4th

International Symposium on Carbon & Functional Materials for Energy & Environment

(4th CMEE)

Feb
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2025

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[Oral 30] Direct Regeneration of LFP Batteries: A Cost-effective Path toward Sustainable Energy Storage

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ABSTRACT

As sustainability concerns grow, the demand for lithium-ion batteries as efficient energy storage devices has steadily risen. This trend is further accelerated by the expansion of the electric vehicle (EV) market, with global EV battery usage seeing a 71.8% year-on-year increase, reaching 517.9 GWh [1]. Among various lithium-ion batteries, lithium iron phosphate (LFP) batteries have expanded their market share due to cost competitiveness and high safety. Consequently, the recycling market for these spent batteries is poised to grow significantly, making their economic and environmental impact increasingly pivotal.

Current battery recycling methods include pyrometallurgical and hydrometallurgical approaches. Moreover, LFP batteries contain few valuable raw materials except lithium; a low-cost, high-efficiency recycling process is essential. One promising technique is direct regeneration, which restores battery performance to near-new levels by replenishing lithium vacancies in the cathode structure. Ongoing research focuses on solid-state sintering, hydrothermal, and electrochemical processes, with results showing more than 95% of the performance of new LFP batteries [2]. Although a substantial influx of spent batteries is imminent, scalable and economical recycling solutions remain challenging to implement. Therefore, rapid advancements in recycling strategies are crucial to conserve resources, protect the environment, and fortify a sustainable battery circulation system.

Keywords: *Lithium-ion battery, LFP battery, Battery recycling, Direct regeneration, Relithiation*

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References

[1] 2022 Jan-Dec Global EV Battery Usage Posted 517.9GWh, 71.8% YoY Growth, https://www.sneresearch.com/en/insight/release_view/68/page/0?s_cat=|&s_keyword=Global%20EV%20Battery%20Usage%20Posted%20517.9GWh#ac_id (accessed on January 10, 2025).

[2] Qi, Cai, et al. "Environmental-friendly low-cost direct regeneration of cathode material from spent $LiFePO_4$." *Journal of Alloys and Compounds* 924 (2022): 166612.

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