



SPINMATE

Scalable and sustainable Pilot line based on INnovative MAnufacturing TEchnologies towards the industrialisation of solid-state batteries for the automotive sector



SPINMATE 3RD NEWSLETTER

OCTOBER 2024



This newsletter will keep you informed about the project progress, research findings, and upcoming events. We will also share initiatives performed by the project partners to present their institution and role in the project, as well as presenting the impact of our work on the broader scientific community.

SPINMATE CONSORTIUM

SPINMATE is a Horizon Europe project with 13 partners distributed among 7 countries, together with a mission to demonstrate a scalable, sustainable, safe, and cost-effective digital-driven proof-of-concept pilot line, at a Technology Readiness Level 6, as a first step towards the large-scale manufacturing of generation 4b (Gen 4b) SSB cells and module, to support the electrification of the automotive sector.

LATEST UPDATES



Project General Assembly and Review Meeting

The third General Assembly and the first Review Meeting were held on April 16th and 17th, 2024, respectively, at **ABEE** in Ninove, a city and municipality in the Flemish province of East Flanders in Belgium. During the General Assembly, we explored and strategized the road ahead, setting clear objectives and defining actionable steps for the future. The Review Meeting marked a significant milestone where we shared the project's overall progress with the PO, **Ms. Monica Giannini**, and meticulously assessed critical task milestones.

Clustering with European Initiatives and projects

First Hybrid Workshop

The First Hybrid Workshop about “Solid State Li-Metal Batteries Towards a Circular Economy: potentials vs. Challenges” was held in Liège, Belgium, on December 12th, 2023. This event was organised by SPINMATE and facilitated by **ABEE & INOVA**. The day was packed with innovation, collaboration, and the latest sustainable energy solutions.

The event highlighted vital insights from collaborative clustering efforts, with SPINMATE playing a critical role in advancing innovations within the SOLID4B cluster. It also focused on sustainable energy, particularly solid-state battery technology, and its contribution to a greener future.



Going solid for safer batteries



Second Hybrid Workshop

The Second Hybrid Workshop about “Scaling up high-energy-density solid-state batteries: A lab-to-pilot perspective” was held in Ninove, Belgium, on April 15th, 2024. The event was organised by SPINMATE and facilitated by **ABEE & INOVA**. SPINMATE was represented by **Rahmandhika Firdauzha Hary Hernandha** as a host and, as presented in the picture above, **Andy Schena**, **Daniela Fontana**, and **June Blanco** (from left to right), who are presented as keynote speakers.

During this Second Hybrid Workshop, we also had the opportunity to have a panel discussion with our esteemed Advisory Board members: **Patrick Van Den Bossche** and **Gabriele Ferrara**, hosted by **Bozorg Khanbaei** as BEPA representative.

Solid4B cluster works to enhance research synergies among the European-level projects working on solid state batteries, translating research data into valuable knowledge for diverse stakeholders. This cluster was built to synchronize and conjointly promote the R&D topics in the electric vehicle field.



SEMESTRAL HIGHLIGHTS

Components development for solid-state batteries

In the Development and Optimisation of Cell Components work package, the development of the SPINMATE battery components has been completed. Solid polymer electrolytes (SPEs) with ionic conductivity of 1 mS/cm at room temperature, high oxidative stability of almost 4.5 V, and high resistance to dendrites growth were developed by **CIC energigUNE** and **ARKEMA**.

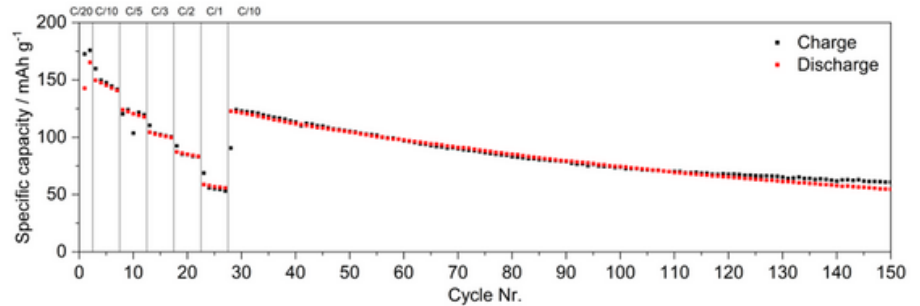


Figure 1. SPINMATE cell cycling (lab-scale trials).

These SPEs were tested in full coin cells, with lithium metal anodes developed by **ABEE**, and solid-state cathodes developed by **CIDETEC** and **CERPOTECH**, with active material loading of 12 mg/sqcm. Cells showed initial specific capacity of ca. 160 mAh/g at C/20, 50 mAh/g at C/1 (Figure 1). Solid polymer electrolytes with optimized formulation are being upscaled for production of 50 monolayer pouch cells.

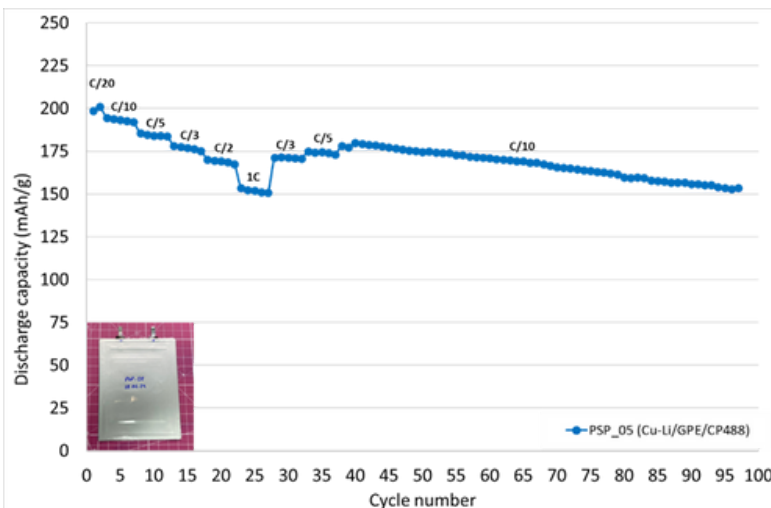


Figure 2. Electrochemical performance (C-rate capability and cyclability) of a "Cu-Li/GPE/NMC811" single layer pouch cell with upscaled solid-state cathode. Testing conditions: C/10 (charge), 3.0-4.3V, 25°C.

Optimisation and development of positive electrode

In the first phase of the SPINMATE project, **CIDETEC** optimized the NMC811-based positive electrode formulation, which contains a catholyte developed in collaboration with **CIC energigUNE** and **ARKEMA**. Once prepared, this cathode was validated in coin cell by electrochemical techniques to guarantee the electrochemical performance and reproducibility. In this second phase of the project, the optimized formulation was upscaled in **CIDETEC** pilot plant for its further integration in single-layer pouch cells.

Thus, a ~1 kg batch of cathode slurry was prepared for manufacturing a homogeneous roll of ~26 m of one-sided solid-state cathode. Finally, this electrode was validated in single layer pouch cell with the gel polymer electrolyte (GPE) developed by **CIC energigUNE** and Cu-Li anode by **ABEE**, obtaining high discharge capacity and coulombic efficiency values at room temperature (Figure 2).

SEMESTRAL HIGHLIGHTS

Adjustments and workshop activities

ABEE and **COMAU** conducted necessary adjustments and workshop activities from the end of 2023 to early 2024. They handled the optimisation process for pilot line equipment for battery making and assembly, as well as Li-Metal instruments for SPINMATE projects. Several Pilot Line and Solid-State Electrolyte Battery Team members from **ABEE** and six people from **COMAU** participated in this activity.

During the SPINMATE GA and Review Meeting, period 1 (April 2024) in **ABEE** HQ, Ninove, Belgium, **ABEE** and **COMAU** conducted a workshop on Li-Metal instrument optimisation.



Figure 3: New cutting-edge full-vacuum Li-Metal coater equipment in the ABEE's dry room facility



Figure 4: Upgrades of ABEE's pilot line assembly part

SEMESTRAL HIGHLIGHTS

Adjustments and workshop activities

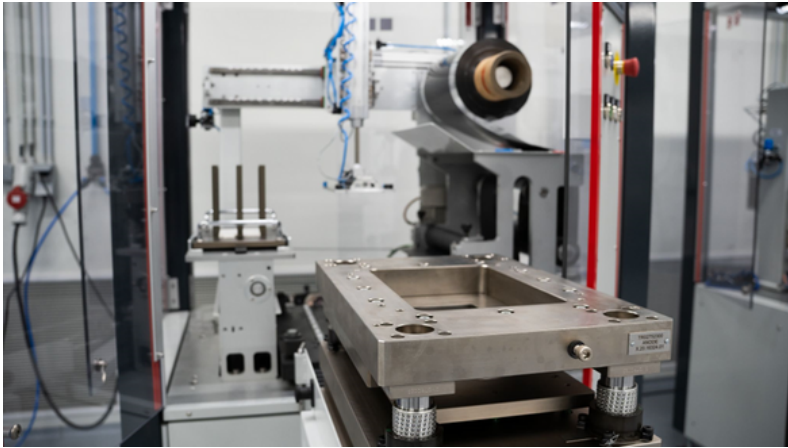


Figure 5: Upgrades of ABEE's pilot line assembly part

This activity is vital to know more about the adjustment possibility and digital twin design of several pilot line equipment and Li-metal coater for the SPINMATE project. Further development and design optimisation are essential and will continue through intensive Ad Hoc virtual meetings. The output of this workshop will be used as fundamental knowledge to improve pilot line equipment and Li-metal coater instrument development for SPINMATE and future Li-ion battery-based European Projects as well as **ABEE** in-house projects.

Process modelling

Development of models to simulate the different process steps of cell manufacturing is going on in the SPINMATE consortium.

COMAU has started to develop Machine-Learning algorithms to model the electrode preparation processes, on the basis of the data collected in the first period of the project. Data cleaning and pre-processing tools have been developed and tested to be reusable, to enable the application of the same methods also to future datasets. Benchmarking of ML models for regression tasks has been performed, identifying the most suitable ones for the following developments within the project.

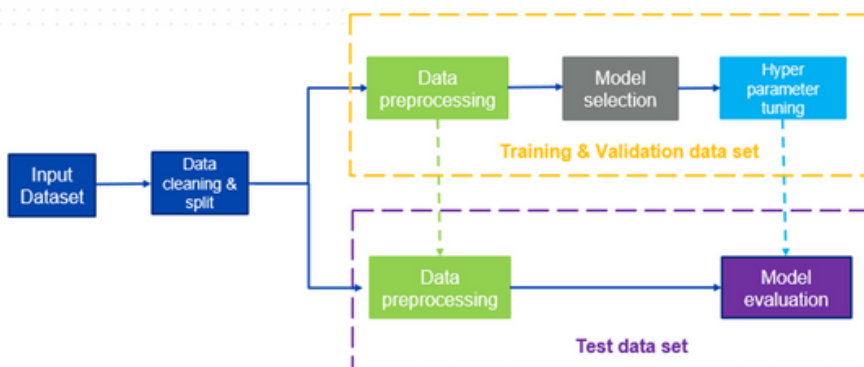


Figure 6: Overview of the Machine Learning Workflow

WITHIN THE SECOND YEAR OF THE PROJECT, THE COMPLETION OF THE DATA COLLECTION IS EXPECTED. DATA COLLECTION IS BEING FINALISED WHICH WILL BE A REPRESENTATIVE OF A WIDE SCENARIO, CHARACTERIZED BY AN HETEROGENEOUS LARGE DATA VOLUME. ONCE PREPARED, THE CATHODES WILL BE CHARACTERIZED AND VALIDATED BY PHYSICOCHEMICAL AND ELECTROCHEMICAL TECHNIQUES TO GUARANTEE THE ELECTROCHEMICAL PERFORMANCE AND REPRODUCIBILITY.

AHEAD OF THE CURVE

During SPINMATE life cycle 3 training pills targeting the workers of the battery industry and research infrastructures will be developed for reskilling and upskilling them in the new SPINMATE solutions.

The first Training Pill can be found on SPINMATE's LinkedIn and YouTube and it is structured by the following six topics and respective targets:



Figure 7: Training Pill on General Aspects of SPINMATE

1. General Aspects

Lowering carbon emissions and improving safety across the battery value chain to ensure sustainability and competitiveness.

2. Battery Materials

Enabling flexible production of mixed oxide materials with high sinterability, aiding solid-state battery development.

3. Manufacturing of cell components

Targeting better performance, stability, and cost by enhancing polymer electrolyte conductivity and oxidative stability.

4. Production Tools

Improving lithium anode morphology and reducing thickness, while PVD methods enhance control and scalability.

5. Testing Batteries

Testing battery performance under various conditions and ensuring safety with abusive tests like thermal runaway.

6. The future of technology

Assessing environmental impact and optimising processes for long-range, fast-charging, and affordable electric vehicle batteries.

Training Pills

SPINMATE training pills are specific communication and dissemination actions, carried out in the "Project Communication, Dissemination and Exploitation" work package to attract the interest of key industrial stakeholders and end users of the battery, EVs and related sectors. Therefore, this training activity aims to facilitate the acquisition of skills by industrialists and research infrastructures for exploiting the project results beyond the boundaries of the consortium.

**Engage, Learn and Share
SPINMATE insights:**

<https://www.spinmate.eu/>



MEET US!

MEET the PARTNERS

INOVA+ IS

RESPONSIBLE FOR IMPLEMENTING THE COMMUNICATION AND DISSEMINATION ACTIVITIES IN SPINMATE – CONDUCTED A SERIES OF INTERVIEWS TO THE SPINMATE PARTNERS.



Inês Ribeiro
Processes and Product
Engineer



Joana Gouveia
Sustainability and Life Cycle
Researcher

“With the urgent need to transit for a carbon neutral mobility, the electrification of transport sector is a must, in which SPINMATE plays an important role. Along with contributing for the decarbonisation goals, SPINMATE project looks to introduce innovative new techniques to potentiate large scale manufacturing of Solid-State Batteries (SSB), in pair with accelerating its cost-reduction, energy savings and enhance its safety. Besides this, SPINMATE looks to adopt industry 4.0 and industry 5.0 concepts, promoting the digitalisation, sustainability and resilience of its manufacturing chain.”



Daniela Fontana
Solutions
Development Leader



“I am enthusiastic about seeing by the end of the project a complete production line for large format solid-state battery cells and the validation at pilot level of the results achieved in the laboratory. I am also excited thinking about the benefits that the application of innovative digitalization tools will provide to R&D and industrial communities. The approach to product and process development and control, now mainly based on trial-and-error, will change thanks to a deeper understanding of the correlations among the different factors involved in manufacturing. I think that both results will really represent a big step forward for the implementation of mass production of solid-state batteries.”



Rezvan Karimi
Research associate



Kevin Voges
Research associate

“In the production process of battery electrodes, a homogeneous distribution and dispersion of all particulate components are crucial to release the full performance of a battery cell. For SSB where solid-solid-contacts are responsible for the ion and electron exchange between active material, solid electrolyte and carbon additives, a suitable particle arrangement is even more important compared to cells with liquid electrolytes.”



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*One step
forward to a
greener and
safer driving*



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