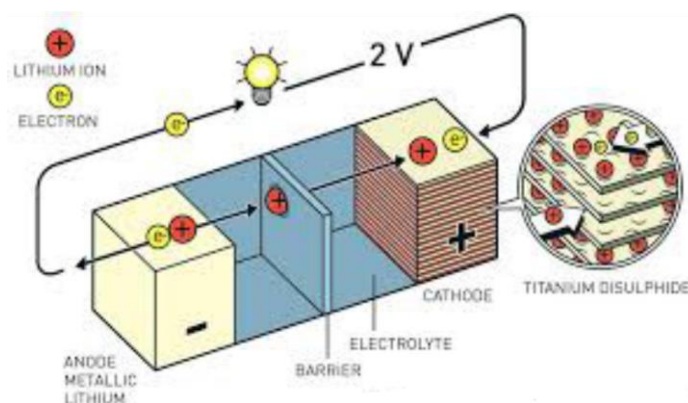
1. INTRODUCTION

A lithium ion battery is a battery which uses lithium ions to work. It is made up of cathode, anode, electrolyte, separator and positive and negative current collectors. Lithium ions move from cathode to anode. Positive charged lithium ions move from anode to cathode and vice versa through separator. Movement of lithium ions creates free electrons. Movement of free electrons creates charge at positive current collector. Electric current flows from positive current collector to negative current collector. Separator blocks flow of electrons inside battery.

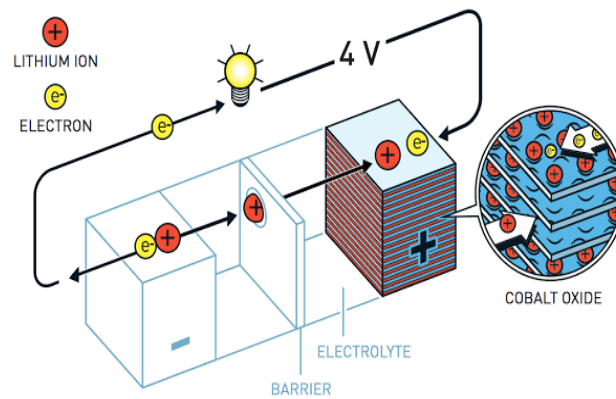
2. HISTORY OF Li-ION BATTERY

In 1970s, Stanley Whittingham of Exxon mobile started working on Exxon mobile. He decided to make a battery which can recharge in a short period of time. He used titanium disulphide and lithium metal as electrodes. This battery had serious safety issues that's why it short-circuited. Later in 1980s John B. Goodenough used lithium cobalt oxide as cathode. This doubled battery energy potential. He was an engineer professor at University of Texas at Austin. In 1985 Akira Yoshino used lithium metal as anode. He also used carbonaceous materials and petroleum coke. He was from Meijo University in Nagoya. All of them helped in discovering first Lithium-ion battery prototype.

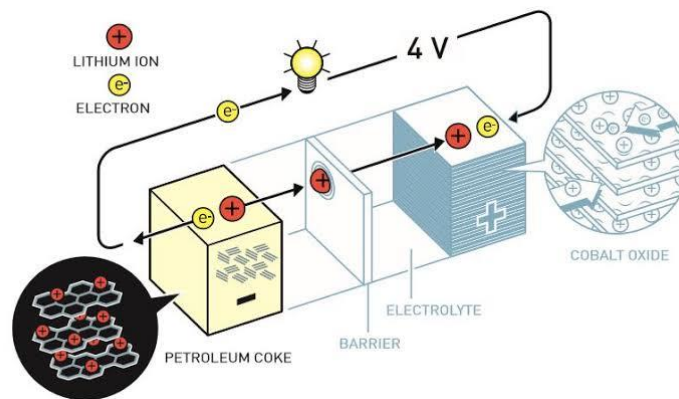
Stanley Whittingham Battery



John B. Goodenough Battery



Akira Yoshino Battery



3. COMPONENTS OF Li-ION BATTERY

The cathode is of lithium oxide coated on aluminum current collector. Anode is of carbon or graphite coated on copper current collector. A separator is used to block the electrons movement. Electrolyte is of lithium salt in an organic solvent.

3.1 Cathode

Lithium is an unstable element that's why we use it with oxygen in our cathode. Lithium oxide is used as cathode and it is also used as active material because it intervenes the chemical reaction at electrode. Lithium oxide, conductive additive and binder are coated over aluminum current collector. The conductive additive increase conductivity and binder acts as an adhesive which helps our active material to settle on aluminum substrate. High amount of lithium increases capacity of our battery and potential difference between cathode and anode, which also increases the voltage.

3.2 Anode

Anode also contains an active material. The active material helps in flowing electric current through the external circuit and allow the emission of lithium ions from cathode. Anode can be of graphite or carbon, which is coated by active material, conductive additive and a binder. Graphite is of stable structure and less reactive which helps in storing lithium ions without getting reacted with it.

3.3 Electrolyte

Electrolyte helps in movement of lithium ions from cathode and anode. It requires high conductive materials which helps in movement of lithium ions. Electrolyte is of salts, organic solvents and additives. Lithium hexafluorophosphate can be used as salt because of its temperature range and conductivity. Vinylene carbonate, sulphone and cyclic sulphate can be used as additives in lithium ion batteries. Salts helps in lithium ions movement, organic solvent helps in dissolving salt and additives are added for increasing graphite anode stability.

3.4 Separator

Separator helps in blocking movement of electrons. It acts as a barrier between cathode and anode. It only allows the flow of ions through its very small holes. Separator cells are made from polyolefin, which is created by polythene and polypropylene.

4. CHARGING AND DISCHARGING

During charging of battery, lithium ions are stored in anode, which are released from cathode. At discharge state when conduction wire connects the cathode, lithium ions flow back to cathode through electrolyte. Movement of lithium ions generate flow of electrons from one side to another. Electrons separated from lithium ions starts moving and generate electricity.

5. CONCLUSIONS

Li-ion batteries are great source of power. Their energy density is high compared to many other batteries. Li-ion batteries requires low maintenance. They have good battery life. They have self-discharge rate of 1.5-2% per month. They have toxic materials like cadmium which can dispose of the battery. Due to all these reasons Li-ion battery is preferred over Ni-Cd battery. There are some safety issues with li-ion batteries. These batteries are very expensive. They have overheat problems and can be damaged at high voltages. To overcome these problems we can give a limit to its voltage and use some safety mechanism in it but this can also reduce the performance of the battery. Li-ion batteries have some limitations which can be overcome by advancement in future technology.

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