

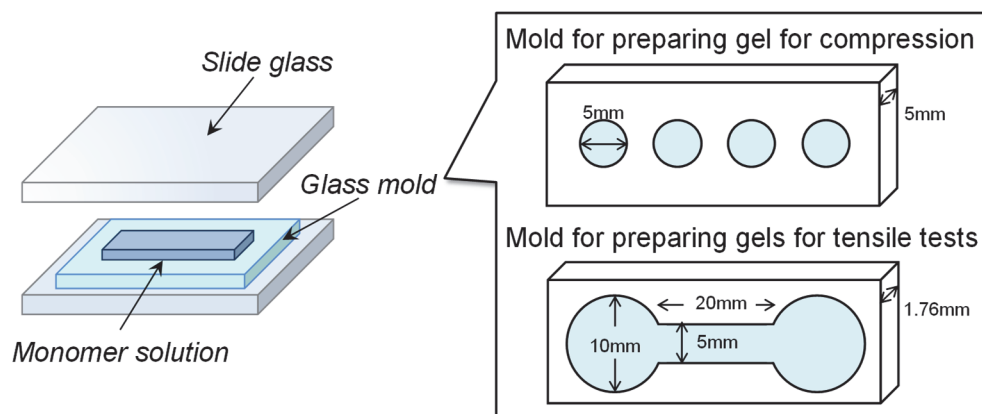
## Supplementary Information

# A universal method to easily design tough and stretchable hydrogels

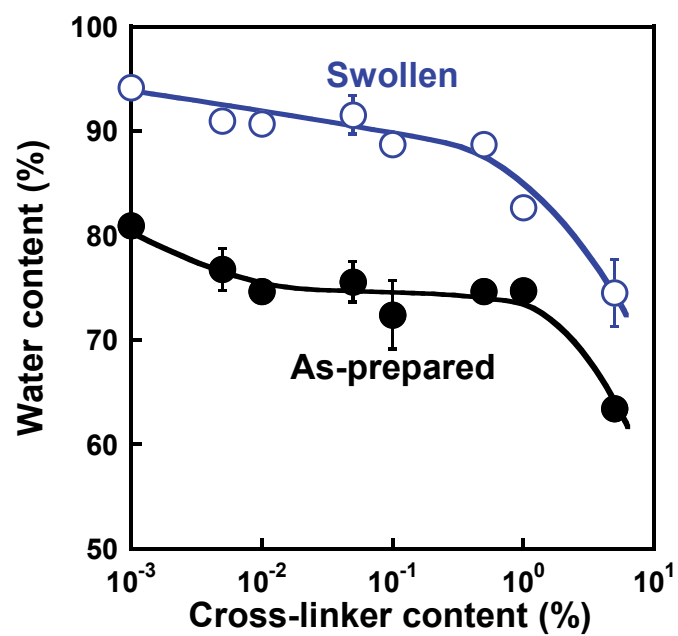
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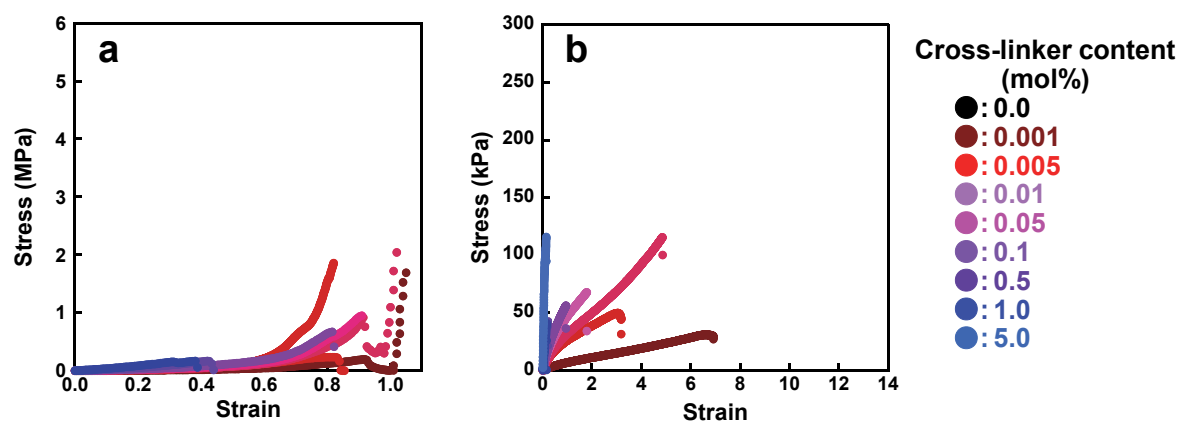
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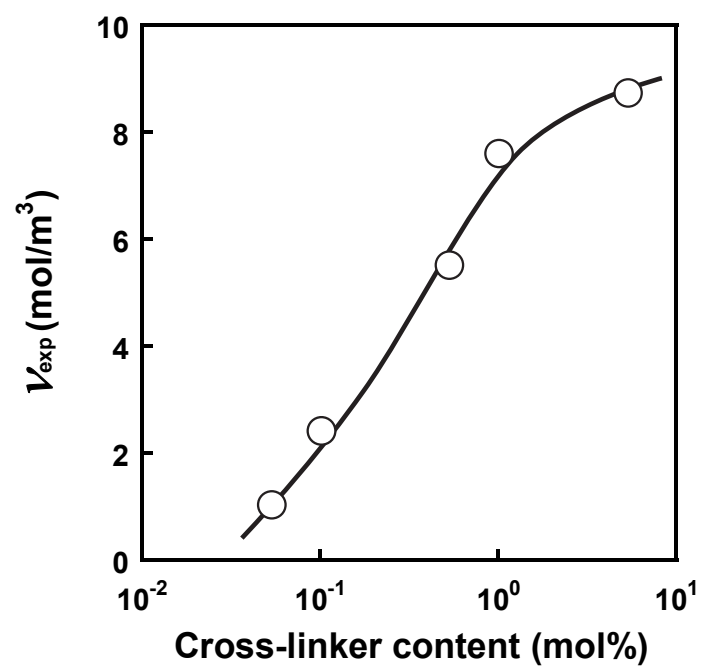
**Fig. S1.** Glass mold for preparing hydrogels for compression and tensile tests. A mold for preparing hydrogels was composed of two slides separated with a 5-mm-thick glass spacer (for compression tests) or a 1.76-mm-thick glass spacer (for tensile tests).



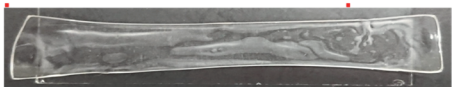
**Fig. S2.** Relationship between the cross-linker content and water content of as-prepared and swollen PAAm hydrogels prepared with the AAm concentration of 5.0 mol/L after the equilibrium swelling ratio was attained in water.



**Fig. S3.** Stress–strain curves of swollen PAAm hydrogels during (a) their compression and (b) tensile tests. The hydrogels were swollen up to the equilibrium in water after they were prepared under the condition of the AAm concentration of 5.0 mol/L and various cross-linker contents.



**Fig. S4.** Relationship between the cross-linker content and  $v_{\text{exp}}$  of as-prepared PAAm hydrogels prepared with the AAm concentration of 1.0 mol/L and various cross-linker contents.

|                   | PAAm hydrogel with a cross-linker content of 0.01 mol%                                      |                                                                                              |
|-------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|                   | AAm conc: 5 mol/L                                                                           | AAm conc: 10 mol/L                                                                           |
| Before elongation | <br>6.5 cm | <br>7.0 cm |
| After elongation  | <br>8.5 cm | <br>7.3 cm |

**Fig. S5.** Photos of the as-prepared PAAm hydrogels before and after the elongation. The hydrogels were prepared by polymerization with the AAm concentration of 5.0 and 10 mol/L and with the cross-linker content of 0.01 mol%. The hydrogels with the AAm concentration of 5 and 10 mol/L were elongated up to the strain of 7 and 4, respectively.

## **Legends for Movies S1 to S6**

**Movie S1 (separate file).** Movies of as-prepared PAAm hydrogels during the compression tests. The hydrogels were prepared under the condition with an AAm concentration of 5.0 mol/L and a cross-linker content of (a) 0.005 and (b) 1.0 mol%.

**Movie S2 (separate file).** Movies of an as-prepared PAAm hydrogel during the tensile test. The hydrogel was prepared under the condition with an AAm concentration of 2.5 mol/L and a cross-linker content of 0.005 mol%.

**Movie S3 (separate file).** Movies of swollen PAAm hydrogels during (a) the compression and (b) shear tests. After the swelling of the hydrogels prepared under the condition with an AAm concentration of 5.0 mol/L and a cross-linker content of 0.005 mol% attained the equilibrium in water, they were used for the compression and shear tests.

**Movie S4 (separate file).** Movies of as-prepared PMPC hydrogels during the compression tests. The hydrogels were prepared under the condition with a MPC concentration of 5.0 mol/L and a cross-linker content of (a) 0.1 or (b) 1.0 mol%.

**Movie S5 (separate file).** Movies of as-prepared PMPC hydrogels during the shear tests. The hydrogels were prepared under the condition with a MPC concentration of 2.5 mol/L and a cross-linker content of (a) 0.1 and (b) 1.0 mol%.

**Movie S6 (separate file).** Movies of an as-prepared PMPC hydrogel during the tensile test. The hydrogel was prepared under the condition with a MPC concentration of 5.0 mol/L and a cross-linker content of 0.1 mol%.