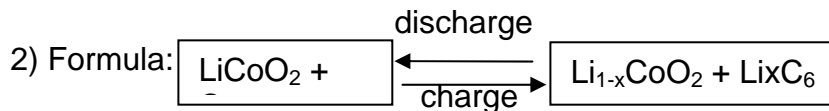


## Lesson on Li-ion Batteries

### 1. About Li-ion Batteries

1) Full Name: Li-ion Rechargeable Battery



Notes:

- 1)  $\text{LiCoO}_2$  is the main material at anode and  $\text{C}_6$  is the material at cathode.
- 2) To charge and discharge the battery is to have the  $\text{Li}^+$  come in or come out of the cathode, so li-ion battery is nicknamed "Rocking Chair Battery".

### 2. Construction

Active materials at Anode + Active materials at Cathode + Insulator + Electrolyte + shape

1) Main material at Anode

- a.  $\text{LiCoO}_2$  (most common used)
- b.  $\text{LiMnO}_4$
- c.  $\text{LiFePO}_4$

2) Material at Cathode –  $\text{C}_6$

3) Insulator

There are 3 layers (PP + PE + PP) in total and the thickness is 20-25um.

4) Electrolyte – conductive liquid that allows the  $\text{Li}^+$  to move freely in and out of  $\text{C}_6$ .  
Commonly, the PH value is around 6.2

5) Shape

- a. Rectangular
- b. Cylindrical
- c. Button/Coin

### 3. Characteristics

1) Voltage

- a. Voltage for storage – 3.65V-3.90V, the best condition to store Li-ion battery is at 3.8V and charge the battery to half capacity.
- b. Operating voltage – 3.6V
- c. Maximum voltage for charging – 4.2V
- d. Minimum voltage for discharging – 2.75V

Notes:

- a. For energy type battery, the maximum discharging current is 2C. Only 85% - 92% of the voltage is available if a battery is discharged at 2C.
- b. Charging battery – The battery is charged to 4.2V at a constant current and then charged at IC at constant voltage, the whole process takes about 2.5 hours.
- c. Discharging battery – the battery is discharged at constant current to 2.75V. For energy type battery, the current is usually 0.2C, 1C or 2C, and for power type, it is usually 3C, 5C and 10C.

2) Internal Impedance

- a. When a PTC is added, the internal impedance of the battery increases.
- b. The impedance changes during different periods of charging.

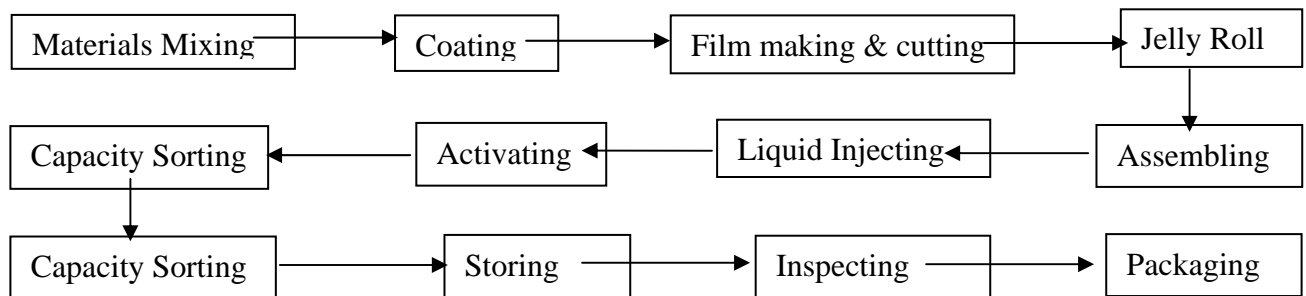
3) Capacity

- a. Formula – capacity (mAh) = Current (I) X Time (t)
- b. Most Li-ion batteries can be used for about 300 cycles, after that the capacity goes down to 80% and less of its initial and the battery is considered as “no use”.

4) Life

The number of charge/discharge cycles that the battery can be recharged to at least 80% of the stated capacity. Normally, the life should be more than 300 cycles.

**4. Production Process**



**5. Information needed for an inquiry**

- 1) Operating current
- 2) Operating voltage
- 3) Operating temperature
- 4) Working time
- 5) Dimensions (Space available in the device to be powered, for battery or battery pack)