

Solid-State Sodium Ion Battery Using Organic/Inorganic Composite as the Electrolyte

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Abstract : This work studies the processing of an all-solid-state sodium-ion battery (ASSB), utilizing sodium vanadium phosphate (NVP) as both the cathode and anode. The solid electrolyte is composed of a polymer matrix combined with nanoscale sodium zirconium phosphosilicate, $\text{Na}_3\text{Zr}_2\text{Si}_2\text{PO}_{11}$ (NZSP) framework. To effectively enhance the desolvation of sodium salt, NaTFSI in the composite electrolyte, ferroelectric nano-ceramic particles are added to the electrolyte, achieving a high ionic conductivity in the range of 10^{-4} to 10^{-3} S/cm at room temperature. The full battery demonstrates impressive cycling performance, maintaining stability over 1000 charge/discharge cycles with minimal degradation. Atomic force microscopy (AFM) is employed to indirectly observe the ion transportation mechanisms within the battery, providing insights into the dynamics of sodium ion (Na^+) movement. This study highlights the potential of polymer-NZSP composite electrolytes in enhancing the performance and longevity of ASSBs for next-generation energy storage applications.

Keywords : solid-state electrolyte, solid-state battery, composite electrolyte, impedance

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