

BASIC CHARACTERISTICS OF LITHIUM-ION BATTERIES

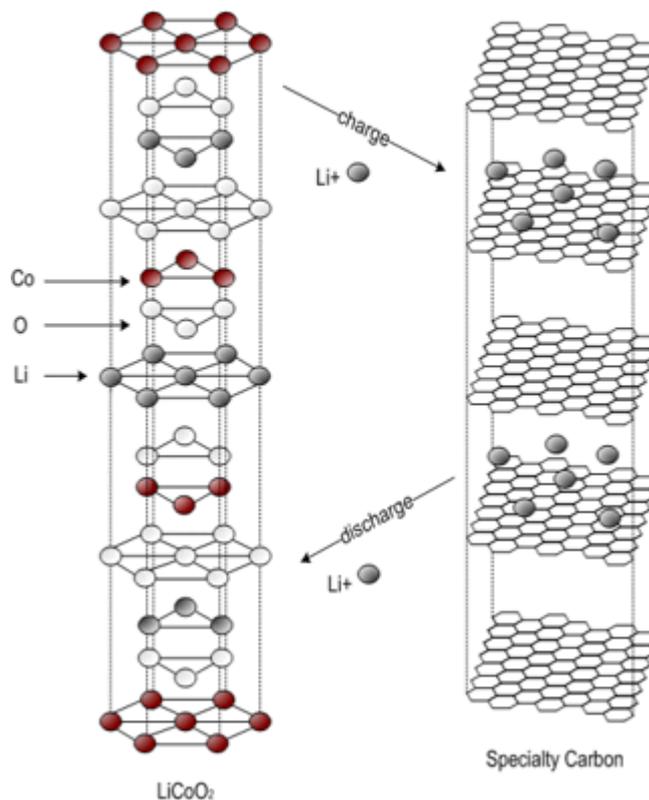
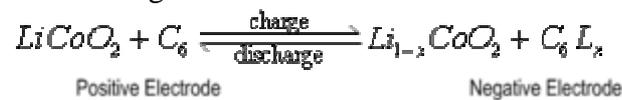
CHEMISTRY PRINCIPLE

Li-ion battery contains lithium oxide instead of metal lithium. It makes use of lithium cobalt oxide as the positive electrode and specialty carbon as the negative electrode.

Only lithium ions move between the positive and the negative poles. The ions are ionized from positive material and move to the negative electrode during charge.

During discharge, the ions move to the positive electrode and return to the original compound.

The reaction for charge and discharge are shown as below:



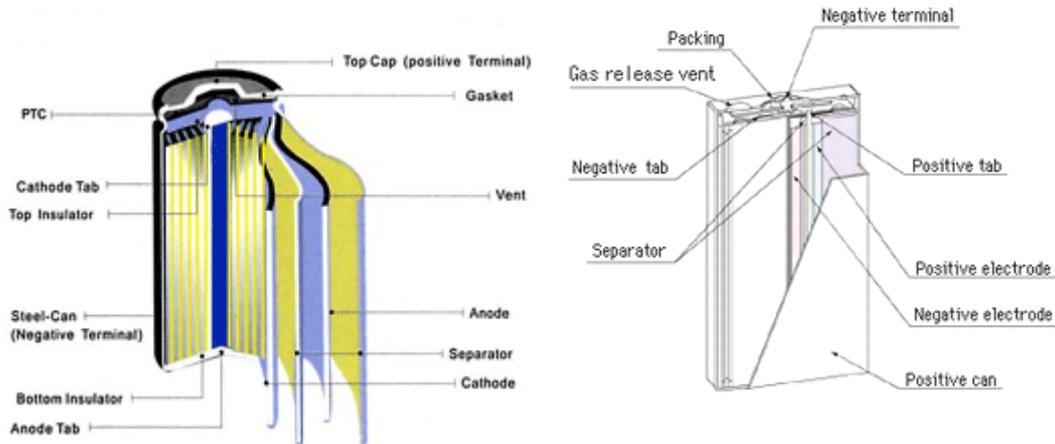
Cylindrical Chemical Reaction of Lithium Ion Battery & Prismatic Lithium-Ion Cell

STRUCTURE OF LITHIUM-ION CELLS

Li-Ion cell has a three layer structure. A positive electrode plate (made with Lithium Cobalt oxide - cathode), a negative electrode plate (made with specialty carbon - anode) and a separator layer.

Inside the battery also exists an electrolyte which is a lithium salt in an organic solvent.

Li-Ion is also equipped with a variety of safety measures and protective electronics and/or fuses to prevent reverse polarity, over voltage and over heating and also have a pressure release valve and a safety vent to prevent battery from burst.

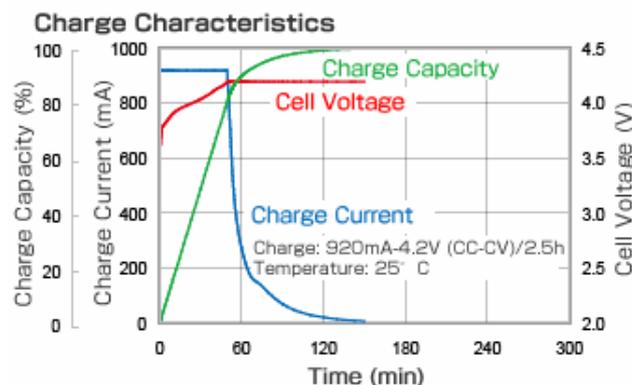


Schematic diagrams of the structure of cylindrical and prismatic lithium-ion cells

CHARGING OF LITHIUM-ION CELLS

Charging method that commonly used for charging of Lithium-Ion cells is constant current - constant voltage (CV-CC). This means charging with constant current until the 4.2V are reached by the cell (or 4.2V x the number of cells connected in series) and continuing with constant voltage until the current drops to zero.

The charge time depends on the charge level of the battery and varies from 2-4 hours for full charge. Also Li-Ion cannot fast charge as this will increase their temperature above limits. Charging time increases at lower temperatures.



Charge voltage – the maximum voltage is 4.2 V multiplied to the number of cells connected in pack

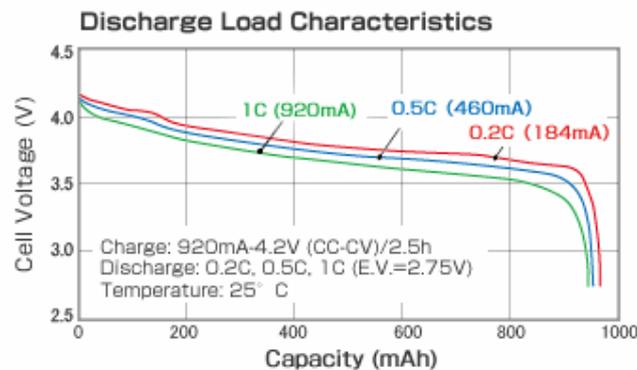
Charge Current – recommended 0.7 CmA, when voltage per cell should be 2.9V or less and charge current of 0.1 CmA or less.

Charge Temperature – range of battery charging temperature should be between 0°C to 45°C

Polarity Charging – we recommend verifying the polarity of the batteries before charging, due to Lithium-Ion batteries are never charged with the reversed polarity.

DISCHARGING OF LITHIUM-ION CELLS

To discharge Lithium-Ion batteries should be used the following method:

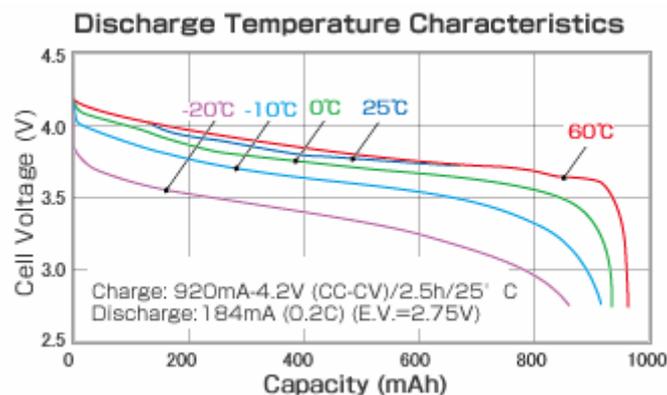


Discharge Termination voltage – we strongly recommended to avoid discharging at voltage less than 3.0V per cell. Due to overcharging can damage the performance of the Lithium-Ion battery. Our recommendation is to use discharge equipment with overcharge prevent mechanism.

Discharge Current – the current should be maintained at 1.0 CmA or less

Discharge Temperature – our recommendations for discharging of batteries are temperature range between -10°C to +60°C.

The following diagram is represented Lithium-Ion discharge Temperature Characteristics:



CAPACITY OF LITHIUM-ION CELLS

At a typical 100% charge level at 25 °C, Li-ion batteries irreversibly lose approximately 20% capacity per year from the time they are manufactured, even when unused. (6% at 0 °C, 20% at 25 °C, 35% at 40 °C). When stored at 40% charge level, these figures are reduced to 2%, 4%, 15% at 0 °C, 25 °C and 40 °C respectively. Every deep discharge cycle decreases their capacity also.

100 cycles leave the battery with about 75% to 85% of the original capacity. When used in notebook computers or cellular phones, this rate of deterioration means that after three to five years the battery will have capacities too low to be still usable.

* Provided information was based on the recommendations of batteries manufacturers