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Concentration-dependent Charge-discharge Characteristics of Non-aqueous Redox Flow Battery Electrolyte Combinations

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Abstract

Non-aqueous redox flow batteries (naRFBs) are promising candidates as high-capacity energy storage devices. Although the wide redox windows associated with the organic solvents used in naRFBs are useful to realize high open circuit voltages, the low solubilities of electrolytes often minimize the energy densities. Strategies have emerged to increase the concentration of active materials employed in naRFBs; however, the dilute conditions typically associated with chronoamperometry and voltammetric experiments are orders of magnitude lower than those found in a working RFB. The electrochemical behavior of non-aqueous electrolytes may differ at high concentrations due to changes in solvation structure, aggregation, solution resistance, and mass transport, which in turn affect the overall cell performance. Accordingly, we studied a series of naRFB systems using ferrocene/TEMPO as a posolyte, and cobaltocenium hexafluorophosphate/N-methylphthalimide as a negolyte, to investigate the effect of concentration on charge-discharge profiles. Cycling studies were performed with four combinations of the above-mentioned catholyte and anolyte materials. Concentration regimes were explored ranging from 10 mM to 1 M depending on the maximum solubility of a given

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