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Topic of Research : **Flexible and High Performance Polymer Composite Electrolytes for Energy Storage Applications**

Finding

The research focused on the development and characterization of polymer electrolytes for sodium-ion batteries (SIBs) and their potential application in energy storage devices. Two series of polymer blend electrolytes were prepared and analyzed. In the first series, a sodium-ion conducting polymer blend electrolyte based on polyvinylpyrrolidone (PVP)/polyvinyl alcohol (PVA) and sodium bicarbonate ($NaHCO_3$) was investigated. The electrolyte exhibited good mechanical stability, reduced crystallinity with increased $NaHCO_3$ content, and enhanced ionic conductivity. The second series involved the incorporation of reduced graphene oxide (rGO) as a filler in the PVP-PVA polymer matrix. The resulting polymer blend composite electrolyte showed improved ionic conductivity, electrochemical voltage stability, and other desirable properties for energy storage applications. In the subsequent chapters, three more series of polymer blend electrolytes were studied. The first series involved the preparation of polymer blend electrolyte films using polyvinyl alcohol (PVA), polyethylene glycol (PEG), and sodium nitrate ($NaNO_3$). The films exhibited increased amorphicity with $NaNO_3$ content, complexation between Na^+ ions and the polymer matrix, and enhanced ionic conductivity. The second series focused on the incorporation of multi-walled carbon nanotubes (MWCNTs) as fillers in the PVA-PEG-$NaNO_3$ polymer matrix. The resulting composite electrolytes showed improved ionic conductivity at different temperatures and dielectric properties. In the last series, barium titanate ($BaTiO_3$) and zinc oxide (ZnO) were added as fillers in PVA-PEG-$NaNO_3$ and cellulose acetate (CA) electrolytes, respectively. These composite electrolytes exhibited enhanced ionic conductivity, improved thermal stability, and good safety features.

Overall, the research findings demonstrated the potential of polymer electrolytes for sodium-ion batteries and energy storage applications, highlighting their improved conductivity, stability, and other desirable properties.