

COMPOSITE POLYMER ELECTROLYTE MATERIAL STRUCTURE WITH SUPERIONIC CONDUCTIVITY AND CATION TRANSFERENCE NUMBER APPROACHING UNIT

A scalable CPE architecture with near-unity cation transference and high ionic conductivity enabling safer, fast-charging solid-state batteries.

Researchers at Purdue University have developed a solid-state electrolyte material structure for Li-ion, Li-metal, and metal-anode batteries. With increasing advancement in the transportation electrification industry, it is imperative that energy storage devices afford higher energy density and improved safety standards. Composite polymer electrolytes (CPEs) are renowned for their high ionic conductivity and flexibility, but do suffer from sluggish ion transport, mainly because of reliance on segmental motions of the polymer. Moreover, current solid-state battery manufacturing processes commonly use materials that are expensive, hard to manufacture, and chemically unstable.

This novel composite polymer electrolyte material structure developed by Purdue University researchers will instead be invaluable for rechargeable battery manufacturers and the transportation electrification industry. The structure addresses the root cause of slow CPE ion transport by enhancing ion transport and eliminating dendrite formation. Equipped with superionic conductivity and cation transference numbers approaching unity, the formulation improves battery energy storage, reduces device costs, and enables faster charging. Unlike current Li-ion batteries, this material structure leverages low-cost polymers amendable to scalable fabrication and offer stability against Li metal dendrite formation.

Technology Validation:

The novel composite polymer electrolyte material demonstrated high ionic conductivity and transference numbers approaching unity. The material was also found to enable the utilization of hitherto not employed, non-ionically conducting polymers that were found to offer higher melting points than

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Category

Chemicals & Advanced
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state-of-the-art materials employed in CPEs.

Advantages:

- Higher energy density, improved safety, and faster charging capabilities than current Li-ion batteries
- Helps increment mileage range, safety, and performance of battery powered vehicles and devices
- Can create macroscopic high conductivity channels in the polymer matrix

Applications:

- EVs
- Trucks
- Drones
- Aviation
- Portable electronic devices

TRL: 3

Intellectual Property:

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Utility Patent, 2025-03-31, United States

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