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Modification of Nafion membrane using fluorocarbon surfactant for all vanadium redox flow battery

Xiangguo Teng ^a, Jicui Dai ^a, Jing Su ^a, Geping Yin ^{b, *}

^a *School of Marine Science and Technology, Harbin Institute of Technology at Weihai, Weihai*

264209, P.R. China

^b *School of Chemical Engineering and Technology, Harbin Institute of Technology, Harbin*

150001, P.R. China

Abstract:

Fluorocarbon surfactant (potassium nonafluoro-1-butanesulfonate) is employed to prepare the Nafion/fluorocarbon (N/FC) membranes for all vanadium redox flow battery (VRFB). N/FC membranes with different FC surfactant mass ratios were successfully prepared by solution casting method. The addition of FC surfactant has effectively suppressed the vanadium ions permeability and improved the proton conductivity of Nafion. The N/FC membrane with 5 wt% of FC surfactant (N/FC-5%) exhibits the highest ion selectivity (ratio of proton conductivity to permeability) of $2.0 \times 10^6 \text{ S min cm}^{-3}$, which is 2.1 times higher than that of pure recast Nafion (r-Nafion) membrane ($9.7 \times 10^5 \text{ S min cm}^{-3}$). Consequently, both coulombic efficiency (*CE*) and voltage efficiency (*VE*) of the VRFB with N/FC-5% membrane are higher than that of the VRFB with r-Nafion membrane. The average energy efficiency (product of *CE* and *VE*) of the VRFB with N/FC-5% membrane is 11% higher than that of the VRFB with r-Nafion at current density of 40-80 mA cm^{-2} .

Keywords: All vanadium redox flow battery; Nafion; Membrane; Surfactant

* Corresponding author. Tel./fax: +86 631 5687232.

Email address: yingphit@hit.edu.cn or tengxghit@163.com

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