

As an expert buyer of tablet pc, you may need to understand the details of the materials that are used for li-ion battery. Different materials mean difference in cost, cycle life as well as safety.

Here is a table showing detail comparison among Li-ion Battery chemistries:

Cathode materials	LiCoO <sub>2</sub>	LiMn <sub>2</sub> O <sub>4</sub>	Li(NiCoMn)O <sub>2</sub>	LiFePO <sub>4</sub>
Reversible capacity (mAh/g)	140	100	150	145
Working voltage plateau (V)	3.7	3.8	3.6	3.2
Charge termination voltage (V)	4.25	4.35	4.3	4.2
Overcharge tolerance (V)	0.1	0.1	0.2	0.7
R.T. Cycle life (cycles)	400	300	400	1000
55 °C Cycle life (cycles)	300	100	300	800
Heat Flow by DSC (kJ/g)	650	150	600	10
Overcharge without PCB	4.9/3C Explosion	8V/3C Firing	8V/3C Firing	25V/3C Pass
Price (US\$/kg)	30	15	22	12
Battery energy density (Wh/kg)	180	100	170	130

1. Lithium cobalt oxide LiCoO<sub>2</sub> chemistry has been used for consumer electronics and digital applications, such as mobile phones and digital cameras, since 1993. LiCoO<sub>2</sub> battery offers very high energy density. However, this chemistry is not suitable to large format Lithium-ion Battery, because that LiCoO<sub>2</sub> material is very expensive and unsafe. The element of cobalt Co in lithium cobalt oxide LiCoO<sub>2</sub> is a precious metal with very limited resource in our planet. Its price has been increased all the time like petroleum. The crystal structure of LiCoO<sub>2</sub> is unstable during recharging process. Slight overcharge to LiCoO<sub>2</sub> would cause its structure collapse, resulting in firing and explosion. Therefore, LiCoO<sub>2</sub> battery can not be the universal solution for consumer electronics.
2. The chemistry of lithium manganese oxide LiMn<sub>2</sub>O<sub>4</sub> is not a good option for high-end consumer electronics, because of its poor cycle life, especially at elevated temperature.. In addition, the energy density of the battery with LiMn<sub>2</sub>O<sub>4</sub> chemistry is the lowest one among all lithium-ion batteries, about 100 Wh/kg, similar to that of Ni-MH battery. Therefore, there is no advantage to use this chemistry in high-end consumer electronics when cycle life is a priority.
3. New material of Li(NiCoMn)O<sub>2</sub> is a better candidate for large format lithium-ion battery. It is technically one kind of ternary( <http://en.wikipedia.org/wiki/Ternary> ). By using only one third of Co metal in the compound, its cost would be much lower than lithium cobalt oxide LiCoO<sub>2</sub>. Its safety is fairly good. By using Li(NiCoMn)O<sub>2</sub> chemistry. Battery makers can provide power packs having better performance, higher safety and lower prices.
4. Recently lithium iron phosphate LiFePO<sub>4</sub> has been becoming "best-choice" materials in commercial Li-ion Batteries for large capacity and high power applications, such as lap-top,

power tools, e-wheel chair, E-bicycles, e-car and e-bus. A LiFePO<sub>4</sub> battery has hybrid characters: as safe as lead-acid battery and as powerful as lithium ion cells, with lower cost. But its working voltage is as low as 3.2V, it is not suitable for consumer electronics like tablet pc.

All the above are technical information, what's the real materials used for the tablet pc in shipments ?

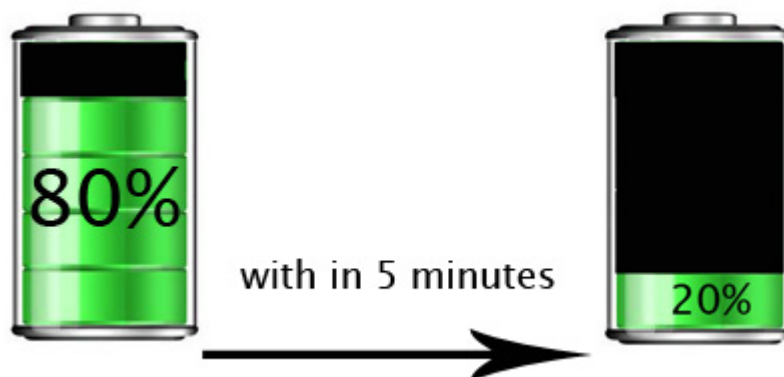
Generally, there are 4 types of combination for the materials discussed above, to make the li-ion batteries for tablet pc.

Let's call them A, B, C, A for LiCoO<sub>2</sub>, B for LiMn<sub>2</sub>O<sub>4</sub>, C for Li(NiCoMn)O<sub>2</sub>.

- 1#. A+B: considerations are cost, high battery capacity and smaller battery size;
- 2#. B+C: considerations are cost, compromising the circle life.
- 3#. A: for high capacity and small size, better circle life
- 4# B: for cost only.

Typical battery issues in tablet pc industry:

1. Why is the battery capacity drop from 80% to 20% just in 5 minutes ?



It is because the proportion of LiMn<sub>2</sub>O<sub>4</sub> is too high, while the compacted density of LiMn<sub>2</sub>O<sub>4</sub> is lowest in all the available materials. Normally, the discharge termination voltage should be 3.6V, while most of the tablet pc designers make it 3.2V, once the voltage drops down to 3.8V, the capacity between 3.8V and 3.2V is almost drained, that's why the indicator of the battery drops so quickly.

2. Why is there a bubble on the battery after just two months ?



Most of the tablet pc batteries have the built-in protection board to manage the charging and discharging, if this board is of poor quality or damaged, overcharging occurs then it will cause some bubble on the battery.

In the other hand, if the workmanship and the materials of the battery is not good enough, this defect happens as well.

### 3. Why do some tablet pc batteries explode ?



The following reasons may incur explosion of li-ion battery:

- overcharging for long time and multi-times, when the protection board is broken ;
- overheating, above 60 degrees for long time
- high pressure on the battery
- short-circuit when the protection board fails to work, discharging sharply also incurs explosion.