

Polybenzimidazole/Nafion hybrid membrane with improved chemical stability for vanadium redox flow battery application

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In order to increase the chemical stability of polybenzimidazole (PBI) membrane against the highly oxidizing environment of vanadium redox flow battery (VRFB), PBI/Nafion hybrid membrane was developed by spray coating Nafion ionomer onto one surface of the PBI membrane. The acid-base interaction between the sulfonic acid of the Nafion and the benzimidazole of the PBI created a stable interfacial adhesion between the Nafion layer and the PBI layer. The hybrid membrane showed low area resistance of 0.166 Ω cm² and very low vanadium permeability of 1.95×10^{-9} cm² min⁻¹. The Nafion layer protected the PBI from chemical degradation in an accelerated oxidizing condition of 1M VO₂⁺/5M H₂SO₄, which was subsequently examined in spectroscopic analysis. In the VRFB single cell performance test, the cell with the hybrid membrane showed better energy efficiency than the Nafion cell with no delamination observed between the Nafion layer and the PBI layer after the test was completed.