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Suppotrting information

Composite porous membranes with ultrathin selective layer for vanadium flow battery

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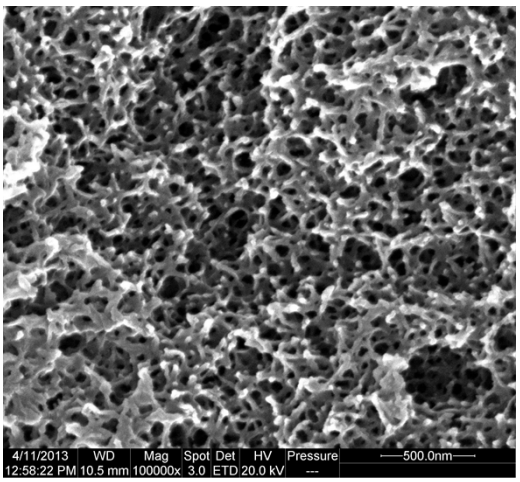

Fig S1. The magnified cross section of M_0

Average pore size measurement

Average pore size of the prepared membranes was measured by the stainless steel dead-end pressure cell with the effective membrane area of 19.6 cm^2. The cell was filled with the deionized water, pressurized with nitrogen and then kept at a certain pressure. The permeate samples were collected in a cooled flasks as a function of time and weighed. The average pore size of membrane was calculated described as follows:

$$J = \frac{\varepsilon D_2 \Delta P}{32\eta L\tau}$$

Where J is the water flux, D is the average pores size, ε is the porosity, τ is the turtosity, η is the water viscosity, L is the average thickness of membranes, ΔP is the pressure difference across the membranes.

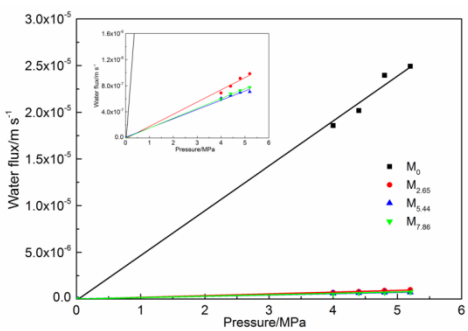

Fig.S2 Water flux of the prepared membranes at different pressure

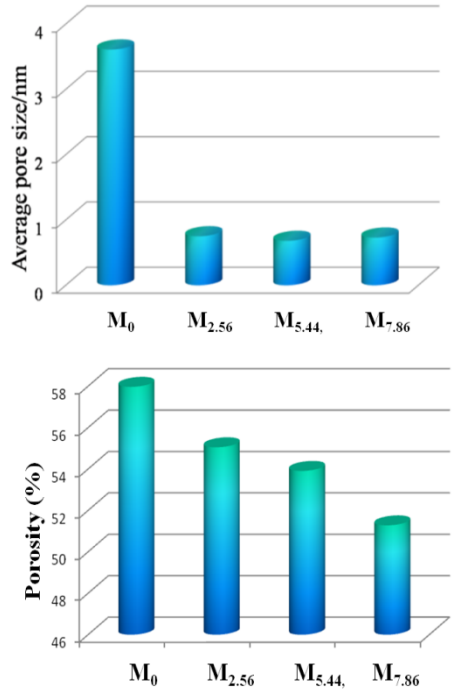

Fig. S3 Average pore size and porosity of the prepared membranes

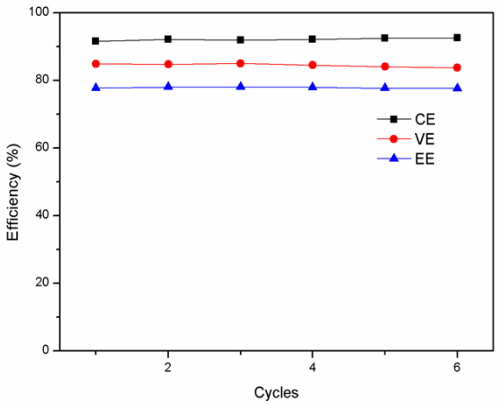

Fig. S4 The battery performance of VFB assembled with $M_{1.08}$

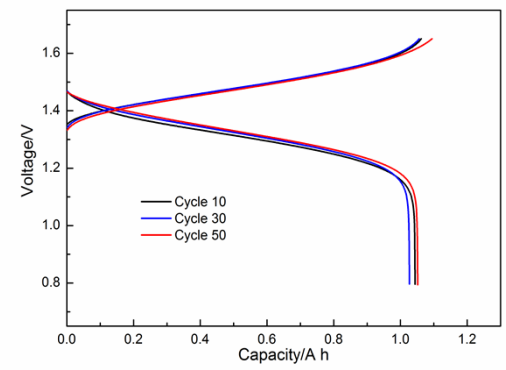

Fig. S5 cell-voltage profile with respect to cell capacity in cycle 10, 30 and cycle 50.

EX-situ stability test

Ex situ chemical stability tests were carried out by immersing membrane samples (0.1 g) in 50 mL testing solution (0.15 MVO_2^+ in 3.0 M H2SO4), held in a water bath at 40°C. The VO2+ concentration in the testing solution was recorded as an indicator of membrane oxidation degradation

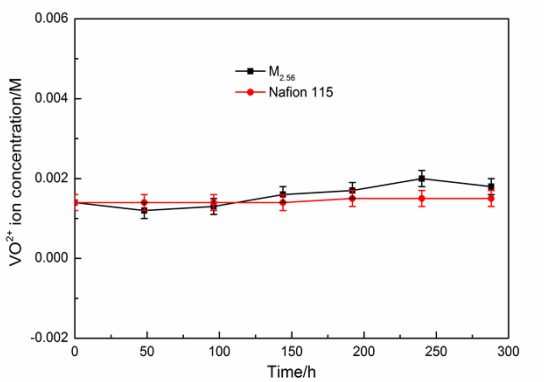

Fig S6. A plot of VO^{2+} concentration versus immersion time in 0.15 M VO_2^+

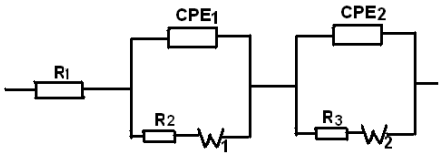

Fig S7. The equivalent circuit

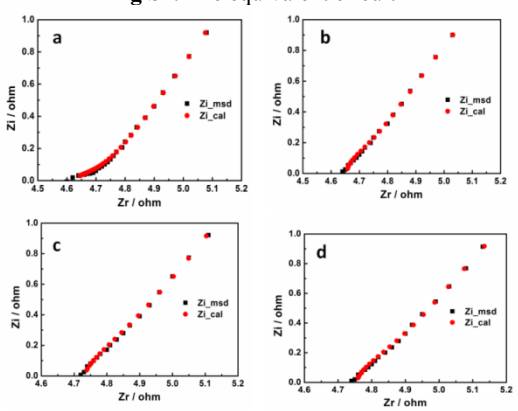

Fig S8. The measured impedance spectra and the calculated impedance spectra via equivalent circuit (a: M_0, b: $M_{2.56}$, c: $M_{5.44}$, d: $M_{7.86}$)