Influence of L-cystine as an Additive in the Negative Electrolyte on Performance of Vanadium Redox Flow Battery

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L-cystine (LC) was employed as an additive to inhibit crystallization of V(II) or V(III) specie in the negative electrolyte and extend the practical application of vanadium redox flow battery (VRB) at below-ambient temperatures. UV-vis spectrometry showed LC has no effect on the absorption in the range of 300-800 nm. Crossover the membrane testing indicated that LC can permeate from Negative side to Positive side across the Nafion 117. Static thermal stability testing showed LC can significantly inhibit precipitation of V(II)~V(IV) ions or V(V) in 1.8 M vanadium electrolyte with 3.0 M H₂SO₄ at 5 or 50 °C. It is found that 2-4 wt% LC in vanadium electrolytes can lower viscosity compared to the blank electrolyte. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) show V(III) electrolyte with 2 wt% LC exhibits superior electrochemical activity and diffusion coefficient, compared with the pristine electrolyte. Introduction of LC into the negative electrolyte can obtain better performance of VRB with higher capacity retention (91.04% vs. 84.3%) and energy efficiency (75.77% vs. 72.27%) than the pristine electrolyte.

Keywords: Vanadium redox flow battery; L-cystine; Negative electrolyte; Thermal stability; Electrochemical activity

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