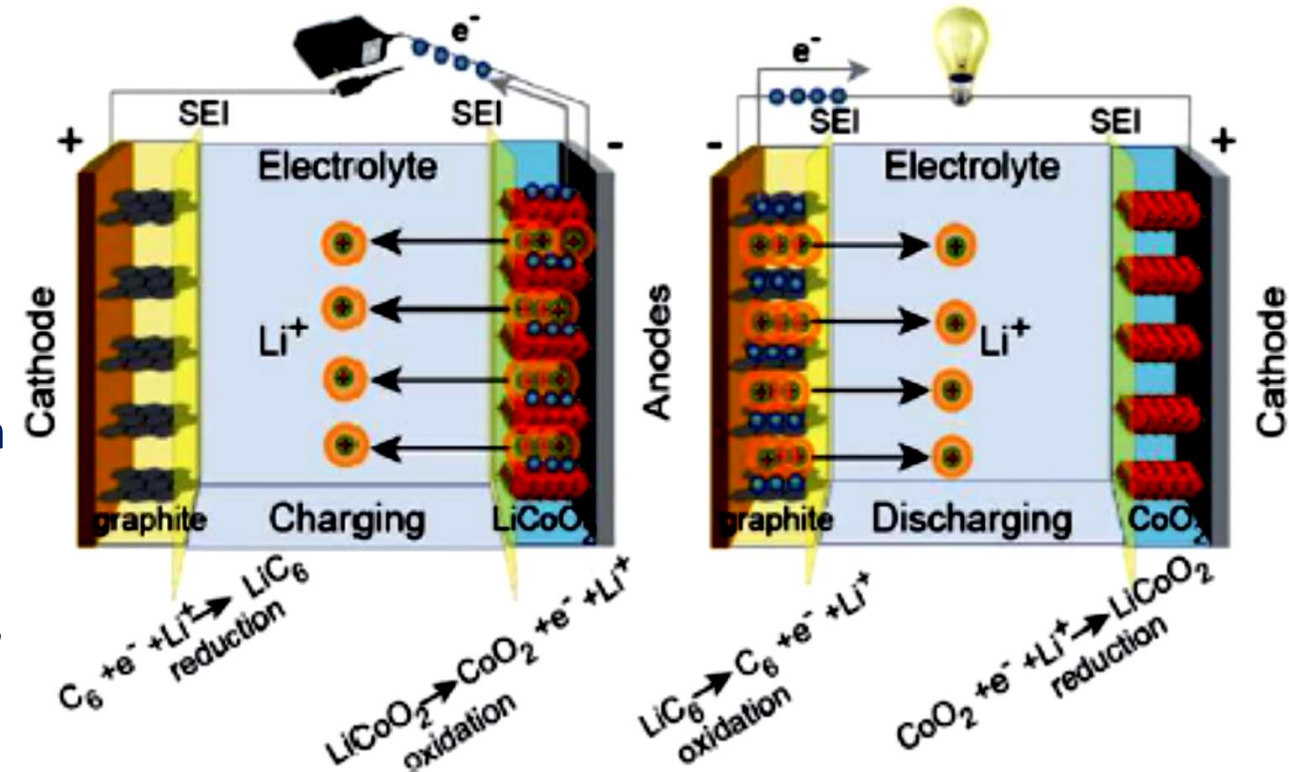
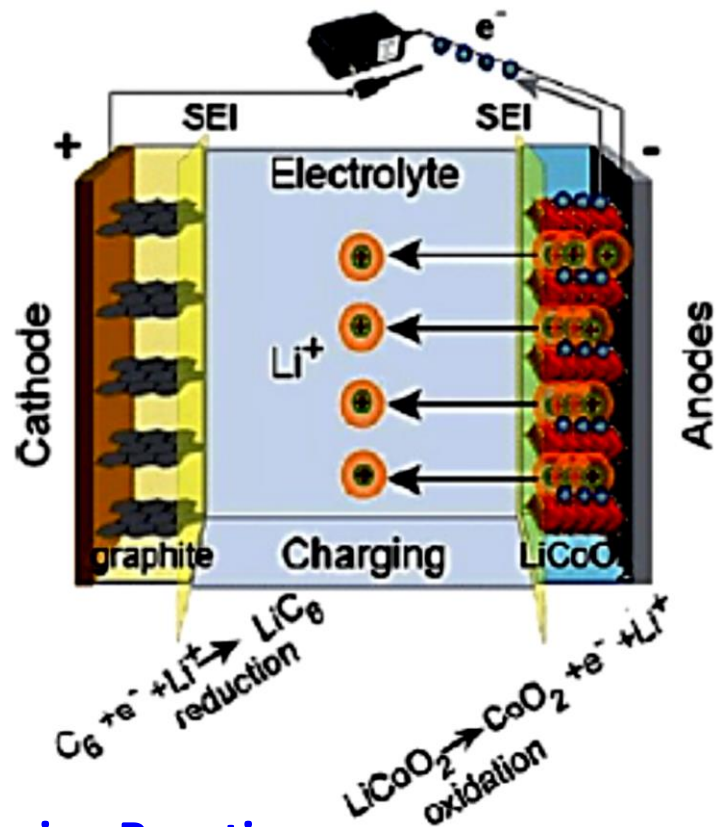


- Lithium-ion battery is a secondary battery, also known as **rocking chair battery**
- It does **not contain metallic lithium as anode**.
- The **movement of lithium ions** are responsible for charging & discharging.

- ⇒ **Electrode I:** Layers of lithium metal oxide (LiCoO_2 , LiNiO_2 and LiMn_2O_4)
- ⇒ **Electrode II:** Layers of porous carbon (graphite, usually with composition $\text{Li}_{0.5}\text{C}_6$)
- ⇒ **Electrolyte:** Polymer gel, organic liquid, gel, polymer and ceramic-solid electrolytes





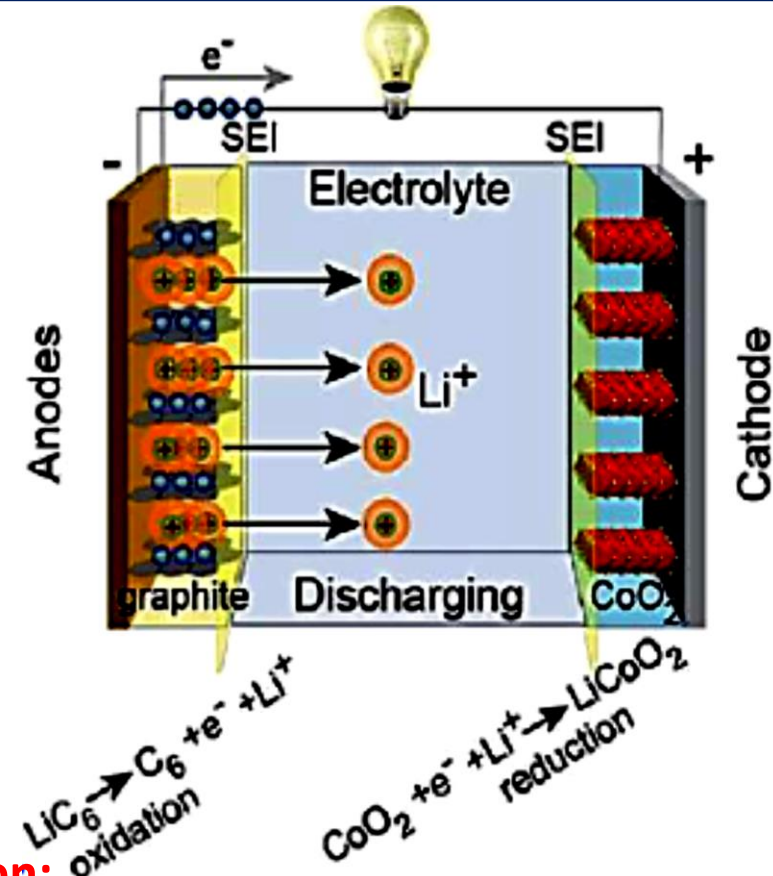
□ Charging Reaction:

- During charging, **Li⁺ ions flow from Anode (LiCoO₂)** to the **cathode (graphite)** through the electrolyte.
- **Electrons also flow** from the one electrode to the another. The electrons and Li⁺ ions **combine at cathode** and deposit there as Li.

□ Advantages/Characteristics:

- Lithium-ion batteries are high voltage and light weight batteries.
- It is smaller in size & produces three time the voltage of Ni-Cd batteries.

- **Uses:** It is used in cell phone, note PC, portable LCD TV, semiconductor driven audio, etc.

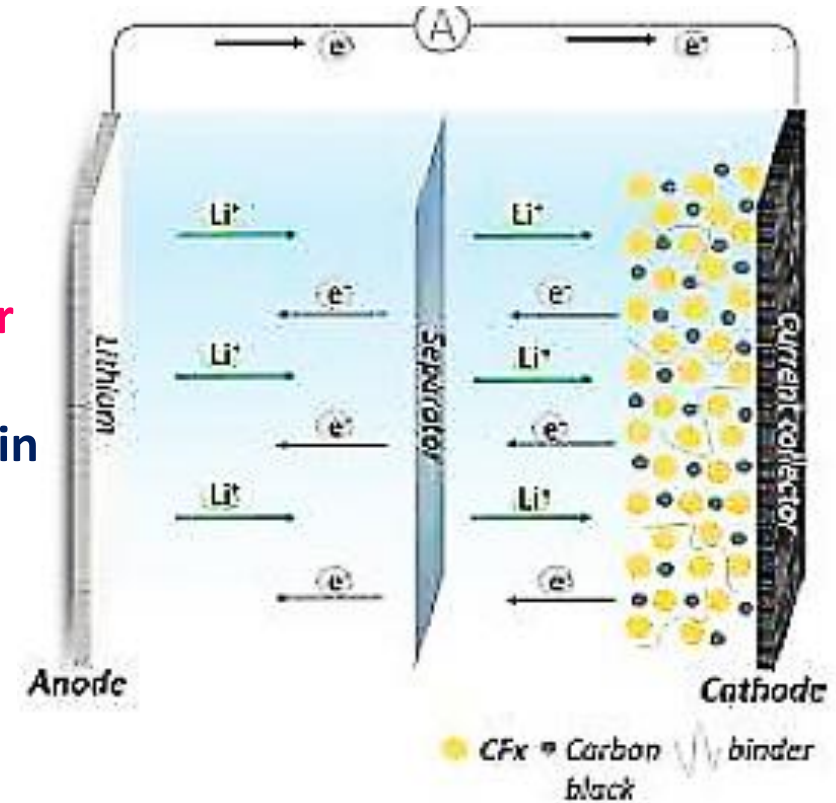


□ Discharging Reaction:

- Li⁺ ions **flow back** through the electrolyte from **graphite electrode** to the positive electrode. Electrons also flow from the negative electrode to the positive electrode.
- The Li⁺ ions and electrons combine at the positive electrode and deposit there as Li

❑ Lithium polymer (Poly-Carbon Monofluoride) batteries

- Polycarbon monofluoride (CF_x) cells have an **output of 2.8 V** and moderately high energy density.
- **Commercial Li/CF_x battery:**
 - ⇒ **Cathode:** Composite of CF_x, conductive additive and a **polymeric binder**
 - ⇒ **Anode:** Lithium
 - ⇒ Polypropylene separator and a non-aqueous electrolyte (such as LiBF₄ in γ-butyrolactone).
 - ⇒ **Discharge reaction:** $\text{CF}_x + x\text{Li} + x\text{S} \rightarrow \text{C}(\text{Li}^+\text{SF}^-)_x$
 - ⇒ **Charge reaction:** $\text{C}(\text{Li}^+\text{SF}^-)_x \rightarrow \text{C} + x\text{LiF} + x\text{S}$



- ⇒ **Lithium Polymer batteries are better than Lithium ion batteries!**
- ❑ Li-ion batteries use **organic solvents as dispersing medium**. In situations where the structure of the battery is compromised, that **solvent can ignite** and vent from the pressurized battery. **The result is a dangerous explosion.**

