## Lithium battery for cell phone



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Yet stories of exploding batteries, rare as they may be, have captured the public"s imagination for reasons that are quite understandable. But what really happens if you"re fixing your phone, your tool slips, and you accidentally poke the battery? Images of scary explosions and chemical burns flash before your eyes--if you hurt the li-po in any way, it feels like a fiery response will be an inevitable outcome.

The iFixit team is here to mythbust the li-po's explosive nature, and, in the process, show you how to prevent a wounded li-po from going postal. To do so, we're going to dissect and stab a few batteries--for science.

A li-po battery is like a tightly packed fruit roll-up. Multiple layers of ultra-thin metals, plastic, and chemical slurries are stacked together, rolled tightly into a flat rectangle and stuffed into a foil pouch. The pouch is filled with a polymer-based electrolyte (hence the lithium polymer name) and sealed, making a single complete battery cell. Multiple cells are connected together in parallel or in series to make larger batteries. For a look at how these batteries are made, check out this in-depth video of an iPhone battery factory in action.

The cathode (+) is a thin sheet of coated aluminum. The coating imparts different charge, discharge, capacity, and cycle characteristics and boasts fun names like Lithium Manganese Oxide (LMO) and Lithium Cobalt Oxide (LCO). The common denominator with all the coatings is lithium, a low-density metal that is a key factor in making the battery work.

The insulating separator is a flexible, semi-permeable sheet that physically separates the cathode (+) and anode (-) layers, while allowing lithium ions to flow through. Without it, the cathode and anode would touch each other and cause a short-circuit.

All of these layers are soaked in a gel-like electrolyte, which gives the lithium ions a medium to flow in. No ion flow = no energy. The electrolyte consists of a mixture of lithium, solvents, and additives--the amount of electrolyte strongly affects how much energy the li-po battery can store. The exact composition is different with every manufacturer and is a closely guarded trade secret for each.

When a li-po battery catches on fire, it's not the battery's lithium content touching air/moisture that ignites the battery. Rechargeable li-ion batteries have very trace amounts of metallic lithium--not enough to supply the "oomph" necessary for ignition (unlike the non-rechargeable primary lithium batteries, which have quite a bit of metallic lithium and can ignite from moisture contact.) Rather, it's the solvents in the electrolyte that are prone to fiery bouts.

Normally, the electrolyte is safely insulated from things that can set it off, but sometimes things (usually pointy) can change that. Let's see what happens when something punctures a li-po battery.



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When we punctured a fully charged iPhone 12 Pro Max battery, for instance, it immediately swelled up and glowed like a hot metallic croissant. Smoke and gasses spewed out the sides, and the vapors quickly caught on fire:

Once the thermal runaway begins, it's very difficult to stop it. Like white-hot coals, you have to cool the reaction to a point where the electrolyte is no longer self-generating fuel and heat. The common approach to lithium-ion battery fires is to douse it with large amounts of water or wait for the battery to burn out, as seen in this Tesla Emergency Response Guide.

Since it's so difficult to put out a li-po battery fire, it's imperative to prevent it from happening in the first place. You can drastically reduce the chance of a thermal event by draining the battery to 25% or less. Without the stored potential energy, the battery has a difficult time generating the heat required to ignite the electrolyte, even when there's a short-circuit. Puncturing a less than 25% charged battery might generate sparks and smoke, and the battery could get really hot, but it's unlikely to catch on fire and enter thermal runaway mode.

This is why you'll see a battery discharge note in our repair guides. We want to make the repair as safe as possible, and discharging the battery makes a big difference. Don't skip this important step!

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