CLEAN ENERGY INSTITUTE
UNIVERSITY of WASHINGTON

Science Highlights Student Reading

Lithium- ion Batteries - electricity through ion motion!

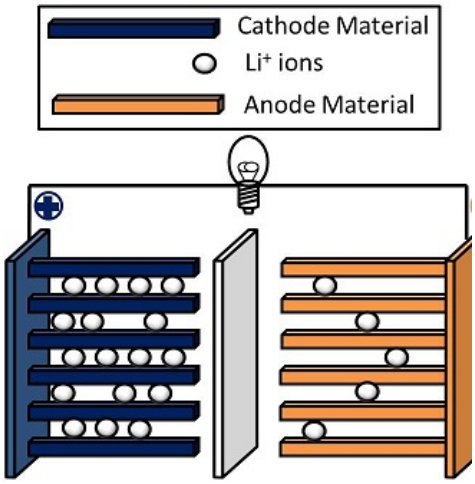

Figure 1: Diagram of Lithium-ion Battery

Lithium-ion batteries are **rechargeable** batteries found in portable electronic devices such as smart phones, tablets and laptop computers. Inside lithium-ion batteries are a **cathode** material, an **anode** material, a **micro-permeable separator**. Cathode materials create the positive terminal of the battery while anode materials create the negative terminal of the battery. Many different materials can be used to create lithium-ion batteries, but the most common materials used are lithium cobalt oxide for the cathode and **graphite** for the anode.

Lithium-ions (Li^+) travel through the **electrolyte** (ion conducting) solution through the micro-permeable separator. The direction the ions flow depends on whether the battery is charging or discharging. When the battery is discharging and being used to supply power, the Li atoms stored in the graphene are ionized and travel from the anode to the cathode where the ions recombine with their electrons and become electrically neutral. When the battery is recharged, the electricity applied to the battery excites the Li atoms into Li^+ ions which travel from the cathode to the anode.

Lithium-ion batteries are preferred to other types of rechargeable batteries for several reasons. Lithium-ion batteries can be much smaller than other batteries because of the small size of lithium compared to other potential ions. Additionally, these batteries can deliver up to 3.6 Volts which is 3 times higher than Nickel-Cadmium (NiCad) or Nickel-Metal-Hydroxide (NiMH) batteries. Finally, Lithium-ion batteries are unique because they do not have a "memory effect" which means the battery be partially charged or discharged without damaging the performance of the battery. One challenge with lithium-ion batteries is that the metal ions physically push themselves into the anode material which expands the material can causes cracks. The lithium can also form metal spikes (dendrites) which can short out the battery. Researchers are looking for new electrode materials and non-flammable electrolytes

Check your understanding:

Name an everyday object or technology that uses lithium-ion batteries.

When *recharging* a lithium-ion battery, which direction do the Li^+ ions move?

What are two reasons that lithium-ion batteries are preferred over other types of rechargeable batteries?