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Rechargeable Battery for Hybrid Diesel-Electric Locomotive

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ABSTRACT

Over time, rechargeable batteries degrade and eventually stop working. You see some combination of declining capacity, rapid self-discharge, and reduced power. Degradation mode depends on battery design, but also on the application. Often, multiple physical processes contribute to degradation. In the laboratory, you can measure performance degradation. You can dissect the battery to discover physical changes and conjecture about underlying causes. To tie physical changes and underlying causes to performance degradation requires electrochemical modeling.

A new, high-energy, sodium battery has commercial applications, including hybrid locomotives. A detailed electrochemical model has been implemented with FEM. Before constructing the model, we measured chemical kinetics for the several phenomena comprising battery operation. The resulting model simulates measured battery performance well, while providing insights into degradation processes.