Battery anodes recycled in a flash

Jolt of electricity zaps impurities in graphite anodes, potentially offering a cheaper and greener recycling strategy

Lithium-ion batteries are powering a revolutionary transition to electric vehicles. But booming battery use will eventually create a mountain of spent batteries—and very few are currently recycled.

A team led by James M. Tour at Rice University has now developed an appropriately electrifying approach to recycling the batteries' graphite anodes. The process uses a pulse of electricity to heat impurities in the anode, making them easier to extract so that the remaining graphite can be turned into new anodes. The researchers say their method, called flash recycling, is cheaper and greener than rival methods (*Adv. Mater.* 2022, DOI: 10.1002/adma.202207303).

In flash recycling, the researchers grind the anode into a powder and load it into a quartz tube between two electrodes. A 1 s jolt of electricity heats the material to about 2,500 °C. The impurities have a much higher electrical resistance than graphite and take the brunt of this flash of heat.

The burst of heat completely carbonizes the organic impurities in the powder and forms inorganic salts and metal oxide nanoparticles. Washing the material with dilute hydrochloric acid removes all the inorganic waste and leaves behind graphite particles.

The researchers made a new anode from the flash-recycled graphite and tested it in Li-ion batteries. The anode retained 77% of its energy capacity after 400 recharge cycles. "This is comparable with commercial graphite, which is around 80%," says Tour's colleague Weiyin Chen, who led the experimental work. The team's life-cycle analyses suggest that using flash recycling to produce graphite for new anodes would require 96% less energy than making fresh synthetic graphite, at roughly 12% of the cost.

"They get decent-quality graphite that performs reasonably well, but it doesn't seem to me that it's good enough yet," says Paul Anderson of the University of Birmingham, who leads the Faraday Institution's Reuse and Recycling of Lithium-Ion Batteries project and was not involved in the work.

Anderson says further improving the quality of the recovered graphite will be crucial. "Anyone who can take low-grade graphite and make it into battery-grade graphite with a lower-temperature, more energy-efficient process is onto a winner."—MARK PEPLOW, special to C&EN