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**Supporting Information**

# Highly conductive, robust, self-healable, and thermally responsive liquid metal-based hydrogel for reversible electrical switch

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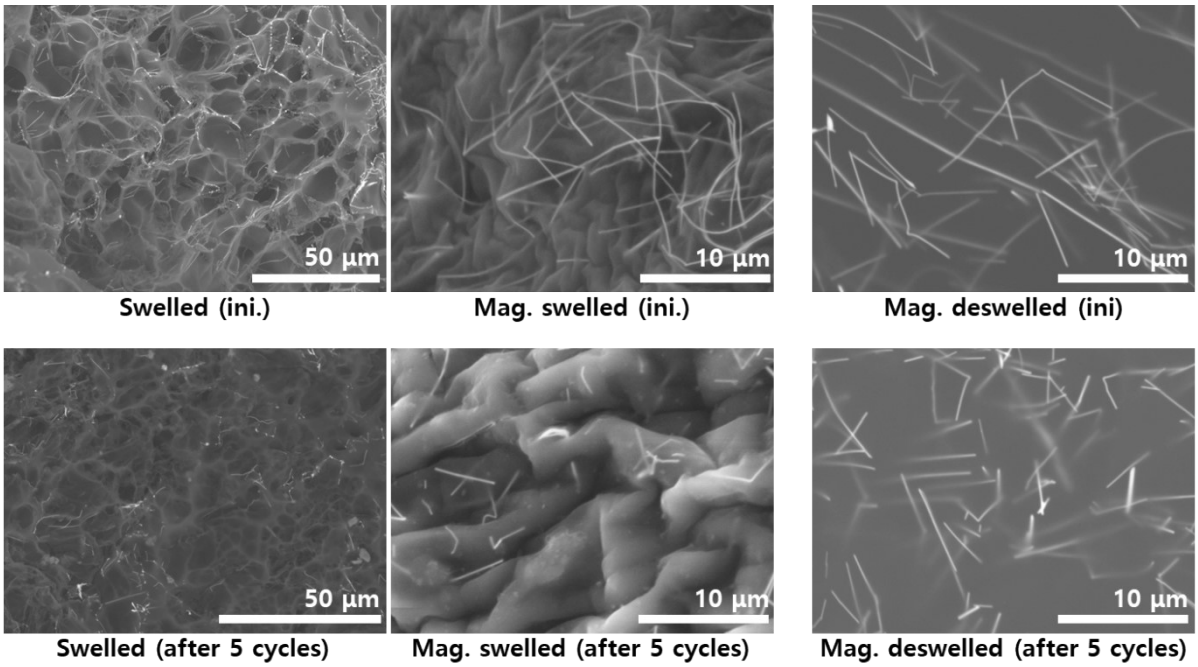


**Figure S1.** Morphologies of the silver ultralong nanowire (AgULNWs) after 5-time swelling/deswelling cycles. Pristine AgULNWs were prepared by the traditional method stated in ref (Curry et al. 2022).

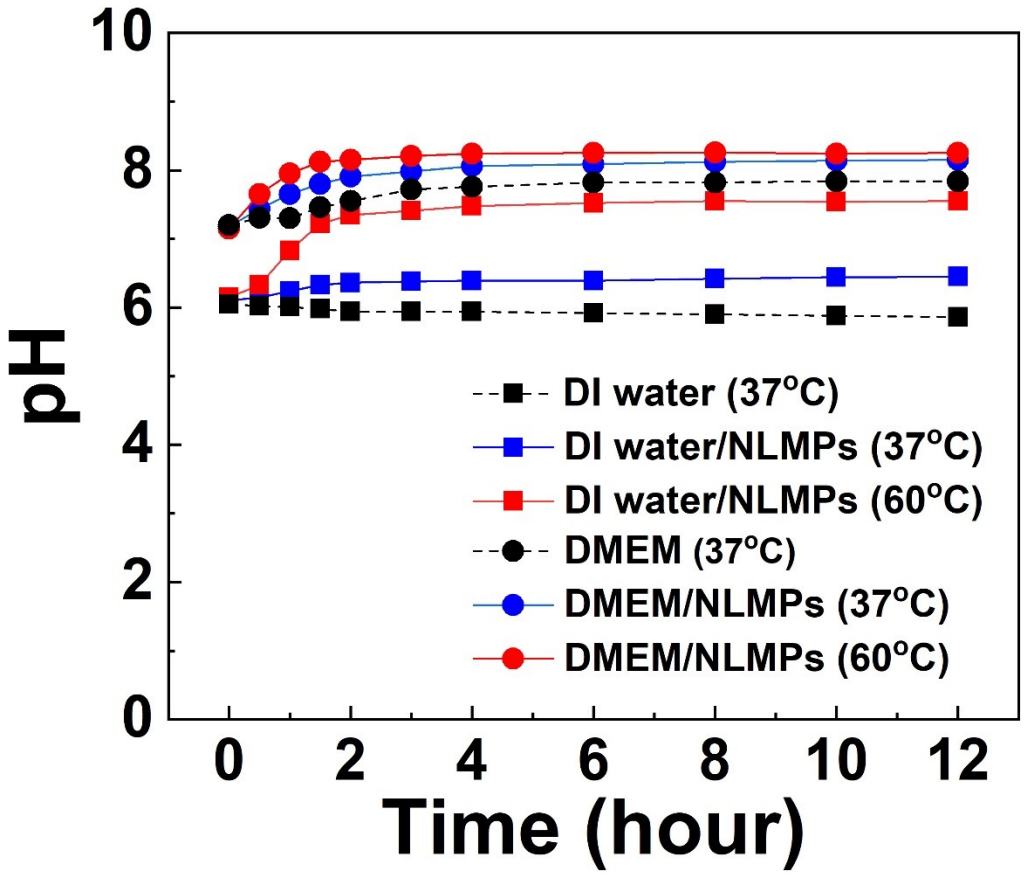


**Figure S2.** pH variation of DI water and DMEM with nanoscale liquid metal particles (NLMPs) at 37°C (blue) and 60°C (red), respectively. The pH of DI water and DMEM without NLMPs were also displayed with dash lines.

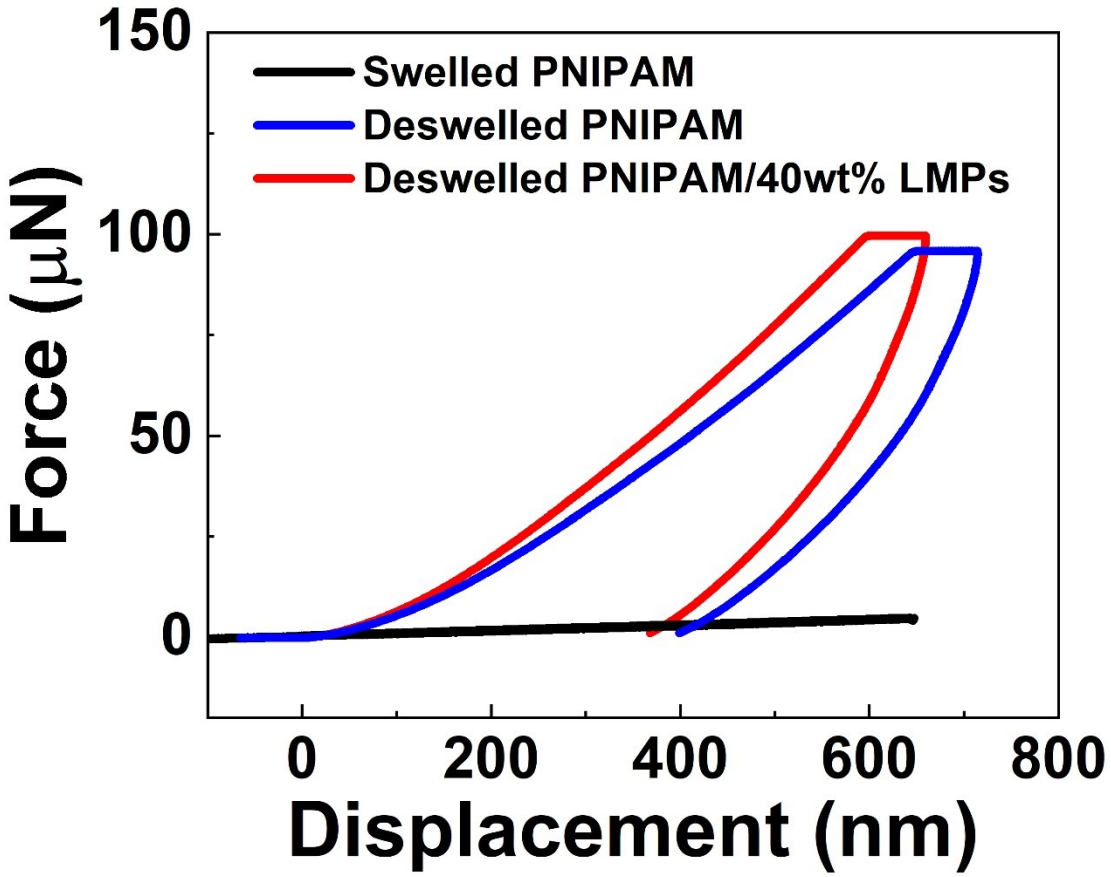


**Figure S3.** Mechanical properties of the swelled (black) and deswelled (blue) PNIPAM hydrogels. 40wt% LMPs integrated deswelled PNIPAM hydrogel was also attached in the graph (red). All the mechanical properties were obtained by nanoindentation.

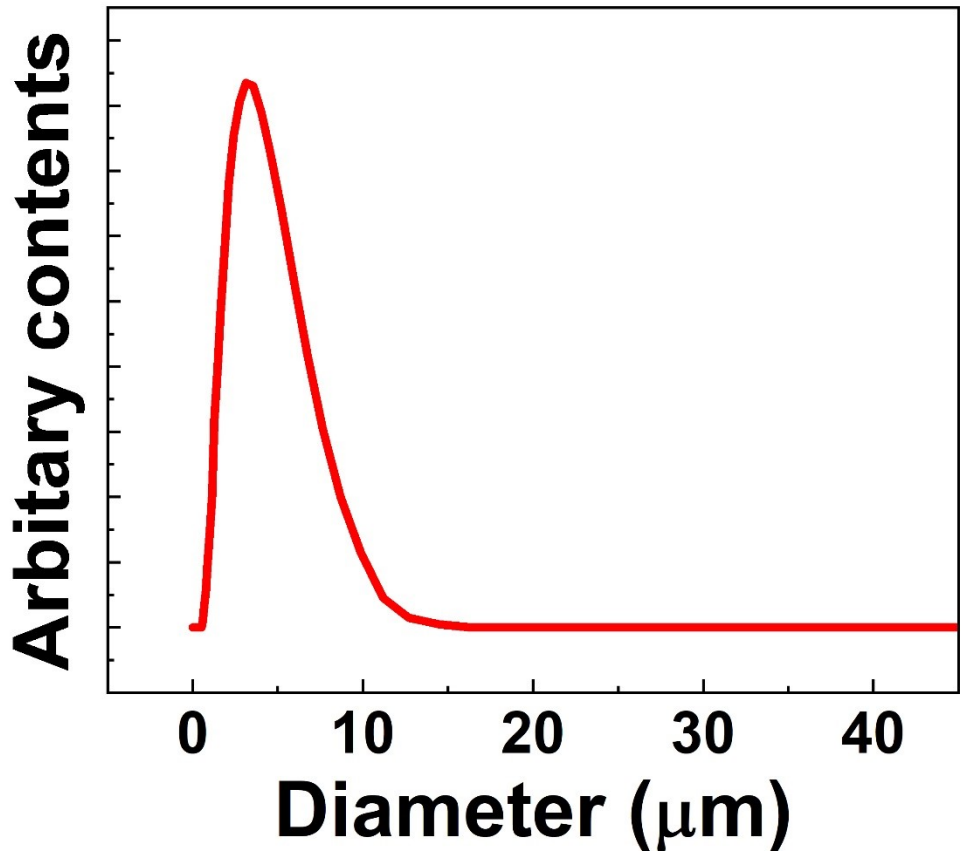


**Figure S4.** Particle size distribution confirmation of LMPs fabricated by sonication method and filtered by a micron-scale mesh. Averaged particle size of the LMPs is 0.72±0.13μm.

**Table S1.** Determination of the nanoscale liquid metal particles concentration in PNIPAM/LMPs hydrogels

| Introduced LMPs (wt%) | Ave. residue (wt%) from 5-time measurement | **Modified LMPs concentration (wt%)** | STD | **Definition** |
|---|---|---|---|---|
| 0 | 0.84 | **0** | 0.06 | |
| 10 | 3.51 | **2.67** | 1.14 | |
| 20 | 9.55 | **8.71** | 1.95 | **10wt% LMPs** |
| 30 | 22.59 | **21.75** | 2.11 | **20wt% LMPs** |
| 45 | 32.54 | **31.70** | 2.59 | **30wt% LMPs** |
| 60 | 40.61 | **39.77** | 1.42 | **40wt% LMPs** |
| 65 | 49.62 | **48.78** | 1.96 | **50wt% LMPs** |
| 80 | 61.29 | **60.45** | 1.37 | **60wt% LMPs** |