Supplementary Information

Implicit rule on the elastic function of a swollen polyacrylamide hydrogel

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Captions for Supplementary Tables and Figures

Figure S1: Variations for Figs. 3(a) and (b), which shows the double logarithmic plots with base ten for (a) G_{AP} and (b) G_{ES} with respect to $J_{\mathrm{ES}}/J_{\mathrm{AP}}$. Note that the sample number is $n = 3$.
Figure S2: Filled circles of (a) $E_{\mathrm{ID}}(X, Y)$ calculated using $\{J_{\mathrm{AP}}, E_{\mathrm{AP}}\}$ in Eq. (9), (b) $m(X, Y)$ calculated using $\{J_{\mathrm{AP}}, J_{\mathrm{ES}}, E_{\mathrm{AP}}, E_{\mathrm{ES}}\}$, and (c) $n(X, Y)$ calculated using $\{J_{\mathrm{ES}}, E_{\mathrm{ID}}\}$, where $a = 0$, $kT = 4.11 \times 10^{-21}$ J, $v = 2.99 \times 10^{-29}$ m^3, and $\chi = 0.49$.
Figure S3: Filled circles of (a) $n(X, Y)$ calculated with $\{J_{\mathrm{ES}}, E_{\mathrm{ID}}\}$ and $a = 0$, (b) $n'(X, Y)$ with $\{J'_{\mathrm{ES}}, E'_{\mathrm{ID}}\}$ and $a = 0$, (c) $n(X, Y)$ with $\{J_{\mathrm{ES}}, E_{\mathrm{ID}}\}$ and $a = 2$, and (d) $n'(X, Y)$ with $\{J'_{\mathrm{ES}}, E'_{\mathrm{ID}}\}$ and $a = 2$, where, $kT = 4.11 \times 10^{-21}$ J, $v = 2.99 \times 10^{-29}$ m^3, and $\chi = 0.49$. Note that Figs. S2(a) and (b) are consistent with Figs. 9(a) and (b) in the main text.
Figure S4: Relationship between the two exponents of (m', n') for (a) $a = 0$ and (b) $a = 2$.
Table S1: Volume swelling ratios (J_{AP} and J_{ES}) for each hydrogel formulation.
Table S2: Standard deviations of α_{AP}, α_{ES}, and β under the as-prepared and equilibrium stable states of hydrogels as listed in Table 3.

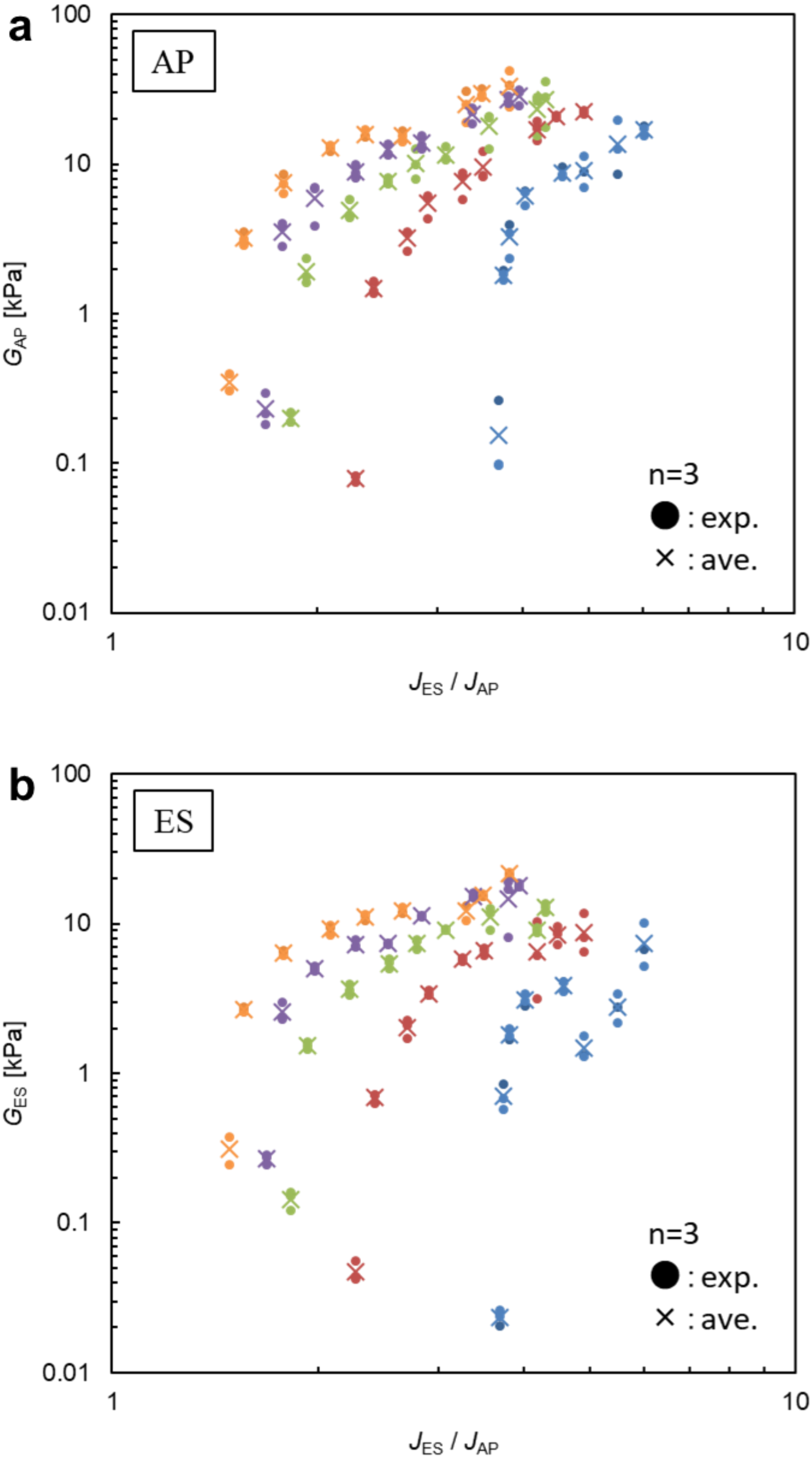

Figure S1: Variations for Figs. 3(a) and (b), which shows the double logarithmic plots with base ten for (a) G_{AP} and (b) G_{ES} with respect to $J_{\mathrm{ES}}/J_{\mathrm{AP}}$. Note that the sample number is $n = 3$.

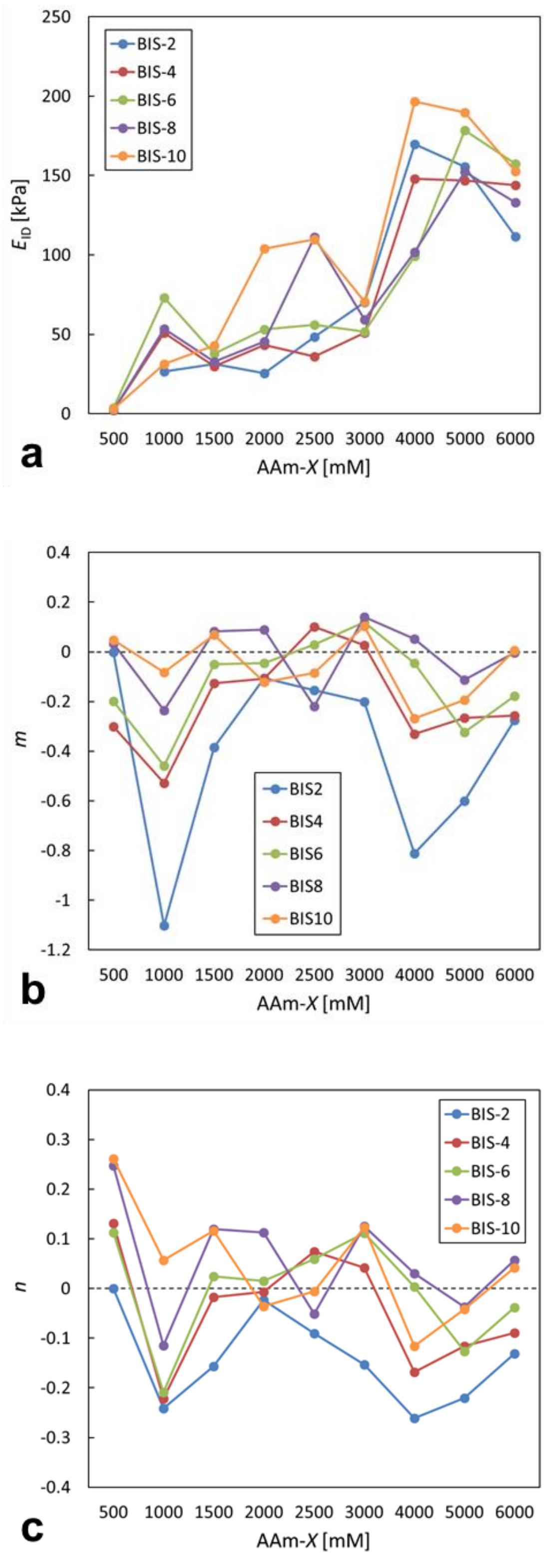

Figure S2: Filled circles of (a) $E_{\mathrm{ID}}(X, Y)$ calculated using $\{J_{\mathrm{AP}}, E_{\mathrm{AP}}\}$ in Eq. (9), (b) $m(X, Y)$ calculated using $\{J_{\mathrm{AP}}, J_{\mathrm{ES}}, E_{\mathrm{AP}}, E_{\mathrm{ES}}\}$, and (c) $n(X, Y)$ calculated using $\{J_{\mathrm{ES}}, E_{\mathrm{ID}}\}$, where $a = 0$, $kT = 4.11 \times 10^{-21}$ J, $v = 2.99 \times 10^{-29}$ m^3, and $\chi = 0.49$.

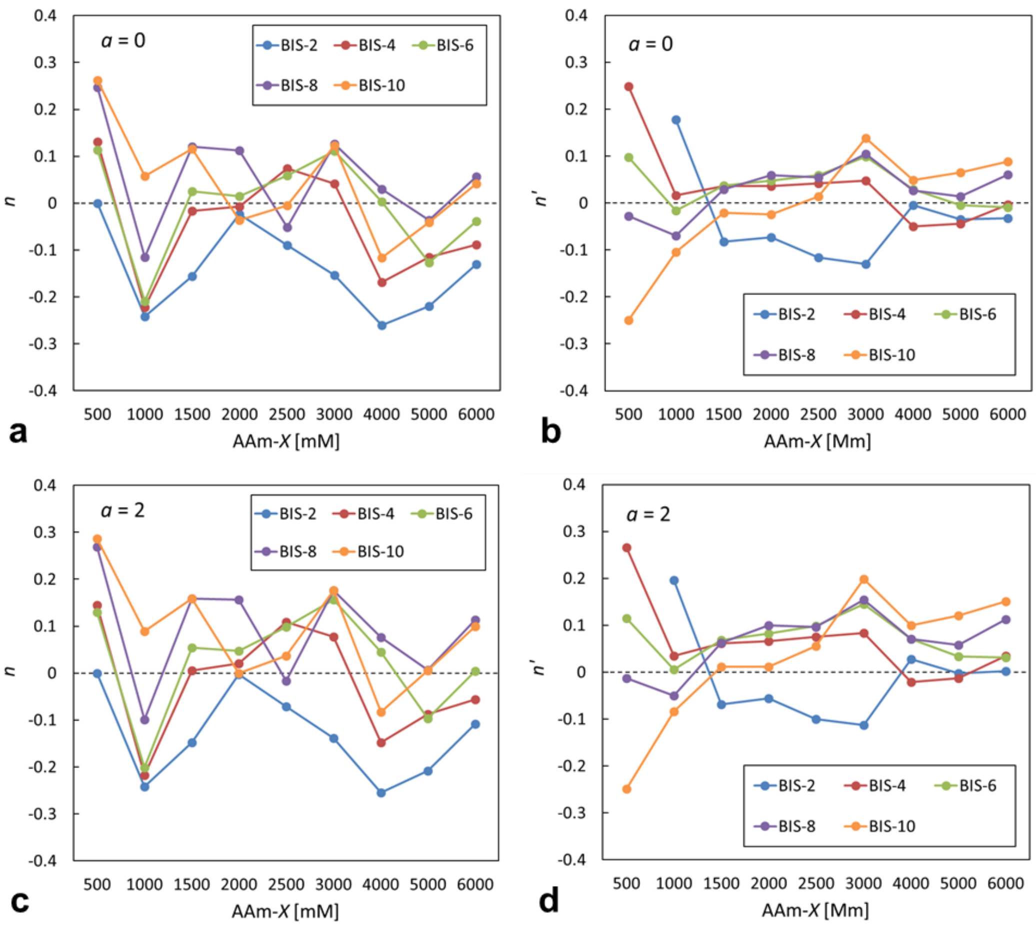

Figure S3: Filled circles of (a) $n(X,Y)$ calculated with $\{J_{\mathrm{ES}}, E_{\mathrm{ID}}\}$ and $a=0$, (b) $n'(X,Y)$ with $\{J'_{\mathrm{ES}}, E'_{\mathrm{ID}}\}$ and $a=0$, (c) $n(X,Y)$ with $\{J_{\mathrm{ES}}, E_{\mathrm{ID}}\}$ and $a=2$, and (d) $n'(X,Y)$ with $\{J'_{\mathrm{ES}}, E'_{\mathrm{ID}}\}$ and $a=2$, where, $kT = 4.11\times10^{-21}$ J, $v = 2.99\times10^{-29}$ m^3, and $\chi = 0.49$. Note that Figs. S2(a) and (b) are consistent with Figs. 9(a) and (b) in the main text.

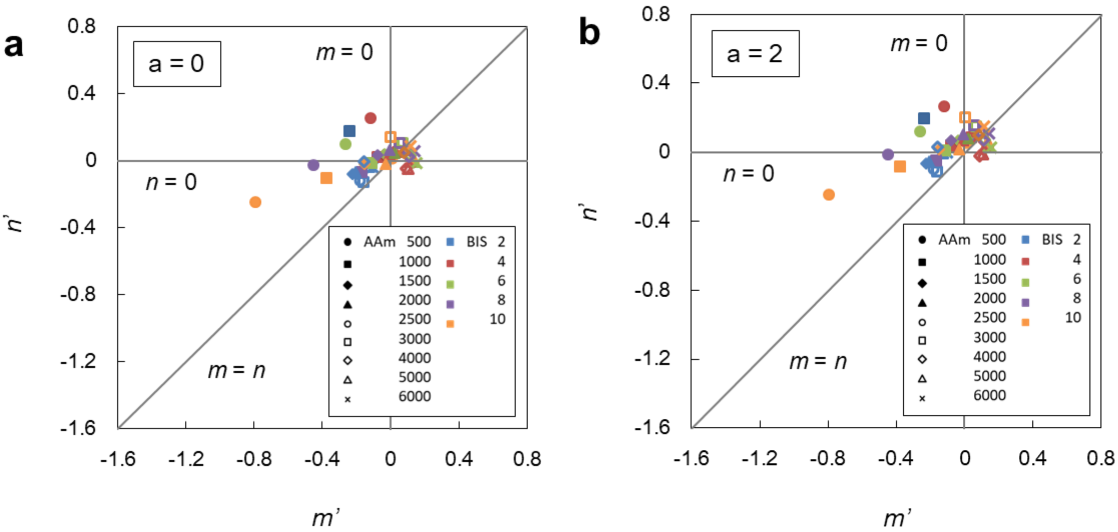

Figure S4: Relationship between the two exponents of (m', n') for (a) $a = 0$ and (b) $a = 2$.

Table S1: Volume swelling ratios (J_{AP} and J_{ES}) for each hydrogel formulation.

	BIS2		BIS4		BIS6		BIS8		BIS10	
	J_{AP}	J_{ES}	J_{AP}	J_{ES}	J_{AP}	J_{ES}	J_{AP}	J_{ES}	J_{AP}	J_{ES}
AAm500	–	–	32.84	74.56	32.85	60.06	32.86	55.23	32.87	48.89
AAm1000	16.91	62.35	16.92	40.97	16.92	32.65	16.93	30.03	16.93	26.43
AAm1500	11.61	43.42	11.61	31.45	11.62	25.86	11.62	23.03	11.62	20.72
AAm2000	8.96	34.17	8.96	26.04	8.96	22.78	8.96	20.37	8.97	18.73
AAm2500	7.37	29.61	7.37	24.00	7.37	20.54	7.37	18.70	7.37	17.31
AAm3000	6.30	28.80	6.31	22.08	6.31	19.42	6.31	17.93	6.31	16.80
AAm4000	4.98	24.41	4.98	20.86	4.98	17.79	4.98	16.81	4.98	16.46
AAm5000	4.18	22.99	4.18	18.74	4.18	17.54	4.19	15.91	4.19	14.60
AAm6000	3.65	21.93	3.65	17.94	3.65	15.74	3.65	14.43	3.66	13.97

Table S2: Standard deviations of α_{AP}, α_{ES}, and β under the as-prepared and equilibrium stable states of hydrogels as listed in Table 3.

AP	BIS-2	BIS-4	BIS-6	BIS-8	BIS-10
$\delta\alpha$	1.95	0.37	0.43	0.79	2.71
$\delta\beta$	1.71	0.33	0.30	0.40	0.97
R^2	0.889	0.993	0.992	0.982	0.876

ES	BIS-2	BIS-4	BIS-6	BIS-8	BIS-10
$\delta\alpha$	0.05	0.02	0.06	0.12	0.16
$\delta\beta$	0.09	0.03	0.05	0.08	0.07
R^2	0.920	0.995	0.998	0.990	0.987

Note that each of the standard deviations was calculated according to the following equations:

$$\delta\alpha = \left(\frac{1}{\langle x^2\rangle - \langle x\rangle^2}\frac{\langle \varepsilon^2\rangle}{(n-2)}\right)^{1/2},$$

$$\delta\beta = \left(\frac{\langle x^2\rangle}{\langle x^2\rangle - \langle x\rangle^2}\frac{\langle \varepsilon^2\rangle}{(n-2)}\right)^{1/2} = \sqrt{\langle x^2\rangle}\delta\alpha,$$

where x and n are the observed values of the sample and the sample number, respectively, ε represents the irreducible error, and R^2 stands for the total variance.