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Abstract	:	Composite-based polymer electrolytes have attracted considerable attention due to their high ionic conductivity and excellent electrochemical performance in energy storage applications. This study explores the influence of Lithium Perchlorate (LiClO4) loading on the electrochemical performance of composite-based solid-state electrolytes (SSEs) based on a composite of poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) and 20% cellulose acetate (CA), referred to as PVDF-HFP/20%CA. Utilizing a solution casting method, four SSE samples were fabricated: a control (0% LiClO4) and three samples with varying LiClO4 concentrations (5%, 10%, and 15%). Comprehensive characterizations, including scanning electron microscopy (SEM), Fourier-transform infrared (FTIR), physical characterization, and electrochemical impedance spectroscopy (EIS) were conducted to assess the impact of LiClO4 on the composites. The Nyquist plot and DC ionic conductivity analysis further validate the superior performance of PH20CA-15Li (PVDF-HFP/20% cellulose acetate with 15% LiClO4), with ionic conductivity increasing from 1.15 × 10−6 S cm−1 for the control sample to 3.7 × 10−6 S cm−1. Loss Tangent and Cyclic Voltammetry analyses underscore the dynamic electrochemical behavior and stability of PH20CA-15Li, with the voltage window expanding from 0.996 V in the control sample to 1.398 V, highlighting its enhanced dielectric properties and energy storage capabilities. ..see more.