Fraunhofer at Hannover Messe 2026

Electrochemical Process Enables Recovery of Valuable Raw Materials

Lithium, cobalt and nickel are in high demand – and they are hard to obtain. Researchers at the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM are developing an electrochemical process to recover scarce raw materials in battery recycling. This new technology could also enable the extraction of rare earth elements from electronic waste in the future.

Demand for lithium-ion batteries, which are indispensable for electric cars, smartphones and laptops, is growing. According to a study by consulting firm Deloitte, lithium imports to Germany rose from 514 million euros in 2013 to 21 billion euros in 2023 – an increase of roughly forty times. Raw materials such as cobalt and nickel are also highly important economically but are difficult to obtain. Importing these materials increases global dependencies.

Researchers at Fraunhofer IFAM in Bremen are working on a solution. "We want to recover valuable raw materials and rare earths at high yield and high purity, thereby closing the product loop and reducing dependencies," explains Julian Schwenzel, Head of Electrical Energy Storage at Fraunhofer IFAM.

Reduced dependency on critical raw materials

In the MeGaBat project, which focuses on methods for electrochemical extraction of active battery materials, researchers are developing an electrochemical process for isolating materials such as lithium, cobalt and nickel in battery recycling. The researchers are also planning to use the process to recover rare earths.

The idea behind the technology: The process water that accumulates in battery recycling is routed to an electrochemical reactor. The reactor holds two electrodes produced by the researchers at Fraunhofer IFAM by screen printing. "With their special properties, the electrodes selectively extract and store ions from the wastewater," explains Cleis Santos, manager of the group for Electrochemical Processes for Recycling and Water Treatment. "This enables them to extract, for example, lithium ions, and we then obtain the separated substance as a high-purity powder at the end of the process."

The purified water is returned to the process after isolation of the desired substance. With the appropriate modifications, the electrodes can also be used to uptake and recover other scarce

raw materials from wastewater, such as cobalt, nickel or copper. "In the long term, it is conceivable that wastewater could be routed through multiple reactors in a large-scale system," Santos explains. "We could thus recycle various critical raw materials within the same plant."

In contrast to current recycling methods such as pyro and hydrometallurgical processing – which is very energy-intensive and generates a lot of CO_2 – the new technology works without chemicals such as bases or acids and requires less energy, making it more cost-effective.

In addition to improving the purity of the recovered raw materials, the efficiency of the entire process can also be improved by an estimated 30 to 40 percent. This is a crucial advantage, Schwenzel explains: "In the future, EU regulations will require that manufacturers more frequently declare their total carbon footprint from raw material to finished product, and new products must also contain a greater fraction of recycled material." Efficiency and quality of recovery are therefore becoming increasingly important."

The researchers have already successfully tested this new technology in the Fraunhofer IFAM laboratory. The team is currently working on a large-scale pilot plant. This could also recover rare earth elements in the future, such as from electronic waste: "So far, we've had to import 100 percent of our rare earth elements. "Our process would enable us to reduce this dependency," says group leader Santos.

The researchers will be presenting a model of the electrochemical process at Hannover Messe. In addition to recycling batteries, as well as recycling rare earth elements from electronic waste in the future, this technology is also of interest for seawater desalination and hospital wastewater treatment.

Funded by the German Federal Ministry of Research, Technology and Space (BMFTR), the MeGaBat project will continue until the end of 2028.



Fig. 1 Researchers at Fraunhofer IFAM are developing specialized electrodes that recover valuable metals such as lithium and cobalt from the process water accumulated during battery recycling. © Fraunhofer IFAM

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