NEWSLETTER

ECO2LIB Project Newsletter

Dear readers,

Welcome back to the third newsletter of the Horizon2020-project ECO2LIB. In this issue, we want to give you an overview of the project activities in the first half of the second year. In addition, for new readers, we also provide a short summary of the ECO2LIB project and some more information on the project consortium.

I hope you enjoy the newsletter and the activities we are doing!

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ECO²LIB Project

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Summary of the ECO2LIB project

After the successful EU-project Sintbat, ECO2LIB aims to continue the effort by focusing on a new KPI, the cycle related costs per energy: €/kWh/cycle. This KPI very well reflects the real need of the customers in the energy storage market if a minimum volumetric energy density is added. The research and development activities will be supported by a clear recycling concept and an extended Life Cycle Assessment, to judge the environmental impact of the different options and to choose the best. To show both ECO-aspects (ECOlogical and ECOnomical) of our project the acronym ECO²LIB was created.
The consortium decided to continue the improvement of the well-established Lithium-Ion system with advanced materials, methods, and corresponding recycling-concept. So, it will be possible to directly exploit the results of ECO²LIB in an IPCEI project, which is under preparation.

Summary of the project progress

COVID-19 was continuing to impact our project activities. Thus, an amendment was prepared to extend the project by six months. Still, some progress was made and as summarised as usual:

Electrodes and Electrolytes: Better cycle life could be demonstrated using lithium thin film deposition without impacting the energy density.

A fast and scalable method for the preparation of a 3D current collector for negative Li-Ion electrodes has been developed. In tests, the 3D current-collector based electrodes showed excellent cycling stability.

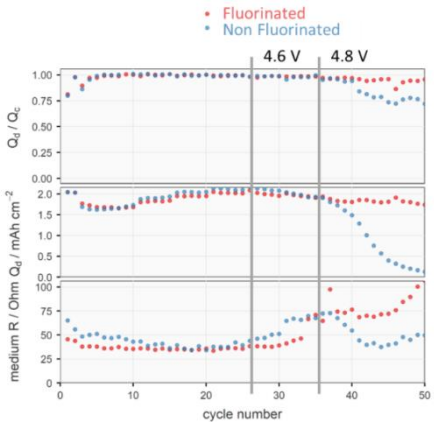
Following the development of a highly liquid electrolyte in the first project months, the focus was now on creating an electrolyte with a higher content of polymer gelifiers. These activities encountered some challenges and are currently still in full progress. More results are expected by the end of the year.

Using the results of the first 18 project months, Generation 1 CoinPower cells with 10% improved capacity have been manufactured. The set target was exceeded, as the cells performed significantly in terms of capacity than the reference cells.

Requirements specification: Different requirements and specifications have been established for two dedicated use cases in high energy and high power applications. Afterwards, different cycling tests were performed to verify the application profiles and underlying expectations.

Recycling: The preliminary design of the foreseen recycling process was finalised. This process will now be validated with a lab-scale test that has been defined. Afterwards, a second and improved version of the design will be realised.

Characterisation: The main focus of this period was to finalise the multiscale morphological/structural characterization of the silicon-based materials. Due to the COVID-19 impact on supply chains, some delays in materials and thus characterisation activities occurred. Still, the foreseen progress was made. As for the characterisation of the electrolyte developed, similar electrochemical performance has been obtained with the fluorine-free as electrolyte compared to the highly fluorinated electrolyte, despite the differences in ion transport properties. However, the battery ageing and the decomposition products are different for each electrolyte. This suggests that fluorine-rich passivation layers are not required, and stable layers can also be formed with more environmentally friendly and less toxic electrolytes, such as fluorine-free alternatives.



Electrochemical results comparing full cells with fluorinated and fluorine-free electrolytes.

Sustainability: The ecological assessment of the storage design of the final system was a main activity of the past six months and is still ongoing. In addition, the main ecological drivers of different state-of-the-art recycling processes have been analysed. This allowed the project to identify savings potentials and derive recommendations for the ECO2LIB recycling process.

Publications

Publications in journals

Multi-scale quantification and modeling of aged nanostructured silicon-based composite anodes

Vorauer, T., Kumar, P., Berhaut, C.L. et al., Commun Chem 3, 141 (2020)

"Advanced anode material designs utilizing dual phase alloy systems like Si/FeSi2 nano-composites show great potential to decrease the capacity degrading and improve the cycling capability for Lithium (Li)-ion batteries. Here, we present a multi-scale characterization approach to understand the (de-)lithiation and irreversible volumetric changes of the amorphous silicon (a-Si)/crystalline iron-silicide (c-FeSi2) nanoscale phase and its evolution due to cycling, as well as their impact on the proximate pore network." Read more: https://doi.org/10.1038/s42004-020-00386-x

Surface Oxidation of Nano-Silicon as a Method for Cycle Life Enhancement of Li-ion Active Materials

Ratynski, M., Hamankiewicz, B., Buchberger, D. A. et al., Molecules 2020, 25(18), 4093

"Among the many studied Li-ion active materials, silicon presents the highest specific capacity, however it suffers from a great volume change during lithiation. In this work, we present two methods for the chemical modification of silicon nanoparticles. Both methods change the materials' electrochemical characteristics. The combined XPS and SEM results show that the properties of the generated silicon oxide layer depend on the modification procedure employed." Read more: https://doi.org/10.3390/molecules25184093

Articles

Ageing of nanostructured silicon-based composite anodes: Morphology changes and inhomogeneous lithiation

Brunner, R. (2020)

"Alloy systems like Si/FeSi nano-composites have great potential as stable anode materials in Li-ion batteries, but their characterization at different scales and throughout their ageing remains challenging due their complex architecture." Read more: https://go.nature.com/3lWmRuC

Innovatives Materialdesign für hocheffiziente Energiespeicher [German]

Brunner, R. (2020)

"Ohne effiziente Energiespeicher und einhergehende Kosteneffizienz wird es keine Energiewende geben. Wie kann Energie möglichst effizient und über eine Vielzahl von Lade- und Entladezyklen gespeichert werden?" Read more: https://www.just-magazin.com/innovatives-materialdesign-fuer-hocheffiziente-energiespeicher/

Improving the Design of Anode Materials in Lithium Ion Batteries

Interview with R. Brunner on the ZEISS Blog

"Researchers use advanced imaging methods to understand the structure-property relationship

Dr. Roland Brunner is a Group Leader for Material and Damage Analytics in the Microelectronics Division at the Materials Center Leoben (MCL) in Austria. The group strongly focuses on 3D nano/micro-structure image- based characterization and analysis with respect to innovative materials used in microelectronics and energy, to trigger improved functional material design for industrial applications." Read more: https://blogs.zeiss.com/microscopy/en/fesem-anode-materials/

Elektrolyt utan giftigt fluor ger elbilsbatterier samma prestanda

Kristensson, J. (2020)

Article on the development of fluorine-free electrolytes at Uppsala University

https://www.nyteknik.se/batterier-premium/elektrolyt-utan-giftigt-fluor-ger-elbilsbatterier-samma-prestanda/1177032

Conferences, seminars, lectures

Date	Presentation title	Event	Speaker
26.05.2020	Operando synchrotron experiments and porous-electrode modeling: a combined approach. Case study: sequential lithiation mechanisms in Silicon-graphite blended anodes.	Battery 2030+ workshop	S. Lyonnard (CEA)
03.09.2020	Elimination of Fluorination: The Influence of Fluorine-Free Electrolytes on the Performance of Si-based Li-ion Batteries	ISE meeting	G. Hernández (Uppsala)
15.10.2020	Monitoring Li-ion batteries by advanced operando neutron techniques	ILL-ESS user meeting satellite workshop	S. Lyonnard (CEA)
11.2020	Elimination of Fluorination: The Influence of Fluorine-Free Electrolytes on the Performance of Si-based Li-ion Batteries	2020 Virtual MRS Spring/Fall Meeting & Exhibit	G. Hernández (Uppsala)
03.12.2020	Ecologically and Economically viable Production and Recycling of Lithium Ion Batteries	H2020 Low TRL Smart Grids and Storage Projects clustering event	B. Achzet (VARTA Storage)

The project consortium

VARTA Microbattery GmbH (Germany)

VARTA Microbattery (VMB) is an internationally leading and globally active manufacturer of retail and OEM batteries and has been operating for more than 125 years. Read more

CEA (France)

CEA is a French government-funded technological research organization. With more than 15,000 researchers and co-workers, its activities cover four main areas: Energy, Defence & security, Health & information technologies, and Fundamental research. Two institutes from CEA, both located on the CEA Grenoble centre, are involved in the ECO²LIB project. Read more

Warwick Manufacturing Group (UK)

WMG is a world leading research and education group, transforming organisations and driving innovation through a unique combination of collaborative research and development, and pioneering education programmes. Read more

VARTA Innovation GmbH (Austria)

VARTA Innovation GmbH (VI), with registered office in Graz, was founded in 2009 as a joint venture between VARTA Microbattery and Graz University of Technology. Within VARTA Innovation both, the industrial fabrication know-how from VARTA Microbattery and the basic research know-how from Graz University of Technology for various electrochemical energy storage systems are merged. Read more

EurA AG (Germany)

EurA AG has been established in Ellwangen (Baden-Württemberg, Germany) in 1999. The company currently employs more than 140 persons on 9 locations in Germany, Portugal, and Belgium. As an innovation service provider, EurA advises more than 1,500 mainly medium-sized companies in Germany, covering all industrial sectors. Read more

Uppsala University (Sweden)

Uppsala University, founded in 1477, is the oldest University in the Nordic countries, and generally ranked among the top 100 universities in the world. Today, it trains more than 43,000 students, and employs 6,000 people. There are about 2,500 active graduate students; 44% of these are women. Each year, the University awards some 270 doctoral degrees. Read more

Materials Center Leoben Forschung GmbH (Austria)

The Materials Center Leoben Forschung GmbH (MCL) is the leading Austrian institution in the field of applied materials science with around 150 employees. Read more

VARTA Storage GmbH (Germany)

VARTA Storage GmbH (VS) is a developer and manufacturer of stationary battery storage systems based in Nördlingen, Germany. The company has substantial know-how in the field of energy storage by using long-life lithium-ion batteries and conducts in this context innovative research and development activities. Read more

University of Warsaw (Poland)

University of Warsaw (UW) was founded in 1816. The University brings together scholars from a variety of disciplines. It is the place of a diversity of scientific research. Nearly 60,000 people study at the University of Warsaw every year. Read more

ACCUREC Recycling GmbH (Germany)

Accurec is a German SME company, founded in 1995 with its primary target to constitute the consumer battery recycling market in Germany. Read more

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