Fraunhofer ISC

PRESS RELEASE

The "funky" side of solid-state battery development

Solid-state batteries (SSBs) are considered the next generation of batteries compared to conventional Li-ion batteries. Despite significant research efforts, very few SSBs are market-ready. In recent years, various promising materials have been introduced, but one of the main challenges persists: the combination of these materials into a stable cell. The project consortium of FUNCY-SSB (pronounced "funky-ssb") with partners from Germany, Slovenia, and Norway aims to change this over the next three years.

Solid-state batteries (SSBs) are particularly interesting for the mobility sector primarily due to their improved energy density. The key component for a high-performance SSB is the solid-state electrolyte (SSE). However, the use of SSEs brings new challenges related to ionic conductivity, processability, recyclability, and sustainability. Additionally, the interface between the active material and the solid electrolyte needs to be carefully controlled.

Combining polymer and inorganic electrolytes is a promising approach to tackle these challenges. However, these electrolytes cannot be created by simply mixing polymer and inorganic components. The challenge of combining polymer and inorganic materials is not only compatibility between all components, but also ensuring a good lithium-transport between the different electrolyte phases. The combination of interface design with coating should improve lithium transport between phases and still provide protection for the moisture sensitive sulfide electrolyte. The components must be specifically tailored to enable efficient lithium-ion transport through the SSE as a whole.

Material design and surface modifications create new opportunities

The FUNCY-SSB project (**FUN**ctional **C**oatings of sulfide electrol**Y**tes for lithium **S**olid-**S**tate **B**atteries) focuses on developing sustainable SSEs with enhanced electrochemical performance to address these key challenges. Functional surface coatings will be used to create SSEs through a combination of sulfide electrolytes with various polymers. Inorganic coatings produced by atomic layer deposition will optimize lithium-ion transport through the polymer into the sulfide electrolyte. The goal is to develop SSEs with high ionic conductivity, improved moisture stability, and an expanded electrochemical stability window using a functional surface coating. This will not only enhance stability but also increase the lifetime and energy density of the batteries.

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There is currently limited data available on the recyclability of SSEs and the sustainability of their production. These aspects are often only considered retrospectively, rather than being evaluated and addressed during the material development phase. Recycling studies, as well as economic and ecological potential analyses, will be conducted during the material development process to optimize the SSEs in terms of recyclability and sustainable production. The manufacturing potential of the materials will be evaluated in collaboration with industry partners. Additionally, FUNCY-SSB will utilize semantic technologies to digitize the synthesis and manufacturing processes of battery materials and components, improving interoperability, speeding up the development process, and reducing the risk of errors.

A clear goal in sight

"By the end of FUNCY-SSB, we intend to demonstrate a solid-state electrolyte concept that leads to improved battery performance and sustainability. Furthermore, our approach to material design, which considers recyclability and sustainability during development, can serve as a template for the design of other solid-state electrolytes", summarizes Dr. Guinevere Giffin, project coordinator and Scientific Head of the Fraunhofer R&D Center Electromobility at Fraunhofer ISC. A proof-of-concept of the new material SSEs in prototype pouch cells, which require reduced external pressure during use, will ultimately showcase the feasibility of the FUNCY-SSB approach to material design. This project will promote the availability of high-quality battery materials and components with tailored properties. The development and fundamental understanding of sustainable advanced electrolyte materials for next-generation batteries will enhance national and European competitiveness in the field of battery research and development.

The project

FUNCY-SSB (**FUN**ctional **C**oatings of sulfide electrol**Y**tes for lithium **S**olid-**S**tate **B**atteries)

FUNCY-SSB was selected in the Joint Transnational Call 2023 of M-ERA.NET 3, which is an EU-funded network of about 49 funding organisations (Horizon 2020 grant agreement No 958174). The project is funded by the German Federal Ministry of Education and Research (BMBF) with Forschungszentrum Jülich GmbH as the Project Management, the Research Council of Norway (RCN) and the Slovenian Ministry of Higher Education, Science and Innovation (MVZI - Ministrstvo za visoko šolstvo, znanost in inovacije).

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National Institute of Chemistry, Slovenia
cylib GmbH, Germany
EurA AG, Germany
Morrow Technologies AS, Norway
Associated Partner: Specific Polymers, France

Pictures

Improved energy density and safety – promising and challenging solid-state batteries
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