

Battery Chemistry

Does your device, appliance, toy, or other item move, make noise, or light up without being plugged in? Then it has a battery! From drones to phones, and tablets to EVs, one common electronic component you find is the battery. The type of battery chemistry used depends on the function and size of the device.

Primary Batteries

Primary batteries are single-cycle, non-rechargeable, batteries. The chemicals inside these batteries are consumed with time. While there are many kinds of primary batteries, alkaline is the most commonly used today.

Alkaline Batteries:

This type of battery uses energy through a reaction of zinc metal and manganese oxide. The electrolyte (most commonly potassium hydroxide) has a pH value above 7. These batteries are commonly used in households and typically found in AA, AAA, C, D, and 9V cell sizes.



Secondary Batteries

These batteries are multicycle because we can recharge them. There are many different types of secondary batteries. Some of the most popular secondary batteries are lithium-ion, lithium-polymer, nickel cadmium, nickel metal hydride, and lead acid.

Lithium-Ion Batteries: (Li-Ion)

Lithium-ion is a general term for a variety of lithium batteries using a lithium cobalt oxide cathode. Lithium-ion batteries can be a safety hazard if not properly engineered and manufactured because they have flammable electrolytes that, if damaged or incorrectly charged, can enter thermal runaway, a state of uncontrolled reaction that leads to fire and explosion. These batteries typically have a rigid casing and are commonly used in consumer electronics, toys, power tools, and electric vehicles. Many of these batteries are also manufactured in the same, or similar, sizes as the cylindrical alkaline batteries (AA, AAA, C, and D cell sizes). You must pay close attention to tell them apart! Keep in mind, if it is rechargeable, it is NOT an alkaline battery.



Lithium-Polymer Batteries: (Li-Po or LIP)

These batteries use a highly conductive gel polymer form of electrolyte. They carry high energy density compared to their weight and are therefore used when weight is a critical feature of function. LiPo cells have a flexible, foil-type (polymer laminate) case, so they are relatively unconstrained and can be formed into many shapes. LiPo batteries are used in mobile devices, power banks, very thin laptops, tablets, portable media players, wireless controllers for video game consoles, wireless PC components, e-cigarettes, and other applications where small form and high energy density outweighs cost considerations.



Nickel Cadmium Batteries: (NiCd)

The positive terminal of these batteries is made of nickel oxide hydroxide, while the negative terminal is made of cadmium, a toxic heavy metal. Due to this toxic component, NiCd batteries are less favored than other rechargeable chemistries by manufacturers, but they are still used in devices that demand high discharge, such as power tools. While they can be found in typical alkaline sizes, they are more frequently sold for device-specific configurations.



Nickel Metal Hydride Batteries: (Ni-MH)

The chemical reaction that produces power in the positive electrode of this battery uses nickel oxide hydroxide. The negative electrodes use a hydrogen-absorbing alloy in lieu of cadmium. They are often used as a substitute for similarly shaped, non-rechargeable, alkaline batteries. These batteries are commonly found in AA, AAA, C, and D cell sizes, as well as battery packs or special device-specific configurations.



Lead-acid Batteries:

Lead acid batteries were the first rechargeable battery! In this battery, the negative plate is made of lead, and the positive plate is lead dioxide. The electrolyte solution contains sulfuric acid, either in liquid or gel form, which stores most of the chemical energy. These batteries are heavy and bulky. They are mostly used in automobiles and grid power stations, though small, sealed lead acid batteries are sometimes used in household applications, including in computer back up power supplies, mobility devices, and ride-on toys.



WAIT! What about Button Batteries? aka Coin Cells.

Stainless steel usually forms the bottom body, which is the positive terminal of the cell and insulates it. The metallic top cap forms the negative terminal. Button cells are used to power small portable electronics devices such as watches, calculators, musical cards, hearing aids, ear buds, gaming headsets, flashing shoes, thermometers, and many more. These batteries have a low self-discharge rate, holding their charge for a long time if not used. Most button cell batteries are primary batteries with varying chemistries including alkaline, silver oxide and lithium metal. Rechargeable coin cell batteries - both Ni-MH and Lithium ion - do exist but are relatively uncommon. This makes proper management of these batteries tricky, but important!

