Low-Temperature Liquid-Phase Synthesis of Lithium Thiophosphate-Borohydride Solid Electrolyte with High Room-Temperature Ionic Conductivity ID# 2023-5587



TECHNOLOGY READINESS LEVEL 2-5

Seeking

Licensing | Research

Keywords

- Batteries
- Energy Storage
- Materials for Energy and Catalysis

Researchers

Donghai Wang, PhD Professor Mechanical Engineering

Daiwei Wang

Postdoctoral Scholar

Other Researchers

Originating College College of Earth and Mineral Sciences

Office of Technology Management Contact Doug Gisewhite drg206@psu.edu

Technology Summary

Lithium-sulfur all-solid-state batteries (Li-S ASSB) using inorganic solidstate electrolytes are considered promising electrochemical energy storage technologies attracting attention as a safe, high-specific-energy, durable, and low-cost power source for potential use in electric vehicles and drones. The ability of inorganic solid electrolytes (SE) to prevent polysulfide dissolution endows Li-S ASSB with potential for achieving higher specific energy and a longer life-span than conventional Li-S batteries using non-aqueous liquid electrolyte solutions. However, developing positive electrodes with high sulfur content, adequate sulfur utilization, and high mass loading is challenging.

Researchers at Penn State have demonstrated a strategy of using low-density, highly ionically conductive SE with small particle size to enable efficient ionic transport in high-sulfur-content cathodes and thus attain Li-S ASSBs with high specific capacity. Researchers further demonstrated that the use of low-density solid electrolyte increases the electrolyte volume ratio in the cathode, reduces inactive bulky sulfur, and improves the content uniformity of the sulfur-based positive electrode. As proof of concept, the argyrodite glass ceramic SE, Li3PS4-2LiBH4 (LPB), was synthesized via a liquid-phase method with a low measured density, high ionic conductivity, and small primary particle size.

Application & Market Utility

The demonstrated strategy enables high-performance Li-S ASSBs with a maximum discharge capacity while also achieving stable cycling with a high initial discharge capacity and a low fading rate. • The global All-Solid-State Battery market was valued at \$975.93 million in 2022 and is expected to reach \$15419.23 million by 2028 at a CAGR of 58.41%.

Next Steps



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