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Surrey Uni leads microbe recyling of lithium batteries

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A microbial electrochemical technology capable of recovering 90-95% of lithium from spent lithium-ion batteries has been developed by scientists at the University of Surrey.

The breakthrough offers a more sustainable and cost-effective alternative to conventional recovery methods and could be expanded to reclaim other valuable battery metals, like cobalt.

Funded by the Biotechnology and Biological Sciences Research Council (BBSRC), the BioElectrochemical LIthium rEcoVEry (BELIEVE) project set out to tackle one of the biggest challenges in lithium-ion battery recycling – reducing the environmental and economic costs.

Professor Claudio Avignone Rossa, Professor of Systems Microbiology at the University of Surrey and principal investigator on the project, said:

“Lithium-ion batteries power so much of our modern technology, from phones to electric vehicles, but current recycling processes remain energy-intensive, costly and inefficient. Our goal was to develop a bioelectrochemical system (BES) that uses microbial electrochemical technology to extract high-purity lithium from used batteries – which is currently very difficult to do.”

Traditional methods recover small amounts of lithium, sometimes as little as 5%, while more advanced techniques achieve higher yields but rely on corrosive chemicals.

Professor Jhuma Sadhukhan, Professor of Engineering and Sustainability at the University of Surrey and co-lead on the project said:

“This project is timely due to stringent legislation for material security, particularly tech-metals like lithium. With this respect, extraction-precipitation, electrosynthesis and crystallisation have been tried to recover lithium from brines; however, the methods have posed specific challenges, including low recovery of lithium compounds.

“Biotechnology-based biorefining is needed to close the LIB loop and thereby improve product grades and recovery rates, process robustness, social justice, economic returns, health, safety, environment and legislation. In this research, we optimised a biological system to recover high purity lithium from industrial black mass, a used lithium-ion battery material after thermal and mechanical processing, separating aluminium and iron.”

Dr Siddharth Gadkari, Lecturer in Chemical Engineering at the University of Surrey and co-lead on the project, said:

“By harnessing specially selected microorganisms to transfer electrons and extract lithium, we have developed a cleaner, more sustainable approach that dramatically reduces reliance on harmful chemicals.

“Our next steps will focus on proposals to expand the technology to recover and separate all valuable metals from batteries, including high-value cobalt, nickel and manganese. While challenging, this is a crucial step toward establishing a truly circular battery economy.”

Developing a scalable process that efficiently recovers lithium, cobalt and other valuable metals will not only reduce waste but also lessen dependence on environmentally damaging mining practices.

It also closely aligns with EU Green Deal 2020 regulations, which aim for a 65% recycling efficiency for lithium-ion batteries and a 70% material recovery rate for lithium by 2030. Similar regulations are anticipated in the UK, underscoring the significance of the BELIEVE project’s contributions to sustainable technology and resource management.

The team now plans to put forward new proposes to explore how they can recover all metals from lithium-ion batteries.