Lithium battery vs polymer battery

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Comparing polymer (LiPo) and lithium-ion (Li-ion) batteries involves evaluating performance, cost, lifespan, and safety123.

Li-ion batteries are cost-effective with higher energy density, suitable for many devices, while LiPo batteries offer design flexibility and enhanced safety, ideal for compact devices1234.

All lithium batteries include a barrier to separate the anode and cathode while also enabling the movement of ions between the electrodes. In a LiPo, the polymer separator also contains the electrolyte. In addition, polymer separators can provide an additional function acting as "shutdown separators" that can shut down the battery if it becomes too hot during charging or discharging. Shutdown separators are multilayer structures with at least one polyethylene layer which can stop current flow when the temperature rises too high and at least one polypropylene layer which acts as a form of mechanical support for the separator.

The intercalation and decalation of lithium ions from a positive electrode and a negative electrode. Except for the polymer separator, LiPos operate on the same principle as Li-ions. However, they are packaged in quite different ways.

Li-ions are usually delivered in a stainless steel or aluminum case. The case is most often cylindrical but can be button-shaped or rectangular (prismatic). The case is relatively costly to produce and tends to restrict the sizes and shapes that are available. But it is also robust, helping to protect the battery from damage. The case is sealed using a laser welding process.

LiPos are packaged in an aluminum foil "pouch" and are called soft or pouch cells. The pouch is mostly prismatic and easier to fabricate, and lower in cost than the stainless steel or aluminum cases of Li-ions. This type of construction also enables the production of batteries with a variety of custom configurations. The other components in LiPos include wafer-thin layers (< 100 mm) that can be mass-produced at a relatively low cost. Substituting the foil pouch for the metal can result in high energy density and lightweight batteries. Both large formats and heights of less than 1 mm can be achieved, but the cells require careful mechanical handling.

The use of LiPos is subject to many of the same challenges that users of Li-ion must contend with, including overcharging, over-discharging, over-temperature operation, and internal shorts. In addition, crushing or nail penetration of the LiPo pouches can result in catastrophic failures ranging from pouch ruptures to electrolyte leaks and fires.

Like Li-ions, LiPos can expand at high levels of overcharge due to the vaporization of the electrolyte. Vaporization of the electrolyte can cause delamination, causing bad contacts between the internal layers of the cell, reducing reliability and cycle life. This expansion can be particularly noticeable for LiPos, which can literally inflate. It can also cause structural damage to the host system.

The table below compares the voltages and typical applications of the six basic lithium battery chemistries. Other characteristics of these batteries include:

Note that the NMC, LCO, and NCA batteries contain Cobalt that helps to provide higher power capabilities. They can provide large amounts of power in a small package but can be more susceptible to thermal events that can cause safety issues.

A polymer electrolyte results in several performance enhancements, including high energy density and lightweight batteries. Depending on the structure of the polymer layers, it can also enhance battery safety. Compared with conventional Li-ion batteries, LiPo batteries can be fabricated with a wider range of specific energy densities (Wh/kg) and specific power densities (W/kg), making LiPo batteries more flexible across a wider range of potential applications. As a result, LiPo technology is used across all the main lithium battery chemistries:

Aluminum-air and solid polymer batteries

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Web: https://kary.com.pl/contact-us/
Email: energystorage2000@gmail.com
WhatsApp: 8613816583346