ENGINEERING CHEMISTRY

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Energy storage devices - Batteries

Class content:

- ***Lithium - ion battery***
  - ***Construction***
  - ***Working***
  - ***Advantages***
  - ***Disadvantages***
  - ***Applications***

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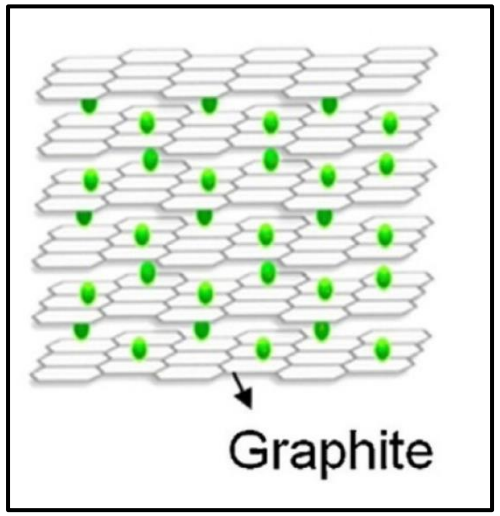
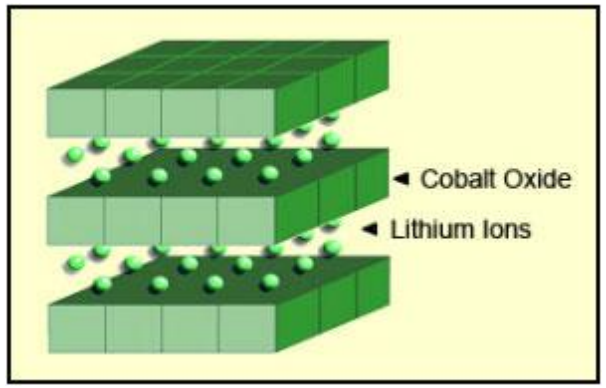
Lithium ion battery

Principle :

- Lithium ion moves from anode to cathode while discharging and from cathode to anode while charging
- Materials used as anode and cathode should be capable of lodging Lithium ions
- Anode material: **Lithiated graphite** Cathodic material : **$LiCoO_2$**



Source:https://www.jecst.org/journal/view.php?number=335&viewtype=pubreader



Source:https://batteryuniversity.com/learn/article/types_of_lithium_ion

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Lithium ion battery

Construction:

Anode: Lithiated -Carbon (Graphite) coated on Copper current collector

Cathode: Lithiated transition metal oxide coated on Aluminium current collector e.g. Lithium cobalt oxide($LiCoO_2$)

Electrolyte: The electrolyte is typically a mixture of organic carbonate solvents such as **ethylene carbonate or diethyl carbonate** containing **lithium salts like $LiPF_6$, $LiClO_4$**

Separator: It is a very thin sheet of micro perforated polypropylene membrane

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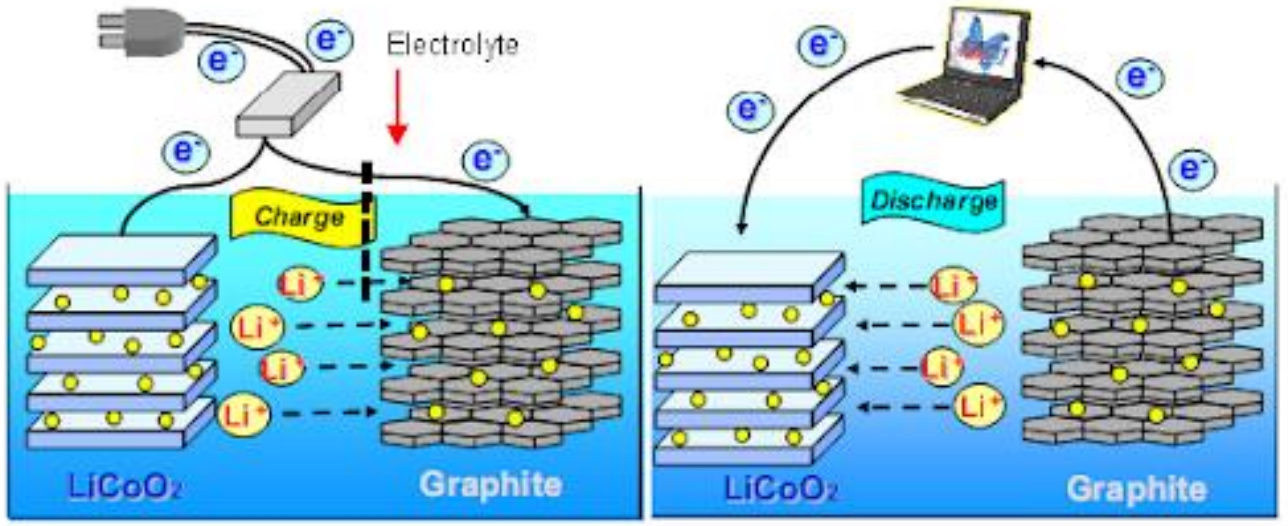
Working:

Charging **Discharging**



Source:http://www.ee.ui.ac.id/epes/research-group/energy-materials

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Reactions:

During Charging:

At Anode: $LiCoO_2 \rightarrow Li_{(1-x)}CoO_2 + xLi^+ + xe^-$

At Cathode: $xLi^+ + xe^- + xC_6 \rightarrow xLiC_6$

$$LiCoO_2 + xC_6 \rightarrow Li_{(1-x)}CoO_2 + xLiC_6$$

During Discharging :

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

At Cathode : $Li_{1-x}CoO_2 + xLi^+ + xe^- \longrightarrow LiCoO_2$

$$Li_{1-X}CoO_2 + xLiC_6 \longrightarrow LiCoO_2 + xC_6$$

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Advantages :

- Lighter than other rechargeable batteries for a given capacity
- Li-ion chemistry delivers a high open-circuit voltage 3.7 V
- Low self-discharge rate
- Do not suffer from battery memory effect
- Good cycle life as the problem of dendrite formation is eliminated(at no point, neither charging nor discharging, Lithium metal is formed)

Disadvantages :

- Rising internal resistance with cycling and age
- Safety concerns if overheated or overcharged

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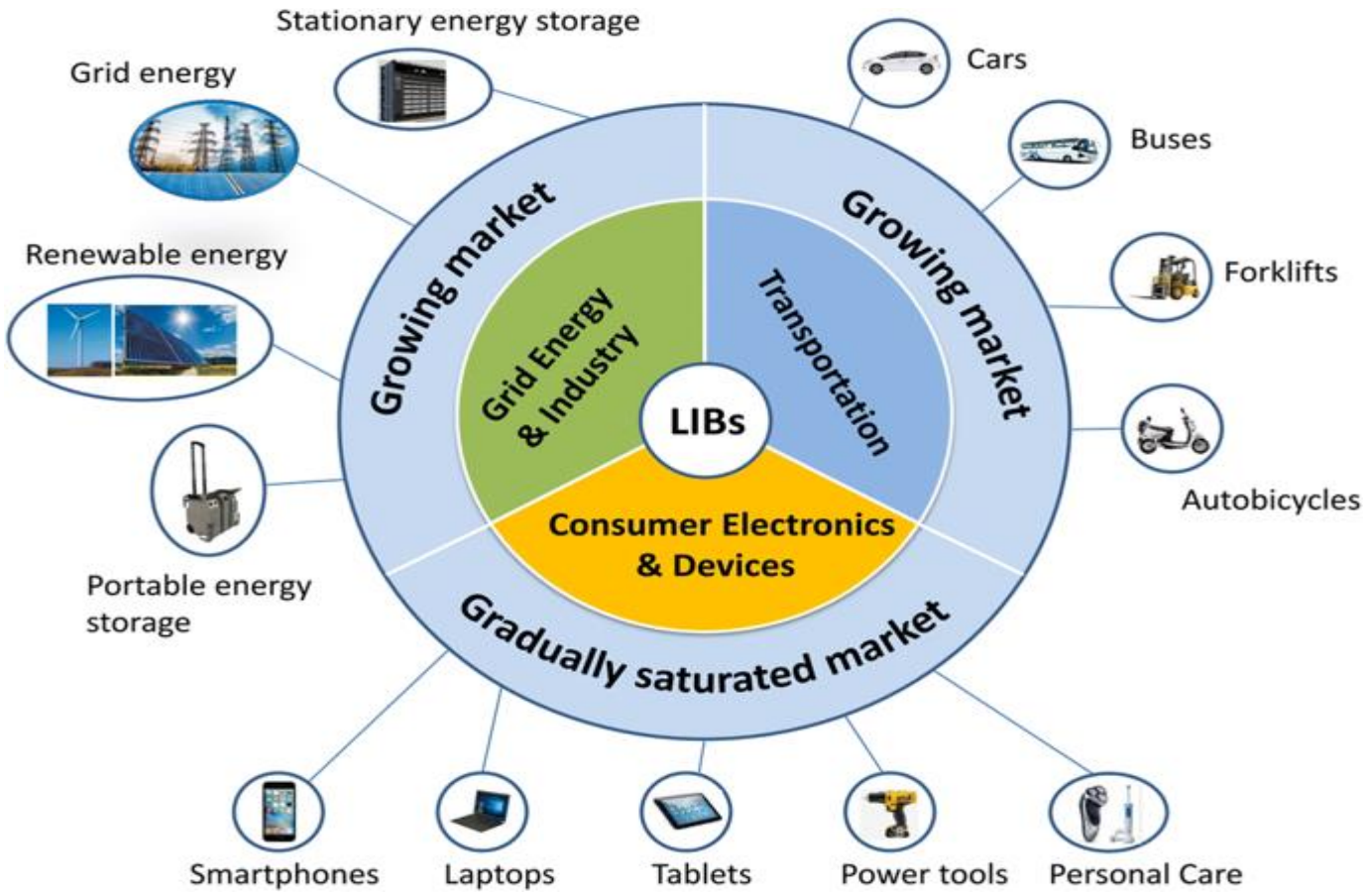

Source:Ding, Y. *et al. Electrochem. Energ. Rev.* **2,** 1–28 (2019).

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