Polymer Zwitterionic Liquids for Enhanced Electrochemical Energy Storage

Tech ID: 34044 / UC Case 2021-875-0

BACKGROUND

The efficient and safe storage of electrochemical energy is critical for emerging technologies including electric vehicles and portable electronic devices. Practical requirements for next-generation secondary batteries include higher energy densities and charge-discharge rates, which hinge on new high-voltage cathode materials and on electrodes and electrolyte components with high ionic conductivities. The wide operating potential window of such cells exceeds the safe operation limits of current organic solvent-based electrolytes and necessitates the design of alternative electrolytes that are leak-proof, electrochemically stable and nonflammable. Solid Polymer Electrolytes (SPEs) have attracted significant interest in this area for their stability and mechanical robustness. However, due to the strong coupling of polymer segmental relaxation rates with ion mobilities, it remains challenging to attain sufficiently high ionic conductivities across the battery operating temperature range without compromising the mechanical properties. There is a need for solid electrolytes with improved ion conduction and mechanical properties.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a new class of SPEs that significantly improved conduction and mechanical properties. Ion-dense regions within the polymer act as highly efficient and selective regions for the transport alkali metal ions and almost completely disallow the motion of other ions that do not contribute to conduction. These regions can add additional structural reinforcement and impart solid-like properties to the material, a feature which prevents the flow of the membrane, even when heated. Its unique design uses bulky 'zwitterionic groups' to solvate and conduct ions, and it is the first to leverage bulky salts as both the cation and anion within the electrolyte. This key innovation imparts the sufficient 'free volume' or unoccupied space to allow for transport of the metal ions like Li+. Other distinguishing features of the zwitterionic polymer include that it is soluble and can be melt processed and then used “as is” as an electrolyte or crosslinked after processing to enhance mechanical stability if desired, and the polyzwitterion electrolyte can dissolve significantly more salt than a typical polymer electrolyte, which helps prevent buildup of detrimental ion concentration gradients and improves power density.

Patent application: https://patents.google.com/patent/US20240258564A1

ADVANTAGES

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OTHER INFORMATION

KEYWORDS

Electrochemical, Electrochemical Energy, Energy, Energy Storage, Battery, Batteries

CATEGORIZED AS

- **Energy**
  - Storage/Battery

RELATED CASES

2021-875-0

- Processibility
- High selectivity and conductivity
- Enhanced structural stability
- Operates efficiently across a wide temperature range
- Very high Li+ Solubility.

APPLICATIONS

- Battery Electrolyte for:
- Electric vehicles
- Portable electric devices

PATENT STATUS

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Mussel-Inspired Underwater Adhesives/Coatings From Renewable Resources

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