**Ionic Conductive Organohydrogel With Ultrastretchability, Self-healable and Freezing-Tolerant Properties for Wearable Strain Sensor**

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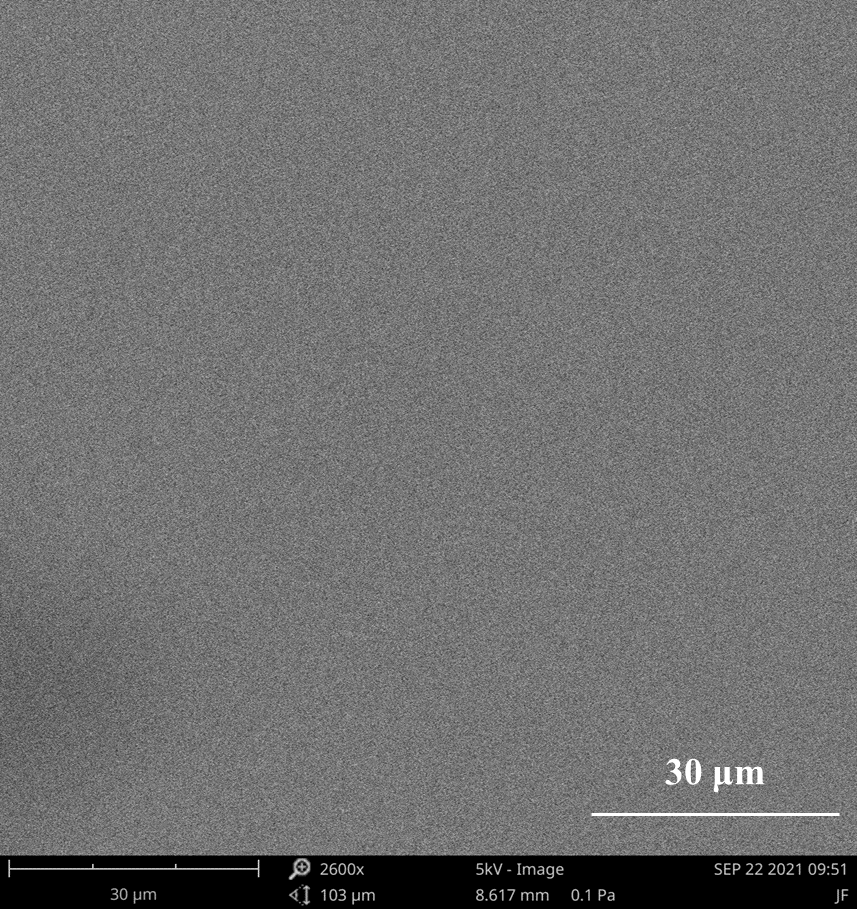
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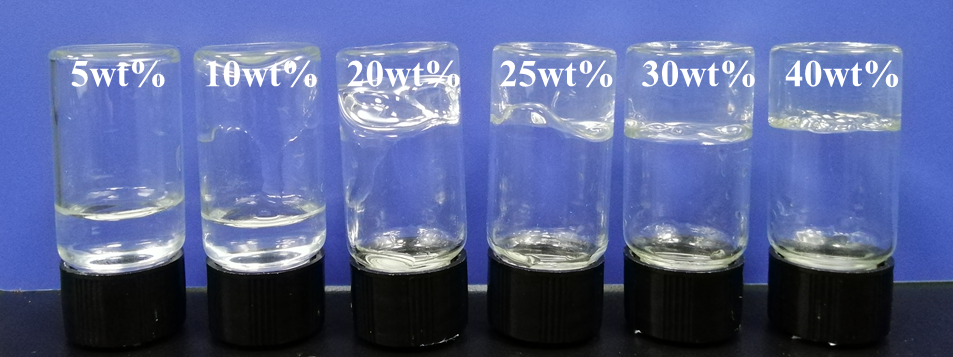
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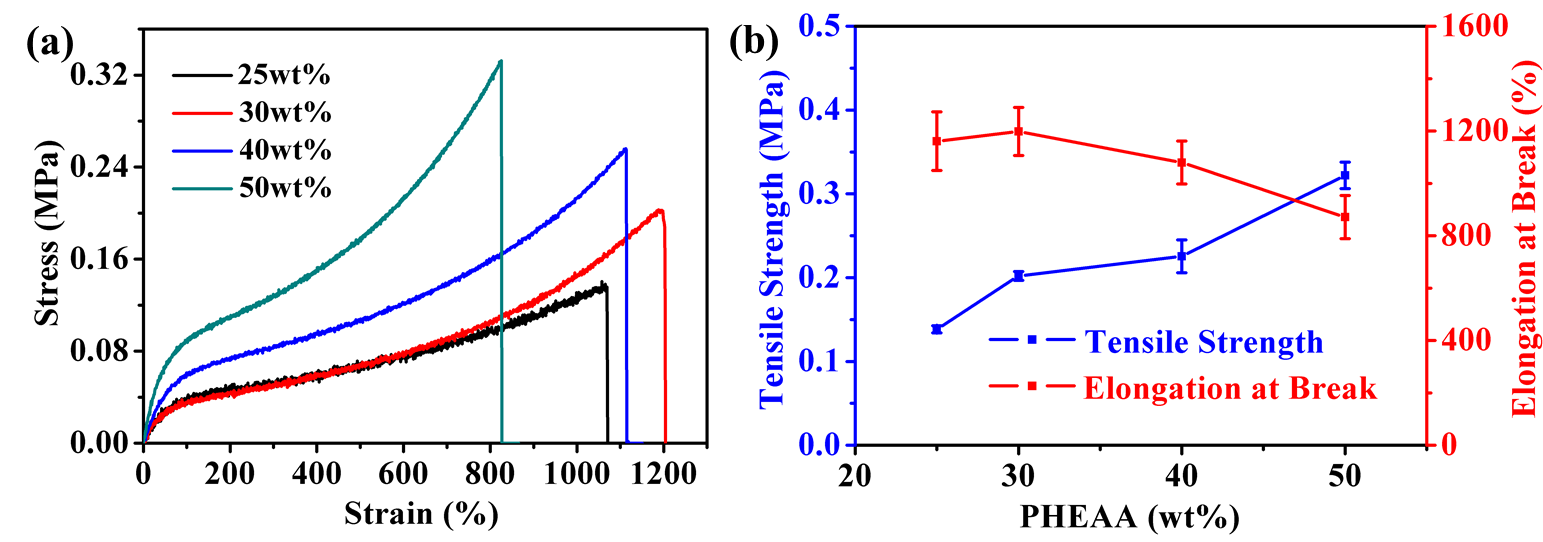
1. **Figures**



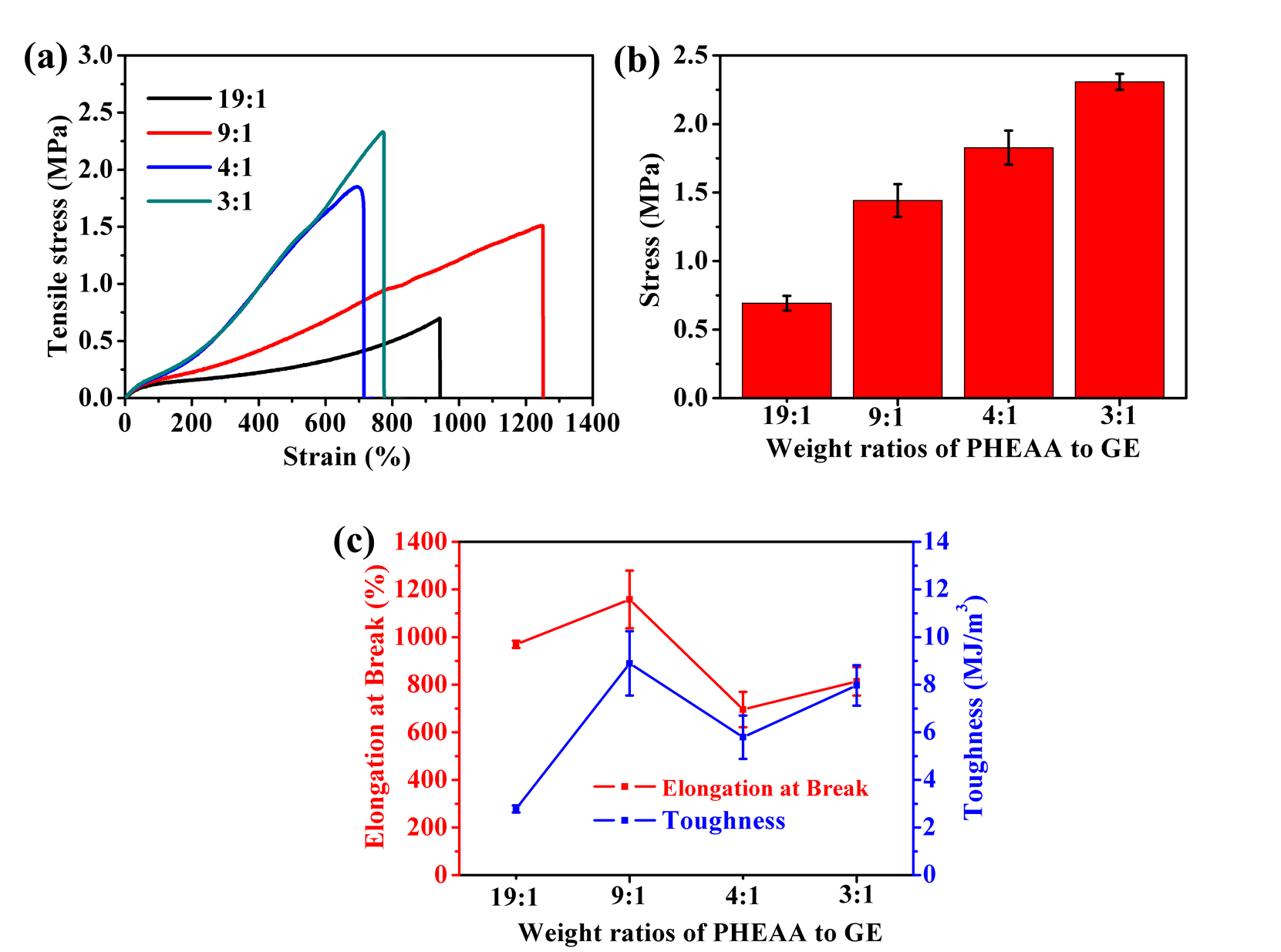
**Figure S1**. The SEM of PHEAA-GE-Gl-LiCl organohydrogel.

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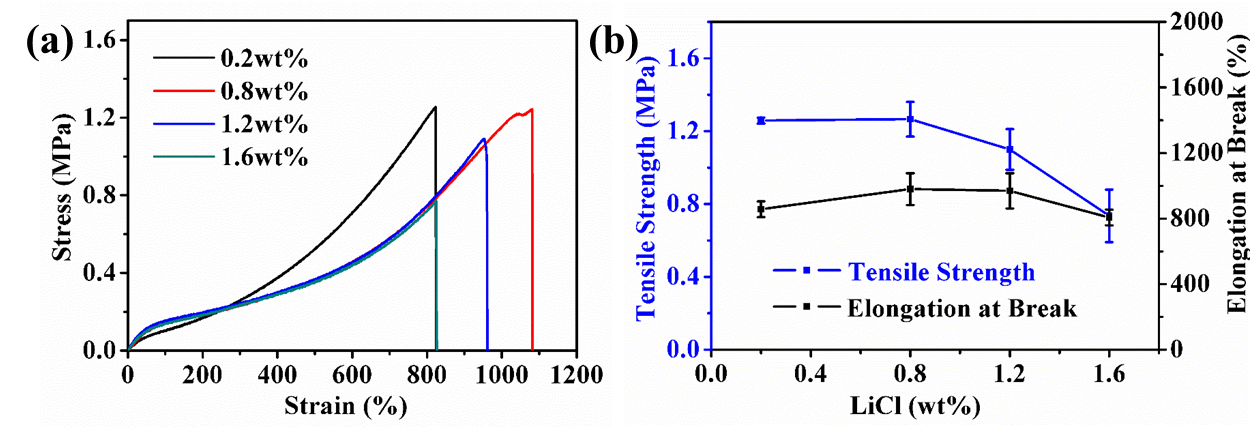
**Figure S2**. Photograph of PHEAA SN hydrogels prepared at different HEAA concentrations.

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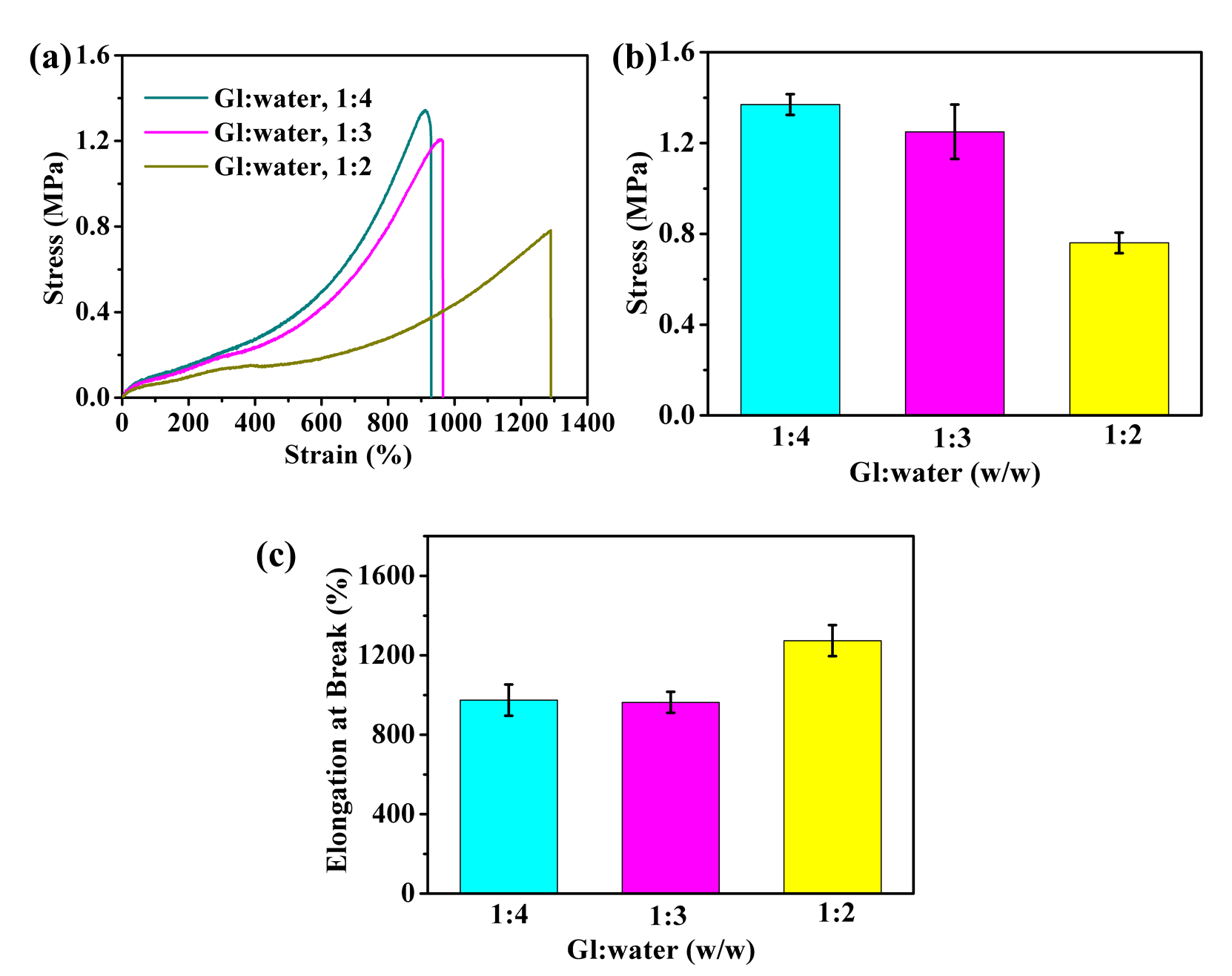
**Figure S3**. Mechanical properties of PHEAA SN hydrogels prepared with different concentrations. (a) The tensile stress-strain curves, (b) tensile strength and elongation at break.



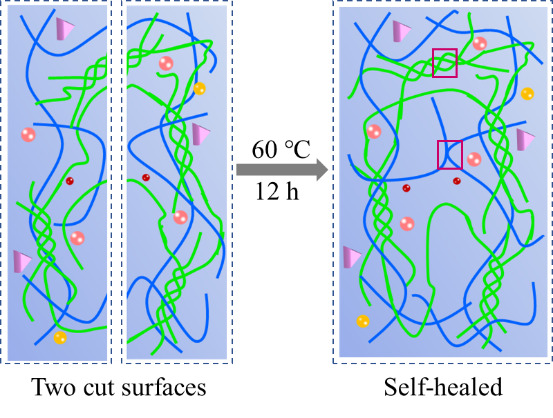
**Figure S4.** Effect of the weight ratios of PHEAA to GE on the mechanical property of PHEAA-GE DN hydrogels. (a) The tensile stress-strain curves, (b) stress, (c) elongation at break and toughness.



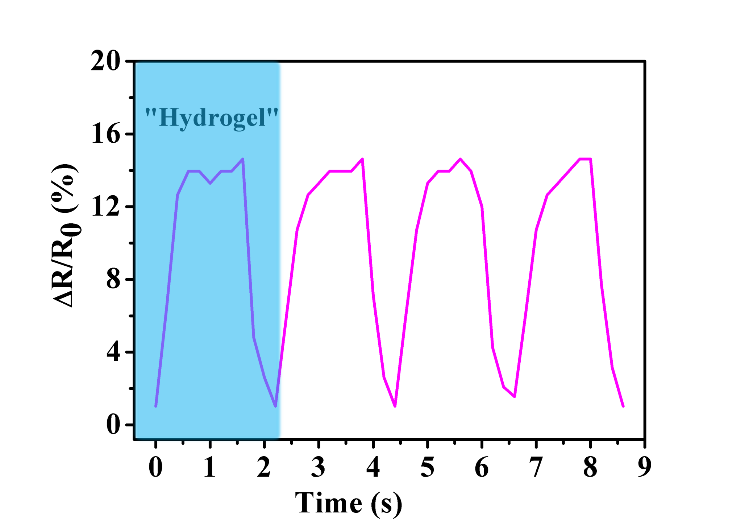
**Figure S5.** Effect of LiCl concentration on the mechanical property of PHEAA-GE-LiCl hydrogel. (a) The stress-strain curves, (b) tensile strength and elongation at break.



**Figure S6.** Effect of the weight ratios of Gl/water on the mechanical property of PHEAA-GE-Gl-LiCl organohydrogel. (a) The stress-strain curves, (b) stress, and (c) elongation at break.



**Figure S7.** The schematic diagram of the self-healing mechanism of PHEAA-GE-Gl-LiCl organohydrogel.



**Figure S8.** Detection of subtle motions of pronouncing word “Hydrogel”.

**2. Tables**

**Table S1.** The self-healing properties of the self-healed gel based on the reported PAAm-polysaccharide or PHEAA-polysaccharide for flexible electronic sensors.

|  |  |  |  |
| --- | --- | --- | --- |
| Composition | Self-healing | strain of the healed gel | Ref. |
| PHEAA-GE-Gl-LiCl | **Yes** | **263%** | **This work** |
| PAAm-GG | Yes | 120% | 1 |
| PAAm-Car-EG/Gl-KCl | Yes | 150%/170% | 2 |
| PAAm-CMCs-NaCl | Yes | 102% | 3 |
| PAAm-Car-EG/Gl-KCl | Yes | 85% | 4 |
| PAAm-Car-KCl | Yes | 83% | 5 |
| PAAm-Car-KCl | Yes | 52% | 6 |
| PAAm-GE-Cit3- | — | — | 7 |
| PHEAA-Agar-[EMIM]Cl | — | — | 8 |
| PHEAA-Cs-Cit3- | — | — | 9 |
| PAAm-CMC-LiCl | — | — | 10 |
| PAAm-CMC-Fe3+ | — | — | 11 |
| PAAm-Agar-LiCl | — | — | 12 |
| PAAm-Agar-NaCl | — | — | 13 |
| PAAm-Agar-Li2SO4 | — | — | 14 |
| PAAm-SA-NaCl | — | — | 15 |
| PAAm-XG-Fe3+ | — | — | 16 |

Note: “—” indicates “not available” in the references.

**Table S2.** The properties of reported anti-freezing hydrogel-based strain sensors.

|  |  |  |  |
| --- | --- | --- | --- |
| Composition | Low temperature | | Ref. |
| **Workable temperature (°C)** | **Strain in workable**  **temperature (%)** |
| PHEAA-GE-Gl-LiCl | **-40** | **608** | **This work** |
| PAAm-XG-Fe3+ | -40 | 530 | 16 |
| GE-Cit3- | -30 | 400 | 17 |
| PVA-Gl-NaCl | -20 | 510 | 18 |
| PAAm-Car-Eg/Gl-KCl | -18 | 950 | 2 |
| Cellulose-Zn2+-Ca2+ | -60 | 85 | 19 |
| PAAm-PAA-Fe3+-NaCl | -24.7 | — | 20 |
| PAAm-PDA-CNTs-Gl | -20 | — | 21 |
| PVA-GE-NaCl | -20 | — | 22 |
| PAAm-CMCs-NaCl | -20 |  | 3 |
| PVC-CS-GO-Gl | -20 | — | 23 |
| PVA-PANi-Gl | -20 | — | 24 |
| PVA-SA-Gl-NaCl | -20 | — | 25 |
| Cellulose ionic hydrogel | -20 | — | 26 |
| PMAANa-PDMC-Gl | -20 | — | 27 |
| PVA-PEDOT-Gl | -20 | — | 28 |
| GG-borax-Gl | -18.7 | — | 29 |
| PAAm-CMC-EG-Fe3+ | -12 | — | 30 |

Note: “—” indicates “not available” in the references.

**Table S3.** The properties of reported conductive hydrogels for flexible electronic sensors.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Composition | Maximal strain (%) | GF | Sensing ranges | Anti-freezing | Ref. |
| PHEAA-GE-Gl-LiCl | **970** | **13.16** | **0-500** | **Yes** | **This work** |
| PHEAA-CS-Cit3- | 692 | 6.90 | 0-400 | Yes | 9 |
| P(AAm-co-AA)-CS-Fe3+ | 450 | 6.60 | 0-400 | No | 31 |
| PVA-Gl-NaCl | 570 | 4.01 | 0-300 | Yes | 18 |
| HP(AAm-AA)-CS-Fe3+ | — | 3.62 | 0-500 | No | 32 |
| PAAm-PHMA-NaCl | 2160 | 2.37 | 0-100 | No | 33 |
| PAAm-GE-Cit3- | 849 | 2.04 | 0-600 | No | 7 |
| PVA-SA-Gl-NaCl | 582 | 2.00 | 0-582 | Yes | 25 |
| PAAm-PAA–Fe3+-NaCl | 573 | 1.96 | 0-500 | No | 20 |
| PVA-CS-GO-Gl | 700 | 1.90 | 0-300 | Yes | 23 |
| PHEAA-SA-Ca2+-KCl | 400 | 1.87 | 0-200 | No | 34 |
| PAAm-Agar-LiCl | 1600 | 1.80 | 0-1100 | No | 12 |
| PVA-PSBMA | 400 | 1.50 | 0-300 | No | 35 |
| PAAm-CMC-EG-Fe3+ | 1086 | 1.40 | 0-30 | Yes | 30 |
| PAA-Fe3+-GO | 630 | 1.32 | 0-500 | No | 36 |
| PVA-GE-NaCl | 715 | 0.75 | 0-700 | Yes | 22 |
| PAAm-PDA-talc | 1000 | 0.69 | 0-1000 | No | 37 |
| PAAm-Car-KCl | — | 0.63 | 0-1000 | No | 5 |
| PAAm-CMCS-NaCl | 1100 | 0.21 | 0-800 | Yes | 3 |

Note: “—” indicates “not available” in the references.

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