Bio-sourced Alternatives for Lithium-Silicon Anodes (BALSA)

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BALSA
BIO-SOURCED BATTERIES

WP1 – Bio-sourced porous Si

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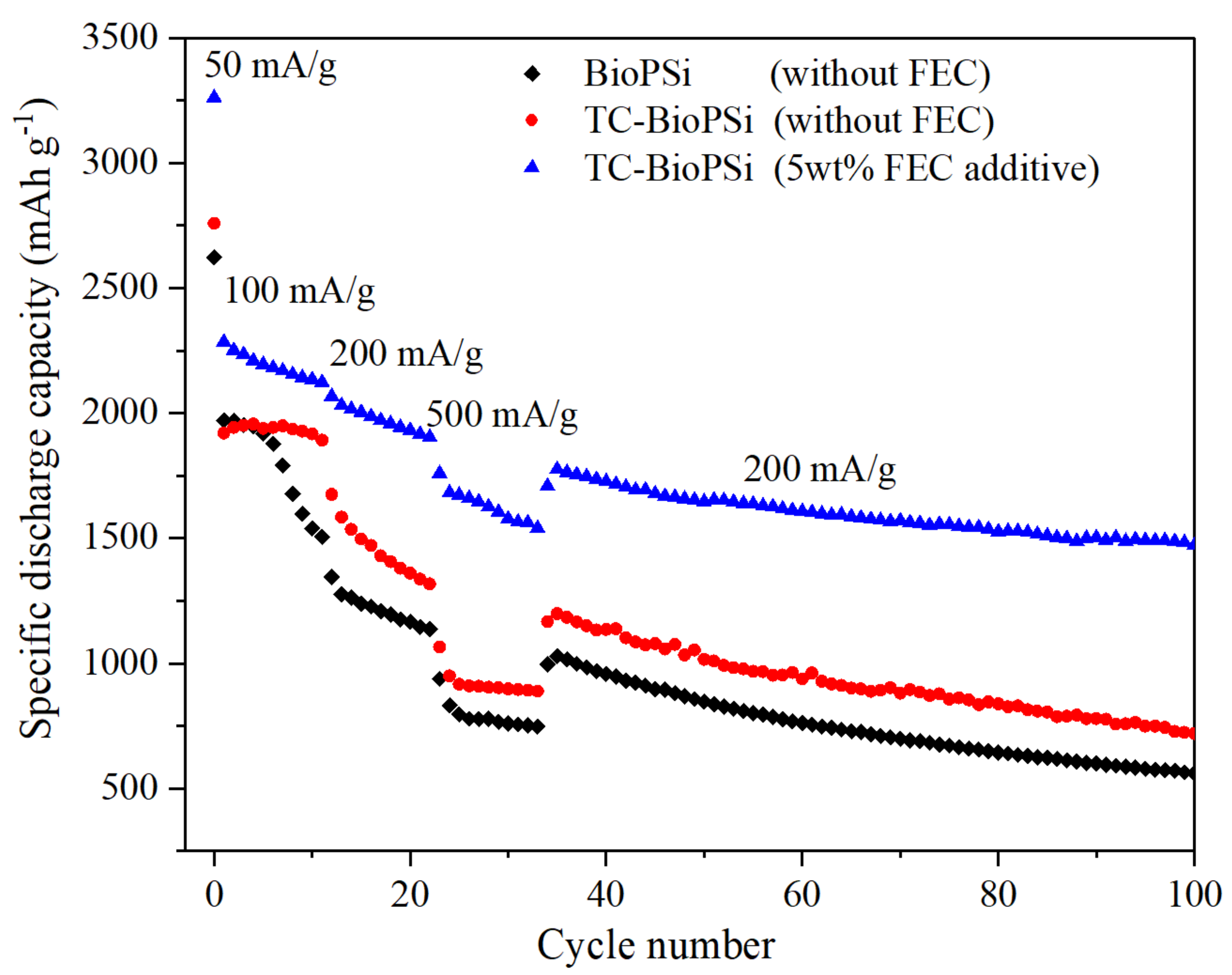
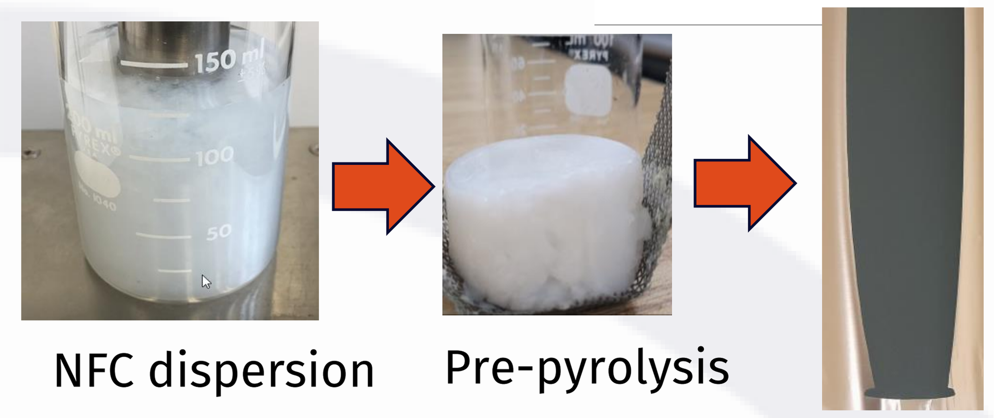
Barley husk is acid-washed and pyrolyzed to obtain porous SiO_2. Magnesiothermic reduction converts to Si, preserving meso-/microporous phytolith structure. Thermal carbonization modifies and protects the surface.



WP2 – Bio-based, free-standing Si/CNF electrode

Nanofibrillated cellulose (NFC) is converted to carbon nanofiber (CNF) to function as conductive additive. Dispersing with Si, supercritical CO2 drying, and pyrolysis to obtain aerogel. Aerogel process adapted to electrode casting. The anode was prepared using a Si:NFC ratio of 1:1.33 (w/w). CMC and PAA were used as binders to enhance the mechanical properties of the formed anode film.

PERFORMANCE BioFilaments
CÉPROCQ Centre d'études des procédés chimiques du Québec, Collège de Maisonneuve



NFC dispersion — Pre-pyrolysis — Pyrolyzed and casted anode

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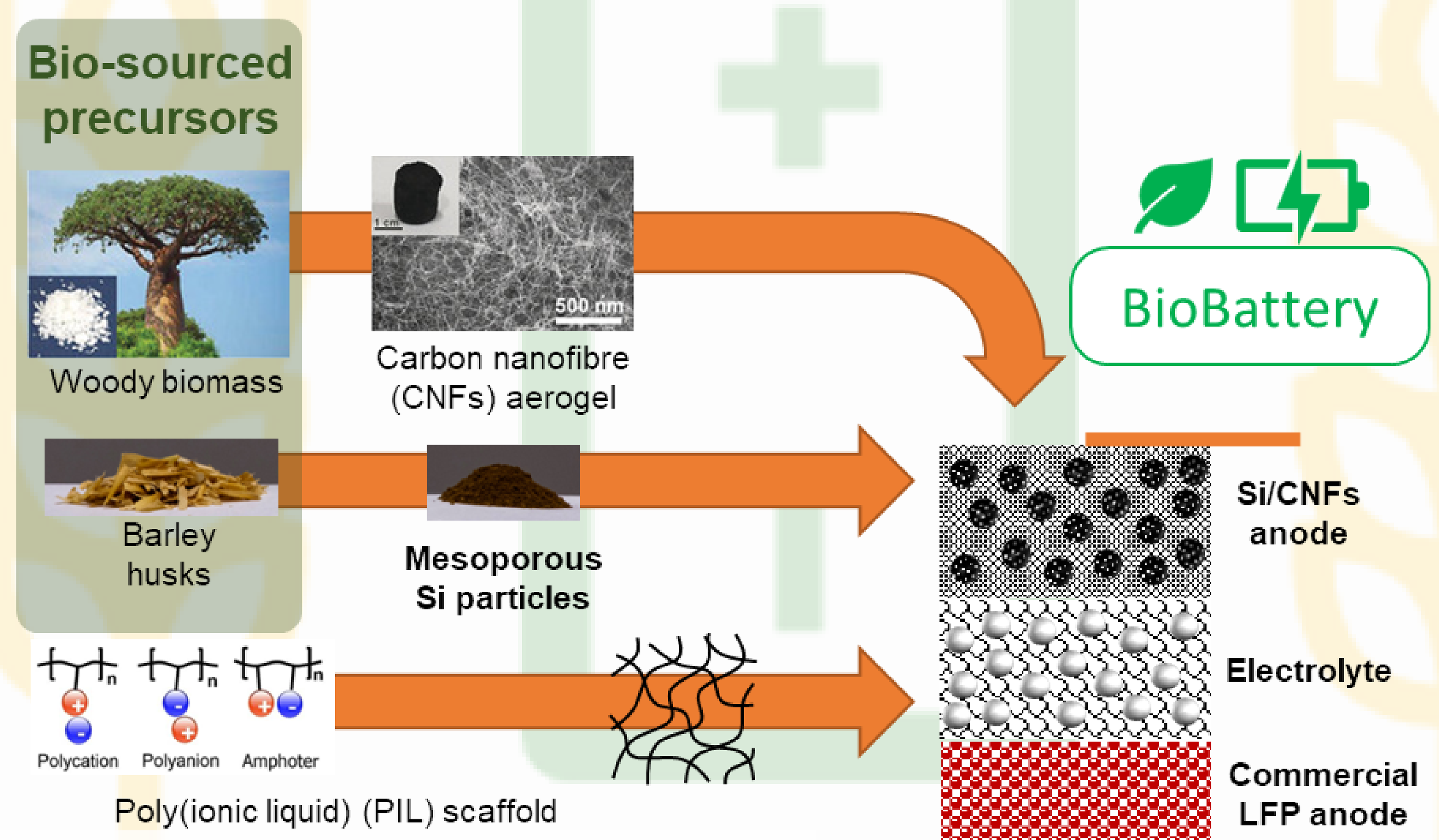
THE BALSA PROJECT CONCEPT

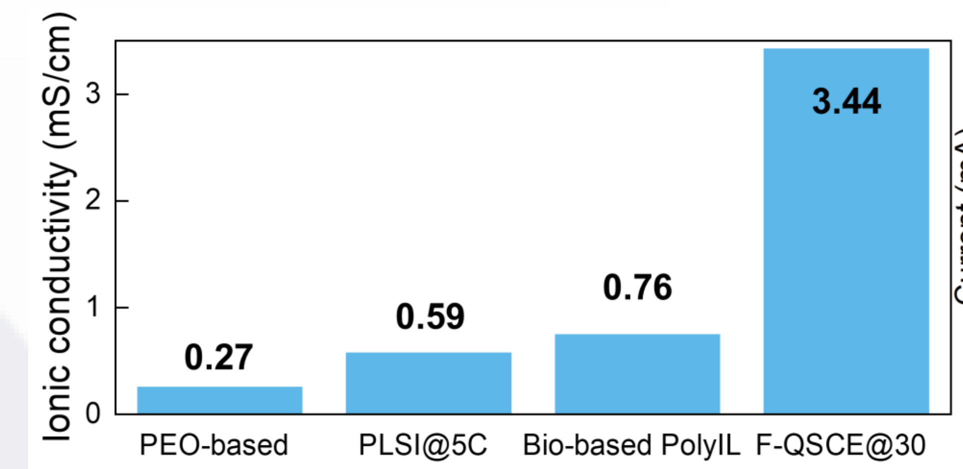
BALSA project aims to develop a bio-based Li-ion battery (LIB) anode and quasi-solid-state electrolyte, in which the active and supporting materials are derived from biological sources, i.e., from plants.

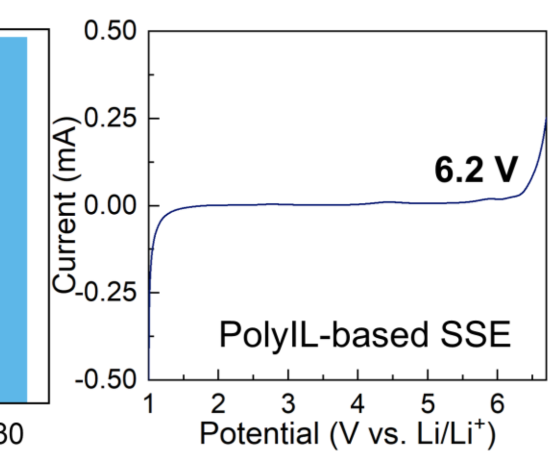


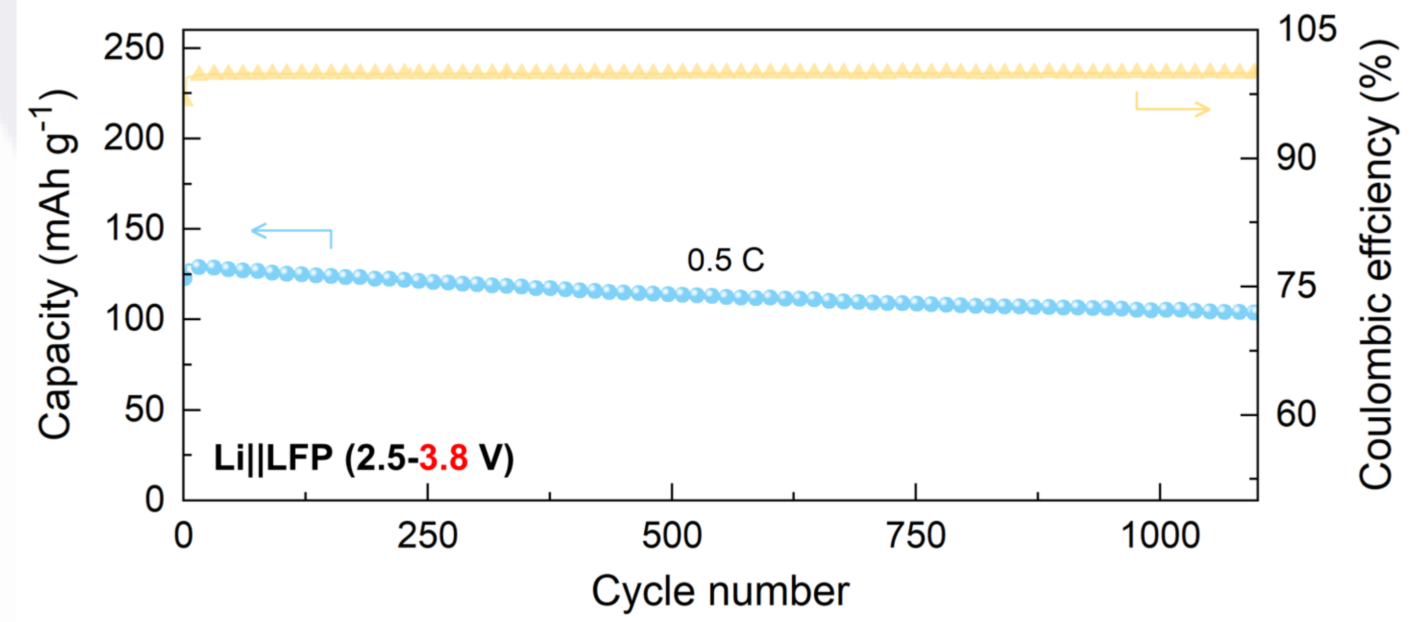
WP3 – Bio-based electrolyte

From PEO-based SSE to PolyIL-based SSE or SSE with SiO_2 fillers, the ionic conductivity, electrochemical stability window, and cycling life of Li//LFP cells gradually increased, successfully meeting the project objectives.

LULEÅ TEKNISKA UNIVERSITET

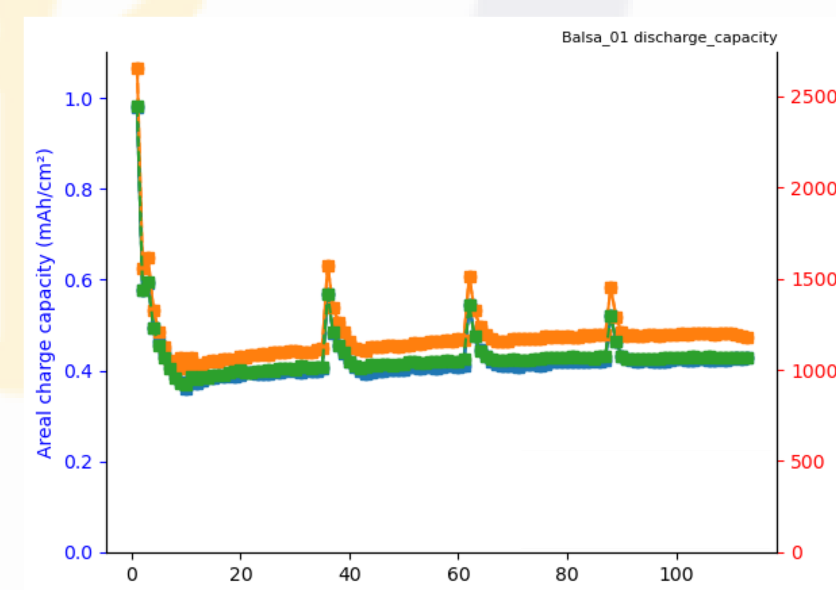


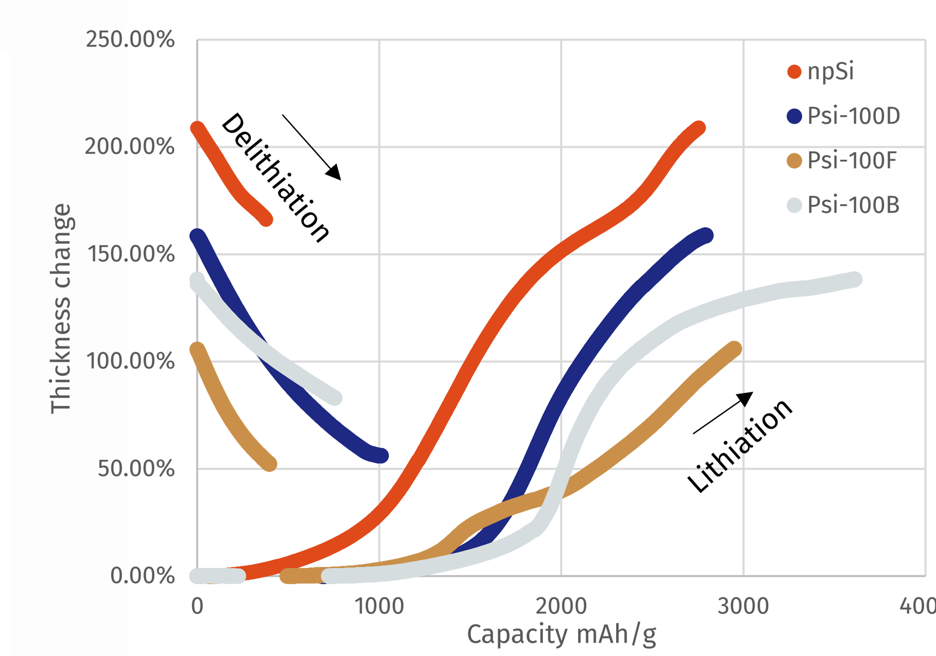


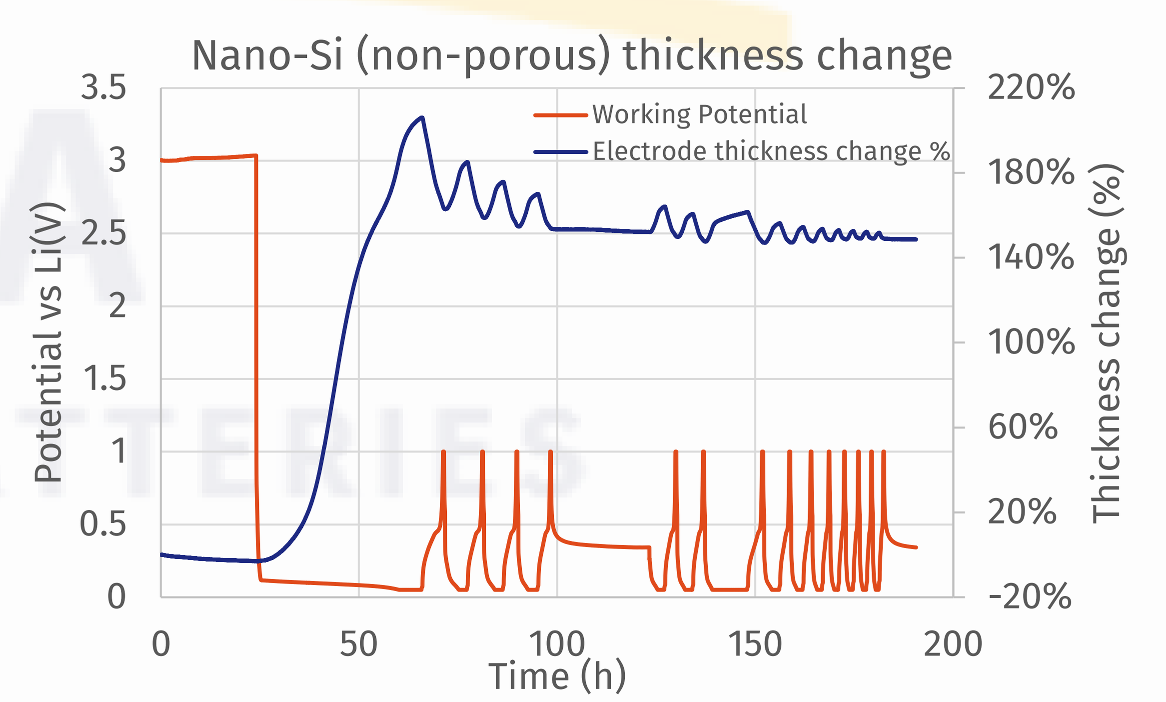


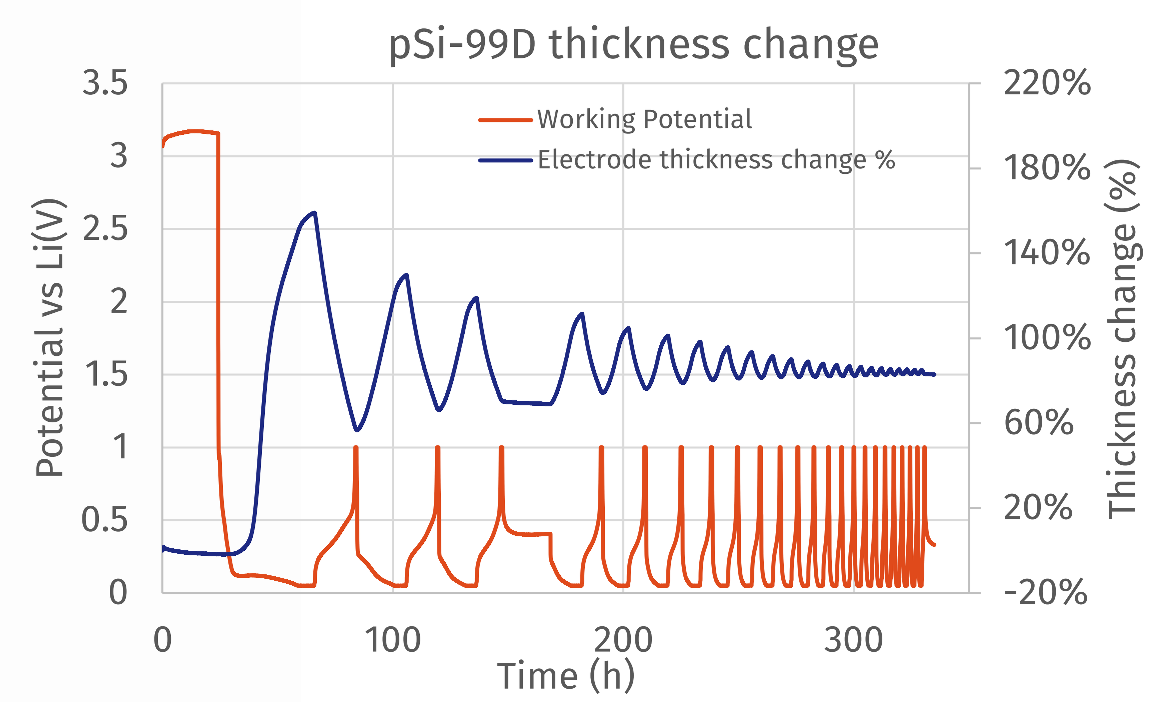
WP4 – Assembly, prototyping, characterization

Dilatometry study has been employed to track the volume expansion of porous Si vs. nano-Si, as a function of thermal annealing, affecting specific surface area and pore diameter.









WP5 – Life cycle assessment

Lab-scale, cradle-to-gate analysis identified calcination of porous Si as the most energy intensive step. Barley husk is free, but processing adds high environmental impact, which are strongly affected by low yield and small scale. Prospective LCA will simulate various production scenarios and projecting to industrial-scale to 2040.

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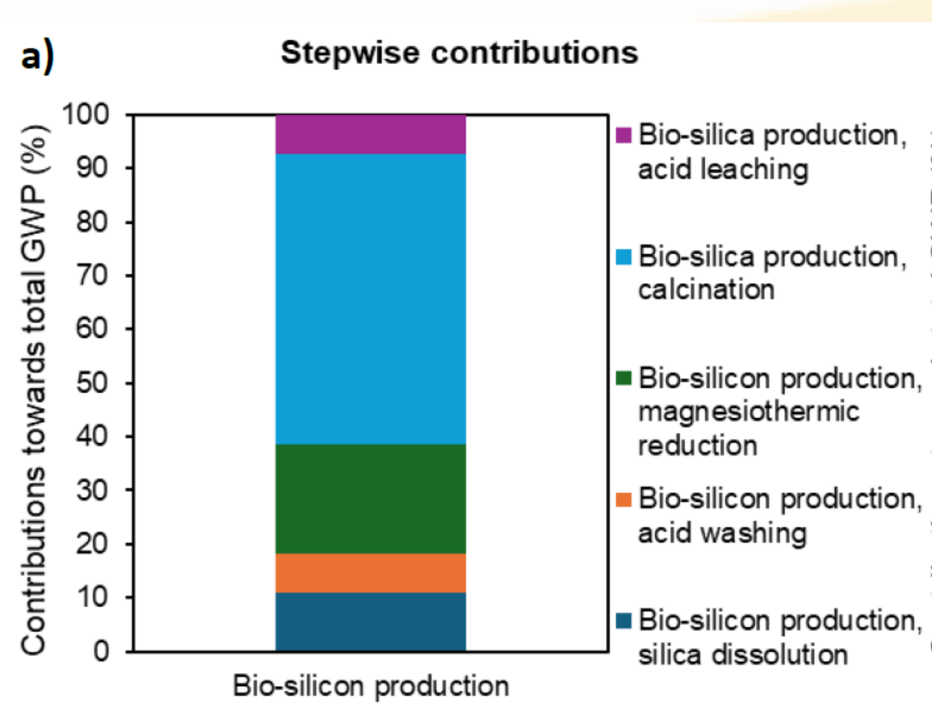

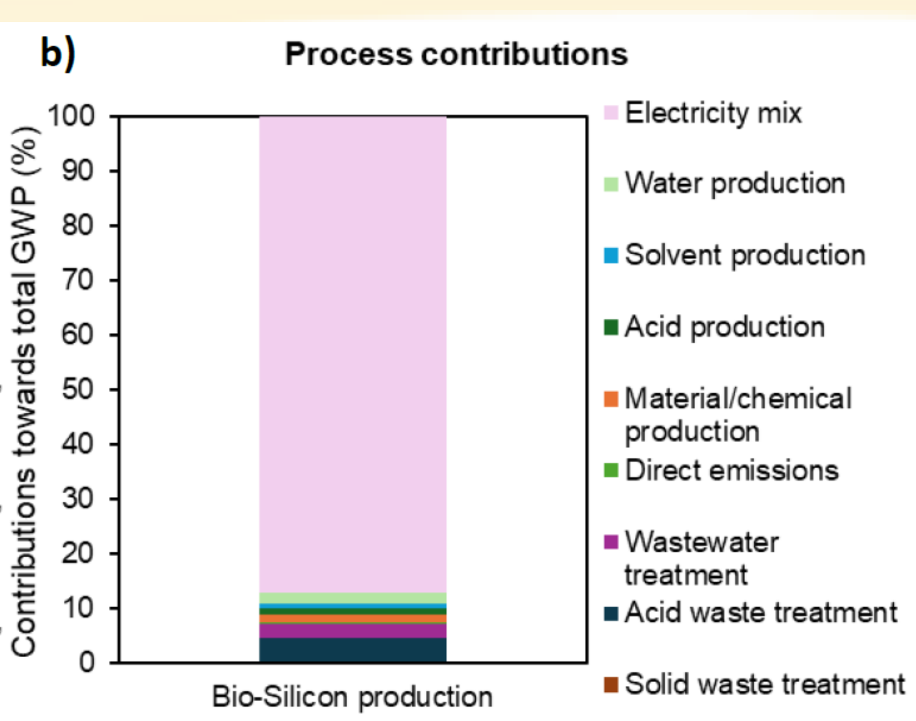

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