

Chemistry behind lithium ion batteries

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Picture a world without lithium-ion batteries (often called Li-ion batteries or LIBs). Need help? Mobile devices wouldn't look the way they do now. Picture huge, heavy cell phones and laptops. Also picture that both of these things are so expensive that only very rich people can afford them. What you are picturing is the 1980s. Scary, isn't it?

A battery is made up of several individual cells that are connected to one another. Each cell contains three main parts: a positive electrode (a cathode), a negative electrode (an anode) and a liquid electrolyte.

When the lithium-ion battery in your mobile phone is powering it, positively charged lithium ions (Li^+) move from the negative anode to the positive cathode. They do this by moving through the electrolyte until they reach the positive electrode. There, they are deposited. The electrons, on the other hand, move from the anode to the cathode.

As long as lithium ions are making the trek from one electrode to another, there is a constant flow of electrons. This provides the energy to keep your device running. Since this cycle can be repeated hundreds of times, this type of battery is rechargeable.

This is for two reasons. First, lithium is the most electropositive element. Electropositivity is a measure of how easily an element can donate electrons to produce positive ions. In other words, it's a measure of how easily an element can produce energy. Lithium loses electrons very easily. This means it can easily produce a lot of energy.

Lithium is also the lightest of all metals. As you've learned, intercalation materials are used as electrodes in lithium-ion batteries instead of actual lithium metal. Still, these batteries weigh much less than other types of batteries that use metals like lead or nickel.

While these batteries are pretty impressive, they do have their downsides. The biggest complaint is that they wear out fairly quickly whether you use them or not. A typical lithium-ion battery will last about 2-3 years before it has to be replaced. That can get expensive! The production and disposal of lithium-ion batteries also has a big impact on the environment, so the longer those batteries can last the better.

However, you don't need to worry too much. These events are very rare. In fact, lithium-ion batteries are actually very safe. Also, right now there is a lot of research going into improving every part of these batteries. For example, researchers have created a liquid electrolyte that turns into a solid when it is hit. This will help keep batteries from heating up or catching on fire if they are damaged! Soon, lithium-ion batteries will likely be even safer, last longer, and cost even less.

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A Silicon Valley startup is giving lithium-ion batteries a much-needed silicon boost (2018)Article by Akshat Rathi outlines new development in lithium-ion battery technology: the addition of silicon to the batteries.

Will there be enough EV Battery Material? (2018)Now You Know video (5:10 min.) discussing the materials used in EV (electric vehicle) batteries and the mathematics behind electric vehicle adoption.

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