Supplementary Information (SI)

Effect of External Salt Solution Concentration on Carboxyl Dissociation Degree (α) and pK_a of Weak Polyelectrolyte Membranes for Sustainable Technologies

Yongha Kim[1], Charleen M. Rahman[1], Michael A. Shaqfeh[1], Kyle M. Tierney[1], Andrew J. Lukaszewski[1], Nikitha S. Kanumuru[2], Dae Eun Kang[3], and Hee Jeung Oh[1,2,4,5]*

[1]Department of Chemical Engineering, The Pennsylvania State University, University Park, PA 16802, USA
[2]Department of Materials Science and Engineering, The Pennsylvania State University, University Park, Pennsylvania 16802, USA
[3]Department of Chemistry, The Pennsylvania State University, University Park, Pennsylvania 16802, USA
[4]Institute of Energy and Environment (IEE), The Pennsylvania State University, University Park, Pennsylvania 16802, USA
[5]Advanced Manufacturing and Design, The Pennsylvania State University, University Park, Pennsylvania 16802, United States

Corresponding Author: Prof. Hee Jeung Oh
Department of Chemical Engineering
Department of Materials Science and Engineering (by courtesy)
Institute of Energy and Environment (IEE)
Advanced Manufacturing and Design (AMD)
The Pennsylvania State University
Email: hjoh@psu.edu
Phone: 814-863-9085

Table S1. Polymer composition of AA–PEGDA series[1-3].

Sample [$n-$ mIEC]	Mass of AA monomer [g]	Mass of PEGDA crosslinker [g]	Mass of DMPA [g]	Mass of water [g]	AA content[a] [wt%]
$10-0$	0.000	15.000	0.015	0.075	0.00
$10-1$	1.081	13.919	0.015	0.075	7.21
$10-2$	2.162	12.838	0.015	0.075	14.41
$10-3$	3.243	11.757	0.015	0.075	21.62
$10-4$	4.324	10.676	0.015	0.075	28.82
$13-0$	0.000	15.000	0.015	0.075	0.00
$13-1$	1.081	13.919	0.015	0.075	7.21
$13-2$	2.162	12.838	0.015	0.075	14.41
$13-3$	3.243	11.757	0.015	0.075	21.62
$13-4$	4.324	10.676	0.015	0.075	28.82

[a] AA content [wt%] = mass of AA [g] / (mass of AA [g] + mass of PEGDA [g]) × 100

Table S2. Added mmol equivalent NaOH per grams of a dry polymer, x_{NaOH} [mequiv/g] with respect to the maximum ion–exchange capacity (mIEC) in a polymer coupon [mequiv/g] for pH titration[1-3].

	NaOH amount (x_{NaOH}) [mequiv/g]											
mIEC [mequiv/g]	0	0.1	0.3	0.5	0.7	0.9	1.0	1.2	1.5	1.7	2.0	-
	1	0.1	0.3	0.5	0.7	0.9	1.0	1.2	1.5	1.7	2.0	-
	2	0.1	0.5	0.7	1.0	1.2	1.5	2.0	2.2	2.5	3.0	-
	3	0.1	0.5	1.0	1.5	2.0	2.5	3.0	3.2	3.5	4.0	-
	4	0.1	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

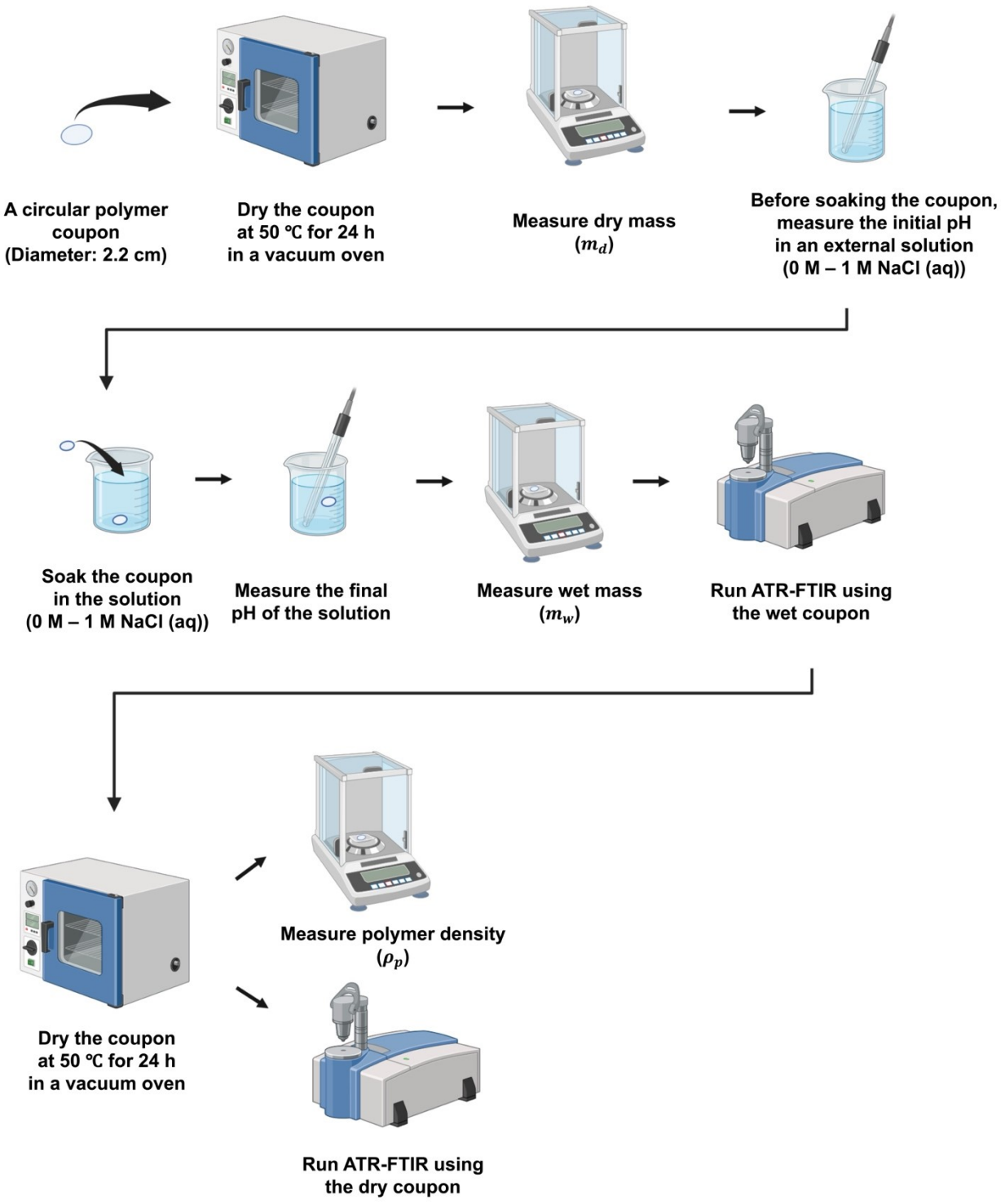

Figure S1. Pre–titration procedure in this study[1, 2].

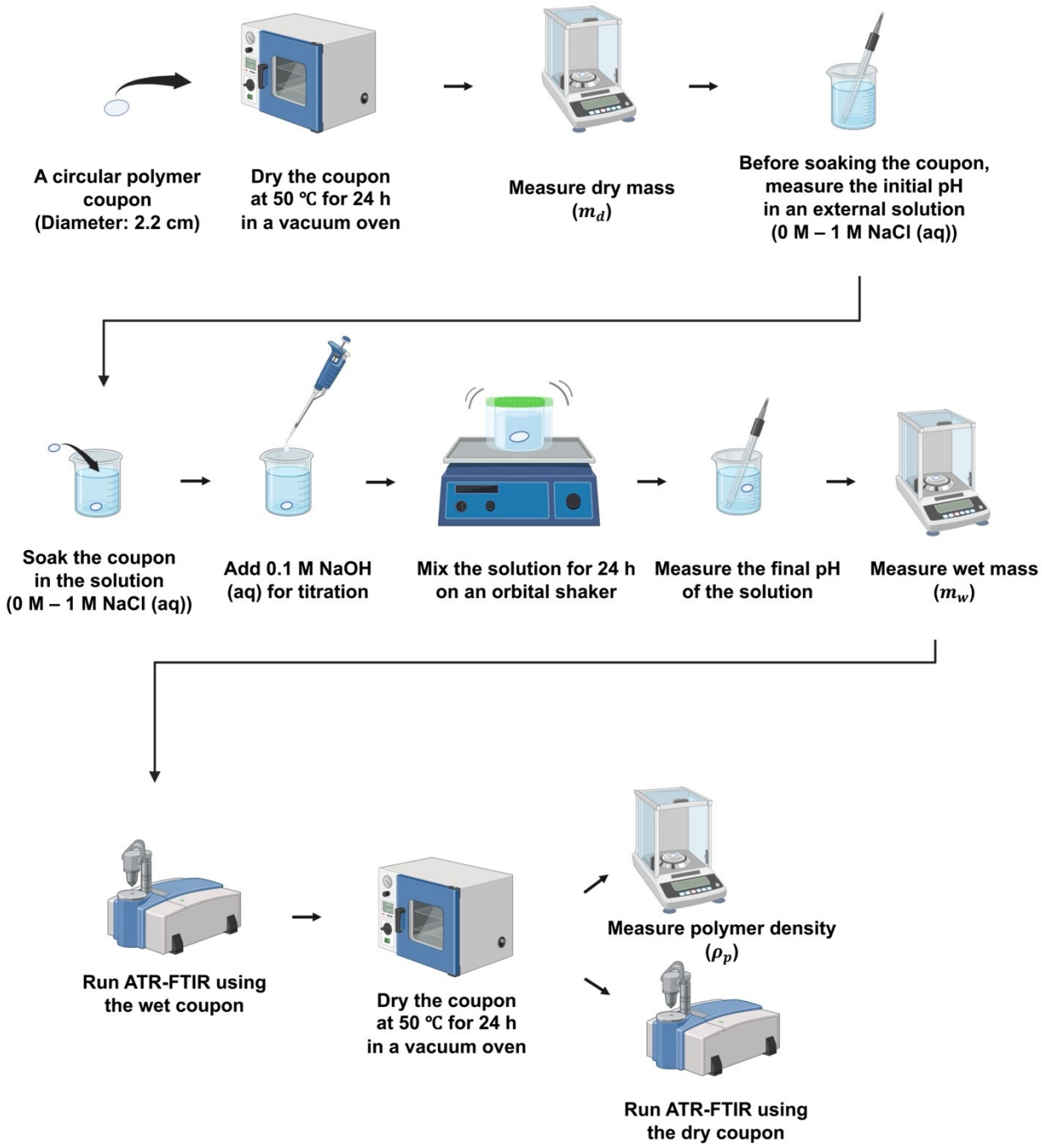

Figure S2. Titration procedure in this study[1, 2].

Table S3. Dielectric constant ($\varepsilon_{p,swollen\ polymer}$) of a swollen 10 – 2 AA–PEGDA network in different NaCl (aq) solutions. Different estimation methods were used with and without adjusting the external salt concentration (C_s) (at the highest pH = 12). NaCl concentration (C_{NaCl}), NaOH concentration (C_{NaOH}) and total external salt concentration (C_s) are shown for easier viewing.

10 - 2 AA–PEGDA network				
NaCl concentration (C_{Nacl}) [M]	0	0.01	0.1	1
NaOH concentration (C_{NaOH}) [M]	0 - 0.003	0 - 0.003	0 - 0.003	0 - 0.003
Total external salt concentration (C_s) [M]	0 - 0.003	0.01 - 0.013	0.1 - 0.103	1 - 1.003
$\varepsilon_{p,swollen\ polymer}$ from the linear mixing rule	47.9	47.2	47.2	45.8
$\varepsilon_{p,swollen\ polymer}$ from the linear mixing rule with C_s correction	47.8	47.1	46.4	39.1
$\varepsilon_{p,swollen\ polymer}$ from the logarithmic mixing rule	33.1	32.5	32.5	31.2
$\varepsilon_{p,swollen\ polymer}$ from the logarithmic mixing rule with C_s correction	33.1	32.5	32.2	28.4
$\varepsilon_{p,swollen\ polymer}$ from Maxwell-Garnett model	31.5	30.9	30.9	29.8
$\varepsilon_{p,swollen\ polymer}$ from Maxwell-Garnett model with C_s correction	31.5	30.9	30.7	27.7
$\varepsilon_{p,swollen\ polymer}$ from Bruggeman model	38.8	38.1	38.0	36.4
$\varepsilon_{p,swollen\ polymer}$ from Bruggeman model with C_s correction	38.8	38.1	37.5	32.2

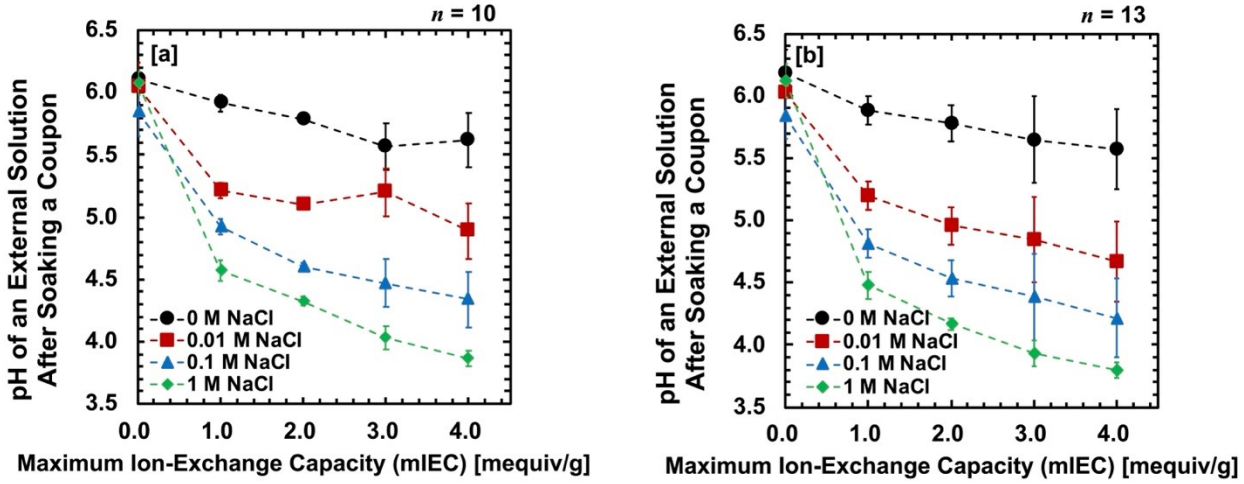

Figure S3. pH of an external solution after soaking AA–PEGDA series in different NaCl (aq) solutions (0 M – 1 M NaCl (aq)) for 2 days before titration. No strong base (NaOH) was added. **[a]** n = 10 and **[b]** n = 13 series. Dashed lines are used to guide the eyes. Error bars are included.

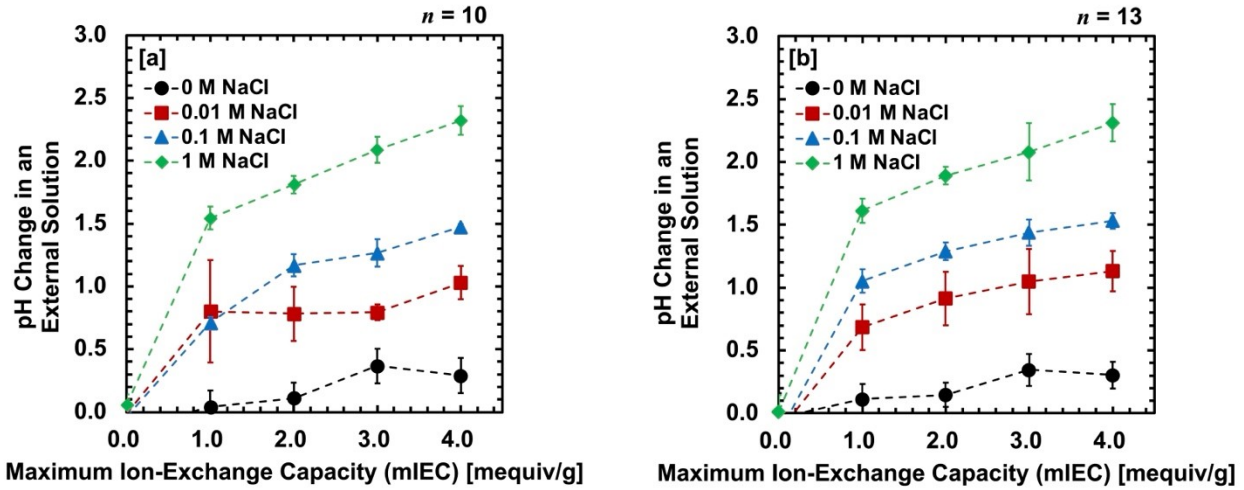

Figure S4. pH change in an external solution after soaking AA–PEGDA series in different NaCl (aq) solutions (0 M – 1 M NaCl (aq)) for 2 days before titration. No strong base (NaOH) was added. Dashed lines are used to guide the eyes. Error bars are included.

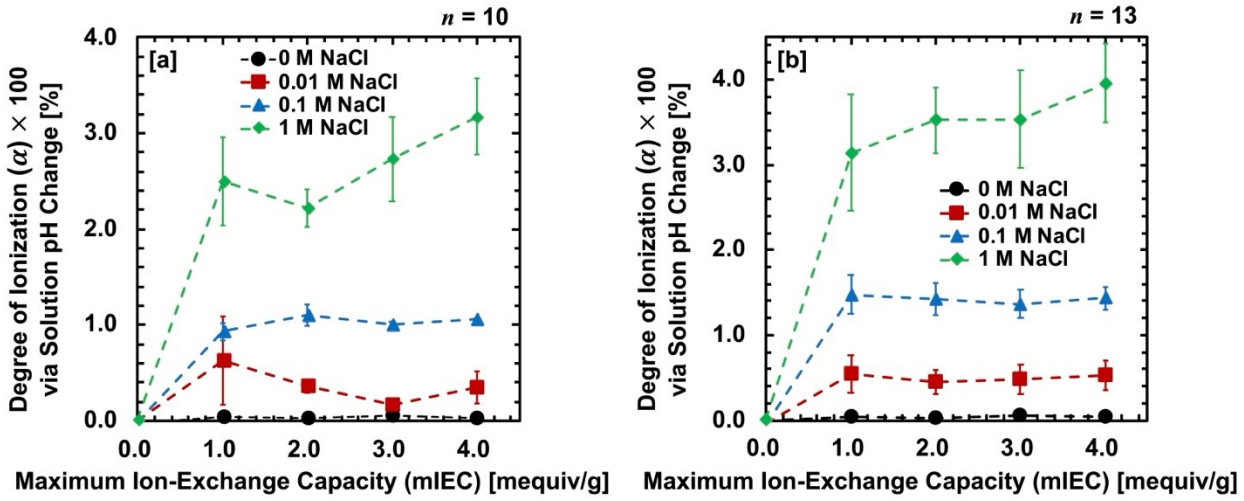

Figure S5. Pre–titration, degree of ionization (α) × 100 [%] via solution pH change vs. maximum ion-exchange capacity (mIEC). **[a]** n = 10 and **[b]** n = 13 series. Dashed lines are used to guide the eyes. Error bars are included.

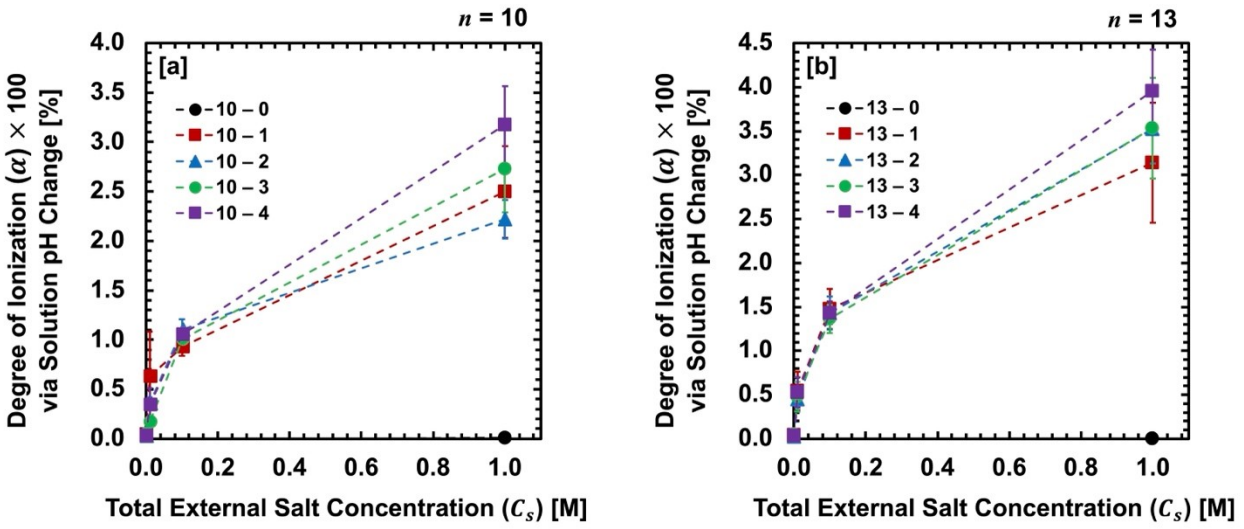

Figure S6. Pre–titration, degree of ionization (α) × 100 [%] via solution pH change vs. total external salt concentration (C_s) (on a linear scale). **[a]** n = 10 and **[b]** n = 13 series. Dashed lines are used to guide the eyes. Error bars are included.

S.1 ATR–FTIR before titration

To further support the pre–titration dissociation results of AA–PEGDA series, we detected the dissociation process in a polymer phase using ATR–FTIR analysis as shown in **Figure S7**. While **Figure 2** shows the dissociation data from recording the pH changes in the solution phase (in equilibrium with a polymer film), **Figures S7-S10** exhibit the dissociation results from probing the concentration changes of dissociable COOH and dissociated COO^- groups in the polymer phase. By combining two methods (detecting both solution and polymer phases together), a more rigorous and detailed analysis of dissociation process can be performed. Detailed analysis methods of AA–PEGDA series have been reported in our previous papers[1-3]. Similar methods have been reported by other researchers[4, 5].

As the representative chemical structure of AA–PEGDA series, the pre–titration ATR–FTIR spectra of 10 – 2 network in different NaCl (aq) solutions are shown in **Figure S7**. As the external NaCl concentration increases (0 M – 1 M NaCl (aq)), the absorbance intensities (and the areas under the curves) of dissociated COO^- groups (at 1575 cm^{-1} and 1400 cm^{-1}) increase (see **Figures S8a-d** and **S9a-b**) while the subtracted areas under the curve at 1700 cm^{-1} (from dissociable COOH groups) decreases (see **Figure S9c-d**) as expected. The absorbance intensities at 1100 cm^{-1} (ether C – O – C stretching from ethylene oxide (EO) groups in PEGDA cross–linker) remain nearly unchanged, suggesting that no chemical degradation occurred in pre–titration studies.

Figure S10 shows the pre–titration, dissociation data (α_{IR}) of 10 – 2 network via ATR–FTIR analysis (subscript $_{IR}$ means the degree of ionization was determined by IR analysis) along with the dissociation data (α) via pH measurement. Consistent with the α results in the solution phase (see **Figure 2b**), α_{IR} data in the polymer phase show similar trends and the similar range of

dissociation degree (0 – 4 %)[1, 2]. As external salt concentration increases, the α_{IR} increases as expected. While the general α trends are consistent between two methods, the α_{IR} values determined via ATR–FTIR analysis are smaller than the α ranges calculated via the solution pH changes. This is likely due to the difficulties arising from the subtraction of related areas (under the curves) at the lower range of dissociation degree in ATR–FTIR analysis. The difference in the measurement methods was also reported previously[1-3].

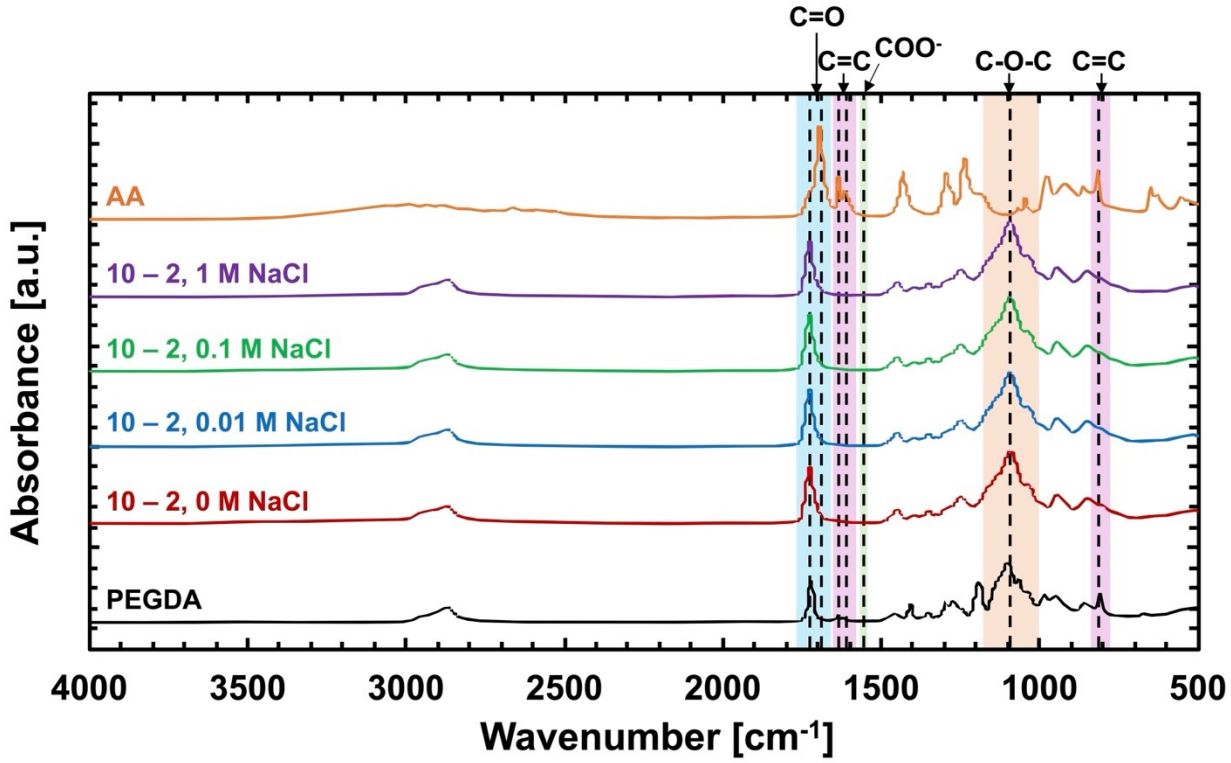

Figure S7. ATR–FTIR spectra of dry 10 – 2 AA–PEGDA network (n = 10 and mIEC = 2 mequiv/g) in different NaCl (aq) solutions (0 M – 1 M NaCl (aq)). Spectra of AA monomer and PEGDA cross–linker (n = 10) are shown for comparison. Spectra are vertically moved for easier comparison. Dashed lines are used to guide the eyes.

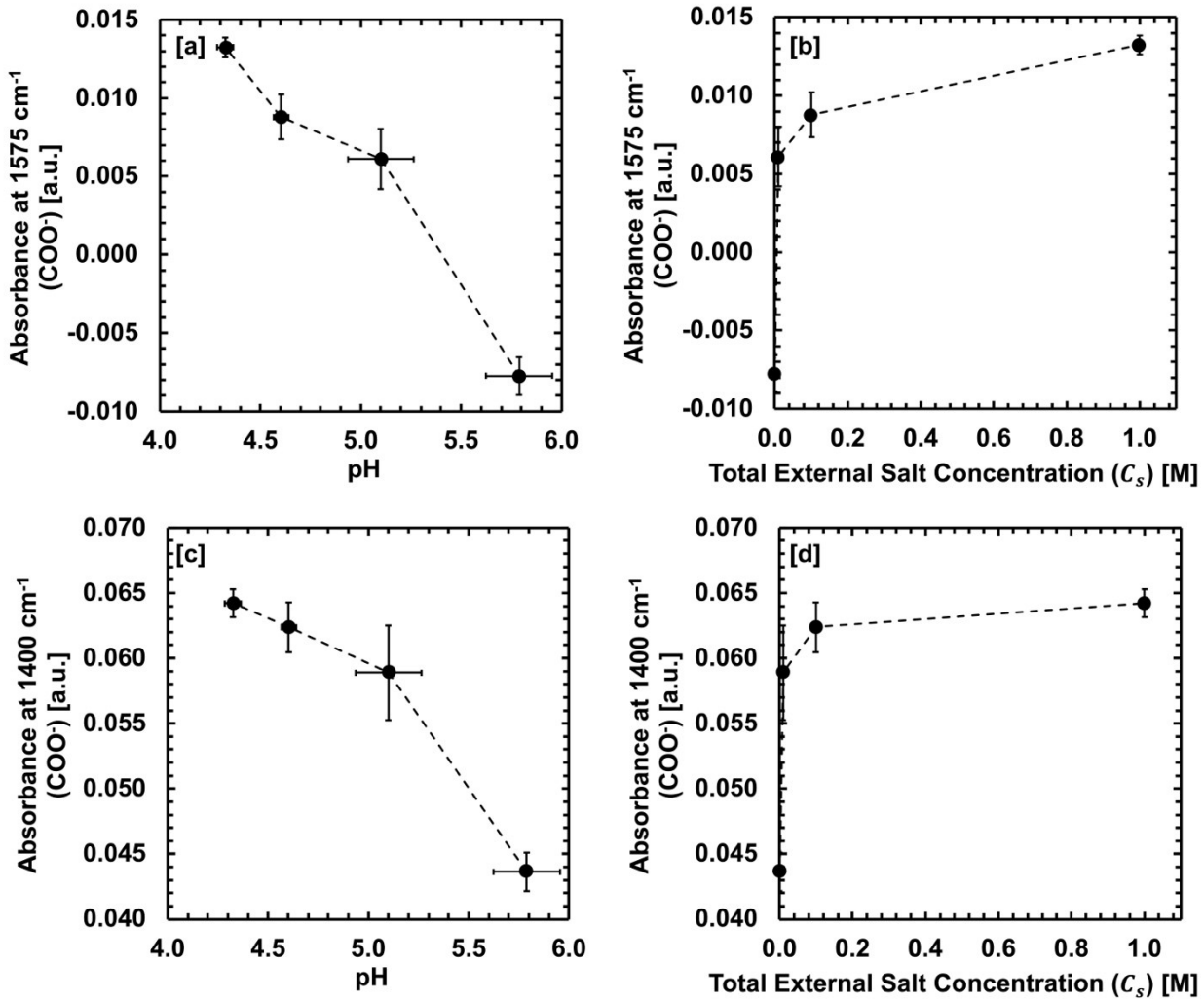

Figure S8. Absorbance intensities at **[a, b]** 1575cm^{-1} (from dissociated COO^- groups), **[c, d]** 1400 cm^{-1} (from dissociated COO^- groups) as a function of **[a, c]** pH and **[b, d]** total external salt concentration (C_s) (on a log scale) of dry 10 – 2 AA–PEGDA network in different NaCl (aq) solutions.

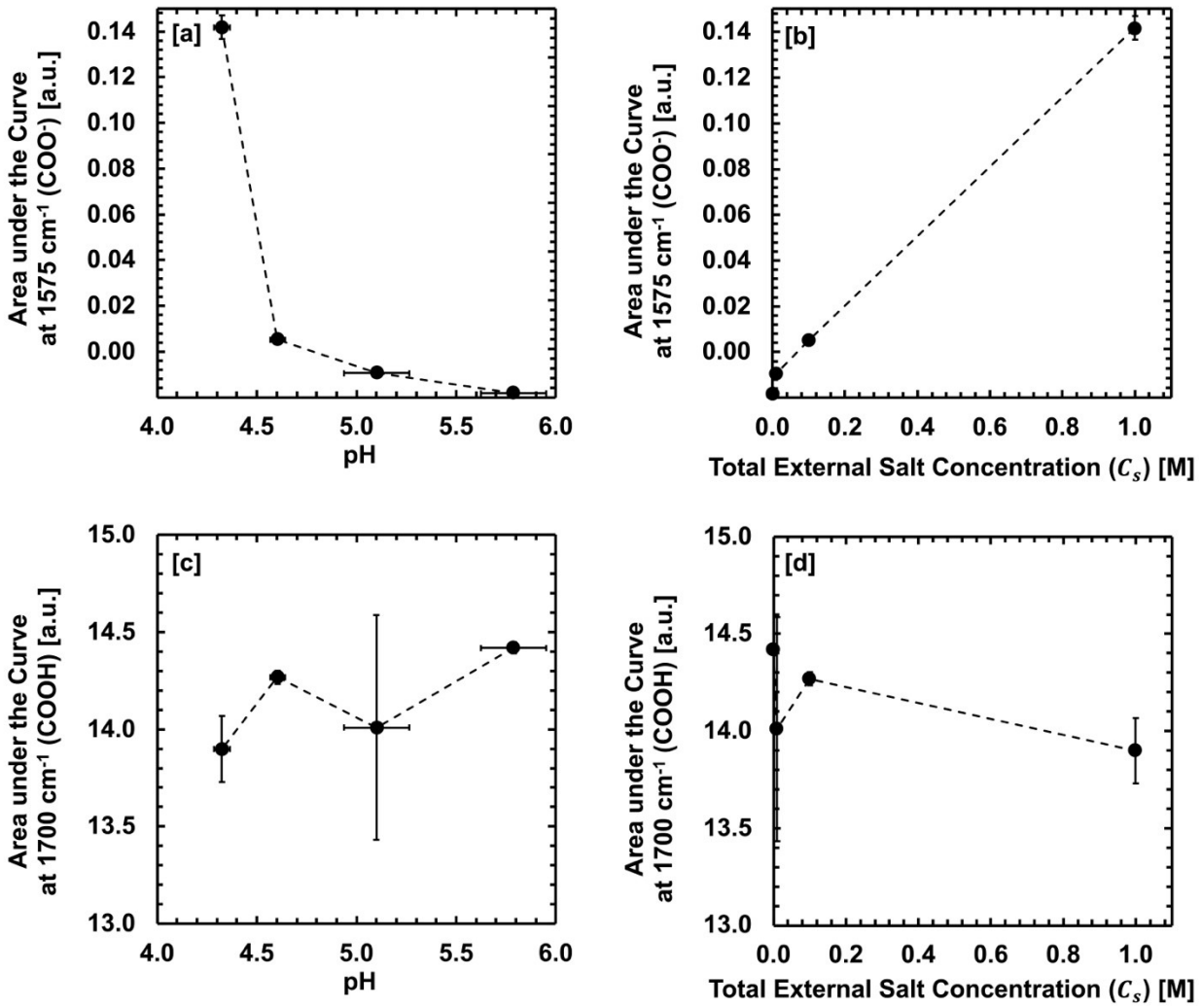

Figure S9. Areas under the curve at **[a, b]** 1575 cm^{-1} (A_{COO^-}, from dissociated COO^- groups) and **[c, d]** subtracted areas under the curve at 1700 cm^{-1} ($A_{C=O\ from\ COOH}$ or A_{COOH}, from dissociable COOH groups) as a function of **[a, c]** pH and **[b, d]** total external salt concentration (C_s) (on a log scale) of dry 10 – 2 AA–PEGDA network in different NaCl (aq) solutions.

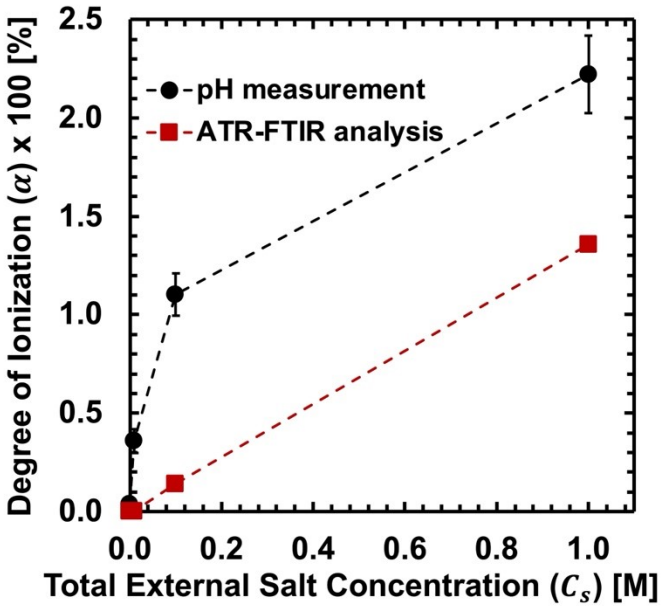

Figure S10. Pre–titration, degree of ionization (α) × 100 [%] via pH measurement and ATR–FTIR analysis. Dashed lines are used to guide the eyes. Error bars are included.

S.2. ATR–FTIR after titration

After pH titration, chemical structure and the concentration of dissociated charged groups in 10 – 2 AA–PEGDA network in different NaCl (aq) solutions were analyzed using ATR–FTIR analysis (see **Figure S11**). The absorbance intensities and the areas under the curve from related peaks were plotted as a function of added NaOH amount [mequiv/g] and the external pH (**Figures S12-S13**). The detailed analysis methods have been reported previously[1-7].

The absorbance intensities at 1575 cm^{-1} and 1400 cm^{-1} (from dissociated COO^- groups) along with the area under the curve at 1575 cm^{-1} (from dissociated COO^- groups) increase with the added NaOH amount (thus, the increased external pH) (see **Figures S12a-d** and **S13a-b**) while the subtracted areas under the curve at 1700 cm^{-1} (from dissociable COOH groups) decrease (see **Figure S13c-d**). In contrast, the absorbance intensities at 1100 cm^{-1} (ether C – O – C stretching from ethylene oxide (EO) groups in PEGDA cross–linker) remain almost unchanged (see **Figure S12e-f**). This suggests that no chemical degradation occurred during pH titration.

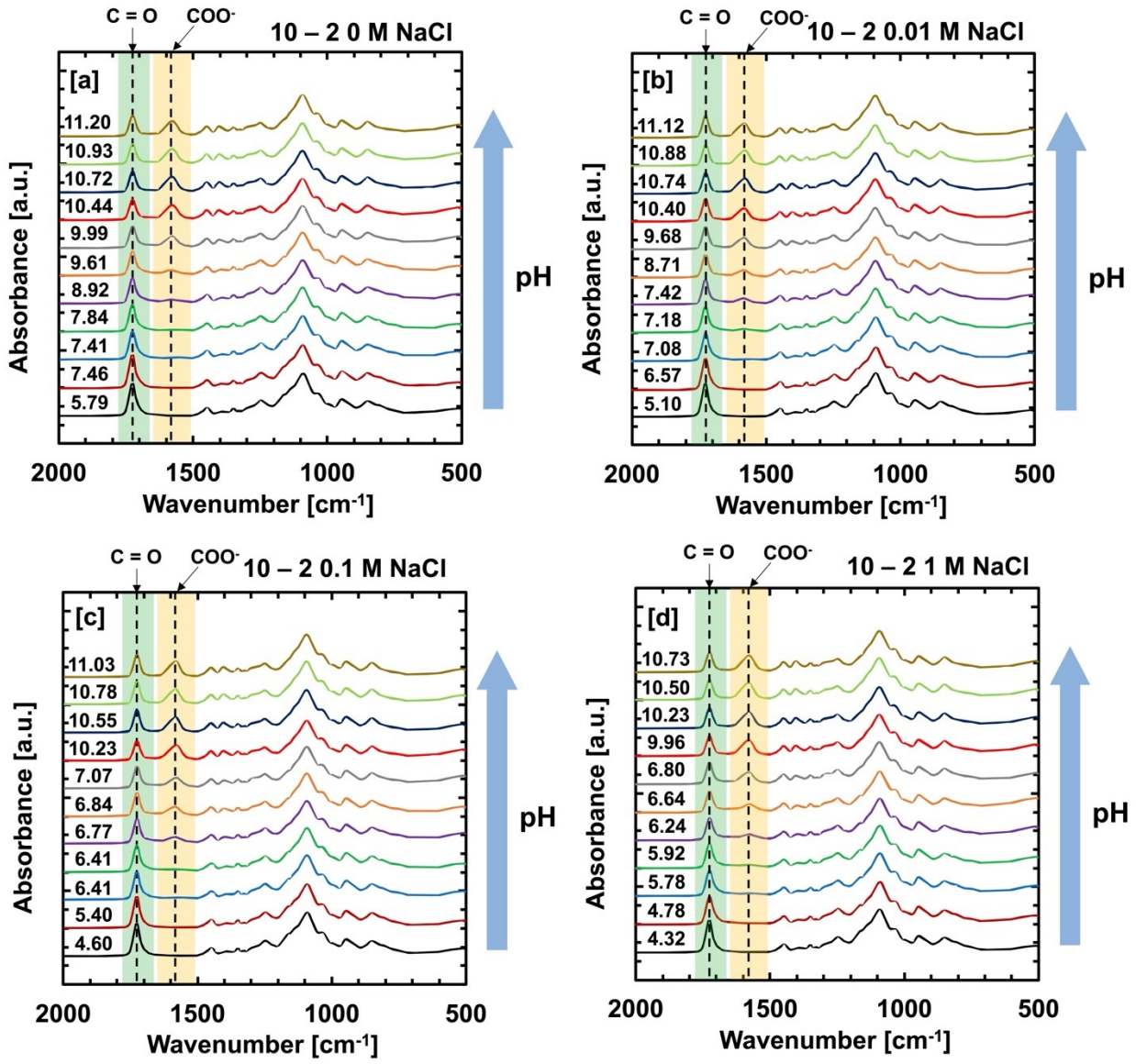

Figure S11. ATR–FTIR spectra of dry 10 – 2 AA–PEGDA network (n = 10, mIEC = 2 mequiv/g) vs. pH in **[a]** 0 M, **[b]** 0.01 M, **[c]** 0.1 M and **[d]** 1 M NaCl (aq) solutions. Spectra are vertically moved for easier comparison. Dashed lines are used to guide the eyes.

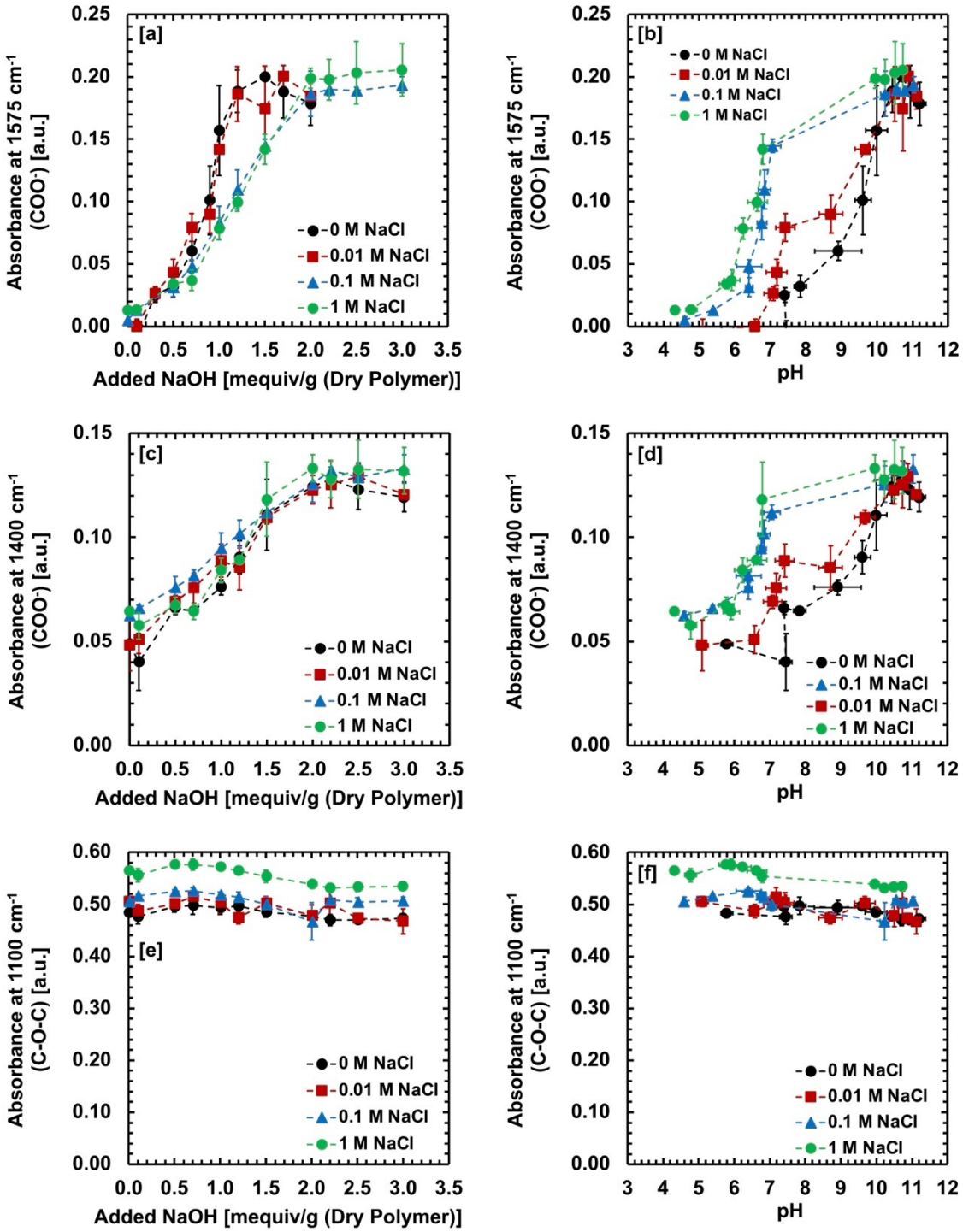

Figure S12. Absorbance intensities at **[a, b]** 1575 cm^{-1} (from dissociated COO^- groups), **[c, d]** 1400 cm^{-1} (from dissociated COO^- groups), and **[e, f]** 1100 cm^{-1} (ether C – O – C stretching from ethylene oxide (EO) groups in PEGDA cross–linker) of 10 – 2 AA–PEGDA network in different NaCl (aq) solutions as a function of **[a, c, e]** added NaOH [mequiv/g] and **[b, d, f]** pH. Dashed lines are used to guide the eyes. Error bars are included.

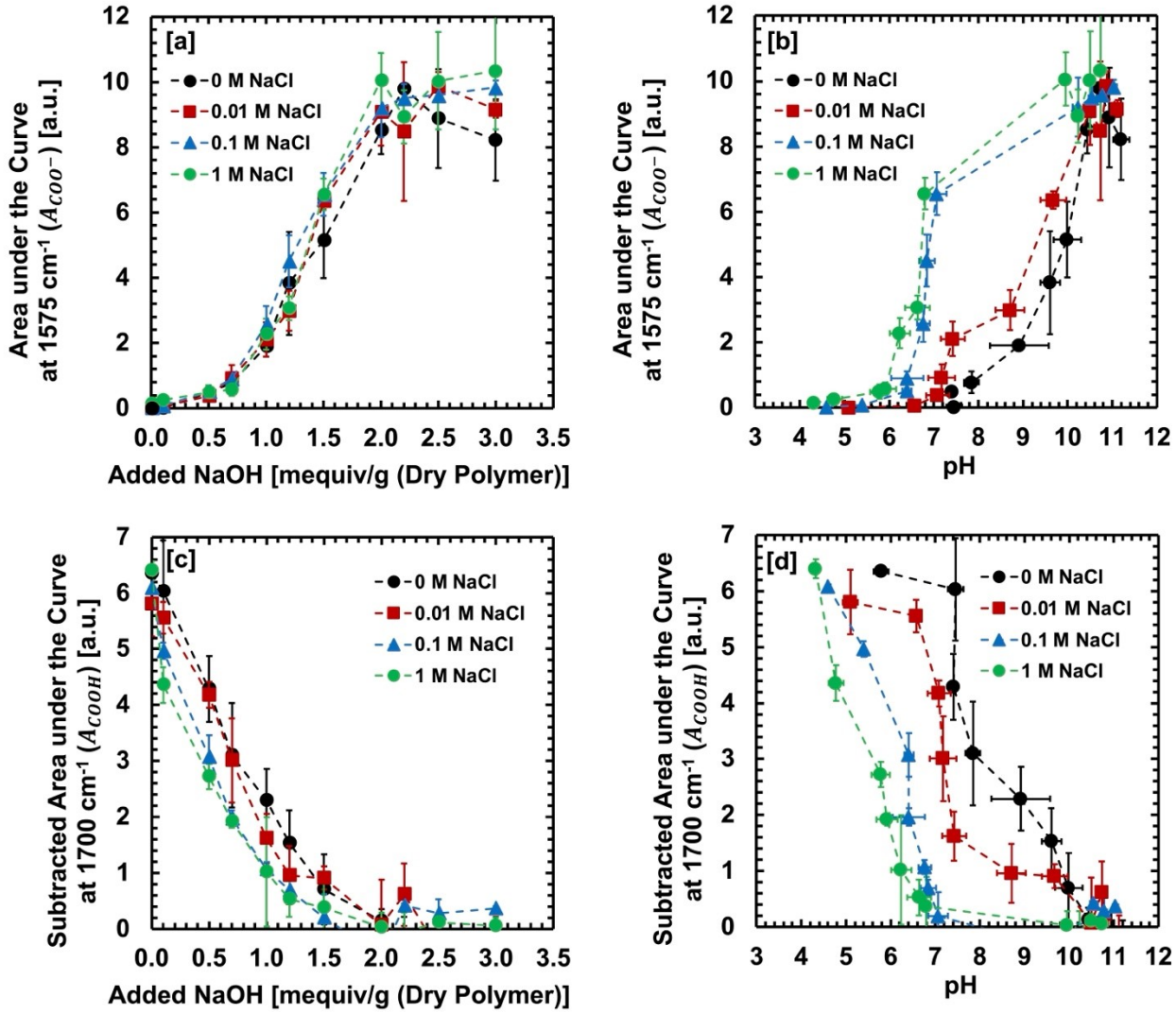

Figure S13. Areas under the curve at 1575 cm^{-1} from dissociated COO^- groups (A_{COO^-}) in 10 – 2 AA–PEGDA network in different NaCl (aq) solutions vs. **[a]** added NaOH amount and **[b]** pH. Subtracted areas under the curve at 1700 cm^{-1} from dissociable COOH groups ($A_{C=O\ from\ COOH}$ or A_{COOH}) vs. **[c]** added NaOH amount and **[d]** pH. Dashed lines are used to guide the eyes. Error bars are included.

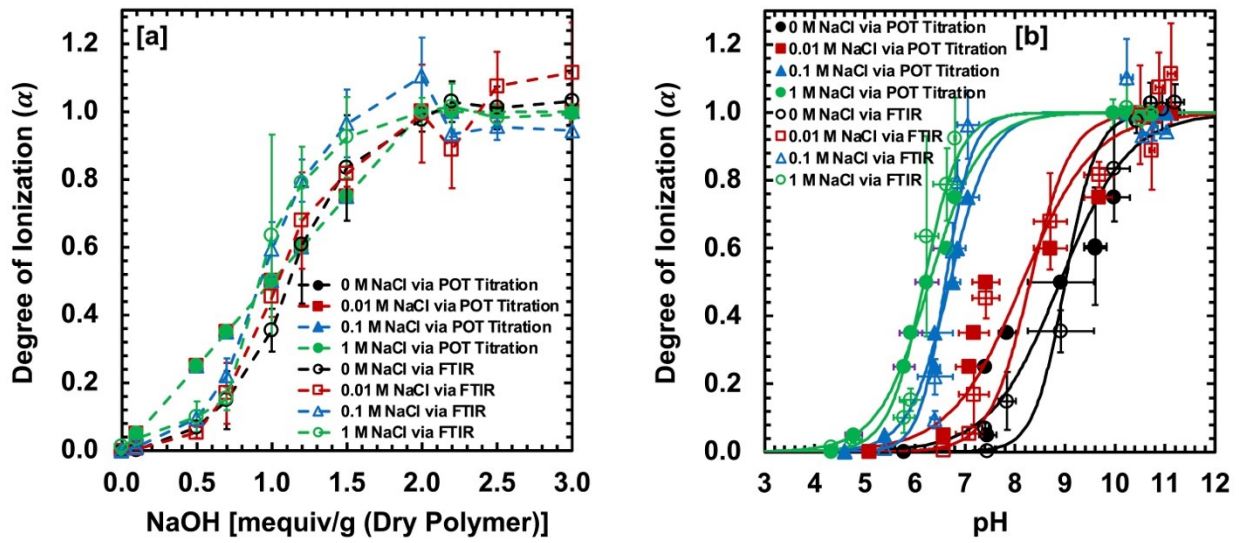

Figure S14. Degree of ionization (α) vs. **[a]** added NaOH amount and **[b]** pH of 10 – 2 AA-PEGDA network in different NaCl (aq) solutions via POT titration and ATR–FTIR analysis. Dashed lines are used to guide the eyes. Error bars are included.

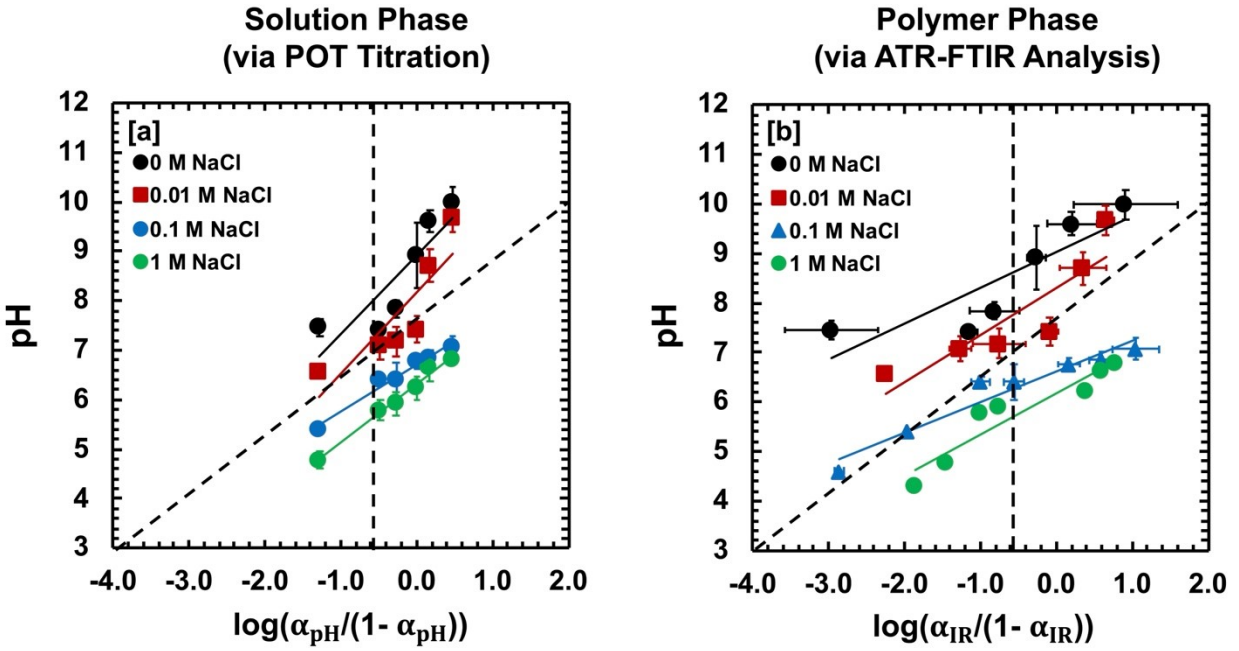

Figure S15. pH vs. $\log(\alpha/(1-\alpha))$ in 10 – 2 AA–PEGDA network via **[a]** POT titration and **[b]** ATR–FTIR analysis in different NaCl (aq) solutions. Solid lines are the best fit using the modified Henderson–Hasselbalch equation. Vertical dashed lines are where $\alpha = 0.5$ (the halfway point) to determine pK_a. Diagonal dashed lines are where $B = 1$. Error bars are included.

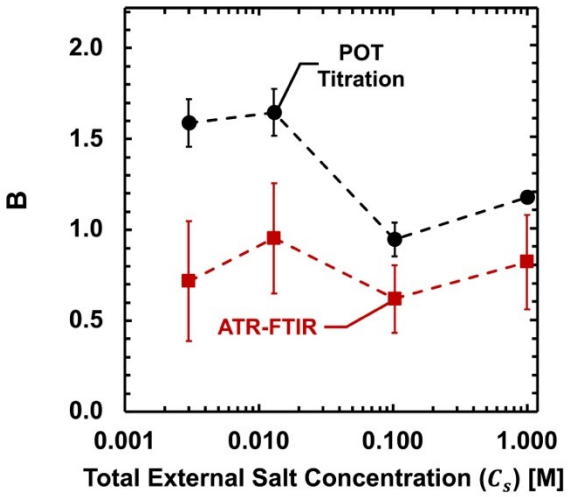

Figure S16. *B* value vs. total external salt concentration (C_S) via POT titration and ATR–FTIR analysis. Dashed lines are used to guide the eyes. Error bars are included.

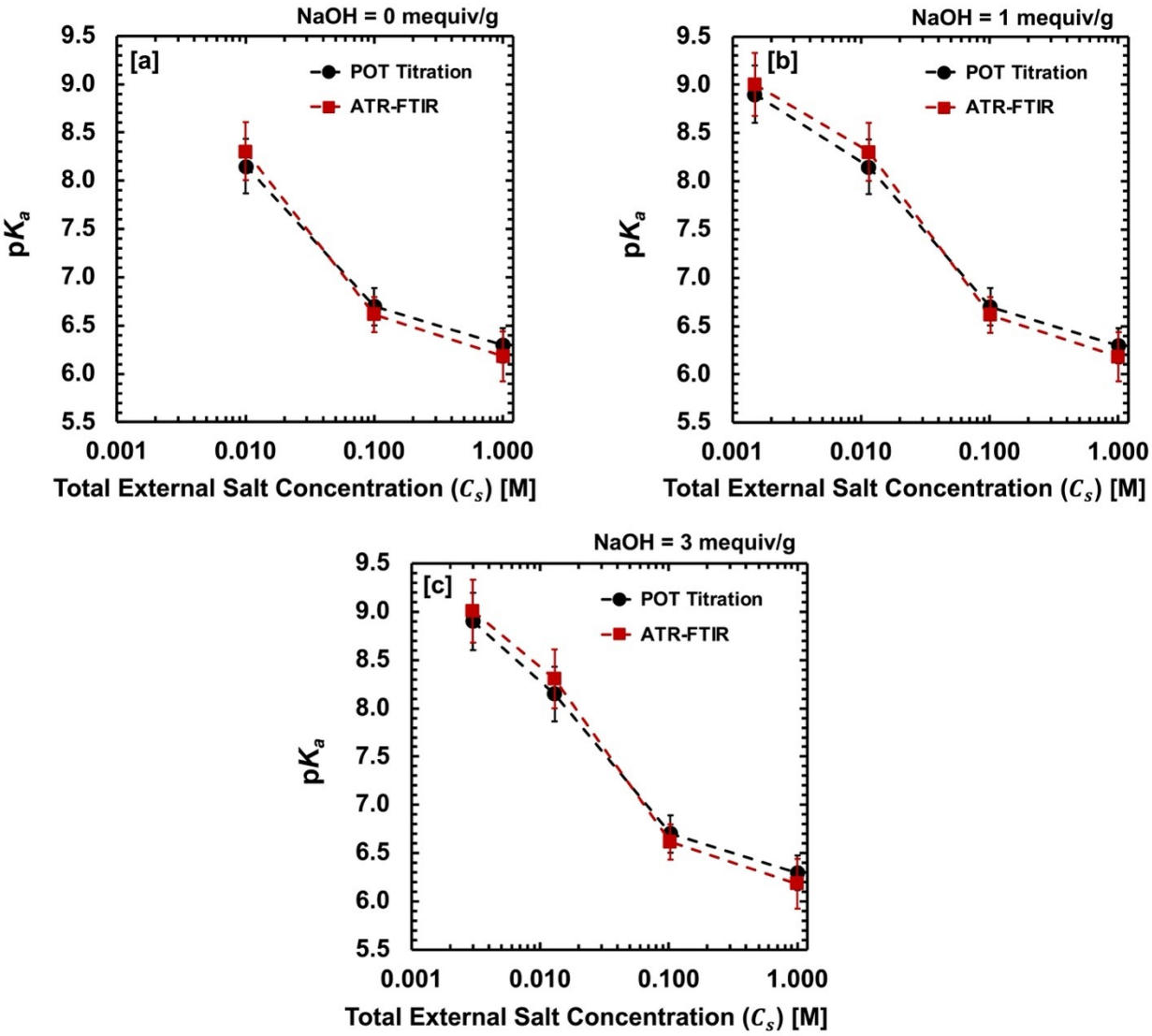

Figure S17. pK_a vs. total external salt concentration (C_S) via POT titration and ATR–FTIR analysis. Total external salts include both NaCl and NaOH. Added NaOH amount varies as shown in **Table S2**. Representative NaOH amounts (0, 1, and 3 mequiv/g) are used to show the trend. Dashed lines are used to guide the eyes. Error bars were included.

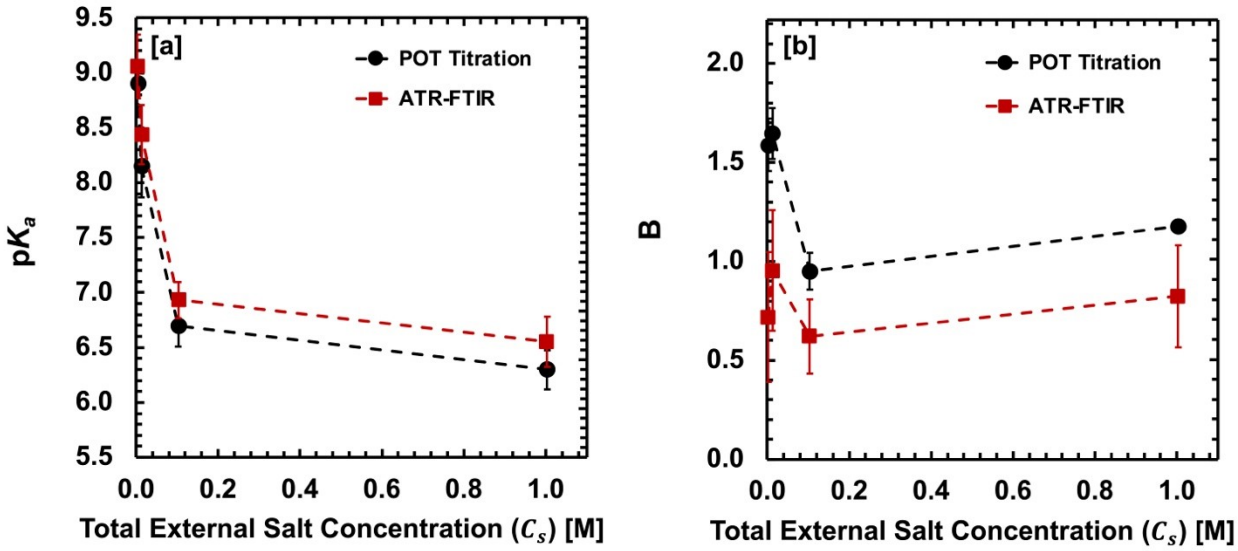

Figure S18. [a] pK_a and **[b]** B values of 10 – 2 AA–PEGDA network vs. total external salt concentration (C_s) (on a linear scale) via POT titration and ATR–FTIR analysis. Dashed lines are used to guide the eyes. Error bars are included.

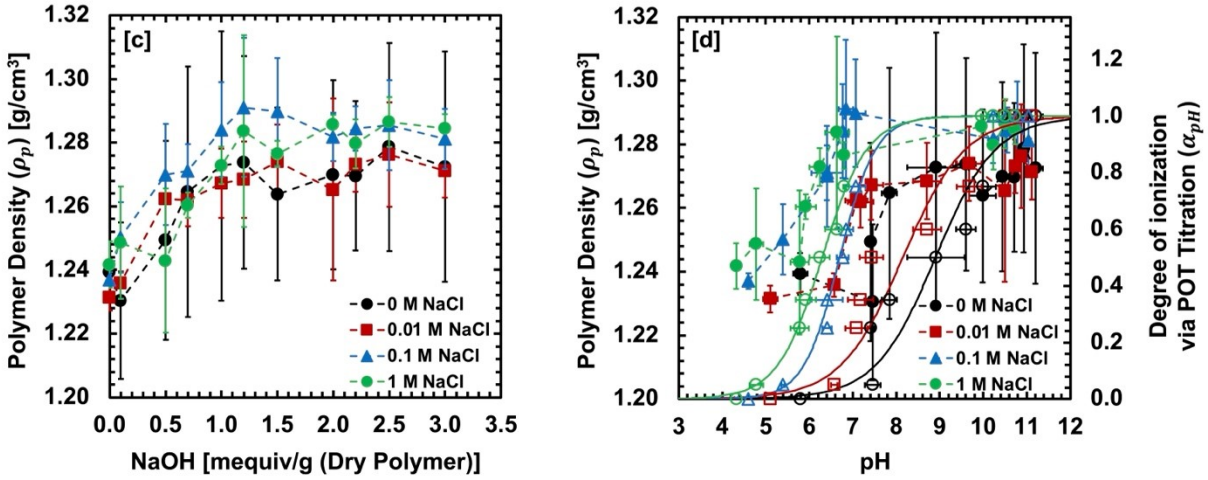

Figure S19. [a] Polymer density (ρ_p) vs. added NaOH amount in different NaCl (aq) solutions. **[b]** Polymer density (ρ_p) and degree of ionization (α_{pH}) vs. pH. Dashed lines are used to guide the eyes. Error bars are included.

Figure S19 shows polymer density vs. added amount of NaOH (x_{NaOH} mequiv/g) (see **Figure S19a**) and vs. pH (see **Figure S19b**) of the 10 – 2 network. As the external pH increases, the dissociated COO^- groups increase, leading to the increased polymer density as expected[1-3]. When the polymer density is plotted against the pH, the trend is consistent with the α vs. pH curve (see **Figure S19b**). As the external salt concentration increases, the polymer density increases as the added external salts screen the electrostatic repulsion between the charged groups, promoting the dissociation[8].

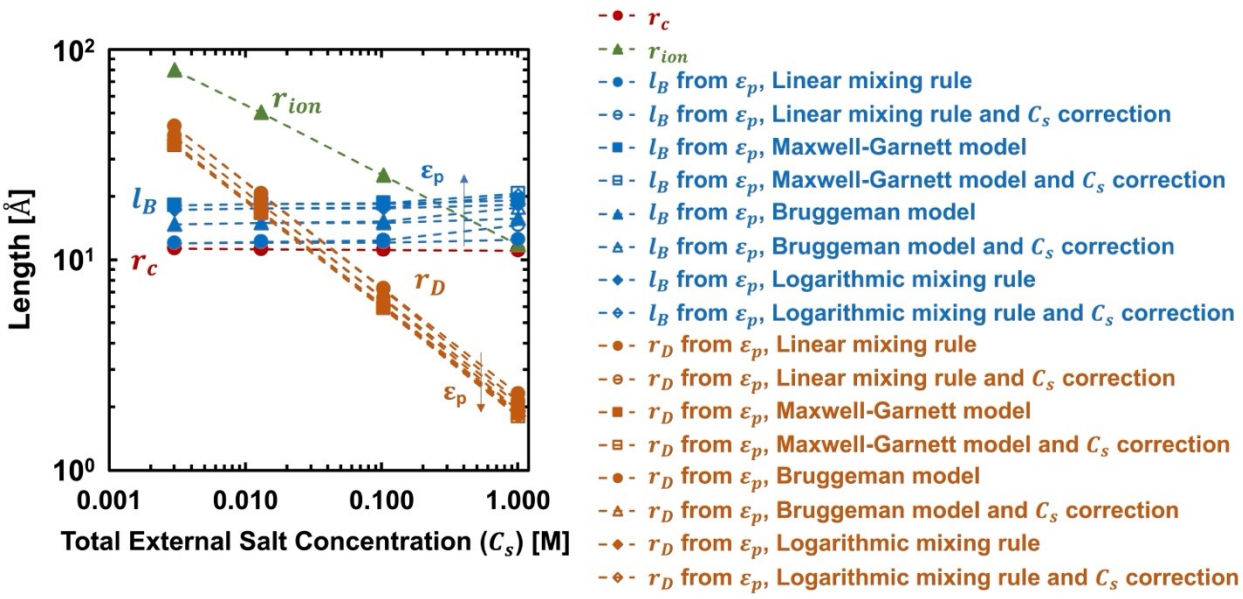

Figure S20. Relevant length scales (r_c, r_{ion}, l_B, r_D) and pK_a (via POT titration) vs. total external salt concentration (C_s) in different NaCl (aq) solutions. Dielectric constants were estimated using different methods with and without adjusting the external salt concentration (C_S).

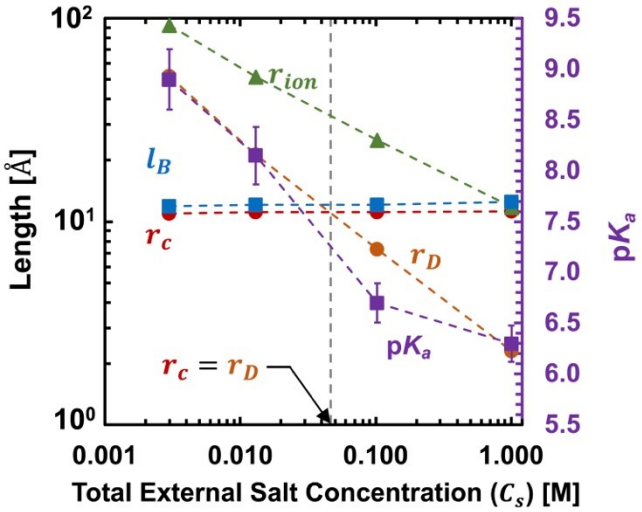

Figure S21. Relevant length scales (r_c, r_{ion}, l_B, r_D) and pK_a (via POT titration) vs. total external salt concentration (C_s) in different NaCl (aq) solutions. Dielectric constants were estimated using the simplest linear mixing rule without adjusting the external salt concentration (C_S).

Table S4. Total external salt concentration (C_s), NaCl concentration (C_{NaCl}), NaOH concentration (C_{NaOH}), the distance between dissociated charged groups (r_C) in a polymer, the distance between salt ions in an external solution (r_{ion}), Bjerrum length (l_B), and Debye screening length (r_D) of 10 – 2 AA-PEGDA network in different NaCl (aq) solutions at pH = 3 – 12. Dielectric constant ($\varepsilon_{p,swollen\ polymer}$) of a swollen polymer was estimated using the linear mixing rule and Bruggeman model with and without adjusting the external salt concentration (C_s).

10 – 2 AA–PEGDA network				
NaCl concentration (C_{Nacl}) [M]	0	0.01	0.1	1
NaOH concentration (C_{NaOH}) [M]	0 - 0.003	0 - 0.003	0 - 0.003	0 - 0.003
External salt concentration (C_s) [M]	0 - 0.003	0.01 - 0.013	0.1 - 0.103	1 - 1.003
Distance between dissociated charged groups in a swollen polymer (r_c) [Å]	26821.0[a] – 11.3	1596.1[a] – 11.2	907.9[a] – 11.1	443.6[a] – 11.0
Distance between dissociated charged groups in a dry polymer ($r_{c,dry}$) [Å]	23458.9[a] – 8.7	1396.5[a] – 8.7	794.1[a] – 8.7	393.9[a] – 8.6
Distance between salt ions in an external solution (r_{ion}) [Å]	247.3[b] – 79.6	55.0 – 50.0	25.5 – 25.2	11.8 – 11.8
Bjerrum length (l_B) from the linear mixing rule [Å]	16.8 – 11.9	16.8 – 12.1	16.8 – 12.1	17.9 – 12.5
Debye screening length (r_D) from the linear mixing rule [Å]	201.6[b] – 43.0	19.8 – 20.5	6.3 – 7.3	1.9 – 2.3
Bjerrum length (l_B) from the linear mixing rule with C_s correction [Å]	16.8 – 11.9	16.9 – 12.1	17.1 – 12.3	20.4 – 14.6
Debye screening length (r_D) from the linear mixing rule with C_s correction [Å]	201.6[b] – 43.0	19.8 – 20.5	6.2 – 7.2	1.9 – 2.1
Bjerrum length (l_B) from Bruggeman model [Å]	23.1 – 14.7	23.1 – 15.0	23.1 – 15.0	24.7 – 15.6
Debye screening length (r_D) from Bruggeman model [Å]	172.7[b] – 38.7	16.9 – 18.4	5.3 – 6.5	1.6 – 2.1
Bjerrum length (l_B) from Bruggeman model with C_s correction [Å]	23.1 – 14.7	23.1 – 15.0	23.3 – 15.2	26.5 – 17.7
Debye screening length (r_D) from Bruggeman model with C_s correction [Å]	172.7[b] – 38.7	16.9 – 18.4	5.3 – 6.5	1.6 – 1.9

[a] α value at the lowest pH range was calculated using **Eqn. 9** in ***Section 3.2***.

[b] r_{ion} and r_D were calculated when C_s = 0.1 mequiv/g (~ 0.0001 M).

Table S5. Total external salt concentration (C_s), NaCl concentration (C_{NaCl}), NaOH concentration (C_{NaOH}), Bjerrum length (l_B), and Debye screening length (r_D) of 10 – 2 AA-PEGDA network in different NaCl (aq) solutions. Dielectric constant ($\varepsilon_{p,swollen\ polymer}$) of a swollen polymer was estimated via different methods with and without adjusting the external salt concentration (C_s) at the highest pH = 12.

10 – 2 AA–PEGDA network				
NaCl concentration (C_{Nacl}) [M]	0	0.01	0.1	1
NaOH concentration (C_{NaOH}) [M]	0 - 0.003	0 - 0.003	0 - 0.003	0 - 0.003
External salt concentration (C_s) [M]	0 - 0.003	0.01 - 0.013	0.1 - 0.103	1 - 1.003
l_B from $\varepsilon_{p,swollen\ polymer}$ from the linear mixing rule [Å]	11.9	12.1	12.1	12.5
l_B from $\varepsilon_{p,swollen\ polymer}$ from the linear mixing rule with $C_s$correction [Å]	11.9	12.1	12.3	14.6
l_B from $\varepsilon_{p,swollen\ polymer}$ from the logarithmic mixing rule [Å]	17.2	17.5	17.5	18.3
l_B from $\varepsilon_{p,swollen\ polymer}$ from the logarithmic mixing rule with C_s correction [Å]	17.2	17.6	17.7	20.1
l_B from $\varepsilon_{p,swollen\ polymer}$ from Maxwell-Garnett model [Å]	18.1	18.4	18.4	19.2
l_B from $\varepsilon_{p,swollen\ polymer}$ from Maxwell-Garnett model with C_s correction [Å]	18.1	18.4	18.6	20.6
l_B from $\varepsilon_{p,swollen\ polymer}$ from Bruggeman model [Å]	14.7	15.0	15.0	15.6
l_B from $\varepsilon_{p,swollen\ polymer}$ from Bruggeman model C_s correction [Å]	14.7	15.0	15.2	17.7
r_D from $\varepsilon_{p,swollen\ polymer}$ from the linear mixing rule [Å]	43.0	20.5	7.3	2.3
r_D from $\varepsilon_{p,swollen\ polymer}$ from the linear mixing rule with C_s correction [Å]	43.0	20.5	7.2	2.1
r_D from $\varepsilon_{p,swollen\ polymer}$ from the logarithmic mixing rule [Å]	35.8	17.0	6.0	1.9
$r_D\ from\ \varepsilon_{p,swollen\ polymer}$ from the logarithmic mixing rule with C_s correction [Å]	35.8	17.0	6.0	1.8
r_D from $\varepsilon_{p,swollen\ polymer}$ from Maxwell-Garnett model [Å]	34.9	16.6	5.9	1.9
r_D from $\varepsilon_{p,swollen\ polymer}$ from Maxwell-Garnett model with C_s correction [Å]	34.9	16.6	5.9	1.8
r_D from $\varepsilon_{p,swollen\ polymer}$ from Bruggeman model [Å]	38.7	18.4	6.5	2.1
r_D from $\varepsilon_{p,swollen\ polymer}$ from Bruggeman model with C_s correction [Å]	38.7	18.4	6.5	1.9

S.3. Molecular picture of dissociation via relevant length scales assuming a spherical ion

In the first simple approximation, a charged group (in a polymer) and a salt ion (in an external solution) in a system are treated as a point charge. In this section, we calculated the distance between dissociated charged groups ($r_{c,eff}$) in a polymer and the distance between salt ions in an external solution ($r_{ion,eff}$) assuming a spherical ion.

The average charged group distance (r_c) assuming a point charge (from **Eq 16**) can be correlated with the average charged group distance ($r_{c,eff}$) assuming a spherical ion as:

$$r_c{}^3 = \frac{4\pi}{3} \cdot (r_{c,eff})^3 \quad \text{(S1)}$$

$$r_{c,eff} = (\frac{3}{4\pi})^{\frac{1}{3}} \cdot r_c \quad \text{(S2)}$$

Thus, the corresponding geometric factor is $(\frac{3}{4\pi})^{\frac{1}{3}}$ = 0.62. This geometric factor (0.62) yields a similar range of length scales assuming a point charge as shown in **Table S6**. $r_{c,eff}$ is slightly smaller than r_c, but both are in a similar range. Similarly, $r_{ion,eff}$ is smaller than r_{ion}, but both are in a similar range of order. Thus, the relative standing of these four length scales ($r_{c,eff}$, $r_{ion,eff}$, l_B, r_D) remains the same as those assuming a point charge.

Figure S22 shows the relative standing of these four length scales, assuming 1) a point charge and 2) a spherical ion. In all external salt concentration range, $r_{c,eff}$ is ~ 7 Å and $r_{ion,eff}$ is 50 ~ 7 Å. The average charged group distance ($r_{c,eff}$ ~ 7 Å) assuming a spherical ion is still shorter than the respective Bjerrum length (l_B ~ 15 ~ 18 Å).

At the lower external salt concentration (0 M – 0.01 M NaCl (aq) solution), $r_{c,eff}$ (and r_c) and l_B are significantly lower than r_D and $r_{ion,eff}$ (and r_{ion}). At the higher external salt concentration

(0.1 M – 1.0 M NaCl (aq) solution), r_D is lower than $r_{c,eff}$ (and r_c) and l_B. Therefore, using the spherical geometric factor (assuming a spherical ion) supports our conclusion.

Table S6. Total external salt concentration (C_s), NaCl concentration (C_{NaCl}), NaOH concentration (C_{NaOH}), the distance between dissociated charged groups (r_c, $r_{c,eff}$) in a polymer, the distance between salt ions in an external solution (r_{ion}, $r_{ion,eff}$), Bjerrum length (l_B), and Debye screening length (r_D) of 10 – 2 AA-PEGDA network in different NaCl (aq) solutions at the highest pH = 10 – 12. $r_{c,eff}$ and $r_{ion,eff}$ are estimated assuming a spherical ion. Dielectric constant ($\varepsilon_{p,swollen\ polymer}$) of a swollen polymer was estimated using the Bruggeman model with adjusting the external salt concentration (C_s).

10 – 2 AA–PEGDA network				
NaCl concentration (C_{Nacl}) [M]	0	0.01	0.1	1
NaOH concentration (C_{NaOH}) [M]	0 - 0.003	0 - 0.003	0 - 0.003	0 - 0.003
External salt concentration (C_s) [M]	0 - 0.003	0.01 - 0.013	0.1 - 0.103	1 - 1.003
Distance between dissociated charged groups in a swollen polymer (r_c) [Å]	11.3	11.2	11.1	11.0
Distance between dissociated charged groups in a swollen polymer ($r_{c,eff}$) [Å]	7.0	6.9	6.9	6.8
Distance between salt ions in an external solution (r_{ion}) [Å]	79.6	50.0	25.2	11.8
Distance between salt ions in an external solution ($r_{ion,eff}$) [Å]	49.4	31.0	15.6	7.3
Bjerrum length (l_B) from Bruggeman model with C_s correction [Å]	14.7	15.0	15.2	17.7
Debye screening length (r_D) from Bruggeman model with C_s correction [Å]	38.7	18.4	6.5	1.9

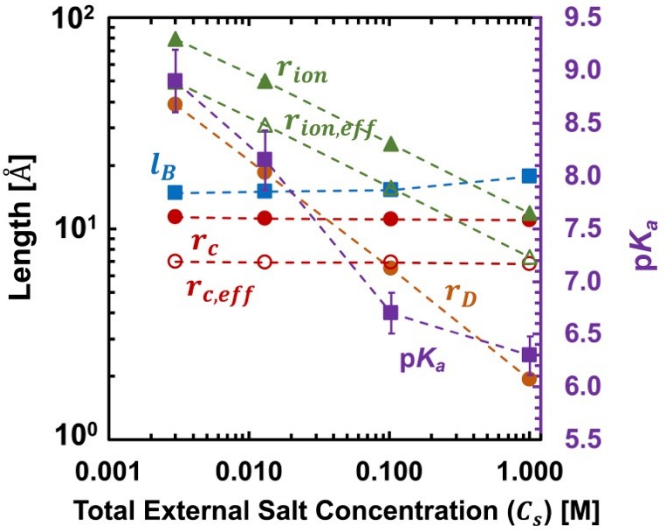

Figure S22. Relevant length scales (r_c, r_{ion}, $r_{c,eff}$, $r_{ion,eff}$, l_B, r_D) and pK_a (via POT titration) vs. total external salt concentration (C_s) in different NaCl (aq) solutions. $r_{c,eff}$ and $r_{ion,eff}$ are estimated assuming a spherical ion.

S.4 References

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