BATTERY 2030+

**Newsletter**
**June, 2023**

**The vision** for BATTERY 2030+ is to invent the batteries of the future, providing European industry with disruptive technologies and a competitive edge across the full value chain, that will enable Europe to take the lead in battery science and technology.

**This newsletter** gives you an update on what's going on within the initiative. Enjoy your reading!

# Kristina Edström,

### Director of BATTERY 2030+

As summer approaches, Battery 2030+ is entering the next phase of its development, with six new projects being granted: Healingbat, Opera, Opincharge, Phoenix, Salamander, and Ultrabat. It was a pleasure to welcome all of them at our Battery 2030+ annual conference held in May. These projects will focus on three new methods to study battery interfaces and three others will merge sensor and self-healing capabilities. More information about these projects can be found in this newsletter.

We extend our gratitude to all participants in our annual conference in Uppsala. The event drew 300 attendees who engaged in insightful lectures, industry discussions (led by EBA250), and exchanges with young scientists. With more than 70 posters on display, we are deeply grateful to our sponsors. Since Sweden holds the Presidency of the Council of the European Union during the first half of 2023 our annual conference was granted to incorporate and use the Swedish Presidency logo in our event. The Swedish Presidency logo represents solidarity and community.

In the next phase of Battery 2030+, our focus will shift towards disseminating the results emerging from existing projects. Standardizing data handling, battery ontology, and protocols for data comparison will be highlighted as critical support tools for the entire battery community.

Over the past year, we have also engaged with various regions in Europe to better understand the battery research and industrial landscape. The diversity within Europe is fascinating, and on June 16th, a joint meeting for representatives in

Europe will be held in Brussels to present the findings and discuss actions to improve European collaboration. These results will also be submitted to the Battery Partnership BEPA as a foundation for continued discussions with our national representatives within the EU.

Should there be any rainy days in Europe, join our online excellence seminar and educational workshops, which can be found at **www.battery2030.eu**.


## Battery 2030+ annual conference and the inner life of batteries

This year the Annual conference for Battery 2030+ was a two-day event at the Ångström Laboratory in Uppsala University. The event was loaded with insights in the complex materia that constitutes batteries. Industry was well represented, about 20 percent of the 300 participants. Welcome words from the commission was given by Mr Aymard de Touzalin DG CNECT, up till recently program officer for the Battery 2030+ consortium. Kristina Edström, coordinator of Battery 2030+ gave us some golden nuggets of what the initiative has achieved so far. Mr Olivier Dahon from 12 EIC Pathfinder Open inspired us to think about innovation possibilities offered by the EU commission

End results for the current six research projects (belonging to this phase) and the vision for the six new projects (belonging to the next phase) were presented. This excellent opportunity to cross examine the projects, to exchange fruitful ideas, experiences and share results was very well received.

Top researchers like Clare Grey and Jean-Marie Tarascon shared their profound knowledge, Clare Grey, from Cambridge University, talked about how new spectroscopic approaches have been developed that can directly visualize intercalation mechanisms, phase transitions, degradation processes and ion transport phenomenon. Jean-Marie Tarascon, Collège de France, talked about optical sensing from concepts to applications in batteries.

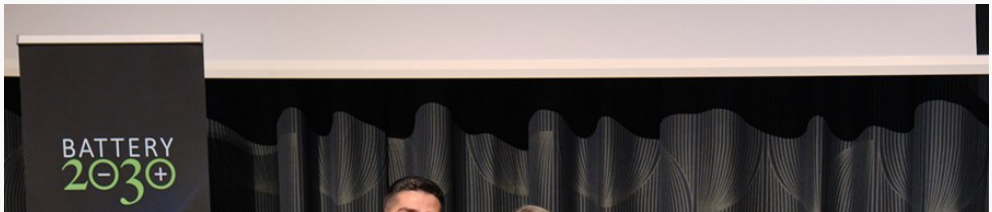
Going from concept, or basic research to application, was generally high on the agenda for the industry participants. As we all know batteries are highly complex and they are not simply linear scalable. A battery coin in the lab will most likely behave completely differently if just upscaled to a pouch cell in an EV-pack.

There is no question however that the transition from promising lab results to industrial uptake is urgent. Global battery need was about 300 GWh three years ago, and in two years, 2025 it is expected to be as much as 1 700 GWh. A more than five-fold increase. And the growth continues – by 2030 it is predicted to be 4 500 GWh, mainly driven by the transition to EVs, but also applications in the energy systems,

Matthew Lacy from Scania told us. Maria Åstrand, Northvolt, focused on how this transition can be done green, which is getting more important considering the growth of the battery industry.

The conference also gave the opportunity to young scientists to share their views both through a poster exhibition and through presentation highlighting the young scientist manifesto.






## Poster prize winners

Among 80 participating abstracts three winners were selected. 1st prize went to Gints Kucinski poster number 37. 2nd price to Guiomar Hernandez poster number 51 and 3rd prize to Hayk Zaharyan poster number 3. You can find all the abstracts **here** in our abstract book.

## The new upcoming  BATTERY 2030+ projects for CSA 3

## Phoenix

**Building more reliable and performant batteries by embedding sensors and self-healing functionalities to detect degradation and repair damage via advanced Battery Management System**

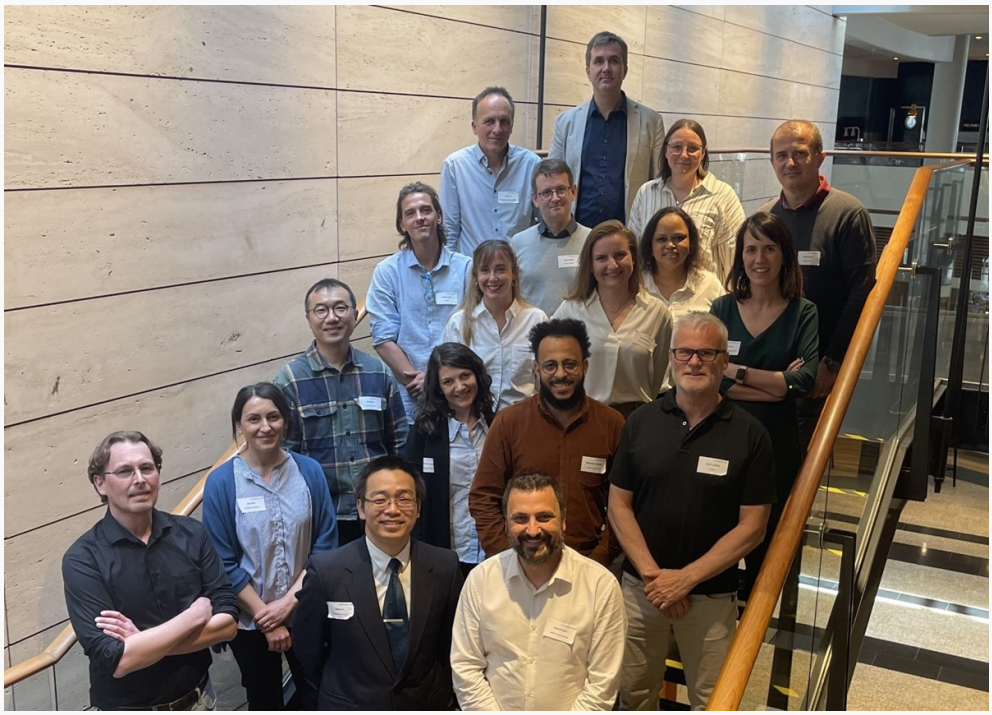
Phoenix aims to develop battery cells with integrated sensors (mechanical, enhanced impedance spectroscopy, temperature, gas, reference electrode) and self-healing functionalities (magnetically activated polymers, thermally activated polymers, metallic organic frameworks coated separator, core-shell NMC composites). Tailor made triggering devices to activate self-healing mechanisms will be developed, prototyped and demonstrated in Generation 3b and 4a Li-Ion batteries. A Battery Management System (BMS), capable of detecting defective operations and of triggering self-healing

functionalities will be developed with in-line communication. The degradation detection and quality, reliability and life will be tested through dedicated profiles (fast charging, extreme temperatures, calendar life). The novel batteries' manufacturing will be studied from a recycling and mass production point of view.

Phoenix is coordinated by the Battery Innovation Centre at MOBI-Vrije Universiteit Brussel (VUB) and is a partnership of 4 research organisations, 1 university, 4 small-to-medium enterprises experts in materials, sensors, modelling, BMS, recycling and battery manufacturing.

Project Coordinator

Maitane Berecibar, Vrije Universiteit Brussel



## Salamander

The vision for Salamander is to develop a battery with smart functionalities, which means that the battery can self-detect and self-diagnose where internal damage and degradation is occurring and respond by activating a self-healing function at the targeted area. In this way, the battery can be higher quality, more reliable, safer, and with longer lifetime, reducing the raw materials and energy consumption. Our goal is to integrate the sensors and self-healing components together into a single cell, which raises many challenges in chemical compatibility, performance, and cell design.

Our recent kick-off meeting had good inputs from all partners, with sharing of experiences in the successes and setbacks of past projects. Our next steps in the road ahead is to work out the many finer details and finish hiring the team, but the gathering has been highly motivating for everyone. As the consortium was organized with clear roles for each partner, their expertises are complementary to each other and the project goals. It is challenging to build a mutual understanding of everyone's expertise, so having good communication tools and establishing common standards early in the project are key steps to collaborating effectively.

Project Coordinator

SamsonYuxiu Lai, Institute for Energy Technology

# Opera

**Development of operando techniques and multiscale modelling to face the zero excess solid-state battery challange**

Green, high-performing and safe batteries based on abundant materials are a key element in the transition to a carbon-neutral future. However, to accelerate their development, a deep understanding of the complex electro-chemo-mechanical processes within the battery is required, which is only accessible through advanced experimental and computational methods. Zero-excess solid-state batteries, where the anode is formed *in situ*, have emerged as a promising new generation of environmentally friendly batteries with high energy density, improved safety and higher cost-efficiency, but only after solutions for non-uniform anode formation are found.

In Opera, seven leading research institutions, two synchrotron radiation facilities, a small-medium sized enterprise and a large technological company, all from complementary research fields such as batteries, surface and material science, and multiscale modelling, propose a unique strategy to face the current challenges of this technology. Opera relies on the development of novel operando experimental techniques at the ESRF, ALBA and DESY *synchrotrons and at the lab-scale,* providing complementary information on multiaxial stress fields, chemical composition, nucleation and growth kinetics, structural defect formation and degradation of well-defined model cells with a resolution *down* to the *atomic scale*. The new insights and collected multiparameter data will be incorporated into a novel multiscale modelling approach supported by machine learning algorithms. This will ultimately lead to a conceptual understanding of the *in-situ* anode formation and, based on this, innovative improvement approaches to enable this type of energy storage technology, which will be an important step towards increasing the global competitiveness, resilience and independence of the EU.

Project Coordinator

Celia Polop Jorde, Autonomous University of Madrid

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Project Coordinator

Celia Polop Jorda, Autonomous University of Madrid

## UltraBat

**Capturing Ultrafast Electron and Ion Dynamics in Batteries**

Batteries are attractive candidates for light weight, high capacity, even mobile energy storage solutions. However, a persistent fundamental knowledge gap is preventing batteries from fulfilling their potential. Despite decades of research, the atomistic mechanisms involved in charge and ion transport across interfaces in batteries remain largely unexplored by experimental techniques. When charges move, the local arrangement of atoms changes in response to the new electronic configuration. How and when these changes occur has a significant impact on how efficiently and how far the charges can move, yet these time and length scales are still poorly understood. Conventional experimental probes used in battery research do not have the required, atomic, and structural resolution, nor the required sensitivity to changes in electronic configuration around specific atomic species. Hence, it is currently challenging to unravel the dynamic rearrangement of atoms and ions which accompany electron transfer, and in turn govern the charge transfer processes.

UltraBat will close this knowledge gap by pushing further the latest development of ultra-bright and ultra-fast X-ray Free Electron Laser (XFEL) scattering and spectroscopy techniques together with visible ultrafast spectroscopy to study charge transfer between different redox centers in Li-rich layered intercalation compounds and at the solid/liquid interface. Advances in NMR spectroscopy will reveal local ordering and lithium interfacial dynamics on the nanometer scale. Coupled with predictions of experimental observables from a new framework for atomic-scale simulations of the electrochemical interface and transport mechanisms, we will reveal phenomena that drive diffusion of ions in complex electrode materials. This will provide the insight required for transformational approaches to control the redox reactions (for example electron transfer) that are common to many energy-related processes, including batteries, photovoltaics, and water-splitting systems.

Project Coordinator

Martin Meedom Nielsen, Technical University of Denmark

## HealingBat

**Advanced sensing, monitoring and self-healing mechanisms to self-repair**

**batteries**

Europe must re-emerge as a world leader in the field of batteries by speeding up the development of underlying critical technologies, enabling a European battery cell manufacturing industry making use of sustainable energy and implementing concepts of the Circular Economy. Today, lithium-ion (Li-ion) chemistries dominate the market for rechargeable batteries, but the current generation is nearing the end of their improvement limits. Li-ion battery performance and manufacturing are unlikely to keep up improvements at a rate that is sufficient to establish a climate-neutral society without substantial breakthroughs. Consequently, innovative ideas are needed to allow for the development of future sustainable batteries, which demand less resources and create the groundwork for EU competitiveness.

Healingbat aims at developing and implementing self-healing concepts and materials in the key battery components, used in conventional Li-S batteries and extrapolate the designs and concepts to develop a new class of self-healing structural battery based on Li-S. Furthermore, a toolbox, consisting of self-healing materials, relevant sensors and bespoke battery management systems to maximize performance of the developed Li-S battery in terms of the quality, reliability and lifetime and avoid or timely heal occurring damages. The purpose of is to control the flow of energy to and from the battery system, monitor for errors and to apply corrective actions if necessary.

Project Coordinator

Stefan Palzer, Technische Dortmund University

## Opincharge

Opincharge aims to develop advanced characterization methods and tools to investigate solid-state interfaces in Li-ion batteries under operando or in-situ conditions at an unprecedented level of detail.

The main goal of this project is to develop new imaging and analytical acquisition methods as well as a new in situ platform for the study of radiation sensitive battery materials and dynamic processes. Electron microscopes can probe the atomic scale changes occurring at interfaces that determine materials performance. A main challenge to probing the interfacial chemical and structural changes defining electrochemical processes is the high sensitivity to the electron beam of the battery materials, of the electrolyte and of the newly formed compounds upon lithiation. New acquisition and processing methodologies are required to gain insight into the structural evolution, charge transfer and SEI formation in batteries under operation conditions. New AI based acquisition methods will also be used to investigate them.

Opincharge is coordinated by LIST and brings together eight academic institutions, research and technology organizations and two businesses, with partners across Europe.

Project coordinator

Santhana Eswara, Luxemburg Institute of Science and Technology

# Do not miss out...

**Excellence Seminars** Did you miss any of our Excellence seminars? Do not worry we have them recorded and transcribed on our website for you to watch **here...**

## Support us

BATTERY 2030+ is a long-term initiative enabling Europe to take the lead in battery science and technology by developing radically new concepts for the batteries of the future.

Help us achieve these ambitious goals by endorsing BATTERY 2030+ as long-term research initiative for Europe. **Read more...**

## Contact us

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Read more about us and find additional contact details on our website: www.battery2030.eu

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