

Engineered Reactor Components for Durable Iron Flow Battery

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Abstract : Iron-based redox flow batteries (IRFB) are promising for grid-scale storage because of their low-cost and environmental safety. Earth-abundant iron can enable affordable grid-storage to meet DOE's target material cost <\$20/kWh and levelized cost for storage \$0.05/kWh. In conventional redox flow batteries, energy is stored in external electrolyte tanks and electrolytes are circulated through the cell units to achieve electrochemical energy conversions. However, IRFBs are hybrid battery systems where metallic iron deposition at the negative side of the battery controls the storage capacity. This adds complexity to the design of a porous structure of 3D-electrodes to achieve a desired high storage capacity. In addition, there is a need to control parasitic hydrogen evolution reaction which accompanies the metal deposition process, increases the pH, lowers the energy efficiency, and limits the durability. To achieve sustainable operation of IRFBs, electrolyte pH, which affects the solubility of reactants and the rate of parasitic reactions, needs to be dynamically readjusted. In the present study we explore the impact of complexing agents on maintaining solubility of the reactants and find the optimal electrolyte conditions and battery operating regime, which are specific for IRFBs with additives, and demonstrate the robust operation.

Keywords : flow battery, iron-based redox flow battery, IRFB, energy storage, electrochemistry

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