

**** BLB Newsletter #1 | First Edition 🎉 ****

Dear BLB Community,

We are very excited to launch our BLB Newsletter today. With this we will inform you about activities, research results and current developments at BLB every few months. Please register for the newsletter via [this link](#) to stay informed in the future.

The first half of the year is now over and we look back on a number of exciting activities. Highlights include:

- Publication of the [Roadmap Battery Production Equipment](#) 2030 by VDMA with the participation of BLB
- [Groundbreaking ceremony of the Fraunhofer ZESS](#) at the Braunschweig research airport
- Technical opening of BLB's lab space at the research airport. [The official inauguration](#) is scheduled for November 6, 2023
- Last chance for your contribution to IBPC 2023. The Call for Abstracts closes soon. [Take this opportunity](#) to present at one of the leading battery production conferences

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– Research Projects –

Batteries for electric aerospace. Compared to lithium-ion batteries, lithium-sulfur batteries can store about twice as much energy for the same weight. This property makes them particularly interesting for aerospace applications. In the SulForFlight project, BLB is conducting research on process development for sulfur-containing cathodes. [>>> to the TU magazine](#)

Contribution of future battery technologies to the achievement of SDGs. In the context of the SE2A (Sustainable and Energy-Efficient Aviation) Cluster of Excellence, BLB researchers have analyzed different configurations of next-generation solid-state lithium-sulfur batteries in a holistic sustainability assessment approach and compared them in terms of achieving the Sustainable Development Goals (SDGs) using a novel, in-house developed, quantification method. The results were published in the Journal of Industrial Ecology. [>>> to the journal paper](#) & [>>> to the SE²A website](#)

Half-time at the research training group CircularLIB. The research training group offers 19 PhD students from natural sciences, engineering and economics the opportunity to conduct interdisciplinary research on the circular economy of battery materials. Their PhD is accompanied by qualification programs in the form of lectures and seminars at the associated research institutes of TU Braunschweig, Fraunhofer IST, TU Clausthal and Leibniz Universität Hannover. The program started in October 2021 and runs until September 2024. [>>> to the BLB website](#)

European research. BLB is increasingly involved in the European battery ecosystem. To this end, BLB is actively involved in various European projects, including:

- [TranSensus LCA](#), to create standards for Life Cycle Assessment of electric vehicles and batteries
- [NoVOC](#), on dry and wet coating without volatile organic compounds
- [SPINMATE](#), on polymer-based solid-state battery cells
- GIGABAT, on the development of battery cell manufacturing equipment to meet the requirements of gigafactories (starting on 01.07.23)
- [ADVAGEN](#), for production research on oxide-sulfide hybrid solid-state batteries
- [SUBLIME](#), on solid-state sulfide batteries development
- [DEFACTO](#), on multiphysics modeling of cells and manufacturing processes

Prof. Kwade, speaker of the BLB, is also a technical advisor to Batteries Europe's Working Group 4 on Cell design and production. In addition, he is involved in the board and management of the pilot line network LiPLANET. [>>> to Batteries Europe](#) & [>>> to LiPLANET](#)

– Publications –

Study on the influence of anode material on performance and fast charging behavior.

This study by Laura Gottschalk (iPAT) investigates the influence of material selection on battery performance, specifically graphite, silicon, and hard carbon in pure and mixed forms. Although pure silicon has higher electrical resistance, silicon-based electrodes show the best performance due to the lower coating thickness and resulting lower ionic resistance, as well as lower tortuosity. <https://doi.org/10.1016/j.est.2023.107706>

Classification of coating defects in electrode production. Alexander Schoo et al. (iPAT) published a catalog for coating defects in electrode production of classical lithium-ion batteries. A machine learning algorithm was used to classify the various coating defects and identify cause-effect relations. In addition, literature and expert knowledge were used to estimate the severity of the defects. A tracking-and-tracing method was used to trace the defects back to the electrode sheet level. <https://doi.org/10.3390/batteries9020111>

Systematic literature review on electrolyte filling and wetting of lithium-ion batteries.

The publication by Nicolaj Kaden et al. (IWF) is a review article providing an overview of the current status quo in electrolyte filling. In particular, the influences of product and process parameters are discussed and future research priorities are identified. <https://doi.org/10.3390/batteries9030164>

BLB goes digital twin. Based on the preliminary work in the Sim4Pro project and the publications on the digitization platform for mechanistic modeling of battery cell production developed therein, H. Karaki (InES) and M. Thomitzek (IWF) presented a mathematical optimization of the microstructure and the process parameters to be used. They determined the best possible microstructure parameters for an NMC 622 cathode at high energy density, while also determining the minimum energy required to process the cathodes. <https://doi.org/10.1002/ente.202200801>

Systematic, model-based process design for novel stacking processes. Christina von Boeselager et al. (IWF) demonstrate a procedure to design a novel handling and stacking process for the fabrication of electrode-separator composites. By choosing an optimized process design, the mechanical stresses on the electrodes during handling and stacking operations are effectively reduced. To this end, a multi-step approach employs various analytical, simulative and experimental methods to successively narrow down the number of possible design options. The systematic approach also creates an understanding of the effect

relationship between process design and process-inherent loads on the electrodes.
<https://doi.org/10.1002/ente.202200687>

Systematic review on Lithium-Ion Battery (LIBs) disassembly processes. Wu. et al. (IWF) addressed a systematic literature review to explore the current state of disassembly processes in LIBs' recycling. The results emphasize disassembly as a crucial process for achieving a high material separation rate and ensuring a high degree of purity of the recycled active material. Investigation into extending the disassembly depth from cell to individual components is limited, particularly in automated approaches. Further research is highly recommended to explore the feasibility and potential of novel automated disassembly procedures at the cell level, contributing to improving the efficiency and sustainability of the recycling process for LIBs. <https://doi.org/10.3390/batteries9060297>

Series of publications as part of CIRP LCE 2023. This year's CIRP LCE conference was held at Rutgers University in New Jersey from 15.5.2023 to 17.5.2023 on the topic of "Enabling absolute sustainability and the circular economy using data and insight". A large delegation from BLB was also present at the CIRP LCE. Details on the contributions can be found in the list below.

- In the publication by Jana Husmann et al. (IWF), factors influencing the evaluation of recycling processes are analyzed and different evaluation approaches are derived and discussed on the basis of a case study. <https://doi.org/10.1016/j.procir.2023.02.006>
- The publication by Johanna Haupt et al. (IWF) is an analysis of the methodological challenges in prospective life cycle assessment of recycling processes, which are currently under development. <https://doi.org/10.1016/j.procir.2023.02.005>
- The publication by Maximilian Rolinck et al. (IWF) compares previous studies on the environmental impact assessment of lithium compound production and evaluates the completeness of available data sets compared to industrial processes. <https://doi.org/10.1016/j.procir.2023.02.122>
- The publications by Abdur-Rahman Ali et al. (IWF) are about the environmental impacts of nickel sulfate manufacturing for battery production and the analysis of existing data sets (<https://doi.org/10.1016/j.procir.2023.02.059>) and the development of a proposed reference framework for the development of technology roadmaps based on absolute environmental sustainability assessments using planetary boundaries (<https://doi.org/10.1016/j.procir.2023.02.061>).
- In the publication by Nelli Kononova et al. (IWF) the method of information entropy is used to derive statements about which materials need to be recycled based on the material composition, cost, and ecological factors for several solid-state batteries. <https://doi.org/10.1016/j.procir.2023.02.032>
- The publication by Christian Scheller et al. (AIP) examines the technological enablers and fundamental challenges of the transformation toward sustainable, circular battery production as part of the collaboration between AIP, IWF, and the University of Tokyo. <https://doi.org/10.1016/j.procir.2023.02.069>
- The publication by Jan-Linus Popien et al. (AIP) deals with the comparison of different battery value chains with regard to their ecological and socio-economic impacts <https://doi.org/10.1016/j.procir.2023.02.069>
- The publication by Hannes Lefherz et al. (Fraunhofer IST), shows that the environmental impact of recycling production scrap from electrode production can be reduced by about 99% if a separate, purely mechanical process chain is used instead of the LithoRec process. <https://doi.org/10.1016/j.procir.2023.02.012>
- The publication by Felix Buck et al. (Fraunhofer IST) presents a modular simulation environment for the technical, economic and ecological evaluation of process chains and their production environments in the solid-state battery context. <https://doi.org/10.1016/j.procir.2023.02.072>

– Society & Transfer –

Roadmap Battery Production Equipment 2030 Update 2023. Organized by the VDMA Battery Production, BLB has contributed to the update of the Roadmap of Battery Production Equipment 2030. Based on the needs of battery cell and battery manufacturers, the study derives and lists the technological requirements for production engineering. Challenges and research and development needs are identified for all issues, which are currently not resolved. [>>> to the BLB news](#) & [>>> to the VDMA website](#)

Step in MINT. BLB opened its doors in January to introduce female students to the subject area of mathematics, computer science, natural sciences and technology (MINT). After a short theoretical input, our PhD students Gabriela Ventura Silva, Christina von Boeselager and Johanna Haupt showed the students the individual production processes. In the following Q&A session the students learned more about the work as a researcher and future perspectives in battery research. [>>> to the BLB website](#)

Future Day 2023 at BLB. As every year, BLB contributed to the Future Day. On April 27, numerous schoolgirls got exciting insights into the work related to energy storage. [>>> to the TU magazine](#)

– Infrastructure –

Groundbreaking ceremony at Fraunhofer ZESS. June 7 was a momentous day for battery research in Braunschweig. The groundbreaking ceremony for the building of the Fraunhofer Research Center for Energy Storage and Systems (ZESS) marked an important milestone for research and innovation in Braunschweig. [>>> to the TU magazine](#)

Virtual tour of the BLB. Take a look inside the pilot line we operate at BLB. In a 4 minute virtual tour through our LabFactory we explain the process steps of battery cell production and how they are implemented at our facility. [>>> to LinkedIn](#)

Opening of the Center for Fire Safety Research (ZeBra). The research building is home to two large calorimeters and a facade test stand as well as an Accelerating Rate Calorimeter (ARC) for battery safety tests under adiabatic conditions. In this infrastructure, which is unique in Europe, the fire behavior of battery systems and even entire electric vehicles can be analyzed. [>>> to the TU Magazin](#) & [>>> to the ZeBra website](#).

– Organisation –

Election of Prof. Thomas S. Spengler to the BLB Board. Prof. Spengler of the Institute of Automotive Economics and Industrial Production (AIP) was elected to the BLB Board on June 7. In the future, he will head the board division "Industrial Networks & Business Strategies". All other board members were re-elected (Professors Kwade, Herrmann and Schröder).

BLB PhD Day. On June 8, organized by InES, the BLB PhD Day took place at the Haus der Wissenschaft. About 100 PhD students from the field of battery research met to share and discuss their latest research results. Besides the scientific talks, the presented posters and the fruitful discussions, the slush ice machine definitely was the star of the day.

Appointment of Prof. Sabrina Zellmer. Prof. Zellmer has been appointed to the professorship of Battery and Fuel Cell Process Technology at the Institute for Particle Technology (iPAT) in cooperation with the Fraunhofer IST. Research focuses include (re)synthesis and (re)conditioning of functional materials as well as the processing of

components (including metal anodes) for batteries and fuel cells with a focus on material-structure-property relationships.

– Networks & Events –

Cooperation with the Norwegian University of Science and Technology (NTNU) expanded. BLB is cooperating with NTNU on the [NorGiBatF](#) project to design energy- and resource-efficient battery production. The first research visit took place within this framework. PhD student Gabriela Ventura Silva was at NTNU in Trondheim for two months with the aim of professional exchange and joint development of energy models for gigafactories. The research visit serves as a starting point for further collaboration between the our research institutions in the future.

BLB at the Advanced Battery Power Conference. The Advanced Battery Power Conference is one of the most important technical conferences in Germany. Therefore, BLB was represented there again this year with a booth. In addition, BLB gave several presentations and presented a number of scientific posters. [>>> to the BLB news](#)

8th ProZell Research Colloquium in Braunschweig. The 8th Research Colloquium of the ProZell Research Cluster of the BMBF was hosted in Braunschweig. On March 13 & 14, concrete results from the research cluster coordinated by Prof. Kwade were presented and discussed. Many results of the cluster were published in the special issue "Towards sustainable, competitive production of large-format battery cells" of the Energy Technology Journal. [>>> to LinkedIn](#) & [>>> to the Energy Technology journal](#)

– Upcoming Events –

In the second half of the year, BLB will again be attending many important conferences and events. An overview of the most important dates can be found here:

- November 6, 2023 | Official opening of the new BLB test hall at the research airport.
- November 7 - 9, 2023 | International Battery Production Conference in Braunschweig. The Call for Abstracts is still open for a few days: [>>> Call for Abstracts](#)

[>>> more events on the BLB website](#)

We hope you enjoyed the first edition of the newsletter. Please [register now](#) to avoid missing any news in the future.