FACTSHEET #15

The objective of RESiLEX is to improve the resilience and sustainability of the entire Silicon value chain and reduce EU dependence on critical raw materials used in solar panel and Li-ion battery production. Silicon is considered a critical raw material for the EU due to its high supply risk and strategic economic importance, mainly because of heavy reliance on imports

From Solar to Batteries – Recycled Silicon for Energy Storage

The goal: recycled silicon as a battery material.

One of the primary objectives of the RESiLEX project was to demonstrate that silicon recovered from end-of-life solar panels can be successfully reused in the manufacturing of lithium-ion batteries. Material Synthesis: The recycled silicon was combined with carbon to produce a "**Si/C composite**" for use as battery anode active material (negative electrode).Prototype Manufacturing: At CEA, 24 pilot-sized pouch cells with a capacity of 2.2 Ah each were assembled. This format is commonly used in a wide range of modern electronic devices. Through **rigorous testing**, a total of 20 cells were systematically tested at the CEA and CSEM research centers to evaluate their initial performance, long-term stability, and operational limits under various mechanical and electrochemical conditions. The manufactured cells demonstrated good initial quality, achieving an energy density of 250 Wh/kg, a promising result for current lithium-ion battery technology.

The goal: recycled silicon as a battery material.

The work carried out by project partner CEA validated the quality of the produced Si/C composite and demonstrated the technical feasibility of integrating recycled silicon into Li-ion batteries. However, the results also identified several areas requiring further development before practical implementation, including the fine-tuning of voltage operating windows and deep of discharge level to ensure stable electrochemical performance.

The Challenge of "Deep Discharge": An important challenge was the rapid degradation observed at 100% depth of discharge (DoD). The Si/C composite material undergoes excessive stress during repeated full charge/discharge cycles, resulting in accelerated capacity fading.

The Solution: Optimizing Battery Utilization: The results showed that the batteries lifetime can be significantly improved by limiting the DoD. This was adequately achieved by increasing the lower voltage cutoff, which limits DoD events and helps to mitigate the performance decay.

- **Doubled Lifespan**: Avoiding full discharge of the battery by increasing the minimum voltage cutoff from 3.3 V to 3.5 V doubled the cycle life, with the cells retaining 80% of their initial capacity after 130 cycles.
- **Long-Term Stability**: Raising the lower voltage cutoff to 3.4 V limits capacity to 1.2 Ah (55% DoD) but significantly improves cycling stability, achieving 74% capacity retention after 400 cycles.

What's next?

Silicon that once generated solar energy can now be used to store it in Li-ion batteries, as the feasibility of integrating end-of-life silicon as an active anode material through a viable upcycling process has been successfully demonstrated. To advance this technology toward mass market readiness, future work will focus on:

- Reducing the initial capacity loss that occurs during the first few cycles by tuning the silicon carbon surface and morphology.
- Improving electrolyte formulations to better stabilize the solid-electrolyte interphase and protect silicon particles.
- Optimizing cathode electrode design to enable an appropriate N/P ratio balance and support deeper discharge operation without compromising structural degradation.

This breakthrough brings Europe closer to a more self-sufficient and circular battery industry value chain, reducing material waste and dependency on primary raw material mining.

Find out more on our channels

resilex-project.eu

RESiLEX Project

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