

Meet the SPINMATE Partners!



Introducing Technische Universität Braunschweig, Institute for Particle Technology (TUBS-iPAT): the Institute deals with modern aspects of particle technology and mechanical process engineering in research and teaching. The Battery Process Engineering division at the iPAT is working on all aspects of electrochemical storage technologies, from basic research to process and manufacturing technology of the industrial electrode production.

<https://www.tu-braunschweig.de/en/ipat>

WWW.SPINMATE.EU

Hello Rezvan Karimi and Kevin Voges! Thank you for this opportunity to meet you and talk about SPINMATE. To kick-off, could you give us, in your own words, a short introduction to TUBS, and your role there?

The Technische Universität Braunschweig (**TUBS**) is the oldest university with technical background in Germany. Our Institute for Particle Technology (**iPAT**) is dealing with all aspects of particle-based research (theoretical and practical) – from synthesis to grinding and mixing, as well as the application in the field of batteries or pharmaceuticals. With more than 140 employees, **iPAT** is one of the largest institutes of TUBS. Together with other institutes in the region, **iPAT** is member of the “Battery LabFactory Braunschweig” (BLB) dealing with research on the whole process chain of battery cell production ranging from material synthesis to battery modules and subsequent recycling. In **SPINMATE**, we will focus on the cathode production of polymer solid-state batteries (SSB) by solvent-based and dry coating approaches. Our experience with PEO-based SSBs will be the foundation for our experimental and modelling work in **SPINMATE**.

To someone reading this who is still not familiar with SPINMATE, how would you describe it in simple terms, and how do you distinguish it from other projects or initiatives?

SPINMATE is an ambitious EU project dealing with the design and production of polymer-based SSB. Beginning with the development and synthesis of the polymer solid electrolyte and the active material (NCM) as well as the (coated) lithium anode, the whole process chain to produce solid-state batteries with up to 10 Ah will be investigated. An accompanying modelling and simulation approach should detect correlations among different process steps and highlight the most important parameters. Digital twins as well as LCAs will be developed, too. While other projects dealing with polymer SSBs are often focused on small (lab-scale) experiments, in **SPINMATE** 12 partners from 7 EU countries are working together to push forward the research on the industrialisation of polymer SSBs and to achieve a Technology Readiness Level of up to TRL8 (for certain processes).

TUBS is the leader of the cell manufacturing at the digital-driven pilot line. This means that you are leading the designing of SSB cell prototypes with optimised components and processes towards the production for testing and validation. How TUBS – together with other SPINMATE partners – will monitor the quality and performance of the cell manufacturing?

The quality of the manufactured cells will be monitored by different methods, in-line during the coating, drying and compaction of the electrode layers as well as manually by taking representative samples at different stages in the process chain. Important parameters to check are for example the slurry viscosity, electrode thickness, mass loading, adhesion to the substrate amongst others. The formation and electrochemical performance of the assembled SSB cell prototypes will be investigated within work package 7 by the respective partners to check whether the capacity and rate capability is according to the specifications.

As part of that process, TUBS is leading the designing of 1 Ah and 10 Ah SSB cell prototypes with the optimised cell components and processes and the manufacturing of electrode and solid electrolyte layers for large cells. Could you tell us more about the methodology and which are the main challenges?

A proper design of high-capacity cells up to 1 Ah or even 10 Ah is challenging, but the know-how and many processes were already established for conventional lithium-ion batteries with liquid electrolytes and can be transferred to polymer SSB quite easily. An important parameter is the areal capacity and the size of the cell layers because it will define the number of layers that have to be stacked to reach the respective capacities. To increase the energy density, cathode, and anode must be balanced to avoid unexploited materials on one side. Additionally, direct electrical contact between cathode and anode must be prevented at all costs to avoid short circuiting, typically by designing the separator layer a bit larger than the electrodes. For double sided coated electrodes and a flexible polymer layer (separator), a Z-folder may be an option to produce multilayer cells. These are just examples to illustrate the complexity of designing good battery cells.

What are you personally most enthusiastic about achieving during SPINMATE?

Conventional lithium-ion batteries with liquid electrolytes are still the benchmark regarding gravimetric and volumetric energy densities right now. We would be very happy if we can achieve similar or even higher energy densities with fully scalable methods which make it easy to transfer the developed processes for polymer SSB to the industry and the customers. Additionally, the dependency on the Asian market that is still dominating the battery production must be reduced. Increasing risks for the global supply chains as well as the energy transition to combustion-free transportation make it necessary for Europe to be more independent in the production of energy storage devices and **SPINMATE** can help to achieve this goal.

TUBS is an expert on research in comminution, dispersing and coating, battery process technology, bulk solid Shandling, and nanomaterials. How SPINMATE will be strengthening your position? Which will be the main benefits of TUBS by participating in this collaborative project?

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.

We already have experience in the production of polymer SSB cathodes with PEO-based solid electrolytes and the assembly to full pouch cells with lithium anodes. Different mixing and dispersing techniques (e.g., ploughshare mixer, dissolver, extruder) are used to produce composite cathode slurries and granulates which are coated or laminated on the substrate current collector foil. Within **SPINMATE**, we will extend our experience to the new PVDF-based polymer electrolyte. Additionally, we want to establish the multilayer pouch cell assembly within the project.

Certainly, there will be readers interested to meet you and discuss your experience in SPINMATE. Which events will be possible to meet TUBS in the upcoming months?

Our employees are typically present at different battery-related conferences, and we would be very happy if you approach us for a discussion. We will be participating at:

- MRS Fall Meeting (November 26th – December 1st 2023, Boston, USA)

Additionally, we are organizing a battery conference each year in November. We would be happy to welcome everyone who is interested in battery production technologies here in Braunschweig:

- International Battery Production Conference (November 7th – 9th 2023, Braunschweig, Germany)



Rezvan Karimi

Research associate



Kevin Voges

Research associate



INOVA+ – responsible for implementing the communication and dissemination activities in SPINMATE – conducted a series of interviews to the SPINMATE partners. If you would like to know more about the project partners, visit our online channels.

SPINMATE Website: www.spinmate.eu

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