Mobile batteries explained

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The batteries in your mobile devices are miracles of chemical engineering, holding huge amounts of energy that can keep your devices running for hours. How do they work, and how can you get the most out of them?

Lithium ion is the most common form of battery because it can store the most energy in the smallest space. That’s measured in terms of specific energy density, which refers to how much energy, in Watt-hours, a kilogram of battery could hold. For lithium ion, the figure can be between 150 and 250 Wh/kg, while a nickel metal hydride (or NiMH) battery can hold about 100 Wh/kg. In other words, lithium ion batteries are smaller and lighter than other types, and that means smaller devices with longer battery life.

All of this chemistry means one thing: Your device’s battery is storing energy, and the chemicals inside are eager to release that energy any way they can. And that can be a problem, as Boeing recently found out when the batteries on a 787 Dreamliner caught fire while the plane was parked.

This is one of the drawbacks of lithium ion: If the batteries are discharged too far, the chemistry breaks down and creates an excess of lithium oxide, which ignites, creating more lithium oxide, and so on. That’s what chemists call a thermal runaway reaction, and what everyone else calls a fire, which is why the FAA grounded the 787. Since the same thing can happen if you puncture the battery, the TSA recommends that air passengers carefully pack batteries in their carry-on baggage, not in checked baggage.

The capacity of a battery is measured in milliampere-hours (or mAh), which indicates how much energy the battery can deliver over time. For instance, if a battery has a rating of 1000 mAh, it could deliver 1000 milliamps of power for 1 hour. If your device uses 500 milliamps of power, the battery should last about 2 hours.

The battery life of a device is a bit more complicated than that, though, as the amount of power a device uses changes depending on what it is doing. If the device’s screen is on, the radio is transmitting, and the processor is working hard, it will use more energy than if the screen is off and the radio and processor are idle.

That’s why you should treat battery-life claims with caution—the manufacturer can extend the battery-life number by turning the screen brightness down, or by turning off parts of the device. If you are curious, you can use an app that monitors the power consumption and battery status of your mobile device, such as Battery Monitor Widget for Android or Battery Life Pro for iOS devices.

Because of their tendency to catch fire, lithium ion batteries have to be closely controlled. Battery makers accomplish that by building in a charge controller that manages the flow of electricity. In effect, every battery has a small computer inside it that prevents it from being discharged too fast, or to a dangerously low level. This component also regulates the flow of power into the battery during charging, slowing the flow of power as the battery gets close to being fully charged to prevent overcharging.

To show how this process works, we charged a Samsung Galaxy Note and measured the flow of power into the device, against the reported percentage for the battery charge. As you can see in the chart above, the flow of power into the battery is highest when the battery is first being charged, and then tapers off. The last few portions of the charge take a long time, as the controller slows the flow of power to a trickle so that the battery won’t be charged too much.

Sulfur may join lithium inside batteries eventually. Scientists at Stanford University recently demonstrated a battery that used nanotechnology to add sulfur to the chemical mix, which increased the energy density of the battery by as much as five times, and also improved its life span. However, this development won’t hit the market for a few years.