

Real-Time Sodium-Ion Battery Data Analysis through a Digital Twin Model for Predicting Thermal and Chemical Degradation

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Abstract

This project presents an advanced system based on an AI-powered digital twin for monitoring sodium-ion batteries and enhancing their real-time performance. The system collects live sensor data, including voltage, current, and temperature, and analyzes it using deep learning algorithms, such as recurrent neural networks and advanced predictive models. This integration enables early prediction of battery degradation and faults before they occur, thereby improving safety and increasing reliability. The results demonstrated the system's capability to enhance thermal and electrochemical efficiency, reduce energy consumption, and extend the battery's lifespan significantly. Additionally, the project provides an intelligent interactive interface that allows users to monitor battery status in real time and receive instant alerts to optimize usage. Thus, the project offers an innovative technical solution that promotes sustainability, improves energy system efficiency, and serves societal needs in smart, industrial, and medical applications.

Keywords

Sodium-Ion Battery, Data Analysis, Thermal