PRY FURTHER AT EDN.COM

Go to www.edn.com/pryingeyes for past Prying Eyes write-ups.

Simple battery technology packs in more features with complex chemistries

Lithium-ion cells are the workhorses of portable energy storage. Battery manufacturers may change the formulation of the coatings for the cathode and the anode and the characteristics of their separators, but the basic components are the same across all rechargeable lithium-ion cells. Formulations optimize battery performance for characteristics such as energy storage, rapid current draw, and cycle life.

The manufacturer welds the internal side of the end cap to the cathode tab. The black ring on the cap insulates it from the can. The cap contains a CID (circuit-interruption device). If the pressure inside the can exceeds the limit that indicates a short, an overcharge, or excessive temperature, the CID opens and permanently disconnects the cell. After inserting the end cap into the can, the manufacturer crimps the can over the cap, sealing the battery. (The second end cap is for illustrative purposes.)

A thin sheet of polypropylene acts as a separator to prevent a short circuit between the cathode and the anode but allows lithium-ion cells to flow through the separator's porous structure. The separator's porosity affects the back-and-forth flow of lithium ions as the cell charges and discharges. If the separator is very porous, lithium-ion cells can flow back and forth more quickly, but very porous separators are also less rugged during manufacturing and less durable. Another characteristic of the separator is its thickness: Thicker separators reduce the occurrence of electrical short circuits but leave less room in the can for the active material on the cathode; the cell also has lower energy density.

A shrink tube provides branding and product information and insulates the can from the outside world.

The jelly roll goes into a stainless-steel can. A welding probe goes down through the center and spot-welds the anode tab to the bottom of the can.

Washers act as plastic spacers to keep the jelly roll tightly packed and in place.

The anode is a coated, thin copper foil. A graphite coating is the most common, but some vendors use LTO (lithium-ion-titanate oxide). An LTO-coated anode gains in increased cycle life and faster charging at a heavy trade-off of lower energy density. This Imara anode uses a conventional graphite coating.

A separator layer tops the cathode, which in turn tops another separator, which in turn tops the coated anode. Manufacturers then roll up the four-layer sandwich to resemble a jelly roll. The anode current collector, or tab, hangs from the jelly roll.

A lithium-ion-battery product line often takes its name from the chemical formulation of the cathode. Some common cathode coatings are iron phosphate, cobalt oxide, and nickel-manganese-cobalt-oxide, plus the major coating ingredient, lithium.