

Periodic graphics

A collaboration between C&EN and Andy Brunning, author of the popular graphics blog **Compound Interest**

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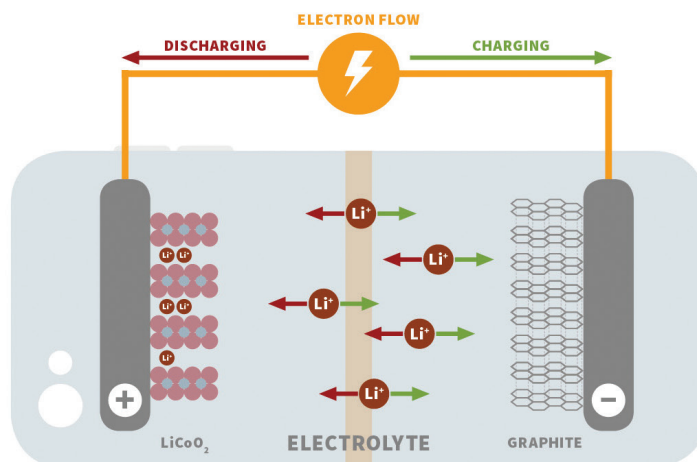
To see more of Brunning's work, go to **compoundchem.com**. To see all of C&EN's Periodic Graphics, visit **cenm.ag/periodicgraphics**.

WHY LITHIUM-ION BATTERIES CATCH FIRE

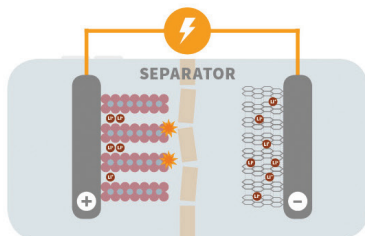
Lithium-ion batteries have been in the news recently with reports of some of Samsung's phones unexpectedly catching fire. Here, we examine how the batteries work and what can make them ignite.

HOW THEY WORK

Lithium-ion batteries often use lithium cobalt oxide (LiCoO_2) as the positive electrode and graphite as the negative electrode. When the batteries charge, lithium ions and electrons move from the positive to the negative electrode. When they discharge, the ions and electrons move from the negative to the positive electrode, powering phones and other devices. The ions move through an electrolyte, typically made of a lithium salt dissolved in an organic liquid.

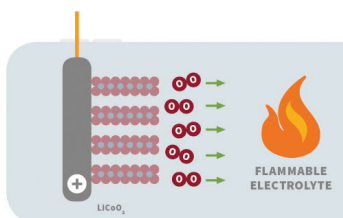


SHORT-CIRCUITING



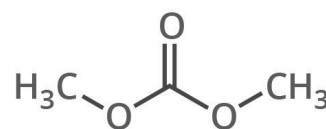
A porous separator keeps the battery electrodes apart. Charging the battery for long periods or inflicting a mechanical blow can damage the separator, causing the battery to discharge rapidly and generate a lot of heat.

OVERCHARGING



When overcharged, lithium cobalt oxide releases oxygen. This can react with the flammable electrolyte and also with cobalt oxide (Co_3O_4) left over after the release of oxygen. Co_3O_4 also increases the resistance of the battery, raising the risk of overheating.

ELECTROLYTE BREAKDOWN



DIMETHYL CARBONATE

Common electrolyte substance

During charging, some of the organic molecules in the electrolyte can break down, forming carbon dioxide. Because the battery is sealed, this causes pressure to build up. If it gets high enough, the battery bursts, exposing the flammable electrolyte.