New strategy improves performance of spent high-voltage lithium cobalt oxide batteries

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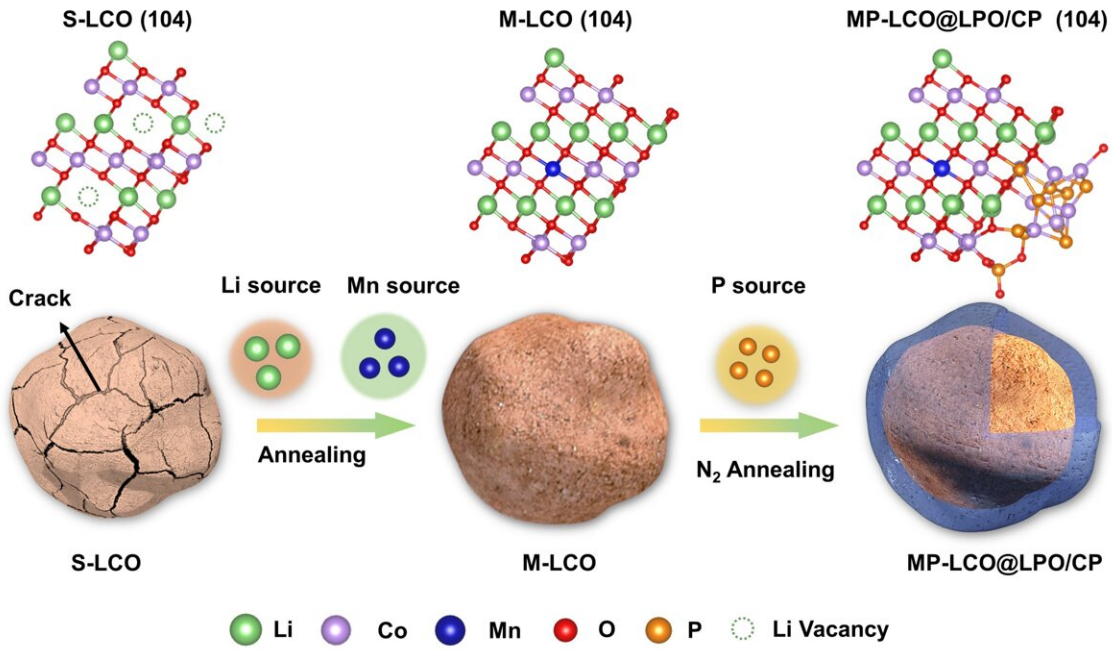

Schematic illustration for the upcycling of S-LCO into MP-LCO@LPO/CP. Credit: Liu Zhenzhen

In a study published in *Advanced Materials*, a research team led by Prof. Zhang Yunxia from the Hefei Institutes of Physical Science of the Chinese Academy of Sciences has developed an integrated bulk and surface commodification strategy to upgrade spent lithium cobalt oxide (S-LCO) batteries to operate at high voltages.

As the demand for high energy density storage devices grows, there's a need to find sustainable ways to upgrade old $LiCoO_2$ (LCO) batteries into more stable, high-voltage cathode materials.

In this study, the researchers developed a simple and effective method for upgrading LCO batteries. They used a combination of wet chemical treatment, heating, and a special phosphorus coating technique.

This process involved adding extra lithium, applying a uniform coating of lithium phosphate/cobalt phosphide (LPO/CP) to the surface, and incorporating manganese into the bulk material, along with a gradient of phosphorus near the surface. These modifications were all achieved simultaneously, resulting in significantly improved battery performance.

The result of these modifications is an improved LCO cathode, named MP-LCO@LPO/CP, which shows significantly improved electrochemical performance. The improved cathode exhibits high specific capacity and excellent cycling stability.

The researchers also investigated why the upgraded cathode performs so well at high voltages. They found that the modifications improve both structural stability and electrochemical properties, resulting in improved battery performance.

"This method is simple and easy to scale up, so it could also be used to recycle other waste cathode materials. This approach has great potential for the sustainable development of the lithium-ion battery industry," said Prof. Zhang.

More information: Zhenzhen Liu et al, Hybrid Surface Modification and Bulk Doping Enable Spent $LiCoO_2$ Cathodes for High-Voltage Operation, *Advanced Materials* (2024). DOI: 10.1002/adma.202404188

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