Battery 2020 Transfer - Battery materials for future electromobile, stationary, and other industrial applications: SilKompAs research project on silicon-based composite anodes in solid sulfide batteries launched.

Storage of electrical energy is indispensable for a future in which electromobility plays an increasingly important social and economic role. In that light, stationary electrical energy storage applications will be crucial for a stable energy supply which relies on renewable energies exclusively. Therefore, further development of energy storage technologies in Germany as a business and technology location is an elementary factor for asserting oneself in international comparison.

The way to achieve this goal is to develop high-performance and safe battery systems. This requires in-depth knowledge of the individual battery components' behavior to optimize them further.

The collaborative project **Silicon-based Composite Anodes for Application in Sulfidic Solid State Batteries (SilKompAs)** started in September 2022. It is funded by the German Federal Ministry of Education and Research (BMBF). In this project, the participating partners from industrial companies and research institutes concentrate on improving anode materials used in batteries. In focus are solid-state batteries as an alternative to conventional lithium-ion batteries with liquid electrolytes. The following partners joined the research project: EL-CELL GmbH as coordinator, the Institute for Inorganic and Analytical Chemistry of the University of Münster, the Institute for Particle Technology of the TU Braunschweig, the Institute of Physical Chemistry of the University of Gießen, SGL Carbon GmbH and Thermo Fisher Scientific. In addition, M.Braun Inertgas-Systeme GmbH participates as an associated partner.

Batteries with a solid electrolyte currently appear to be an adequate next step in the development of lithium-ion batteries. On the one hand, safety risks associated with a liquid electrolyte are eliminated. On the other hand, it allows the usage of certain high energy density anode materials for which a liquid electrolyte battery does not represent an optimal environment. As a result, while increasing safety, batteries with higher energy densities can be developed.

Ideally, lithium metal offers itself as a simple high-energy-density anode material. While the challenges of using metallic lithium in a liquid electrolyte battery are well known, currently available solid electrolytes not optimal: their chemical stability against metallic lithium is insufficient, and the rate stability is not assured. In addition, dendrite growth occurs here at high current densities, which can lead to short circuits. While solutions to deal with for chemical instability seem to be in sight, the morphological problems still offer much room for research.

Here, solid-state lithium-ion batteries with a silicon-based anode may be a viable alternative: A very high theoretical capacity can be achieved by using silicon as active material in the anode. Since metallic lithium is not used here, the associated safety risks are reduced at the same time. Processing of the anode materials offers great potential for optimisation.

Therefore, the primary goal of the SilKompAs project is to evaluate the potential energy and power density, rate capability, aging and chemomechanical behavior, combined with a critical examination of the practical feasibility and scalability of a silicon-based solid-state battery compared to the variant with lithium metal anodes.

Project data:

The following partners from the German industrial and research landscape are involved in the BMBF-funded project:

EL-CELL GmbH, the Institute for Inorganic and Analytical Chemistry at the Westfälische Wilhelms-Universität Münster, the Institute for Particle Technology at the Technische Universität Braunschweig, the Institute of Physical Chemistry at the Justus Liebig University of Giessen, SGL Carbon GmbH, Thermo Fisher Scientific, and M.Braun Inertgas-Systeme GmbH as an associated partner.

The project started in September 2022 and will end in August 2025, with total BMBF funding of 2.3 million euros.