

## NiMH Battery vs NiCd Battery

NiMH rechargeable battery is a technology extension of the reliable sealed NiCd battery. Absorb hydrogen instead of adopting metallic cadmium as negative as basic negative electrode. This kind of change improved the capacity of unit weight and unit volume (Calculate base on Ah, the terminology are weight ratio capacity and volume ratio capacity), no memory effect like NiCd battery, meanwhile no cadmium, removed the concerns of the metallic cadmium toxicity. In other aspects, NiMH battery are quite alike with NiCd battery. There are almost no difference on the application parameters, and no obvious design issue generated during the transaction from NiCd battery to NiMH battery.

## Li-ion Battery vs NiMH Battery

Generally, Lithium ion battery have below several chemistries:

**Lithium cobalt oxide (LiCoO):** Which offers high energy density but presents safety risks.

**Lithium nickel manages cobalt oxide (NMC):** offer good balance performance, good at high discharge current, such batteries are widely used for electric tools.

**Lithium manganese oxide (LMO):** Low cost, high power performance, but may suddenly fail, safety concern still exist, widely used in E-bike etc.

**Lithium iron phosphate (LFP):** Long cycle life, bad low temperature performance, difficult to control the consistency, less safety risk compared with other Lithium chemistry..

Lithium nickel cobalt aluminum oxide (NCA) and lithium titanate (LTO) are specialty designs aimed at particular niche roles.

The most widely used Lithium ion battery is LiCoO, Negative electrode material is carbon, generally it is graphite particles in layers or nano carbon. Electrolyte is carbonate ester organic material. Lithium ion battery has good performance of self discharge, no need maintenance after one year storage, less weight, smaller volume, so, it is taking most part in 3C market, including cell phone, digital camera, MP3/MP4, tablet PC, etc.. Positive electrode in LiCoO is strong reactant, when over discharge or at high voltage status, Lithium ion will penetrate the separator to negative electrode and form dendrites, which will cause short circuit, even explosion. When negative electrode of lithium ion battery exposed in water, it can catch fire, thus strict charge control need to be applied when charge lithium ion battery.

Since 2006, Lithium ion battery achieved great improvement on technology, new solution comes one by one. There are many measures adopted regard to the lithium ion battery safe issue, including use NMC and NCA materials to replace LiCoO, use Si, Sn materials in negative electrode, add flame retardant etc., however there are still reports of fire catching coming continuously on cell phone, notebook, even lithium ion EV, hence safety is still the most important concern.

Lithium ion Polymer battery electrochemical reaction are very similar to Li-ion battery, however colloid polymer are used in both electrodes and separators, many battery experts believe the adoption of colloid polymer is safer compared with liquid electrolyte, however there are no official safety report to prove this. Lithium ion polymer cell can be built in

various shapes, so it is widely used on PDA, MID, MP4. Nowadays, many of the so called Polymer are actually “soft packing” lithium ion batteries, as the electrolyte is still in liquid form.

Here below are the comparison between NiMH battery, NiCD battery and the most common lithium ion battery—LiCoO, other Li-ion chemistry may have different parameters.

Item	NiCD Battery	NiMH Battery	Li-ion Battery
Nominal Voltage	1.2V	1.2V	3.6V
Working Voltage wide	1.0-1.4V	1.0-1.4V	2.7-4.2V
Weight/Energy(Wh/kg)	60	107	150-158
Power density((Wh/L)	200	428	245-430
Deep cycle life(times)	500	500	500
Charging Temperature	0-45°C	0-45°C	0-45°C
Discharge temperature	-40-70°C	-40-70°C	-20-40°C
Discharge rate	1-20C	1-20C	1-5C
Fastest charge time	1hour (Special design)	15mins (Special design)	1 hour
Self discharge	20%/month	Standard:20-30%/months LSD:15-20%/year Super LSD:25%/3 years	6%/years
Memory effect	Yes	No	No
Environmental friendly or not	No, cadmium is toxic	Yes	Yes
Charge method	Constant current	Constant current multiple steps	Constant current + constant voltage

Be objectively, when weight is the key element to evaluate products performance and maintenance is available, Lithium ion battery is the best choice, while if need bigger rate discharge, better safety, reliable and economic, NiMH battery is the option.

All Lithium ion batteries need PCBA to protect over charge, high voltage, and over discharge etc. After long time storage at high temperature, Li-ion battery capacity may be unrecoverable; this is an element need to be considered when calculating projects cost and safety.