Electronic Supplementary Information (ESI)

Insights into iron induced fouling of ion-exchange membranes revealed by a quartz crystal microbalance with dissipation monitoring

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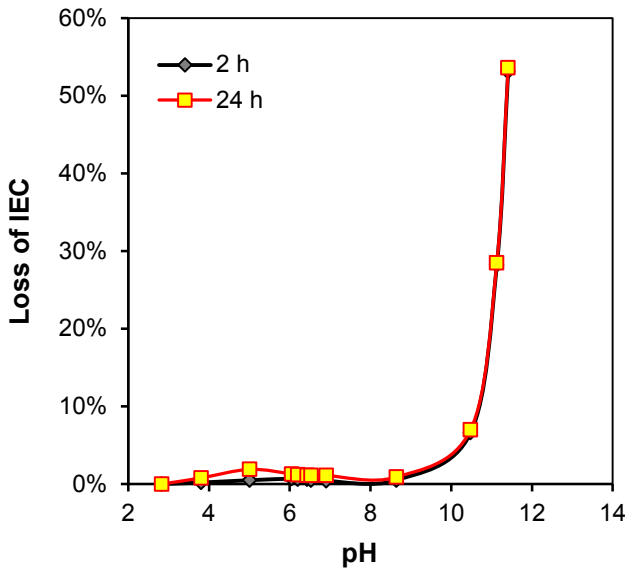

Fig. S1 Loss of IEC at different initial pH following reaction time of 2 and 24 h.

Kinetics modeling: As stated in the paper, the initial mass gain might be attributed to (i) the change of solution properties and/or (ii) rapid Fe(III) deposition, which is not associated with the variation of membrane resistance. Therefore, Δf_5 after injection of 10 mM Fe(III) for 60 s (t_0 = 720.8 s in Fig. S2) was introduced as the baseline (-13.9 Hz) of the modeling:

$$\Delta f_5(t) = \Delta f_{5,m} - (\Delta f_{5,m} - \Delta f_0) e^{-k_{app}(t-t_0)} \quad (1)$$

where $\Delta f_5(t)$ is Δf_5 at an injection time of t, $\Delta f_{5,m}$ is the maximum $|\Delta f_5|$ with an infinite injection of 10 mM Fe(III), Δf_0 is the hypothetical initial Δf_5 (-13.9 Hz) and k_{app} is the apparent rate constant. Fitting of the results was conducted using nonlinear regression function of SigmaPlot 12.0: $\Delta f_{5,m}$ = -20.7 Hz, k_{app} = 0.0017 s^{-1}, R^2 = 0.9914.

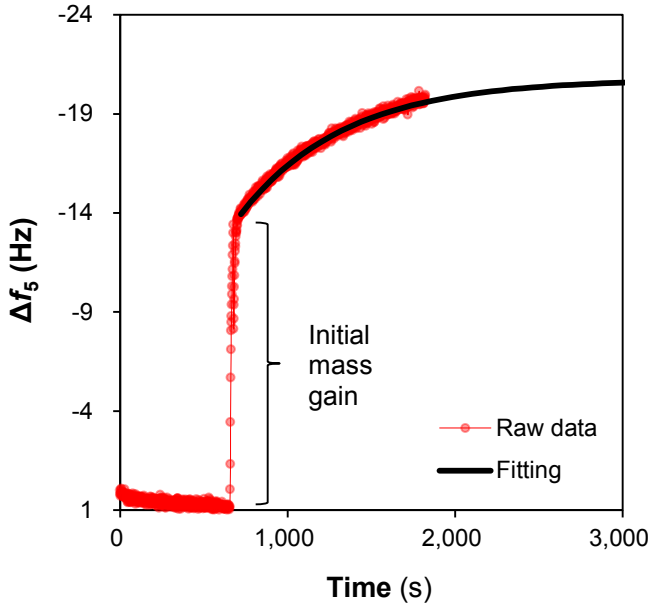

Fig. S2 Kinetics modeling results of Δf_5 representing Fe(III) deposition on Nafion film surface. Experimental conditions: [Fe(III)] = 10 mM.

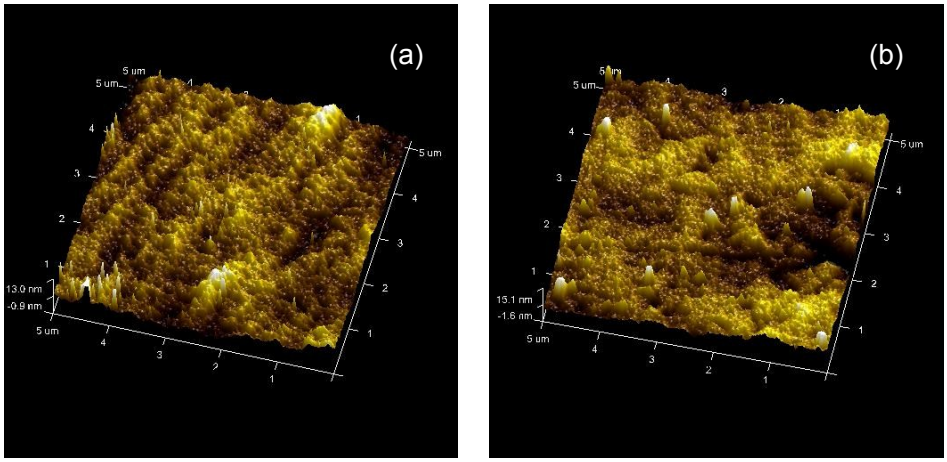

Fig. S3. AFM images of (a) the pristine Nafion 117 membrane and (b) the fouled one upon exposure to 10 mM Fe(III) solution for 60 min.

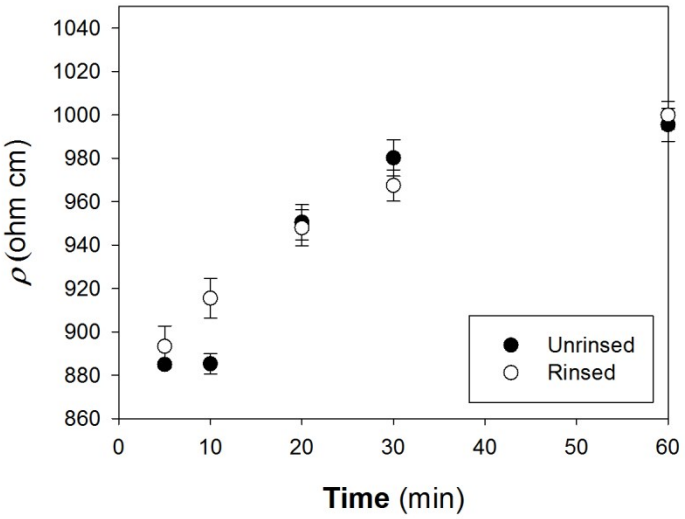

Fig. S4 Change in membrane specific resistance (ρ). The black circles represent the ρ of Nafion membrane measured following the exposure to 10 mM Fe(III) solution without rinse, and the white circles the ρ measured after the rinse with copious amount of ultrapure water (pH of 6.50).