Selective recovery of valuable materials from spent lithium-ion batteries

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With the increase in the demand for energy, recently energy storage devices have become the key components in day-to-day day life. As a result, several types of batteries, particularly lithium-ion batteries (LIBs), have been widely used in modern day electronic devices.

LIBs are considered the first choice for automotive power due to their high energy and power density, high load, and long life. With this enormous demand for LIBs, it is expected that the market size will reach 100 billion USD by 2025. However, Irreversible phase changes in cathodes due to repeated charging and discharging process leads to limited life of LiBs of about 3-8 years. The limited life cycle of these batteries results in more battery production which results in huge spent battery waste. If these spent batteries are not treated/discarded properly, they may bring severe health and environmental hazards, while valuable materials like lithium and cobalt might be lost.

Fig. 1: Spent Lithium-ion batteries (picture from https://thewest.com.au/business/public-companies/lithium-australia-perfecting-battery-recycling-tech-c-396990)

Therefore, recycling and recovery of these spent LIBs is a major concern. Addressing recycling of spent LIBs can significantly reduce the environmental pollution and simultaneously the extracted valuable metals from the spent LIBs help in the circular economy of our country.

Combinatorial Materials Lab focuses on Electrochemical Materials Processing and works on metals recovery from e-wastes like spent LiBs. The lab could successfully recover copper, cobalt, nickel sequentially from spent LiBs through hydrometallurgical and electrowinning methods with minimum or no wastage.

Our work could recover all metals with high purity (>98%). This work was selected among the top eight technologies in TATA Steel Material NEXT 3.0 (2022). It is also presented at the Innovation Day 2023 of IIT Hyderabad.

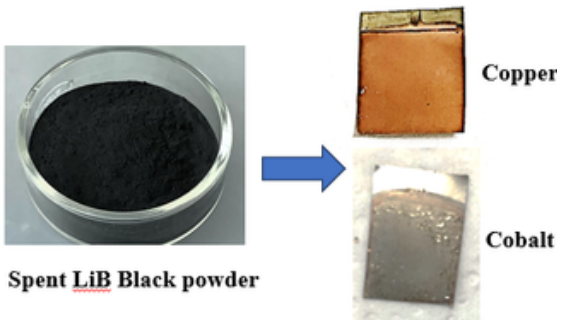

Fig. 2: Recovered metals from the spent LiBs in the Combinatorial Materials Lab, MSME, IITH

With India targeting to become a global hub for electronics manufacturing and design, recycling and recovery of spent LiBs are crucial and important to address e-waste management and can provide significant contributions towards resource management on recovery & reuse of precious and critical materials for specific applications. In addition, recycling and recovery of valuables from spent LIBs contributes to develop a sustainable method for a circular economy while contributing towards Atmanirbhar Bharat.

Fig. 3: Felicitation of Combinatorial Materials Lab members at TATA Steel MaterialNEXT 3.0 (2022).

A technology (TRL 4) on sequential recoveries of copper, cobalt, nickel, and manganese is achieved through combined Hydro- & Electrometallurgical routes from the spent lithium-ion batteries.

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