Novel surface modification of solid electrolytes for improved cycling stability of solid-state batteries

Alkali metal-ion battery, lithium-ion battery, electric vehicles, electronics, solid-state batteries, energy storage, secondary battery, sulfur-containing solid electrolytes

DESCRIPTION OF TECHNOLOGY

Batteries are indispensable in today's world. They are used in electric vehicles and electronic devices, and are needed for many renewable energy storage solutions. However, due to cell degradation, they gradually loose capacity during usage. Ways for improving life-cycle stability are therefore urgently needed.

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This invention presents a novel surface modification of sulfur-containing solid electrolytes which can be easily performed via classical "wet"-processing in suspension. No complex and cost-intensive processes like PVD/CVD are needed.

This modification of solid electrolytes is the second one of two major ways of reducing cell degradation, the other one being optimisation of the electrode material. It also improves the long-term stability of battery cells by increasing the number of achievable recharge-cycles and the capacity at different C-rates, without relying on the optimization of electrode structures. Thus, both ways constitute an ideal combination for life-cycle optimisation of battery cells!

The novel surface modification of solid electrolytes is especially applicable to all types of sulfur-containing solid electrolytes and is based upon modifying the electrolyte-surface with small-molecule Lewis-bases, e.g. dimethylformamide (DMF) or N-methyl-pyrrolidone (NMP). This modification of solid electrolytes is ideally supplementing the optimisation of electrode materials, for it can be done independently from any modification of electrode materials (e.g. polymer-coating of electrode materials).

AT A GLANCE …

Application Fields

- Rechargable alkali metal-ion batteries

Business

- Battery manufacturer
- Chemical industry
- Automobile industry
- Renewable energy storage

USP

- Reduced degradation
- Improved long-term stability
- Improvement of Battery performance
- Easily applicable via "wet"-phase-chemistry in suspension
- Can be freely combined with methods for optimisation of electrode materials

Development Status

- Functionality is proven on laboratory scale

Patent Status

Priority application filed on Sept. 9th 2024 at the EPO

REFERENCE NO. **TM 1221**

APPLICATION FIELDS

Preferred area of application of the invention is manufacturing of solid-state lithium ion batteries, due to their prevalent usage in nearly all areas where storage of electric energy with high energy density and safety is required.

The basic principle is applicable to other types of batteries also, so that nearly all kinds of solid-state batteries may gain better performance by use of the surface modification. Especially, batteries for electric vehicles and applications for intermediate storage of renewable energy to ensure grid stability may benefit most from the new improvement of electrolyte stability.

ADVANTAGES OVER THE PRIOR ART

The surface modification of solid electrolytes reduces interfacial degradation and improves the long-term stability and performance of solid-state batteries, especially lithium-ion batteries, thus further pushing their broad applicability.

Because the surface modification can be easily done via “wet”-processing, it provides versatile low-cost and high-throughput manufacturing, which requires only minor adaptations of existing production processes.

STATE OF PRODUCT DEVELOPMENT

Product development is currently still at an early stage. First electrochemical evaluations with solid-state batteries have been performed under laboratory conditions and show significant performance improvements.

MARKET POTENTIAL

The growing demand and need for electronic energy storage solutions with the transition to renewable energies and the increase in electric vehicles, provides a continuously growing and attractive future-oriented market.

COOPERATION OPPORTUNITIES

On behalf of Justus-Liebig-University Giessen, TransMIT GmbH is looking for cooperation partners or licensees worldwide.

A TECHNOLOGY OF

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