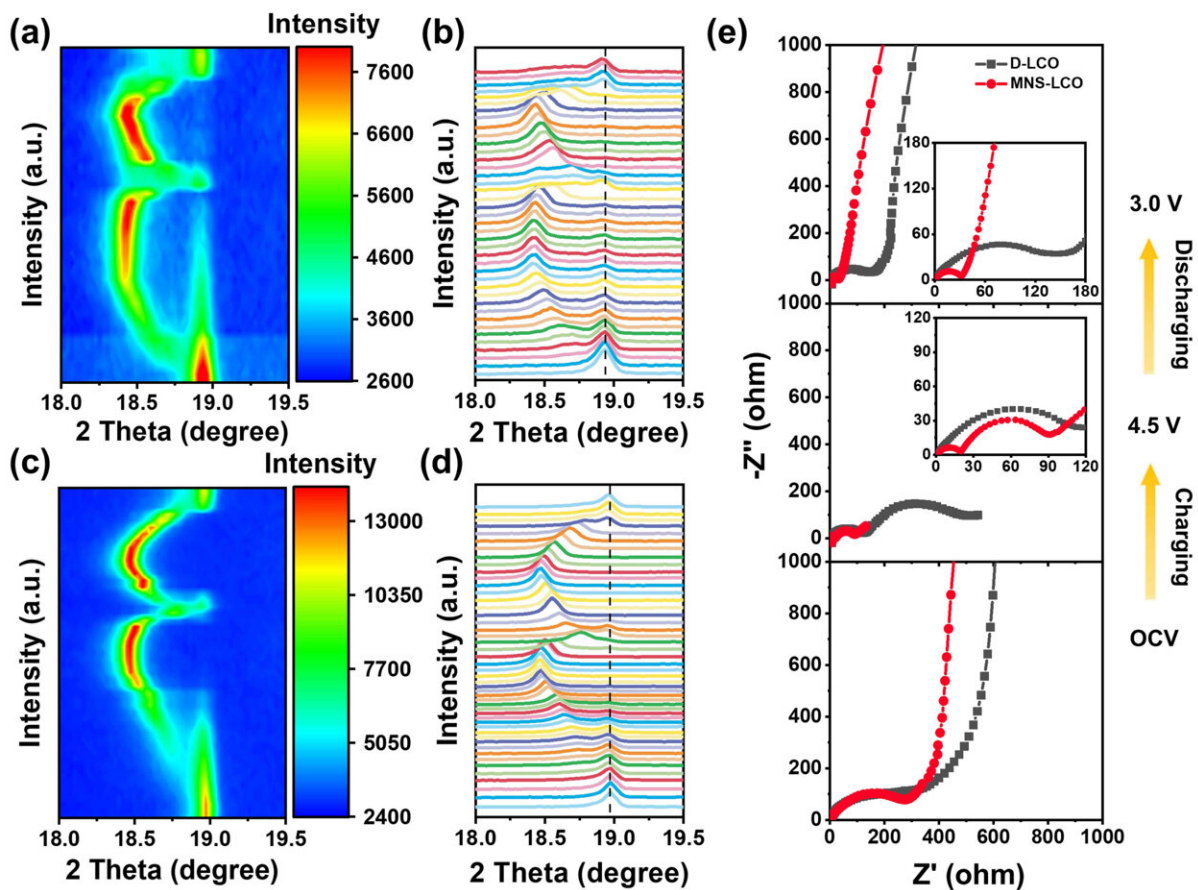


Researchers upcycle degraded cathodes to create high-performance lithium-ion batteries

August 31 2023, by Zhang Nannan



In situ XRD for D-LCO (a-b) and upcycled MNS-LCO (c-d); (e) EIS spectra. Credit: Liu Zhenzhen

In a study published in *Advanced Energy Materials*, a research team led by Prof. Zhang Yunxia from the Hefei Institutes of Physical Science of the Chinese Academy of Sciences developed a solid-phase sintering strategy to enable direct conversion of the degraded LiCoO_2 (D-LCO) into the high energy density cathode materials.

With the impending influx of end-of-life lithium-ion batteries, it is critical to investigate effective regeneration and upcycling strategies in order to alleviate resource scarcity, reduce [environmental pollution](#) and meet the demand for high [energy](#) density [cathode](#) materials.

In this study, a simple, non-destructive, one-stone-for-three-birds solid-phase [sintering](#) strategy was proposed to regenerate the degraded D-LCO cathode and even improve its stability at high voltages.

"It's like killing three birds with one stone," said Prof. Zhang, referring to the simultaneous integration of lithium supplementation, Li_2SO_4 coating, and Mn doping in Co sites, together with N and S doping in Li-O plates, using a one-pot solid-phase sintering approach.

The upcycled cathode not only exhibited a high specific discharge capacity of 188.2 mAh/g at 0.2 C, but also delivered superior cycling performance with 92.5% of capacity retention after 100 cycles at 0.5 C and excellent rate capability at a high cut-off voltage of 4.5 V, superior to the freshly commercialized counterpart.

Apparently, different used LCO cathode materials from different manufacturers or with different Li/Co molar ratios could be effectively upgraded into high performance lithium-ion batteries, highlighting the universality and feasibility of the developed solid-phase sintering method.

"Our study provides meaningful guidance for the up-cycling of D-LCO

into high energy density batteries with long-term cycling stability," said Prof. Zhang, "it can also be extended to upgrade other degraded cathode materials into high performance lithium-ion batteries."

More information: Zhenzhen Liu et al, Upcycling of Degraded LiCoO₂ Cathodes into High-Performance Lithium-Ion Batteries via a Three-In-One Strategy, *Advanced Energy Materials* (2023). [DOI: 10.1002/aenm.202302058](https://doi.org/10.1002/aenm.202302058)

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