Performance-Boosting Multifunctional Binder for Lithium Ion and Lithium Iron Phosphate Batteries

Tech ID: 33247 / UC Case 2023-848-0

BACKGROUND

Lithium ion batteries are used in countless products, and their applications continue to grow. All lithium ion batteries use binders to hold their electrode components together and retain contact with the active material hosting lithium ions. Polyvinylidene Fluoride (PVDF) is the most popular binder, despite its negative environmental impact and its limited performance capabilities. Due to environmental concerns, widely used nickel/cobalt containing lithium ion batteries (NMC/NCA), are being replaced with batteries that use lithium iron phosphate (LFP) as the active material. Despite environmental and cost benefits, LFP batteries suffer from poor electronic conductivity and rate performance, which currently prevents them from replacing NMC/NCA lithium ion batteries in high power applications such as electric vehicles. A solution that would enhance the performance of both battery types could disrupt a $45 Billion industry and set it on a more sustainable trajectory.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a novel battery binder for lithium ion and LFP batteries that dramatically improves their rate capability, cycle stability and lowers kinetic overpotential. The most popular conventional binder, PVDF, serves only to hold the electrode components together and itself is an insulator that prevents electron and ion transport. The key feature of this technology is the complex of two oppositely charged polyelectrolytes which, in addition to binding the key battery components together, also facilitates conductivity. While other multifunctional binders have emerged, they are incompatible with the industry-standard slurry casting process of fabricating electrodes, and they require a non-conventional electrolyte. Furthermore, they require a tradeoff between ionic and electronic conductivity. This invention enables both electronic and ionic charge transport, does not dissolve in most battery electrolytes, and enhances battery performance enough to realize more sustainable next generation technologies such as LFP batteries.

ADVANTAGES

- Multifunctional: maintains contact between electrode components and facilitates enhanced conductivity
- Enhanced rate capability, cycle stability and lower kinetic overpotential
- Compatible with commonly used slurry casting technique for fabricating electrodes
- Does not dissolve in conventional electrolytes

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OTHER INFORMATION

KEYWORDS

Multifunctional Battery Binder, Enhanced Rate Capability Binder, Cycle Stability Enhancer, Kinetic Overpotential Reducer, Sustainable Lithium-ion Binder, High-Performance Battery Binder, Conductive Polyelectrolyte Complex, Electrode Slurry Casting Binder, Eco-friendly Battery Binder

CATEGORIZED AS

- **Energy**
  - Other
  - Storage/Battery
- **Materials & Chemicals**
  - Polymers

RELATED CASES

2023-848-0

- Resolves previously untenable rate performance and energy density in LFP batteries

APPLICATIONS

- Lithium Ion batteries
- Lithium Iron Phosphate batteries

PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Reference for National Filings	WO2024098067	07/11/2024	2023-848

Patent Pending

RELATED MATERIALS

- A Coacervate-Based Mixed-Conducting Binder for High-Power, High-Energy Batteries - 05/30/2023

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Polymer Zwitterionic Liquids for Enhanced Electrochemical Energy Storage

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