Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Facile Preparation of Injectable, Thermosensitive, and Physically Cross-linked Hemostatic Hydrogel with Rapid Gelation and Robust Network

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Experimental Section

Synthesis of 2-((diethylcarbamothioyl)thio) Acetic Acid (RAFT CTA): The synthesis of RAFT CTA was carried out as follows[1]: sodium chloroacetate (5.17 g, 44.5 mmol) and NaDC (10.0 g, 44.4 mmol) were dissolved in 100 mL deionized water. The solution was stirred for 24 h at room temperature. HCl (3 mol/L) was then added to the solution to precipitate the product. The product was filtered and recrystallized from acetone to obtain the final product (white powder, 27% yield).

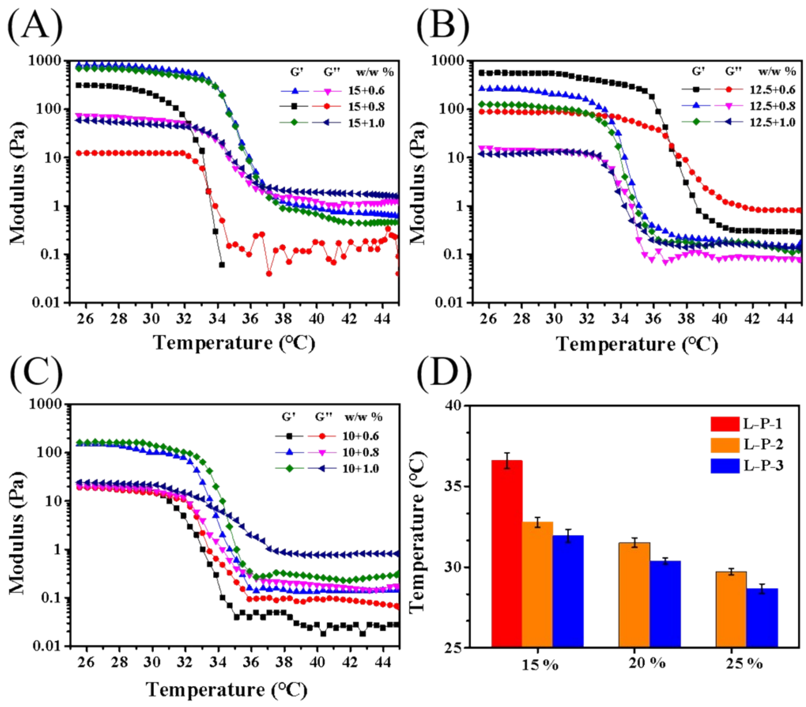

Figure S1. Temperature dependences of the dynamic moduli (G' and G'') of the G/HA solutions with different proportions of components. A) The G/HA solutions prepared using 15 w/w% gelatin and 0.6%, 0.8%, and 1.0% (w/w) HA. B) The G/HA solutions prepared using 12.5 w/w% gelatin and 0.6%, 0.8%, and 1.0% (w/w) HA. C) The G/HA solutions prepared using 10 w/w% gelatin and 0.6%, 0.8%, and 1.0% (w/w) HA. D) The LCST of L-P-1, L-P-2, and L-P-3.

For the preparation of the hydrogels $G_{15}/HA_{0.6}$/L-P-1, L-P-1 was difficult to dissolve in water due to its strong hydrophobic end-group effect, resulting in the inability to prepare the L-P-1 solution with higher concentration (e.g. 20% and 25% (w/w)). So only the $G_{15}/HA_{0.6}$/L-P-1_{15} hydrogels were prepared (**Table S1**).

Table S1. Preparation of different $G_{15}/HA_{0.6}$/L-P-1_{15} hemostatic hydrogel samples and their formulation.

No.	Sample	G(w/w %)	HA(w/w %)	L-P-1 (w/w %)	G/HA:L-P-1 (w/w %)[a]
1	$G_{15}/HA_{0.6}$/L-P-1_{15} (1:9)	15	0.6	15	1:9
2	$G_{15}/HA_{0.6}$/L-P-1_{15} (2:8)	15	0.6	15	2:8
3	$G_{15}/HA_{0.6}$/L-P-1_{15} (3:7)	15	0.6	15	3:7

[a] G/HA:L-P-1 (w/w %) indicates the weight ratio of G/HA to L-P-1.

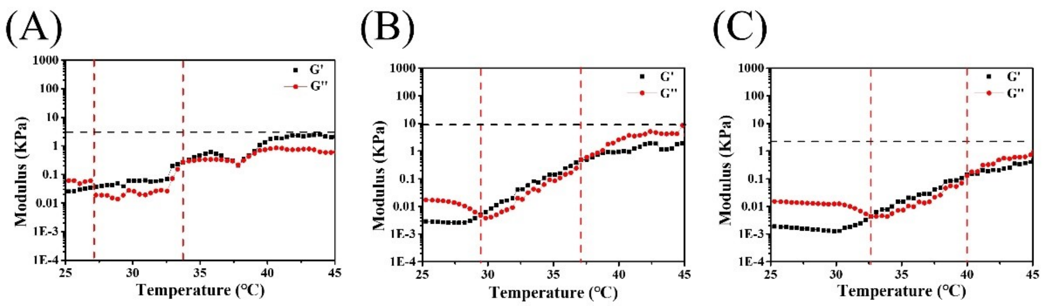

Figure S2. Temperature dependences of the dynamic moduli (G’ and G’’) of the $G_{15}/HA_{0.6}$/L-P-1_{15} hydrogels with different weight ratios of G/HA to L-P-1. A) $G_{15}/HA_{0.6}$/ L-P-1_{15} (1:9). B) $G_{15}/HA_{0.6}$/L-P-1_{15} (2:8). C) $G_{15}/HA_{0.6}$/L-P-1_{15} (3:7).

Table S2. Preparation of different $G_{15}/HA_{0.6}$/L-P-2 hemostatic hydrogel samples and their formulation.

No.	Sample	G(w/w %)	HA(w/w %)	L-P-2 (w/w %)	G/HA: L-P-2 (w/w %)[b]
1	G$_{15}$/HA$_{0.6}$/L-P-2$_{15}$ (1:9)	15	0.6	15	1:9
2	G$_{15}$/HA$_{0.6}$/L-P-2$_{15}$ (2:8)	15	0.6	15	2:8
3	G$_{15}$/HA$_{0.6}$/L-P-2$_{15}$ (3:7)	15	0.6	15	3:7
4	G$_{15}$/HA$_{0.6}$/L-P-2$_{20}$ (1:9)	15	0.6	20	1:9
5	G$_{15}$/HA$_{0.6}$/L-P-2$_{20}$ (2:8)	15	0.6	20	2:8
6	G$_{15}$/HA$_{0.6}$/L-P-2$_{20}$ (3:7)	15	0.6	20	3:7
7	G$_{15}$/HA$_{0.6}$/L-P-2$_{25}$ (1:9)	15	0.6	25	1:9
8	G$_{15}$/HA$_{0.6}$/L-P-2$_{25}$ (2:8)	15	0.6	25	2:8
9	G$_{15}$/HA$_{0.6}$/L-P-2$_{25}$ (3:7)	15	0.6	25	3:7

[b] G/HA:L-P-2 (w/w %) indicates the weight ratio of G/HA to L-P-2.

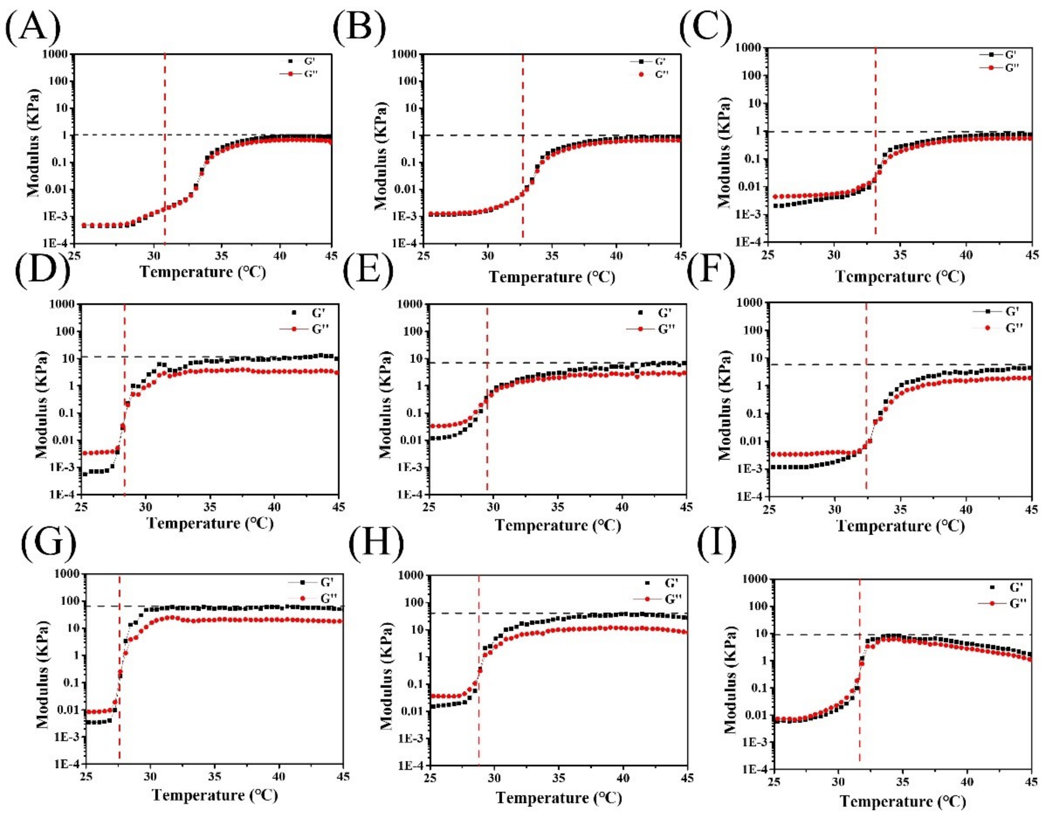

Figure S3. Temperature dependences of the dynamic moduli (G' and G'') of the G$_{15}$/HA$_{0.6}$/L-P-2 hydrogels with different proportions of components. The temperature at the intersection of G' and G" represents the phase transition temperature (LCST). A)

$G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{15}$ (1:9). B) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{15}$ (2:8). C) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{15}$ (3:7). D) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{20}$ (1:9). E) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{20}$ (2:8). F) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{20}$ (3:7). G) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{25}$ (1:9). H) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{25}$ (2:8). I) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{25}$ (3:7).

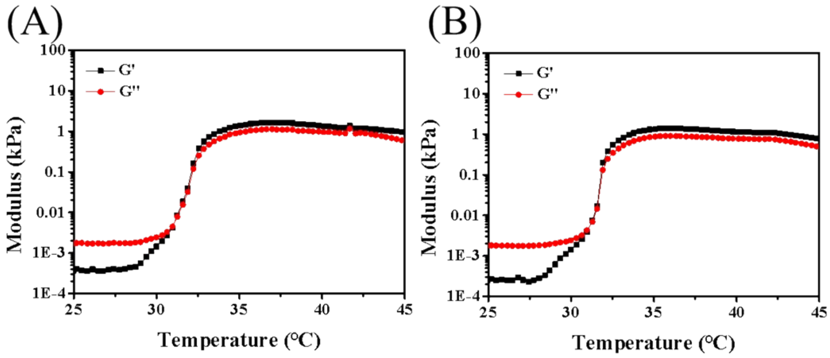

Figure S4. Temperature dependence of the dynamic moduli (G' and G'') of 20% L-P. A) L-P-2. B) L-P-3.

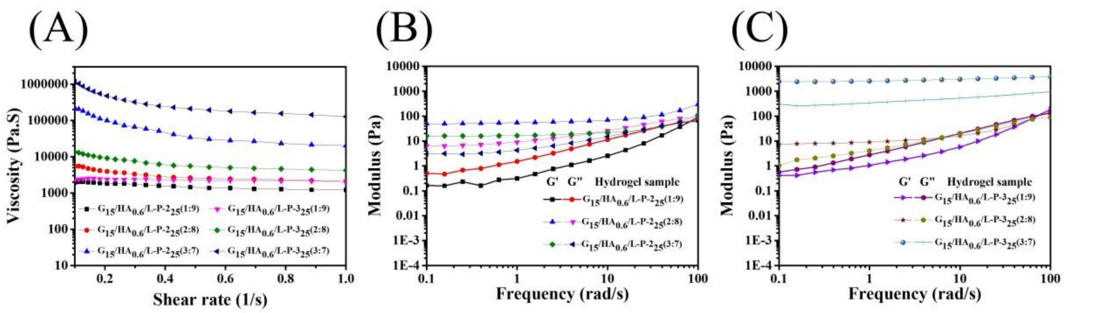

Figure S5. Viscoelastic moduli and viscosity analysis of the hydrogels $G_{15}/HA_{0.6}/L\text{-}P_{25}$ with different proportions of components. A) Shear-thinning behavior of hydrogels. The dependences of dynamic moduli (G' and G'') on dynamic frequency for the hydrogels B) $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{25}$ and C) $G_{15}/HA_{0.6}/L\text{-}P\text{-}3_{25}$ with different weight ratios of G/HA to L-P.

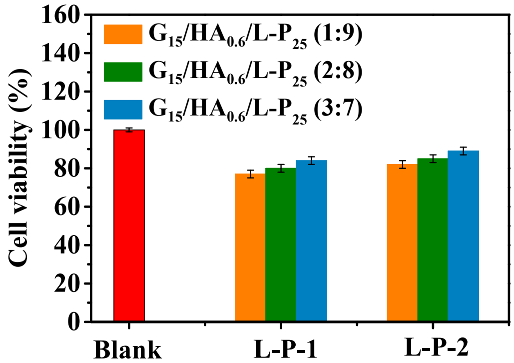

Figure S6. The cell viability of the blank group, the $G_{15}/HA_{0.6}/L\text{-}P\text{-}1_{15}$ and $G_{15}/HA_{0.6}/L\text{-}P\text{-}2_{25}$ hydrogel groups after incubation for 24 h.

Movie Caption List

Movie S1. Demonstration of burst pressure testing of the hydrogel $G_{15}/HA_{0.6}/L\text{-}P\text{-}3_{25}$ (1:9) adhered to pigskin at 36.5 ± 0.5 °C.

Movie S2. Experimental demonstration of the rapid thermoresponsive sol-gel transition and strong adhesion of the hydrogel $G_{15}/HA_{0.6}/L\text{-}P\text{-}3_{25}$ (1:9) on the wet surface of glass at 36.5 ± 0.5 °C.

Movie S3. Experimental demonstration of the rapid thermoresponsive sol-gel transition of the hydrogel $G_{15}/HA_{0.6}/L\text{-}P\text{-}3_{25}$ (1:9) on the wet surface of finger joint and the stable wet adhesion of hydrogel under ultrasonic treatment.

References

(1) Xing, X.; Yang, H.; Tao, M.; Zhang, W., An overwhelmingly selective colorimetric sensor for Ag+ using a simple modified polyacrylonitrile fiber. *Journal of Hazardous Materials* 2015, *297*, 207-216.