

Supplementary Materials

Effect of Elevated Temperature Annealing on Nafion/SiO₂ Composite Membranes for the All-Vanadium Redox Flow Battery

Sixiu Zeng, Liuli Zeng, Rui Wang, Wei Guo * and Haolin Tang *

State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, Wuhan University of Technology, Wuhan 430070, China

* Correspondence: guowei2016@whut.edu.cn (W.G.); thln@whut.edu.cn (H.T.)

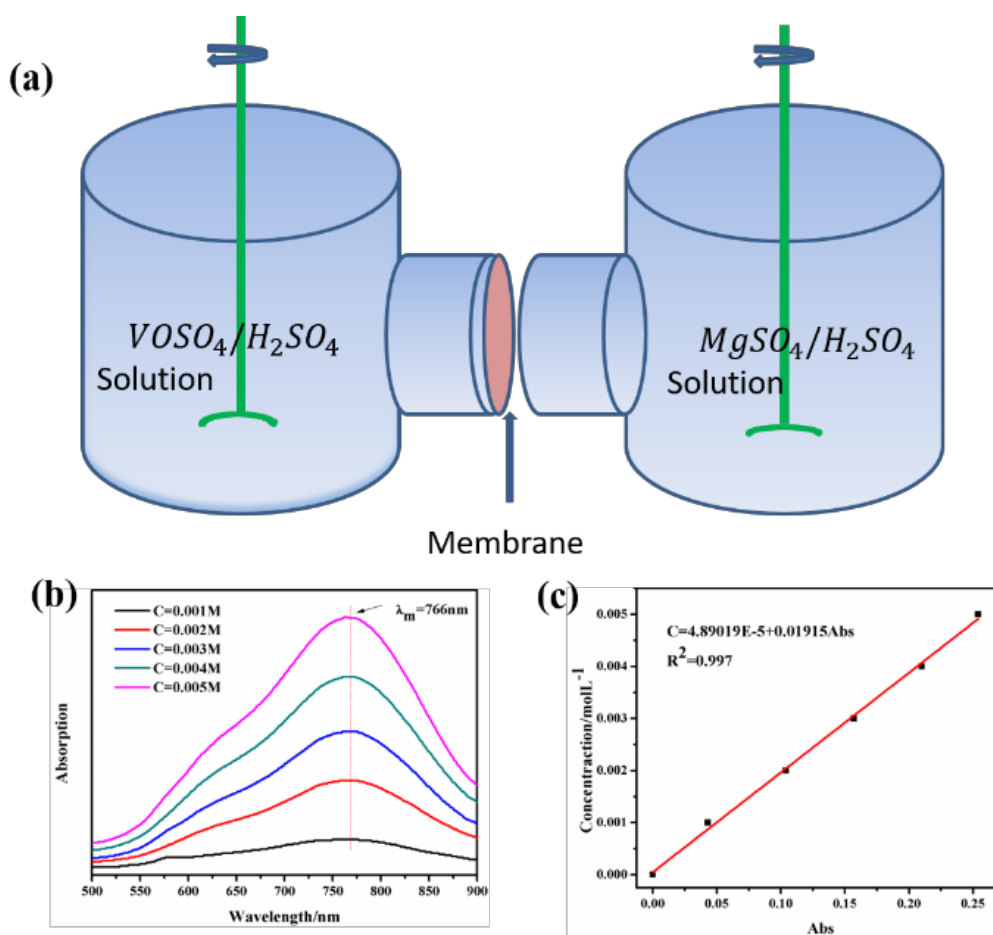


Figure S1. (a) Schematic diagram of the diffusion cell used to measure the VO^{2+} crossover; (b) sorption spectra of the $VOSO_4$ solution for four different concentrations at $\lambda_{max} = 766\text{ nm}$; and (c) the calibration curve of the $VOSO_4$ solution with the concentration range between 0.001 M and 0.005 M.

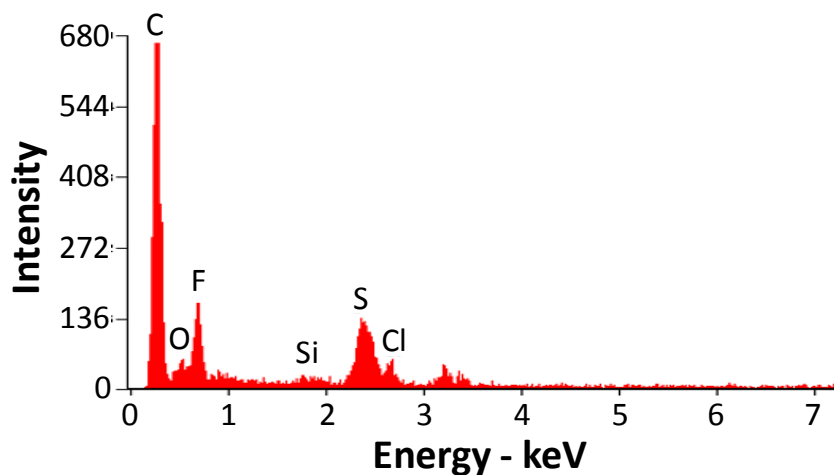


Figure S2. EDX data of the 5%@Nafion/SiO₂@270 °C sample.

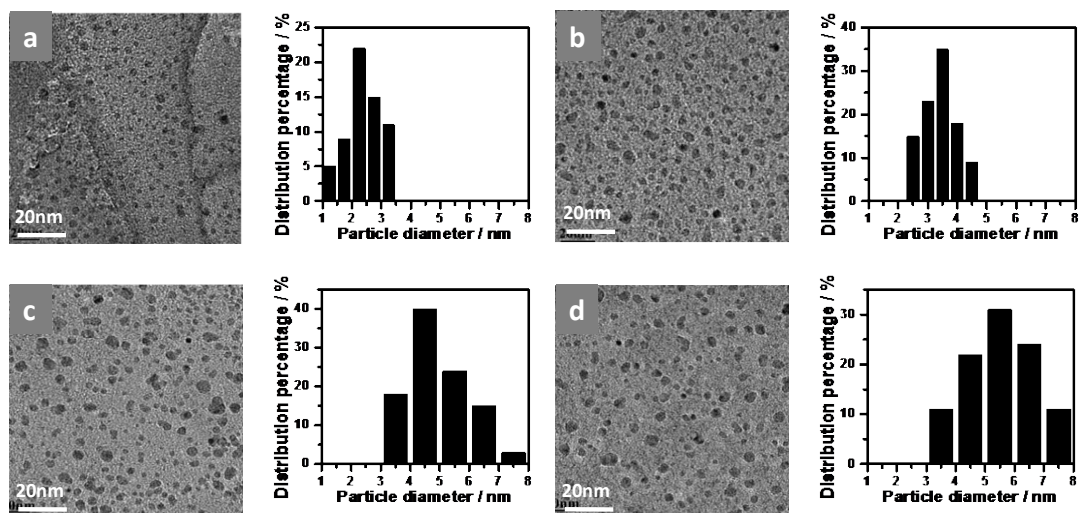


Figure S3. TEM micrographs and particle diameter distribution of 3%@Nafion/SiO₂@270 °C (a); 5%@Nafion/SiO₂@270 °C (b); 10%@Nafion/SiO₂@270 °C (c); and 15%@Nafion/SiO₂@270 °C (d) samples.

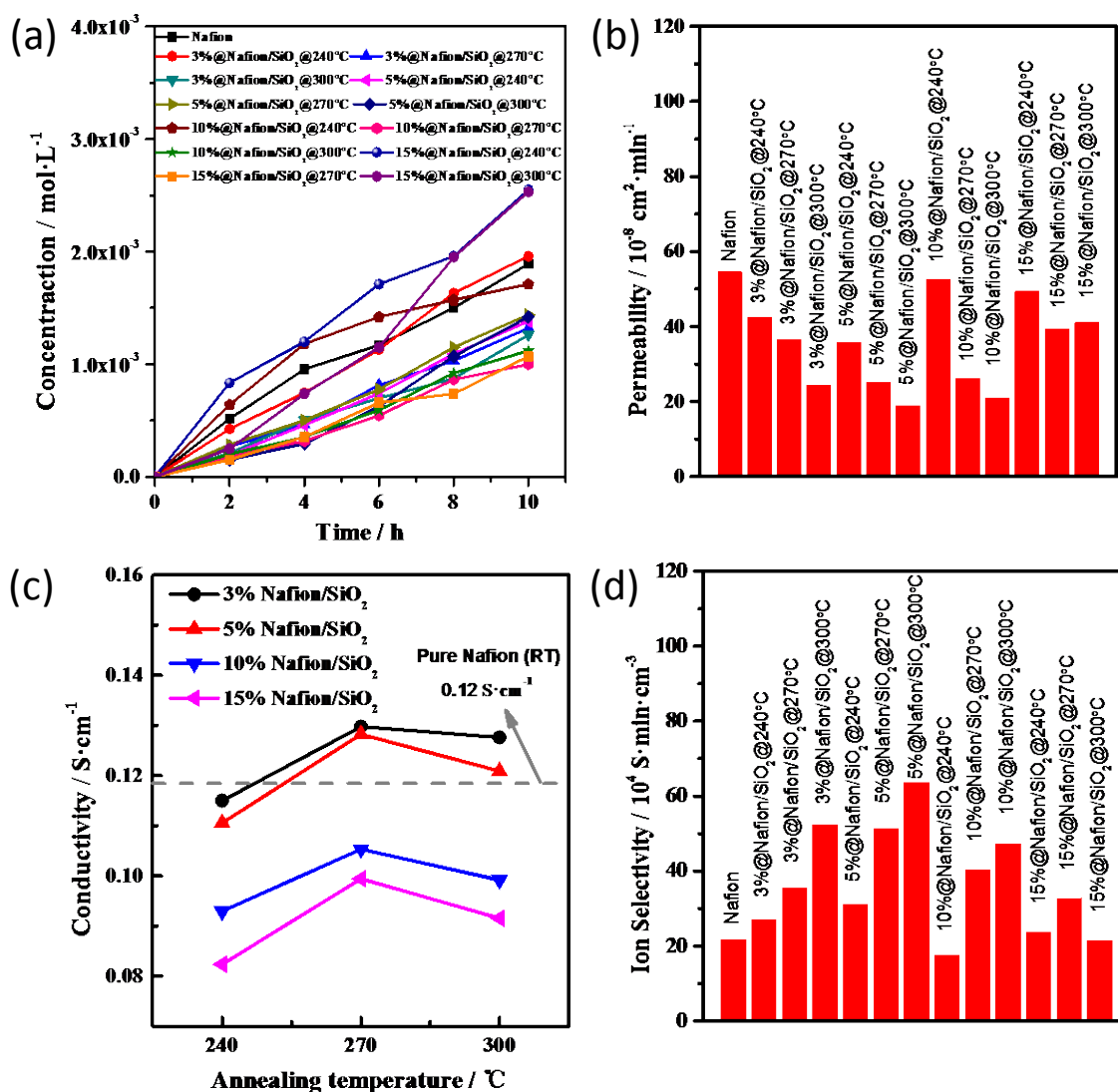


Figure S4. Comparison of the time-dependent vanadium ion concentrations (a), permeability (b), proton conductivities (c), and ion selectivity (d) of 3%@Nafion/SiO₂@240 °C, 3%@Nafion/SiO₂@270 °C, 3%@Nafion/SiO₂@300 °C, 5%@Nafion/SiO₂@240 °C, 5%@Nafion/SiO₂@270 °C, 5%@Nafion/SiO₂@300 °C, 10%@Nafion/SiO₂@240 °C, 10%@Nafion/SiO₂@270 °C, 10%@Nafion/SiO₂@300 °C, 15%@Nafion/SiO₂@240 °C, 15%@Nafion/SiO₂@270 °C, 15%@Nafion/SiO₂@300 °C, and pure Nafion samples.

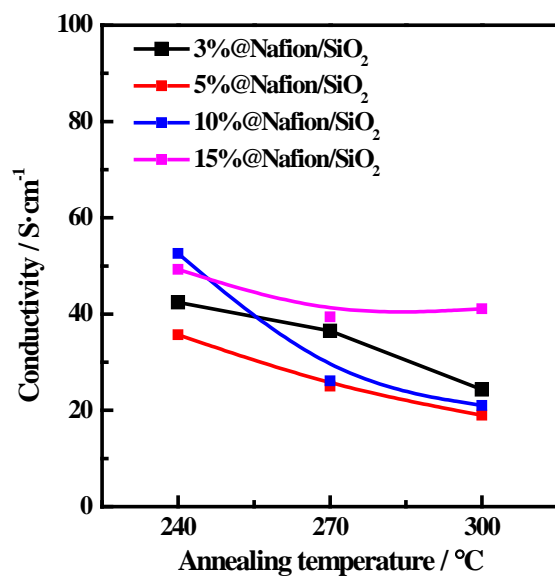


Figure S5. The ratio of proton conductivity and temperature of 3%@Nafion/SiO₂, 5%@Nafion/SiO₂, 10%@Nafion/SiO₂, and 15%@Nafion/SiO₂ samples.

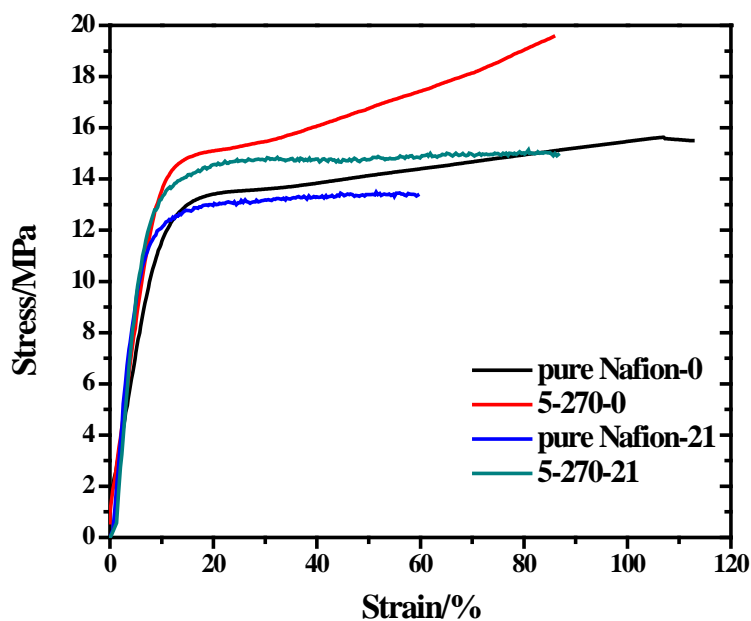


Figure S6. The stress-strain behavior for pure Nafion and 5%@Nafion/SiO₂@270 °C samples before and after 21 days of immersion in V⁵⁺ solution.

