Study on Discharge characteristics of the Lithium - Ion Battery

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Abstract **- This paper based on discharge characteristics of the Li-Ion battery under different discharging rates. Li-ion batteries with not only high power, high capacity, high charging rate, long life, but also dramatically improved safety performance and low cost. They are used for various applications such as energy storage, portable devices, electric vehicle and space equipment etc. In this paper, discharging voltage with respect to time is studied by experimentally and this discharge rate of battery use to achieve the actual power requirements.**

Index Terms **- Lithium – Ion battery, Discharge rate, Voltage, Time, Power, Multimeter etc.**

I.INTRODUCTION

Lithium – Ion batteries are proven for high energy density and good power output capacity. Li – ion batteries are the powerhouse for the digital electronic revolution in this modern mobile society, exclusively used in mobile phones and laptop computers. In 1980s attempts to develop rechargeable lithium batteries followed but the endeavor failed because of instabilities in the metallic lithium used as anode material. Lithium is the lightest of all metals, has the greatest electrochemical potential and provides the largest specific energy per weight. Rechargeable batteries with lithium metal on anode could provide extraordinarily high energy densities, however cycling produced unwanted dendrites on the anode that could penetrate the separator and cause an electrical short. The cell temperature would rise quickly and approaches the melting point of lithium causing thermal runaway also known as “venting with flame” When the cell charges and discharges, ions shuttle between cathode and anode. On discharge, the anode undergoes oxidation, or loss of electrons and the cathode sees a reduction or a gain of electrons. Charge reverses the movement. All materials in a battery possess a theoretical specific energy and the key to high capacity and superior power delivery lies primarily in the cathode. For last 10 years the cathode has characterised the Li-ion battery. Mixing cathode and anode material allows manufacturers to strengthen intrinsic qualities, however an enhancement in one area may compromise something else.

This paper mainly studies the performance changes of lithium-ion battery packs under different discharging rates. This experiments at different magnifications are used to obtain the parameter curves that characterize their state changes, thus provide a theoretical basis for the effective and safe use of lithium battery.

II. EXPERIMENTAL PROCEDURE

1. Connect cell across battery holder. Connect positive and negative cable across the battery holder.
2. Charge battery at 0.5C i.e. at 1.25A by keeping charger voltage 4.2V
3. After full charge of battery, connect battery across rheostat. Set rheostat resistance according to current required.
4. Discharge battery for different current i.e. at different C rating.
5. Draw a graph of voltage and time.

Factor	Parameters
Rated voltage (V)	3.7
Maximum voltage(V)	4.2
Minimum voltage (V)	2.8
Rated capacity (Ah)	5
Discharge cut-off voltage (V)	3
Working temperature range (°C)	25 - 50

Table.1 - Basic technical parameters of 18650 lithium battery (cell)

III. DISCHARGING CHARACTERISTICS OF DIFFERENT RATE

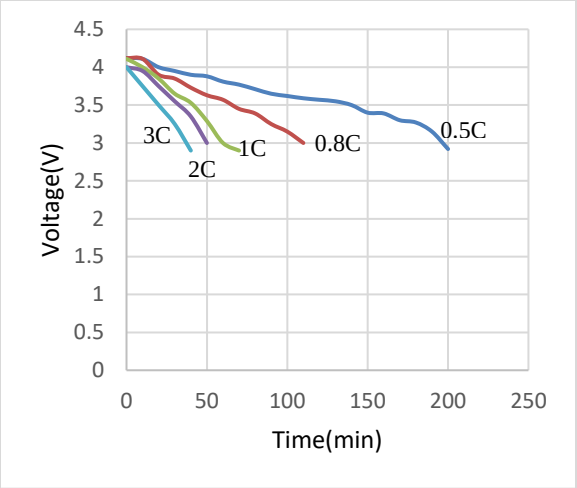

Fig.1 - Change of battery voltage with time at different discharge rate

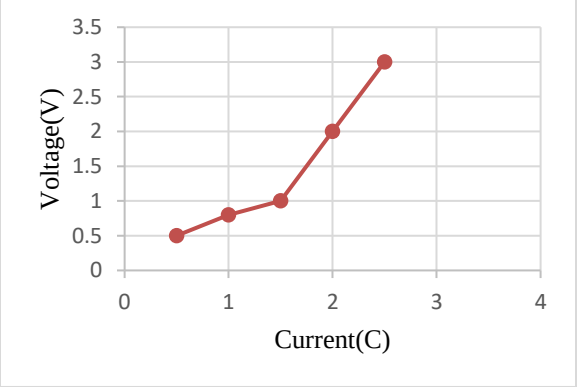

Fig.2 - Variation of voltage recovery with discharge rate

As shown in Fig.1, lithium battery cell is drawn through experimental data to draw the curve of battery voltage changing with time at different discharge rates in the discharge process.

Due to the influence of the li-ion battery cell inconsistencies, a battery monomer to cut-off voltage in advance and make the battery voltage can't down to 2.8v, as shown in Fig.1, the voltage is greater than 2.8v voltage variation curve. Learning from the curve, the discharge inception voltage is affected by the charging differences and temperature, in the process of discharge of the lithium battery cell, the discharge current ratio, the greater the battery faster to set the default of electric discharge by the voltage, and reaches the cut-off voltage value, the smaller the discharge end because of the ohm internal resistance under different discharge rate and polarization resistance, the influence of the size of the voltage recovery also has bigger difference.

Fig.2 is the relationship between the voltage recovery of the li-ion battery and the discharge rate after an hour after discharge. Fig.2 illustrates the battery discharge after the electricity, the ohmic resistance and the polarization resistance caused by voltage recovery are positively correlated with the charging current rate, the growth trend along with the increase of current ratio gradually flatten out.

IV. CONCLUSIONS

By detecting in non-charging and discharging rate, lithium-ion battery discharge curves of voltage and the voltage change on stand for an hour after charging and discharging, this paper analyzed the relation between discharge rate and lithium battery properties. In the discharge process, can use large rate discharge current that the battery could be withstood to achieve the actual power requirements.

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