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Metal recovery from spent lithium-ion batteries (MetCycle)

A greener, faster process for recovering critical metals from spent lithium-ion battery materials.

For battery recyclers, manufacturers and supply-chain partners seeking cleaner domestic sources of lithium, nickel, cobalt and manganese. A team of academics at the University of Cambridge developed new hydrometallurgical process that recovers valuable metals from spent lithium-ion battery cathode materials rapidly at room temperature.

The process is designed to reduce energy use, chemical consumption and waste while improving recovery speed and supporting a more resilient circular battery supply chain.

Background

The rapid growth of electric vehicles and stationary energy storage is driving increasing demand for lithium-ion battery materials, placing pressure on constrained supplies of critical raw materials including lithium, nickel, cobalt and graphite. At the same time, the UK and Europe lack sufficient downstream processing capacity to extract and purify metals from black mass, the shredded metal-rich material produced from spent batteries.

Current recycling routes are limited. Pyrometallurgical processes are energy-intensive and can fail to recover lithium efficiently, while conventional hydrometallurgical approaches often require concentrated acids, sacrificial reagents and long processing times. This creates a need for faster, lower-energy and more sustainable ways to recover metals domestically from battery waste.

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Technology overview

MetCycle uses a proprietary mediator solution to selectively extract valuable metals from spent lithium-ion battery material, commonly known as black mass. Operating at room temperature, the process has demonstrated rapid metal extraction within minutes, achieving high recovery efficiencies while enabling the leaching solution to be reused without loss of performance.

The technology has been validated across multiple commercial black mass feedstocks, and the team is now seeking to scale the process towards larger-scale demonstration and commercial deployment.

Benefits

- Significantly reduced energy requirements compared to both pyro- and hydro- metallurgic alternatives.
- Full solubilisation of metals achieved in minutes at room temperature (hydrometallurgy requires several hours at 90°C).
- Continuous, closed-loop process – allows the facile recovery and re-use of reagents with minimal waste.
- Eliminates the need for sacrificial agents, organic acids, or peroxides.
- Applicable to both existing and emerging nickel-rich cathodic materials.
- Supports domestic recovery of critical battery metals and strengthens circular supply chains.

Applications

Potential applications include recycling services for spent lithium-ion battery, production of recovered critical metal salts for battery manufacturers, integration into existing hydrometallurgical plants, and future continuous-flow recycling facilities.

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Opportunity

Cambridge Enterprise is seeking commercial partners and collaborators to support scale-up, validation, pilot testing of this technology.