2. Zn-Air Battery, Lithium Batteries, Li-ion Battery

09 November 2023 10:06

MODERN BATTERIES

- Zn-air battery
- Li-ion battery

ZINC-AIR BATTERY

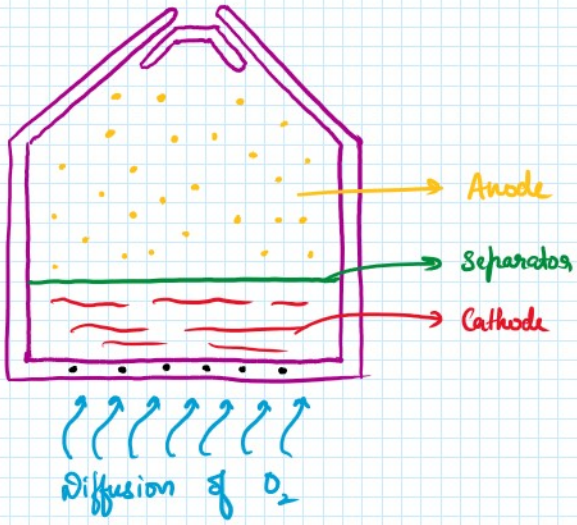
- Metal-air battery
- Depends upon atmospheric oxygen
- High energy density
- Long shelf life with sealed condition
- Small size

Anode: Zn granules + 30% KOH paste + gel with electrolyte → DOUBT

Cathode: C + MnO_2 catalyst + Teflon layer + permeable gas coated on Ni mesh
→ waterproof layer b/w air & electrolyte

Electrolyte: 30% KOH

Separator: Polypropylene soaked with electrolyte



EQUATIONS

Anode: $Zn \longrightarrow Zn^{2+} + 2e^-$

$Zn^{2+} + 2OH^- \longrightarrow ZnO + H_2O$

$Zn + 2OH^- \longrightarrow ZnO + H_2O + 2e^-$

Cathode: $H_2O + \frac{1}{2}O_2 + 2e^- \longrightarrow 2OH^-$

TOTAL: $Zn + \frac{1}{2}O_2 \longrightarrow ZnO$

Disadvantages

- Effect of CO_2

$CO_2 + KOH \longrightarrow K_2CO_3 + H_2O$

Applications

- Medical application
- Hearing aids
- Railway signals
- Remote communications

NOTE: Why Zn-air battery has high energy density

Cathode active material (O_2) is not stored inside the battery. It is collected from the atmosphere.

More O_2 ⟶ more cathode reaction

↓

more anode reaction

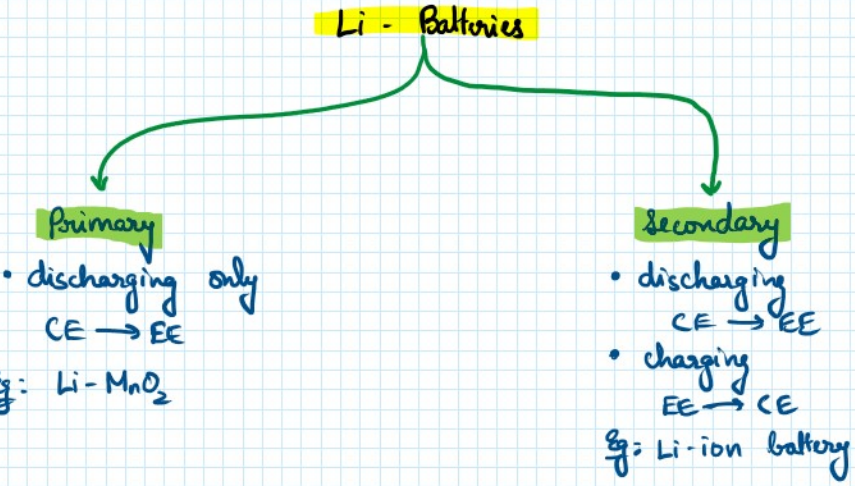
⇓

more energy density

LITHIUM BATTERIES

Why does Li act as an anode?

- Small size
- $E^\circ_{Li^+/Li} = -3.05\ V$ } Highly negative E° value
- 7g Li ⟶ 1F of charge } Small amount has high charge
- Produces 4V } DOUBT
- Li-ion batteries (-40°C to 70°C)
- Uses only organic, inorganic electrolytes
- Aqueous electrolyte ⟶ explosive



Li - MnO_2

Anode: Li

Cathode: MnO_2

Electrolyte: Organic compound w/ acrylonitrile

[OR]

Electrolyte: Organic compound w/ acrylonitrile
[OR]
Polypropylene carbonate w/ $LiClO_4$

Separator: Polypropylene

Advantages of Li batteries
- High energy density
- High cycle life

Disadvantages of Li batteries
- Highly reactive metal

Li-ION BATTERY
- High energy density
- High cycle life
- High electricity storage density
- High tolerance of service condition
- Temp: $-40°C$ to $70°C$

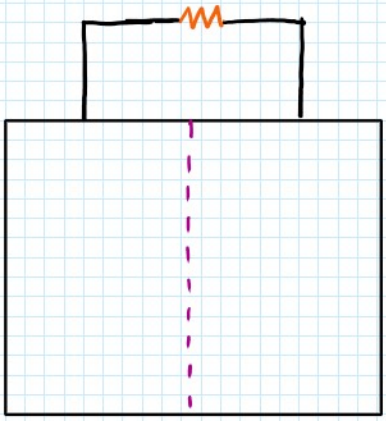
Anode: Graphitated Li (LiC_6) coated on Cu plate

Cathode: $LiCOO_2$ coated on Al plate

Electrolyte: Polypropylene carbonate (organic solvent) with $LiClO_4$

Separator: Polypropylene

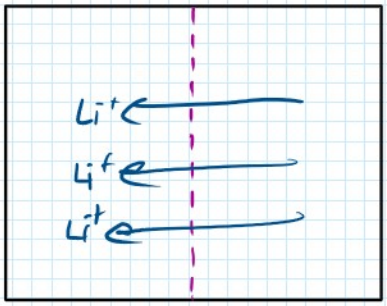
DISCHARGING



$x\,LiC_6$ $\quad Li_{(1-x)}COO_2$

Anode: $xLiC_6 \longrightarrow xLi^+ + xe^- + xC_6$

CHARGING



Anode: $LiCOO_2 \longrightarrow Li_{(1-x)}COO_2 + xLi^+ + xe^-$

Anode: $xLiC_6 \longrightarrow xLi^+ + xe^- + xC_6$

Cathode: $Li_{(1-x)}COO_2 + xLi^+ + xe^- \longrightarrow LiCOO_2$

Total: $xLiC_6 + Li_{(1-x)}COO_2 \longrightarrow LiCOO_2 + xC_6$

Anode: $LiCOO_2 \longrightarrow Li_{(1-x)}COO_2 + xLi^+ + xe^-$

Cathode: $xLi^+ + xe^- + xC_6 \longrightarrow xLiC_6$

Total: $LiCOO_2 + xC_6 \longrightarrow Li_{(1-x)}COO_2 + xLiC_6$

APPLICATIONS

- Mobile phones
- Electrical vehicles
- Laptops

DISADVANTAGES

- More reactive metal
- Explosive in nature
- Transportation is also difficult