PURDUE INNOVATES | Office of Technology Commercialization

Development of a quasi-solid-state electrolyte for use in solid-state batteries

A quasi-solid electrolyte that resists ignition, suppresses dendrites, and supports high energy density for safer solid-state batteries.

Conventional commercial batteries use a liquid electrolyte inside the cell to enable ions to move back and forth between the cathode and the anode. The liquid electrolytes, while needed for battery function, also pose a flammability safety risk and promote dendrite formation leading to battery failure.

Researchers at Purdue have developed quasi-solid-state electrolytes (QSSEs) with a fire-retardant solvent and high energy-density for use within solid-state, lithium-ion batteries. The QSSE technology combines the advantage of both a solid-state as well as a liquid electrolyte battery that addresses the major drawbacks of commercially available electrochemical batteries on the market. QSSEs have several advantages that make them suitable for use in high-performance solid electrolyte batteries. These batteries can provide a high energy density, are safe to use, and are reliable over a wide range of temperatures.

Publications:

- Role of Solvents in Solid-State Batteries with Enhanced Thermal Safety. 2023 AIChE Annual Meeting. https://aiche.confex.com/aiche/2023/meetingapp.cgi/Paper/670972

- Mechanistic Elucidation of Electrostatic Solvent Interactions within Composite Solid Electrolytes, with In Situ Safety Study (poster presentation). 2023 Materials Research Society Annual Meeting. https://www.mrs.org/meetings-events/presentation/2023_mrs_spring_meeting/2023_mrs_spring_meeting-3838407

- Purdue news release. https://www.purdue.edu/newsroom/releases/2023/Q1/purdue-engineers-create-safer-solid-state-lithium-ion-batteries-from-new-composite-

Technology ID
2023-POL-69972

Category
Energy & Power Systems/Energy Storage
Materials Science & Nanotechnology/Composites & Hybrid Materials

Authors
Vilas Pol
Annie Y Sun

Further information
Will Buchanan
wdbuchanan@prf.org

Jacob Brejcha
jjbrejcha@prf.org

View online

materials.html

Technology Validation:

Electrochemical cell efficiency was illustrated through repeated testing of the cell via galvanostatic cycling using the quasi-solid-state electrolyte, showing minimal decrease in performance.

Fire resistance was demonstrated through an open flame test, showing remarkable fire resistance and extreme nonflammability as well as little heat released up to 300Â°C.

Advantages:

- Properties of the quasi-solid-state electrolyte make the solvent significantly less prone to ignition than liquid electrolyte counterparts

- Suppression of lithium dendrites seen at high temperatures

- Better compatibility with a lithium metal anode (LMA), offering higher energy density than commercial LIBs

Applications:

- Solid-state batteries

- Flexible solid-state batteries

TRL: 4

Intellectual Property:

Provisional-Patent, 2022-10-25, United States | PCT-Patent, 2023-10-25, WO | NATL-Patent, 2025-04-17, United States