

# OVERVIEW OF LITHIUM ION BATTERIES

Meeting the Needs of Portable Electronic Devices:

## Lithium Ion Batteries



### • Overview

Panasonic lithium ion batteries, products of Panasonic's long experience with batteries and leading-edge battery technology, are excellent sources for high-energy power in a variety of portable devices, such as portable computers and cellular phones. Light weight and boasting high voltage ratings (3.6 V), these high-energy density batteries provide a variety of features that will contribute to the weight reduction and downsizing of portable products.

### • Structure

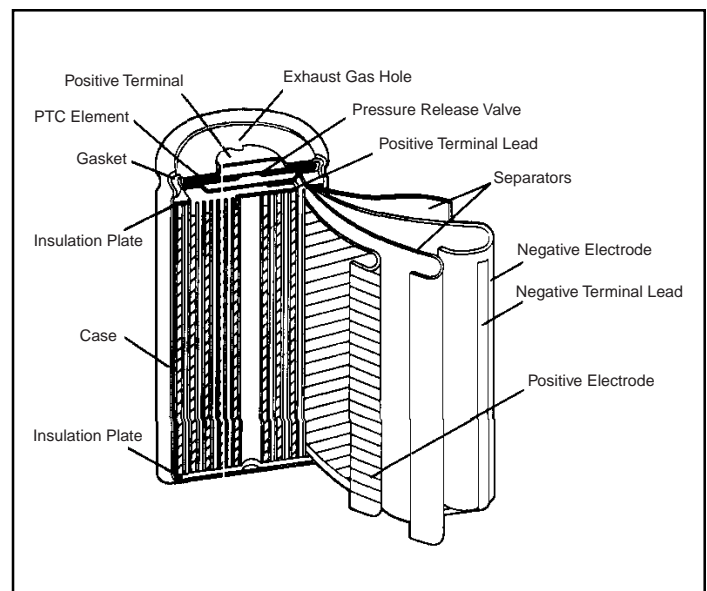
The lithium ion battery has a three-layer, coiled structure within its case. These three layers are comprised of a positive electrode plate (made with lithium cobalt oxide as its chief active ingredient), a negative electrode plate (made with a specialty carbon as its chief active ingredient), and a separator layer.

The battery is equipped with a variety of measures to insure safety, along with a pressure release valve that releases gas if the internal pressure exceeds a specific value, thereby preventing the battery from rupturing.

### • Safety (UL)

Panasonic's lithium ion batteries (CGR17500, CGR18650HG, CGR18650A, CGA533048, CGA633450A, CGA103450) have obtained UL1642 approval.

### The Structure of Lithium Ion Batteries (Cylindrical)

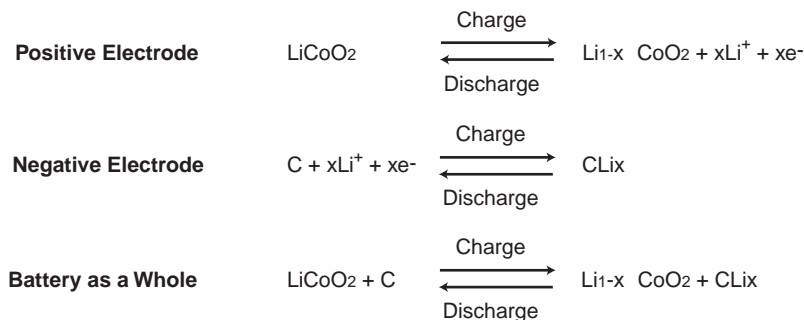


# OVERVIEW OF LITHIUM ION BATTERIES - CONTINUED

## • Battery Reaction

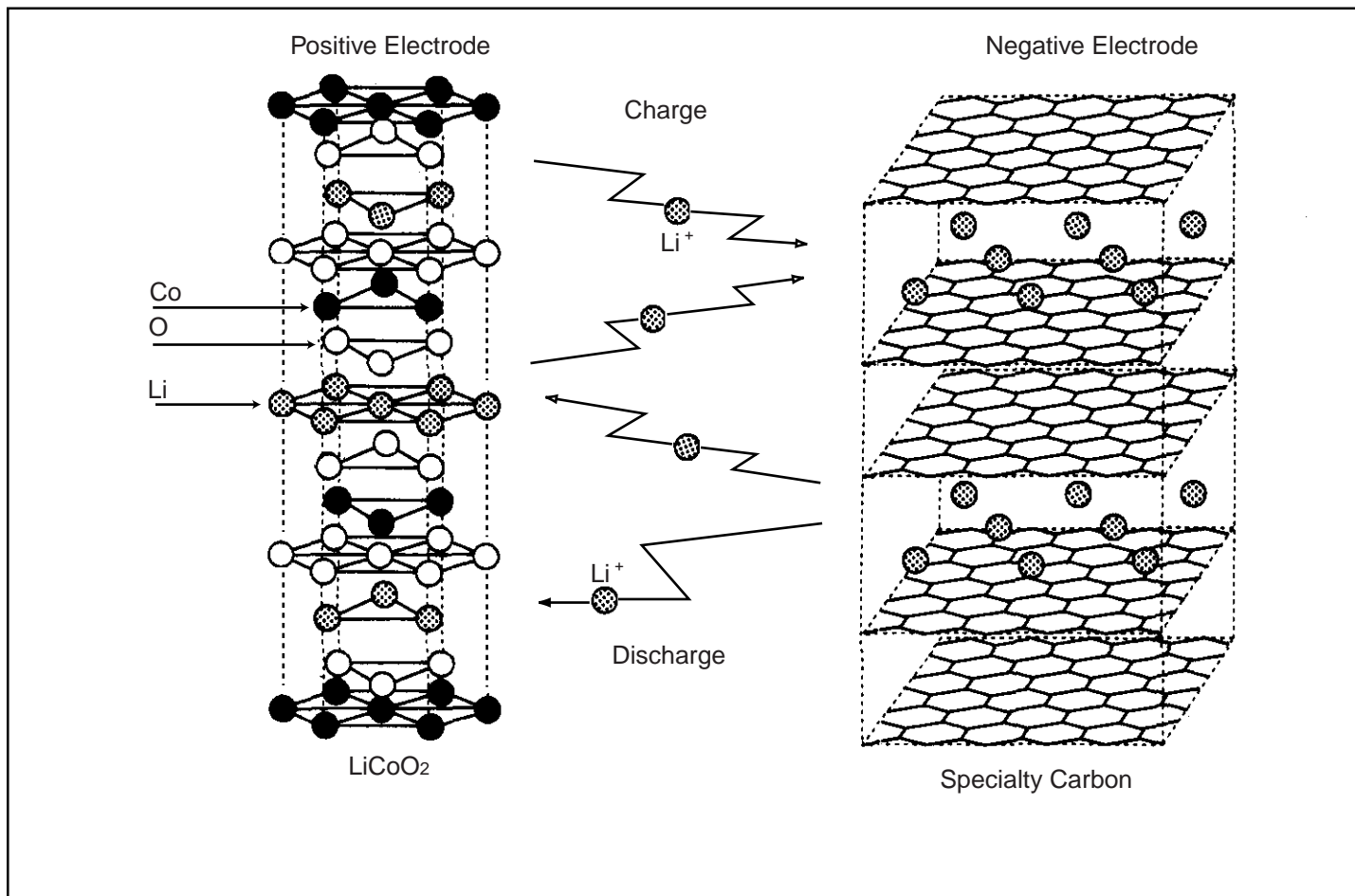
The lithium ion battery makes use of lithium cobalt oxide (which has superior cycling properties at high voltages) as the positive electrode and a highly-crystallized specialty carbon as the negative electrode. It uses an organic solvent, optimized for the specialty carbon, as the electrolytic fluid.

The chemical reactions for charge and discharge are as shown below:



The principle behind the chemical reaction in the lithium ion battery is one where the lithium in the positive electrode lithium cobalt oxide material is ionized during charge, and moves from layer to layer in the negative electrode. During discharge, the ions move to the positive electrode and return to the original compound.

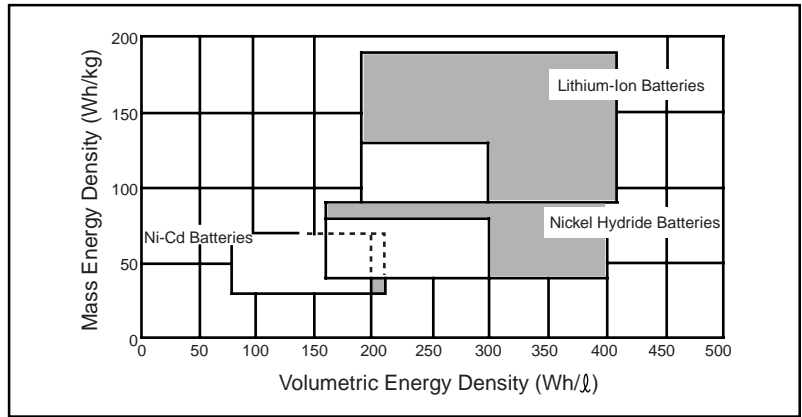
## Schematic Diagram of the Chemical Reaction of the Lithium Ion Battery



# FEATURES OF LITHIUM ION BATTERIES

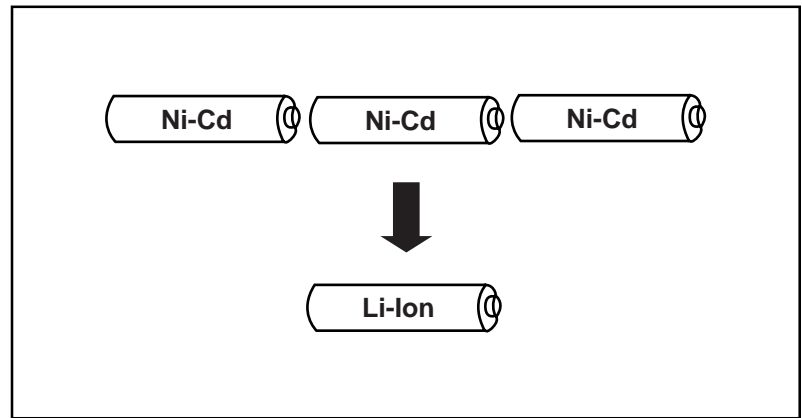
## • High Energy Density

Because the lithium ion batteries are high voltage/light weight batteries, they boast a higher energy density than rechargeable nickel cadmium (Ni-Cd) batteries or nickel metal hydride (Ni-MH) batteries.



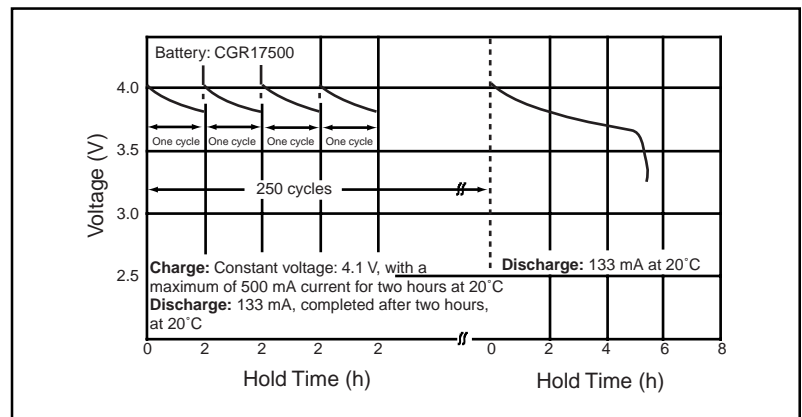
## • High Voltage

Lithium ion batteries produce 3.6 volts, approximately three times the voltage of rechargeable Ni-Cd batteries or Ni-MH batteries. This will make it possible to make smaller, lighter equipment.



## • No Memory Effect

Lithium ion batteries have none of the memory effects seen in rechargeable Ni-Cd batteries ("memory effect" refers to the phenomenon where the apparent discharge capacity of a battery is reduced when it is repetitively discharged incompletely and then recharged).



## • Flat Discharge Voltage

The use of the specialty carbon creates an extremely flat discharge voltage profile, allowing the production of stable power throughout the discharge period of the battery.

