Electronic Supplementary Material (ESI) for Soft Matter.

Electronic Supplementary Information for

Double-network hydrogel with adjustable surface morphology and multifunctional integration for flexible strain sensors

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Table S1. Sample composition in weight percentage of the studied DN hydrogels

κ-carrageenan (wt%) / PIL (wt%)	1	2	3
5	K1-P5	K2-P5	K3-P5
10	K1-P10	K2-P10	K3-P10
15	K1-P15	K2-P15	K3-P15
20	K1-P20	K2-P20	K3-P20

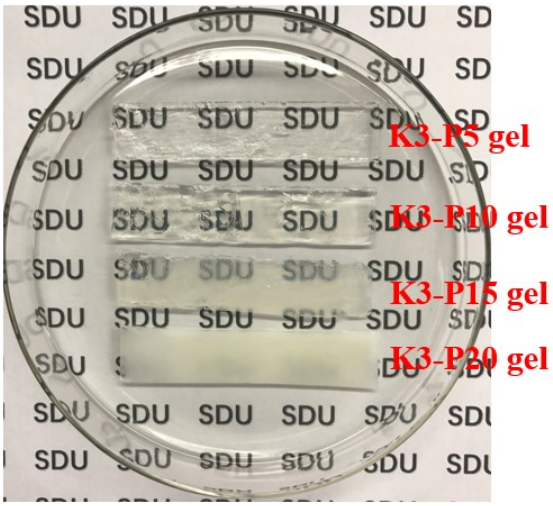


Fig. S1 The appearance of obtained κ-carrageenan/PIL DN hydrogels.

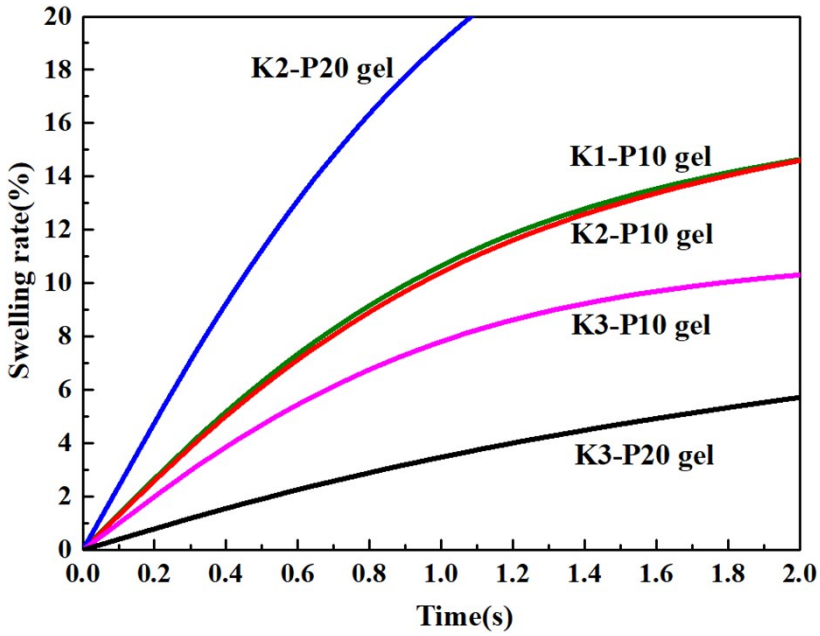


Fig. S2 The swelling rate in the initial stage for different hydrogel samples.

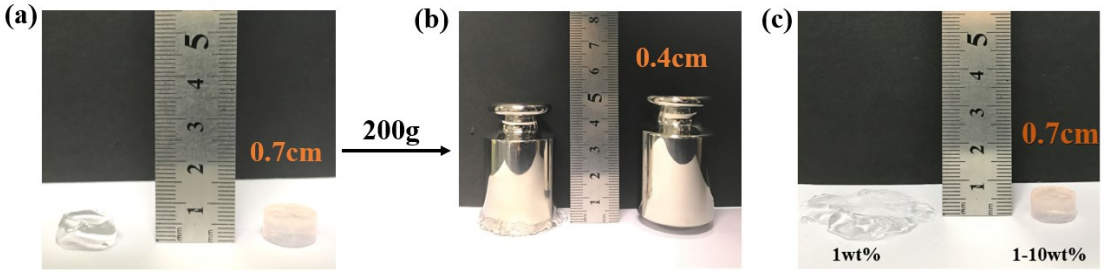


Fig. S3 Load-bearing capacity tests of K1 and K1-P10 hydrogels (the weight is 200g).

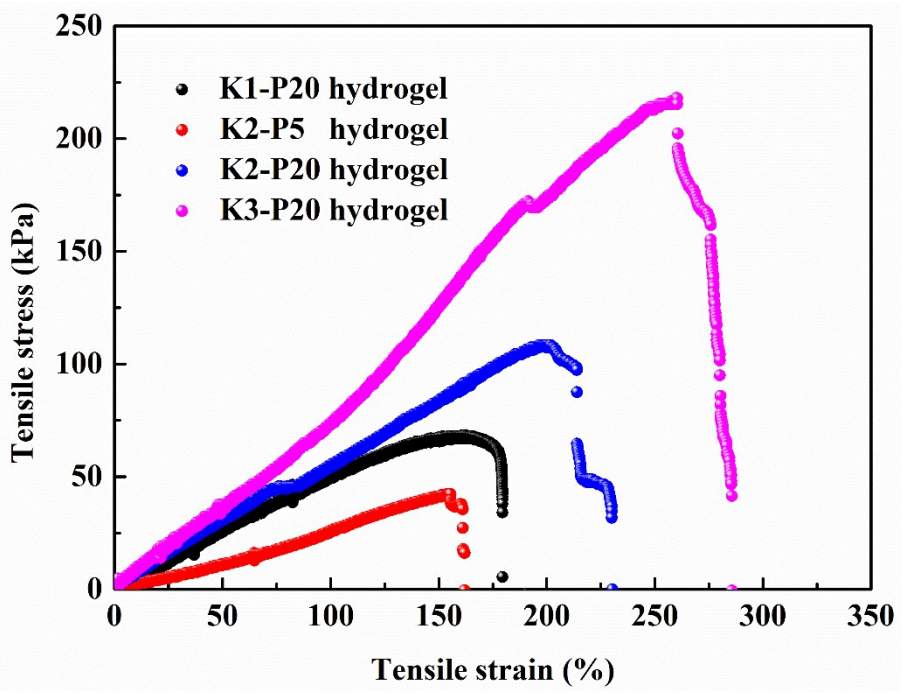


Fig. S4 Strain stress-strain curves of different hydrogels.

a

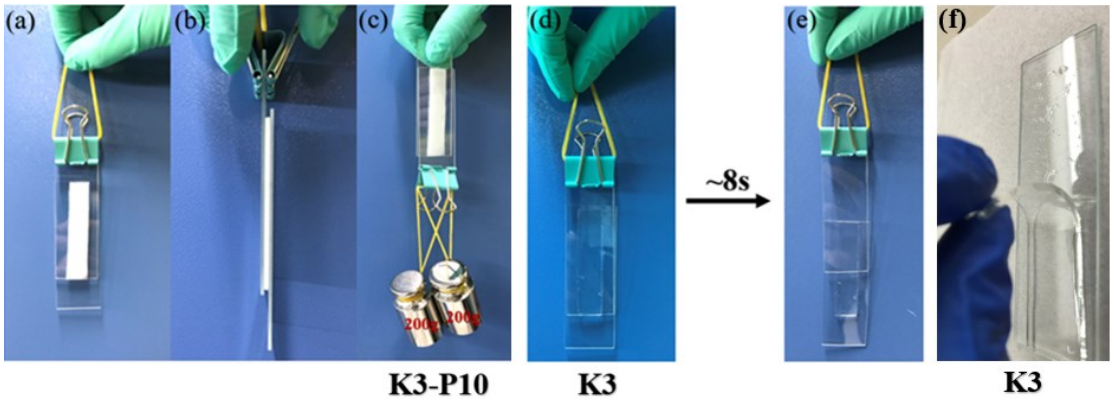


Fig. S5 (a-c) Schematic of static shear test of the K3-P10 DN hydrogel adhesion on glass substrates and 400 g hanging weight. (d-e) Illustration of the K3 hydrogel adhesion on glass, and the glass slides will slide off without the weight hanging. (f) The K3 hydrogel is peeled from the glass plate with water left.

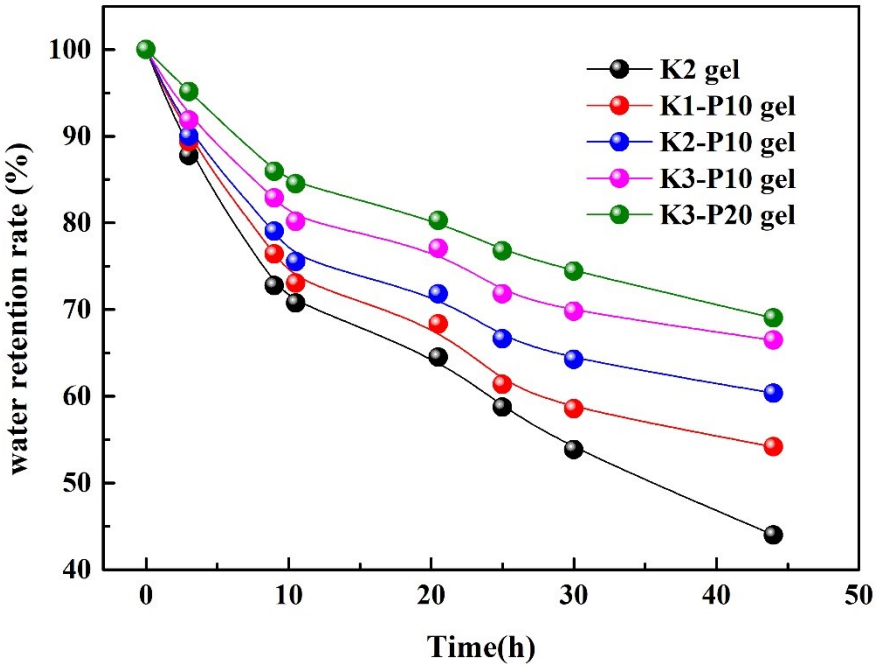


Fig. S6 Plot of water retention rate (%) versus time for different hydrogel samples.

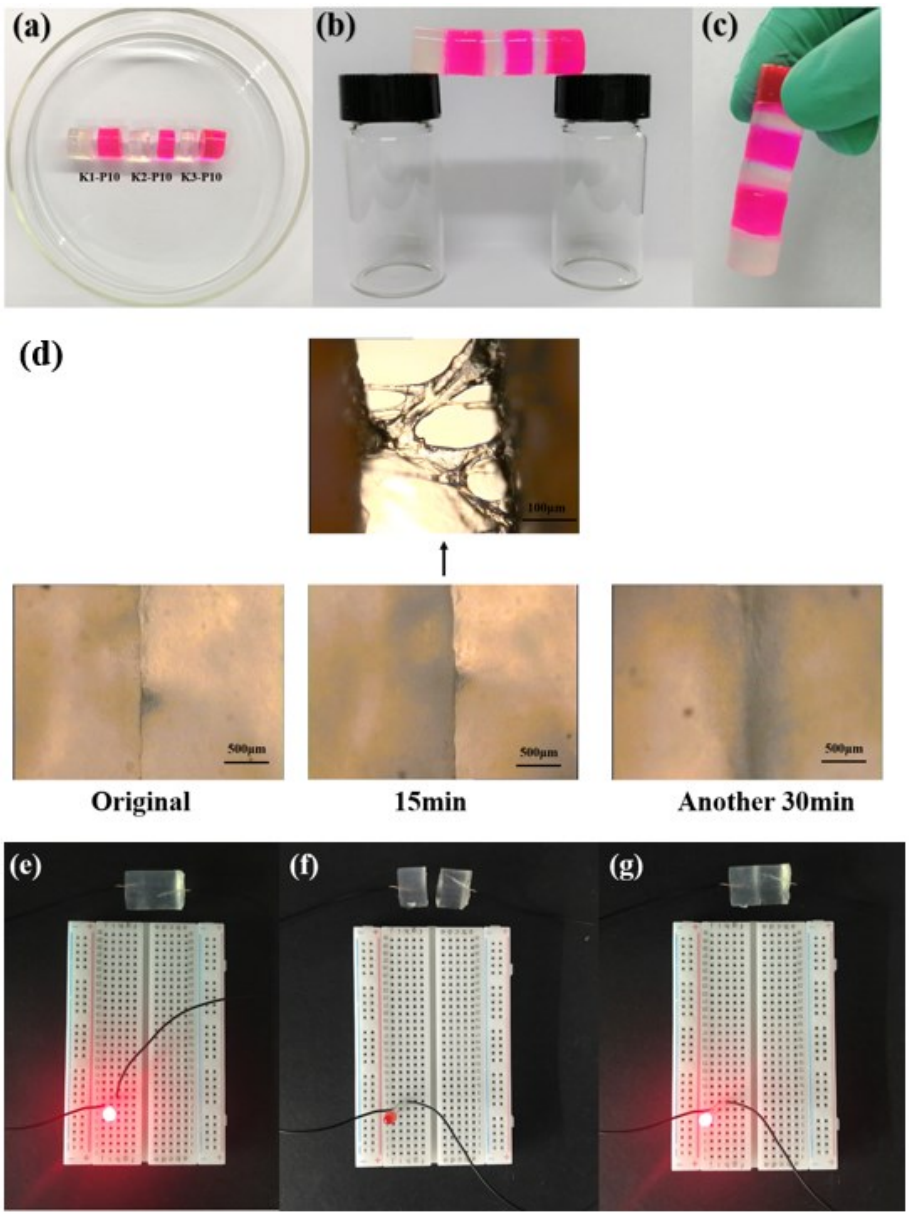


Fig. S7 (a-c) Self-healing process of K1-P10, K2-P10, and K3-P10 hydrogels. (d) Self-healing process of 1-15 hydrogel under optical microscope. (e-g) Circuit comprises an LED indicator connected by (e)undamaged, (f)cut, and (g)self-healed K3-P10 hydrogel column.

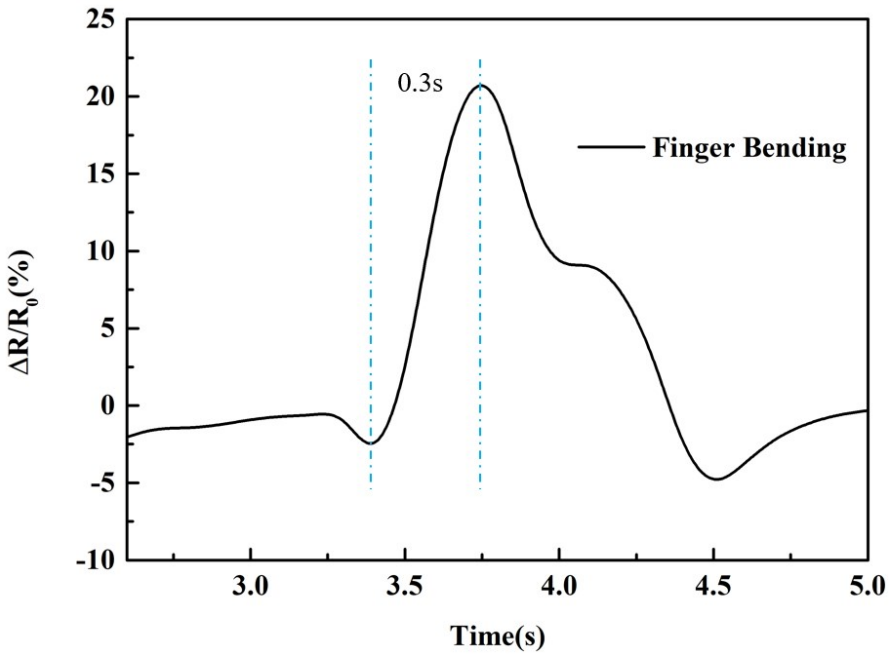
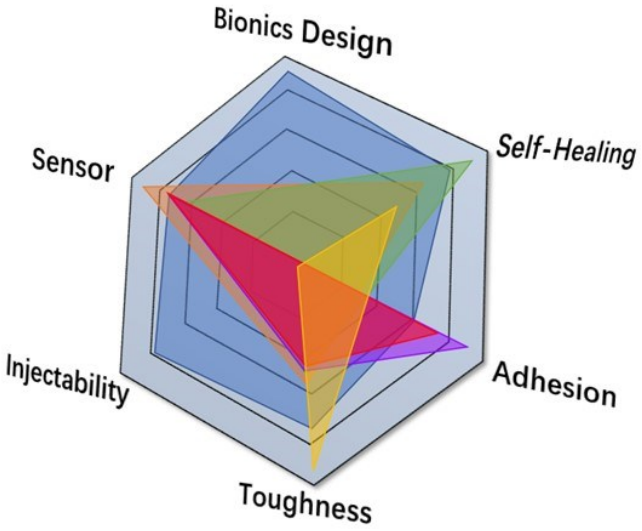


Fig. S8 The response time of K3-P20 hydrogel to monitor the joint motion of fingers.



	Ref.	Materials
	J. Mater. Chem. C, 2020, **8**, 8368-8373	poly(acrylic acid) ionogel
	J. Mater. Chem. A, 2019, **7**, 27099-27109	polyacrylamide/calcium-alginate/graphene foam hydrogel
	Mater. Horiz., 2019, 6, 595-603	κ-carrageenan/polyacrylamide/KCl (ethylene glycol/ glycerol) organohydrogel
	ACS Appl. Mater. Interfaces, 2018, **10**, 19097-19105	κ-carrageenan/polyacrylamide/KCl hydrogel
	ACS Appl. Mater. Interfaces, 2018, **10**, 37544-37554	κ-carrageenan/polyacrylamide/KCl (8 wt % SDS/0.9 M NaCl water solution) hydrogel
	This work	κ-carrageenan/poly(ionic liquid)

Fig. S9 Radar charts for comparison of the multifunctionality of different gels based on various materials.

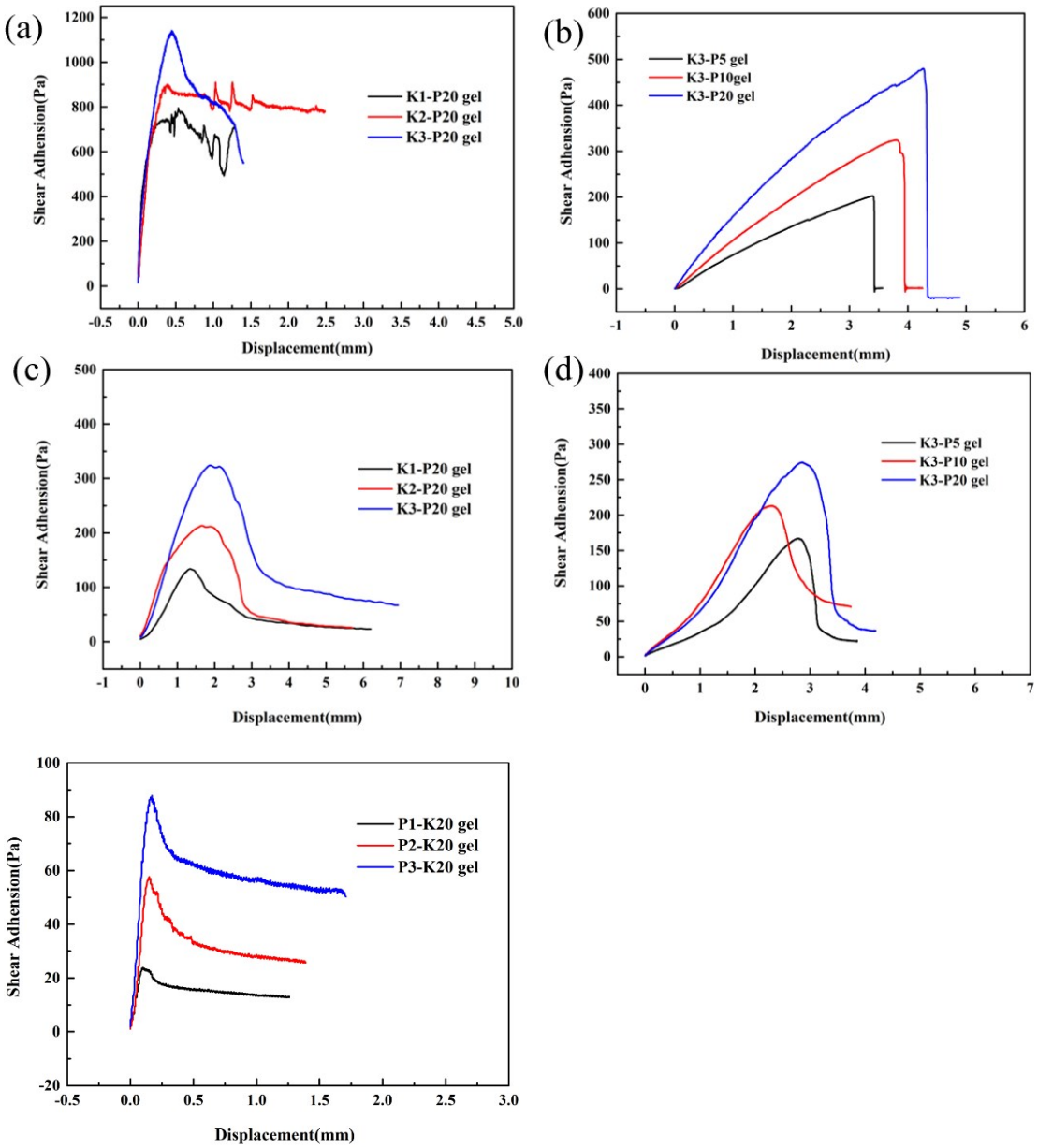


Fig. S10 Adhesion strength of different hydrogels on various substrates (a)glass, (b) silicone, (c) plastic, (d) hogskin and (e) stainless steel.