Direct recycling of lithium ion batteries

The rapid growth in the use of lithium-ion batteries is leading to an increase in the number of battery cell factories around the world associated with significant production scrap rates. Direct recycling of this scrap material has both environmental and economic benefits, such as reducing the carbon footprint of cell manufacturing, as well as ...

The explosive growth and widespread applications of lithium-ion batteries in energy storage, transportation and portable devices have raised significant concerns about the availability of raw materials. The quantity of spent lithium-ion batteries increases as more and more electronic devices depend on them, increasing the risk of environmental pollution. Recycling valuable ...

Report Efficient Direct Recycling of Lithium-Ion Battery Cathodes by Targeted Healing PanpanXu,1 QiangDai,2 HongpengGao,3 HaodongLiu,1 MinghaoZhang,1 MingqianLi,1,6 YanChen,4 Ke An,4 Ying Shirley Meng,1,3,5 Ping Liu,1,3,5,6 Yanran Li,7 Jeffrey S. Spangenberger,8 Linda Gaines,2 Jun Lu,9 and Zheng Chen1,3,5,6,10,* SUMMARY Recycling ...

This study aims to develop a direct recycling process of spent lithium-ion batteries (LIBs) from an electric vehicle. In this direct recycling process, the electric vehicle battery pack is first discharged and disassembled to obtain the spent cathode material, which is then hydrothermally relithiated at 220 °C for 2 h followed by sintering at 850 °C for 4 h in air.

For more information on lithium-ion battery recycling, check out the following resources: EPA Resources: Lithium-ion Battery Recycling FAQs. Used Lithium-Ion Batteries. Frequent Questions on Lithium-ion Batteries. Universal Waste Webpage: Batteries section. Workshop on Lithium-Ion Batteries in the Waste Stream.

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Abstract The growing demand and production of lithium-ion batteries (LIBs) have led to a critical concern regarding their resources and end-of-life management. ... composition, morphology, and electrochemical performance. Additionally, Jacob is actively involved in research on Li-ion battery recycling, particularly in direct recycling. Citing ...

The rapid expansion of electric vehicle (EV) fleet calls for large number of lithium-ion batteries to be recycled at their end-of-life. Various recycling methods have been developed or under development to recover the high-value materials from retired lithium-ion batteries.

Advancement in energy storage technologies is closely related to social development. However, a significant conflict has arisen between the explosive growth in battery demand and resource availability. Facing the

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Facing the upcoming large-scale disposal problem of spent lithium-ion batteries (LIBs), their recycling technology development has become key. Emerging direct recycling has attracted widespread attention in recent years ...

Billions of dead lithium-ion batteries, including many from electric vehicles, are accumulating because there is no cost-effective process to revive them. ... Instead, Princeton NuEnergy is upgrading and renewing the cathodes themselves in a form of direct recycling. The team"s method for process recovers much of the structure and composition ...

Re-use: entailing secondary usage of LIBs to prolong their service life, especially for EV batteries. Recycling: involving the recovery of valuable materials from spent LIBs and their return to the value chain. Recovery: considering using certain materials from spent LIBs as fuel in processes like pyrometallurgy to extract energy from waste.

RecyLIB (Direct Recycling of Lithium-Ion Batteries) Topic: Recycling and Re-use of End-of-Life products and assets Total Budget: 1.1 Mio EUR Duration: 36 months, May 01, 2022 - April 30, 2025 Coordinator: Fraunhofer Institute for Silicate ...

A Critical Review of Lithium-Ion Battery Recycling Processes from a Circular Economy Perspective. Batteries 2019, 5 (4), 68, DOI: 10.3390/batteries5040068 Lv, W.; Wang, Z.; Cao, H.; Sun, Y.; Zhang, Y.; Sun, Z. A Critical Review and Analysis on the Recycling of Spent Lithium-Ion Batteries.

Direct recycling is the recovery, regeneration, and reuse of battery components directly without breaking down the chemical structure. As a method used to recycle lithium-ion batteries, direct recycling has generally been less studied than hydrometallurgical or pyrometallurgical processes.

The recycling of spent lithium-ion batteries is an effective approach to alleviating environmental concerns and promoting resource conservation. LiFePO4 batteries have been widely used in electric ...

Regarding the increase in environmental legislative restrictions, LIB"s waste management requests, and market trends that prioritize sustainability, the demand for eco-friendly battery recycling methods grows. Thus, direct recycling can be positioned as a key player in addressing these evolving dynamics and fostering a more sustainable future.

For higher-value lithium-ion batteries, such as nickel-manganese-cobalt (NMC), direct recycling is most applicable for the waste material that comes directly from manufacturing because the crystalline structure of the electrode is damaged during the use of the battery. Before recycling, the batteries are shredded.

The authors also found that the solvent could be continuously reused, leading to the development of a

closed-loop ecosystem and lithium-ion battery circular economy. The ultrafast delamination was driven by the competitive inhibition of binding through the weakening of hydrogen bonding.

Direct recycling is an alternative low-cost process that retains the structure of the lithium-ion battery cathode rather than going through materials dissolution and repurification. While the process shows promise, various steps need to be better understood and studied to identify possible roadblocks, cost-intensive steps, and needed variations in protocol that may ...

This review investigates the state-of-the-art direct recycling technologies based on effective relithiation through solid-state, aqueous, eutectic solution and ionic liquid mediums ...

Today, new lithium-ion battery-recycling technologies are under development while a change in the legal requirements for recycling targets is under way. Thus, an evaluation of the performance of these technologies is critical for stakeholders in politics, industry, and research. We evaluate 209 publications and compare three major recycling routes. An important aspect ...

Lithium-ion batteries (LIBs) present a global challenge in managing their end-of-life (EOL) issues. As LIB"s raw materials are critical and valuable, they are considered as a secondary resource. The volume of publications and patents on LIB recycling has significantly increased, rising a 32% annual growth, compared Journal of Materials Chemistry A Recent Review ...

Improving the "recycling technology" of lithium ion batteries is a continuous effort and recycling is far from maturity today. The complexity of lithium ion batteries with varying active and inactive material chemistries interferes with the desire to establish one robust recycling procedure for all kinds of lithium ion batteries.

This perspective provides a comprehensive analysis of the obstacles that impede the practical implementation of direct recycling, ranging from disassembling, sorting, and ...

Direct regeneration is considered as an environmentally benign and cost-effective way to recycle spent lithium-ion batteries (LIBs). This review comprehensively summarizes the state-of-the-art regene...

A commercially viable direct recycling technique will increase the security of lithium-ion battery component supplies, contribute to their sustainability as an alternative to liquid fuels for energy storage, and serve as a crucial instrument in lowering CO 2 emissions from people, mitigating climate change.

As the dominant means of energy storage technology today, the widespread deployment of lithium-ion batteries (LIBs) would inevitably generate countless spent batteries at their end of life. From the perspectives of environmental protection and resource sustainability, recycling is a necessary strategy to manage end-of-life LIBs.

The center"s mission is to decrease the cost of recycling lithium-ion batteries in order to ensure that critical

materials are available in the future, and to decrease energy use compared to the energy used to produce raw materials. ... Essehli, R.; Belharouak, I. Sustainable direct recycling of lithium-ion batteries via solvent recovery of ...

Typical direct, pyrometallurgical, and hydrometallurgical recycling methods for recovery of Li-ion battery active materials. From top to bottom, these techniques are used by OnTo, (15) Umicore, (20) and Recupyl (21) in their recycling processes (some steps have been omitted for brevity).

Direct recycling technologies of cathode in spent lithium-ion batteries Yi Ji 1, Edwin E. Kpodzro 2,3, Chad T. Jafvert 4 and Fu Zhao 1,2, * 1 Environmental and Ecological Engineering, Purdue University, West Lafayette, IN 47907, USA

Direct recycling methods for spent LIBs aim to repair the structural defects and lithium loss of the cathode materials so that they are directly regenerated into new electrodes without decomposition into the separate elements or destroying the original crystal structure [32, 33].

In contrast with traditional, large-scale, implemented recycling methods, such as pyrometallurgy or hydrometallurgy, direct recycling technology constitutes a promising solution for LIB EOL treatment with outstanding environmental ...