



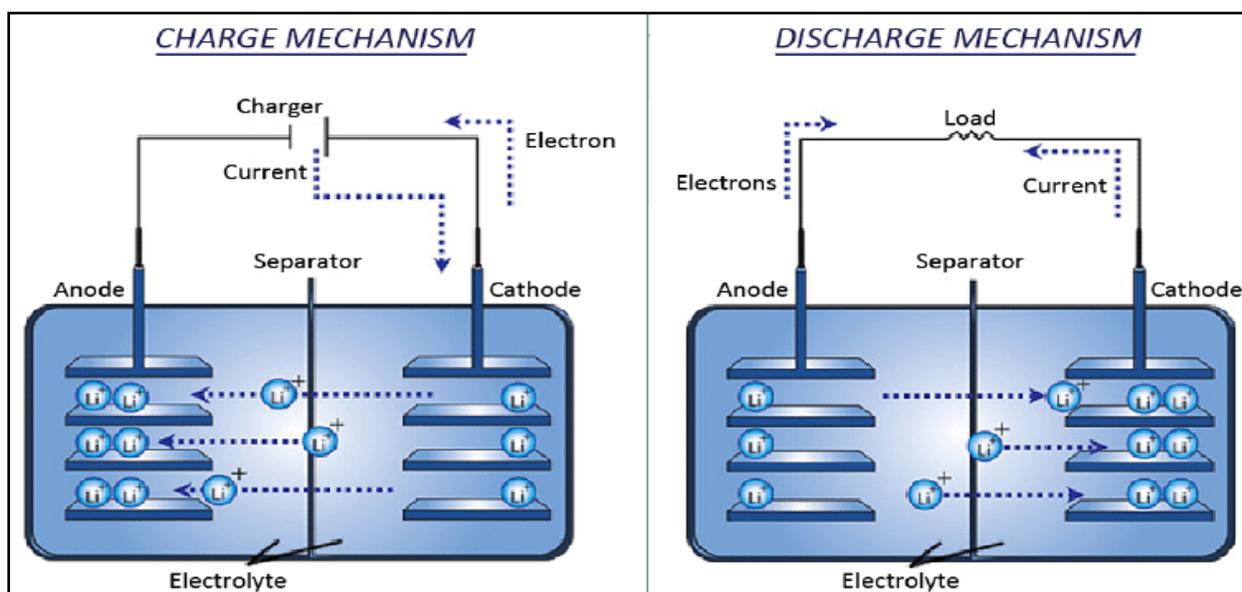
MODERN BATTERIES

Modern batteries are at the heart of today's technological advancements, powering everything from smartphones and laptops to electric vehicles and renewable energy storage systems. These devices convert chemical energy into electrical energy through electrochemical reactions, and as technology evolves, so do the batteries that make our modern lifestyle possible

Lithium Ion Battery

Like any other battery, a rechargeable lithium-ion battery is made of one or more power-generating compartments called **cells**. Each cell has essentially three components: a **positive electrode** (connected to the battery's positive or + terminal), a **negative electrode** (connected to the negative or – terminal), and a chemical called an **electrolyte** in between them. The positive electrode (Cathode) is typically made from a chemical compound called lithium-cobalt oxide (LiCoO_2) or, in newer batteries, from lithium iron phosphate (LiFePO_4). The negative electrode (Anode) is made from Lithium metal and the electrolyte is Lithium Based gel or Solid polymer which is varied from one type of battery to another

Diagram



Working



Lithium ion batteries work by using the transfer of lithium ions and electrons from the anode to the cathode. At the anode, neutral lithium is oxidized and converted to Li^+ . This results in the reduction of Co (IV) to Co(III) when the electrons from the anode reaction are received at the cathode.

Reaction

The positive (cathode) electrode **half-reaction** in the lithium-doped cobalt oxide substrate is:^{[83][84]}



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



The full reaction (left: charged, right: discharged) being:



Advantages

1. Eco-friendly: **Lithium-ion batteries** contain relatively low levels of toxic heavy metals found in other types of **batteries**, such as lead-acid and nickel-cadmium (Ni-Cd) **batteries**
2. Lightweight and compact and High energy density
3. Low maintenance and Low self-discharge rate

Disadvantages

1. **Lithium ion** cells and **batteries** are not as strong as some other rechargeable technologies.



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2. Requires protection circuit to maintain voltage and current within safe limits.
3. They require protection from being over charged and discharged too far. In addition to this, they need to have the current maintained within safe limits.

Uses

Electronics: Cell phones, tablets, laptops, wireless headphones.

Power tools: Cordless drills, saws, routers, grinders, and sanders.

Garden tools: Hedge-trimmers, leaf-blowers, and edge-trimmers.

Vehicles: Electric vehicles, plug-in hybrids, e-bikes, e-scooters, skateboards.

Medical devices: Hearing aids, keyless car remotes

Industrial: Robots, drones, IoT sensors, submarines, and rockets