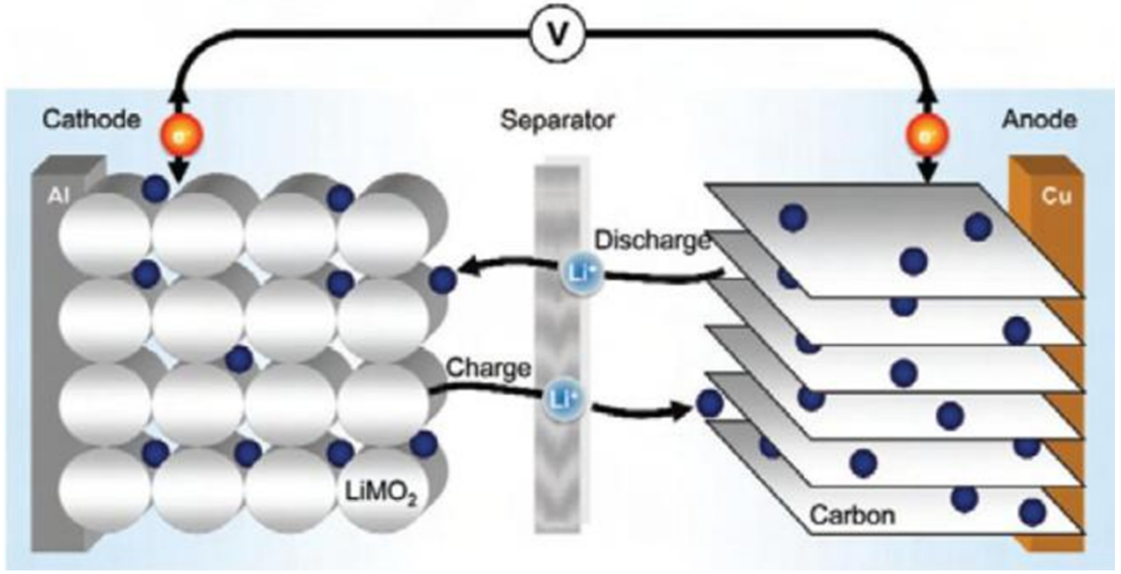
- **Disadvantages:**
- **Protection required:** Lithium ion cells and batteries are not as robust as some other rechargeable technologies. They require protection from being over charged and discharged too far.
- **Ageing:** Lithium ion batteries suffer from ageing. Often batteries will only be able to withstand 500–1000 charge discharge cycles before their capacity falls.
- **High Cost:** A major lithium ion battery disadvantage is their cost. Typically they are around 40% more costly to manufacture than Nickel cadmium cells.
- **Chances of explosion:**
  - **Bad design or manufacturing defects:** In that case, there wasn't enough space for the electrodes and separator in the battery. When the battery expanded a little as it charged, the electrodes bent and caused a short circuit.
  - **Overcharging:** When overcharged, lithium cobalt oxide releases oxygen which can react with flammable electrolyte leading to overheating.
  - **Electrolyte breakdown:** On overheating, Dimethyl carbonate decompose to form CO_2 which causes pressure build up in battery, resulting in a dangerous explosion.

- The anode of a Lithium-ion battery is composed of Lithium, dissolved as ions, into a carbon based electrode
- The cathode material is made up from Lithium liberating compounds, typically the three electro-active oxide materials, **Lithium Cobalt-oxide $LiCoO_2$, Lithium Manganese-oxide $LiMn_2O_4$, and Lithium Nickel-oxide $LiNiO_2$**
- Since lithium reacts violently with water, and the cell voltage is so high that water would decompose, a non-aqueous electrolyte must be used.
- A typical electrolyte is $LiPF_6$ dissolved in an ethylene carbonate and dimethyl carbonate mixture.



Electrode reactions

The positive electrode (cathode) half-reaction in the lithium-doped cobalt oxide substrate is:

$$\mathrm{CoO_2 + Li^+ + e^- \rightleftharpoons LiCoO_2}$$

The negative electrode (anode) half-reaction for the graphite is:

$$\mathrm{LiC_n \rightleftharpoons C_n + Li^+ + e^-}$$

The full reaction (left to right: discharging, right to left: charging) being:

$$\mathrm{LiC_n + CoO_2 \rightleftharpoons C_n + LiCoO_2}$$

- Anode here is a non-metallic compound, e.g. carbon, which can store and exchange lithium ions.
- A lithium ion-accepting material (Intercalation), for example CoO_2, is then used as the cathode material, and lithium ions are exchanged back (deintercalation) and forth between the two during discharging and charging. These are called intercalation electrodes.

Lithium-ion Polymer batteries

- Lithium-ion polymer batteries use Lithium-ion electrochemistry in a matrix of ion conductive polymers that eliminate free electrolyte within the cell.
- The electrolyte thus plasticises the polymer, producing a solid electrolyte that is safe and leak resistant.
- A polymer matrix, such as polyvinylidene fluoride (PVdF) or poly(acrylonitrile) (PAN), gelled with conventional salts and solvents, such as **$LiPF_6$** is used as the electrolyte
- These cells have not reached full commercialization and are still a topic of research