Supporting Information

Biomimetic Photonic Crystal Double-network Hydrogel for Visual and Electrical Dual Signals Bluetooth-Enabled Wearable Sensor

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This file includes Supporting Figure S1−S13, Supporting Table S1−S4, and Supporting Movie S1-S2.

Supporting Figures

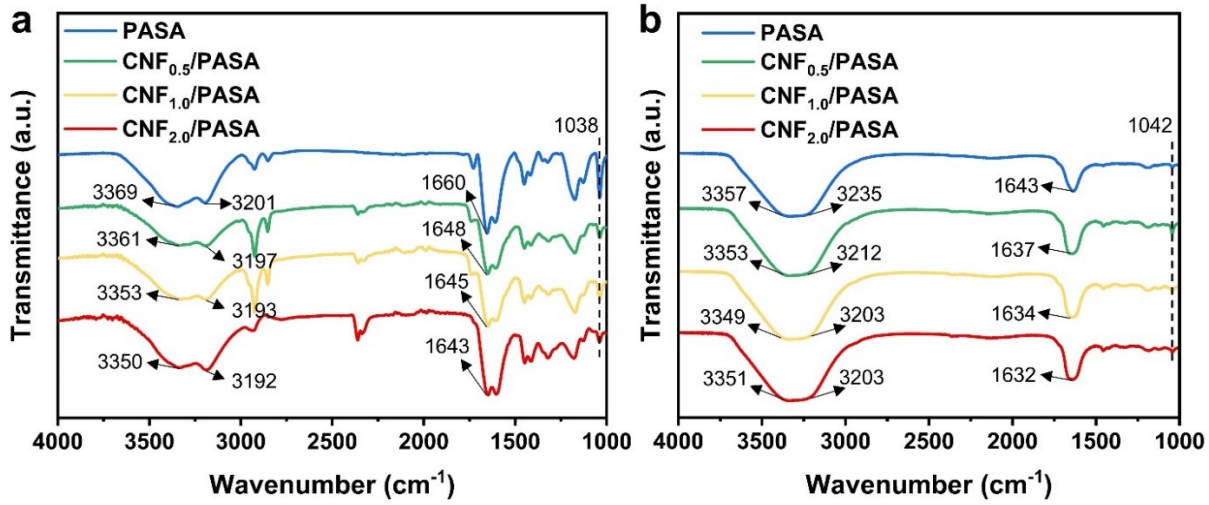

Figure S1. ATR−FTIR spectrum of a) the xerogels and b) the original hydrogels with different concentrations of CNF.

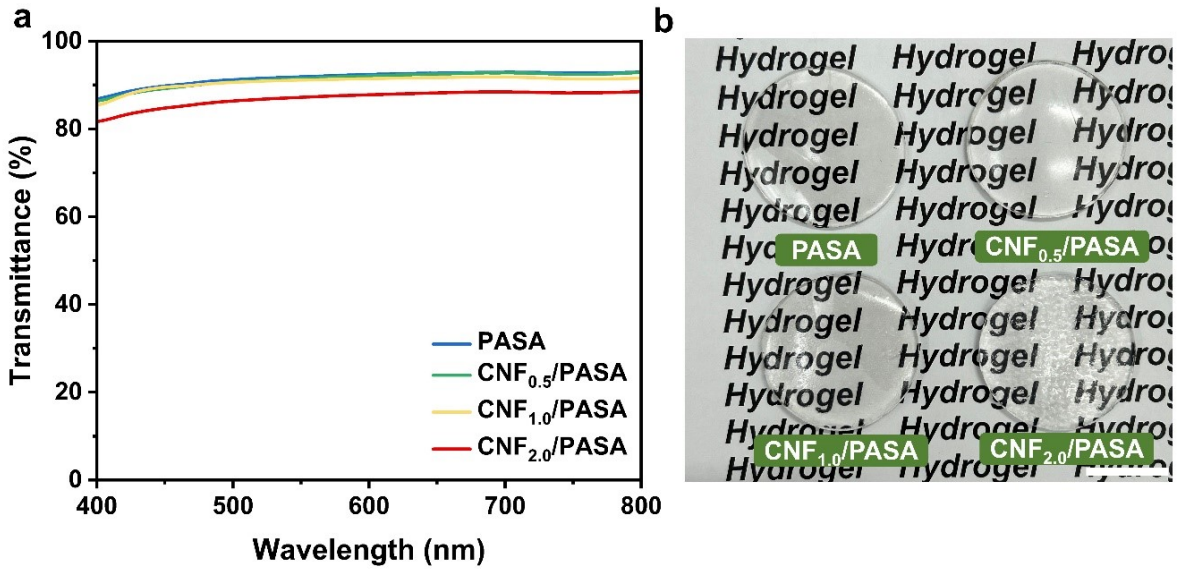

Figure S2. a) UV−Vis transmittance spectra and b) optical images of the hydrogels with various concentrations of CNF (Scale bar: 1 cm).

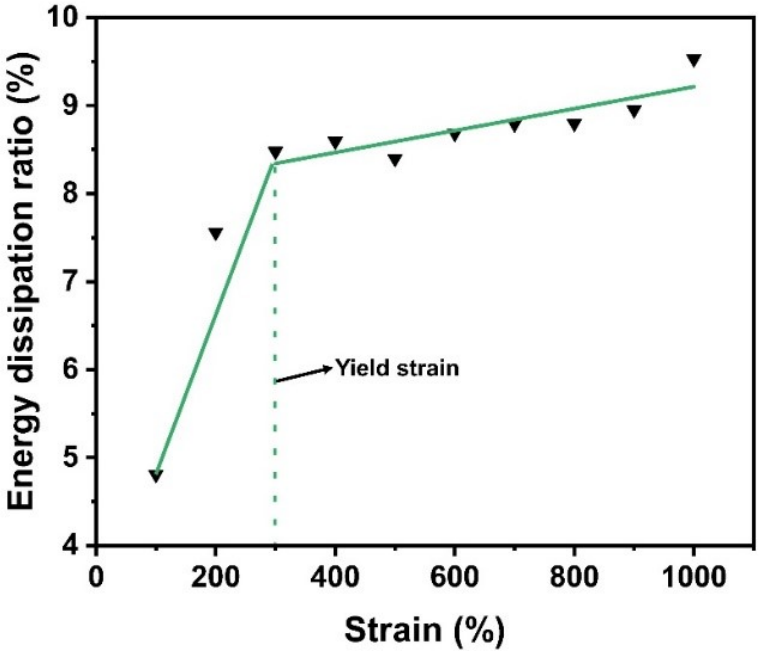

Figure S3. Dissipated energy ratio of the $CNF_{1.0}$/PASA hydrogel.

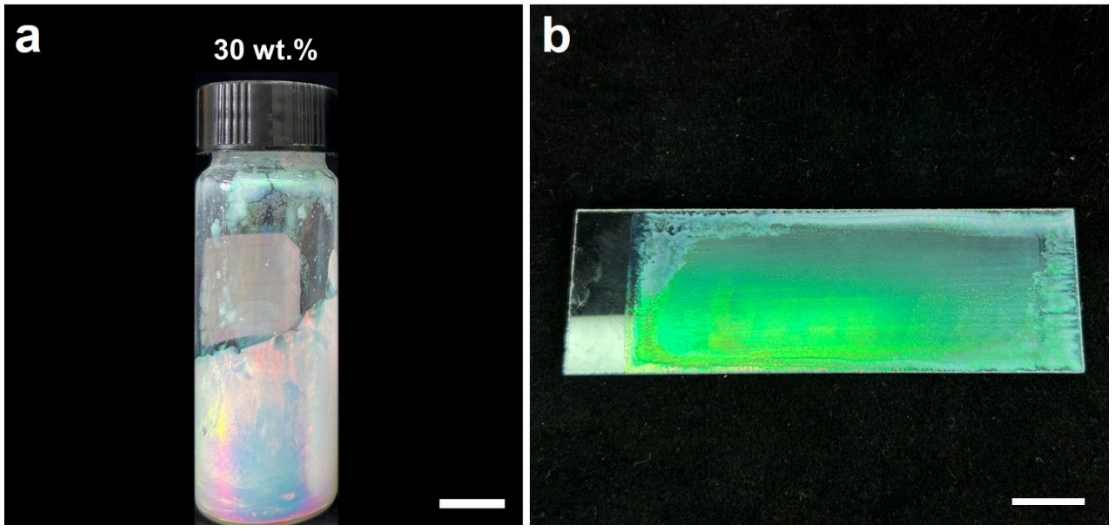

Figure S4. Digital image of a) the PS colloidal crystals and b) PC array. The scale bar is 1 cm.

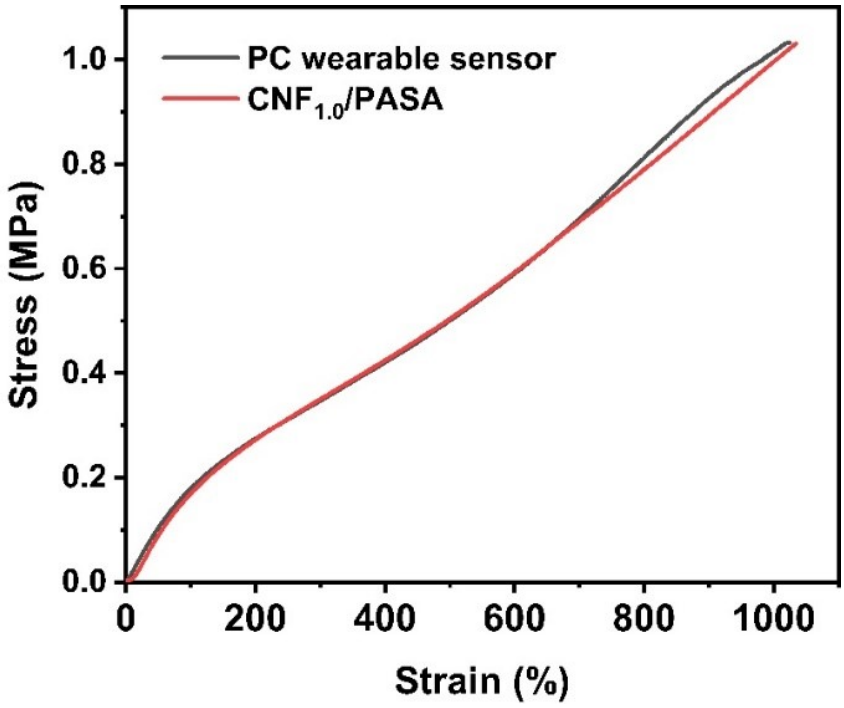

Figure S5. Stress−strain curves of PC wearable sensor and the $CNF_{1.0}$/PASA hydrogel.

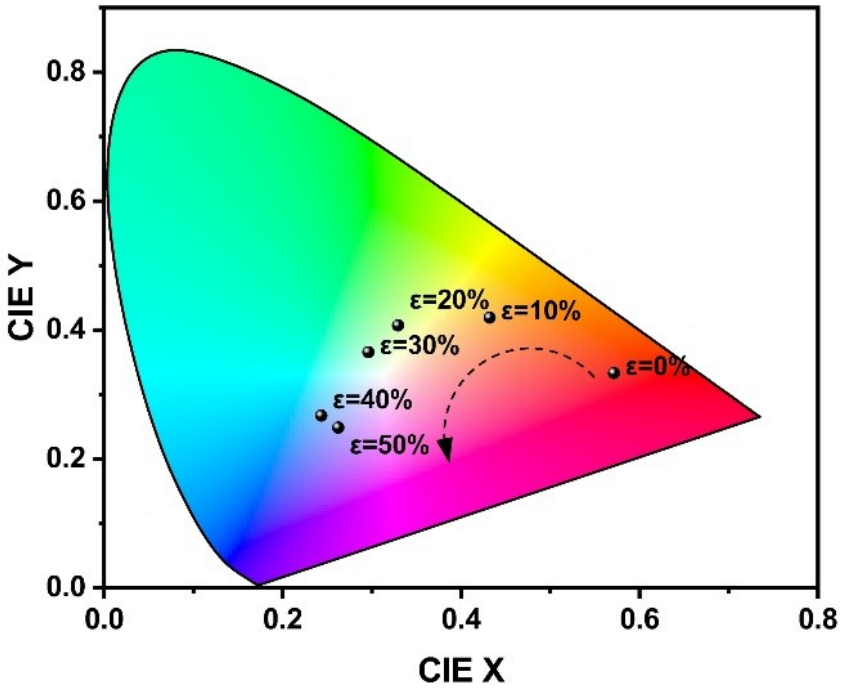

Figure S6. CIE 1931 chromaticity diagram of the PC wearable sensor under different strains (0−50%).

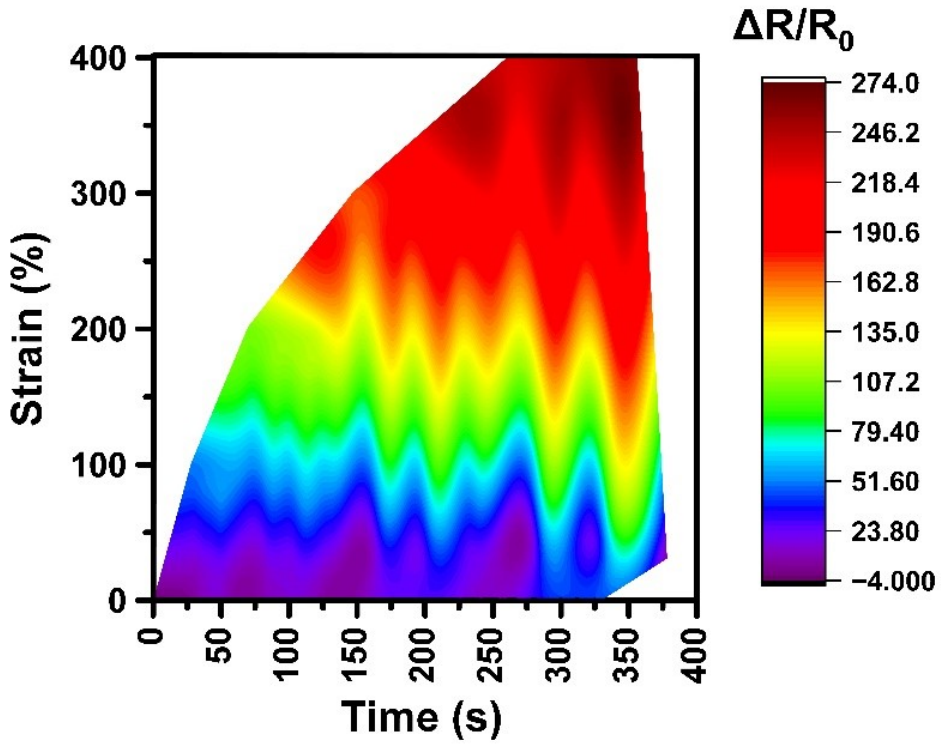

Figure S7. Real-time changes of the relative resistance at 0−400% strains.

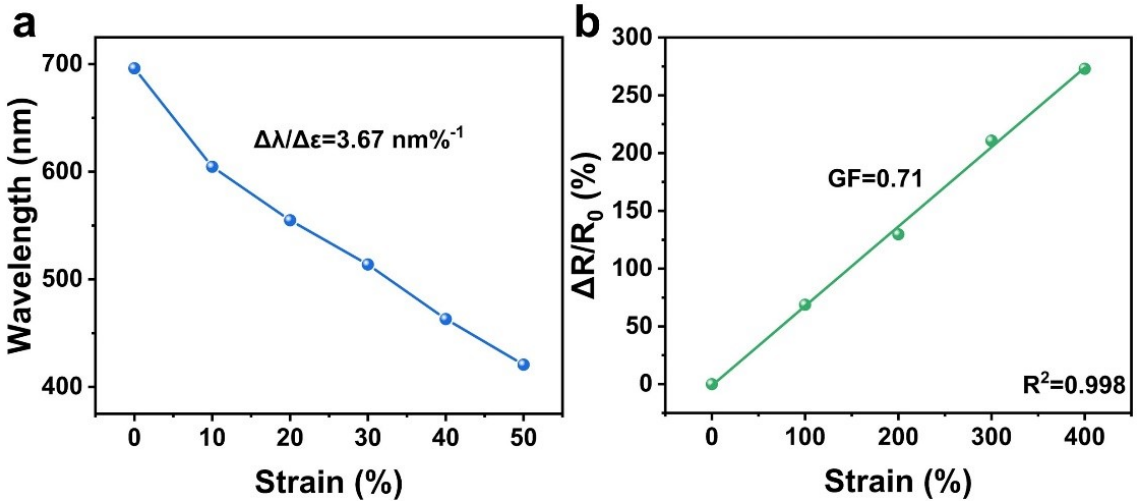

Figure S8. a) Mechanochromic sensitivity and b) GF of the PC wearable sensor.

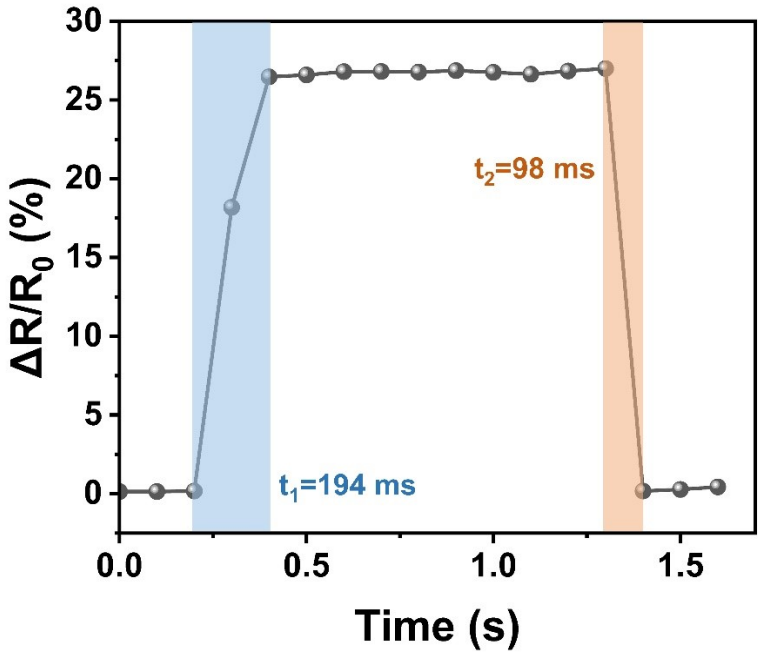

Figure S9. Time response of the PC sensor at a strain of 40%.

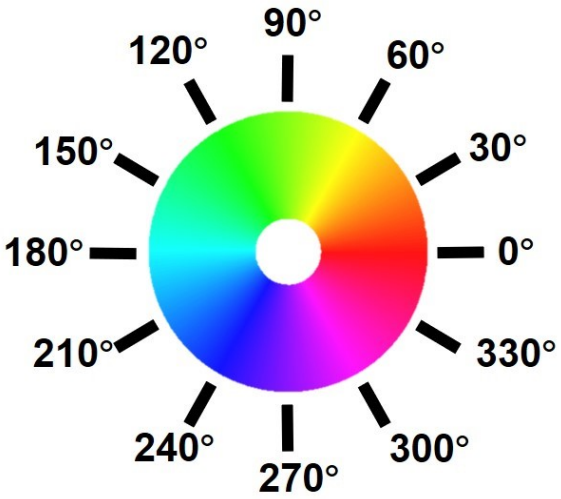

Figure S10. Hue circle.

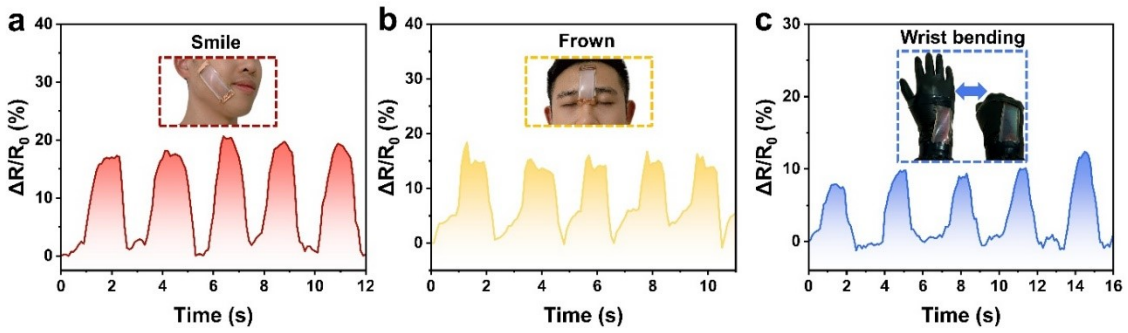

Figure S11. PC wearable sensor to monitor human motion, including a) smile, b) frown and c) wrist bending.

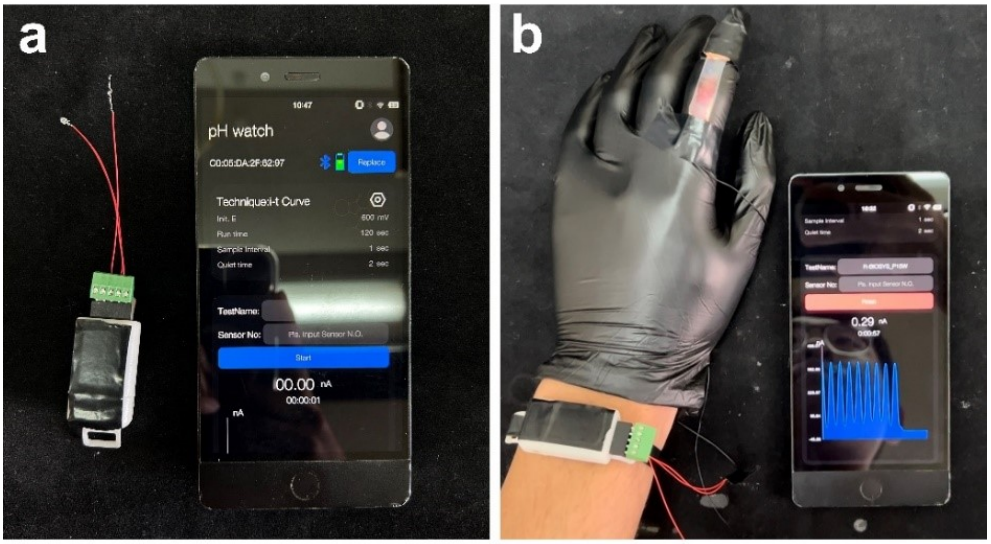

Figure S12. a) wireless miniature electronic device with Bluetooth module and smartphone. b) visual and electrical dual signal output in real-time human motion detection.

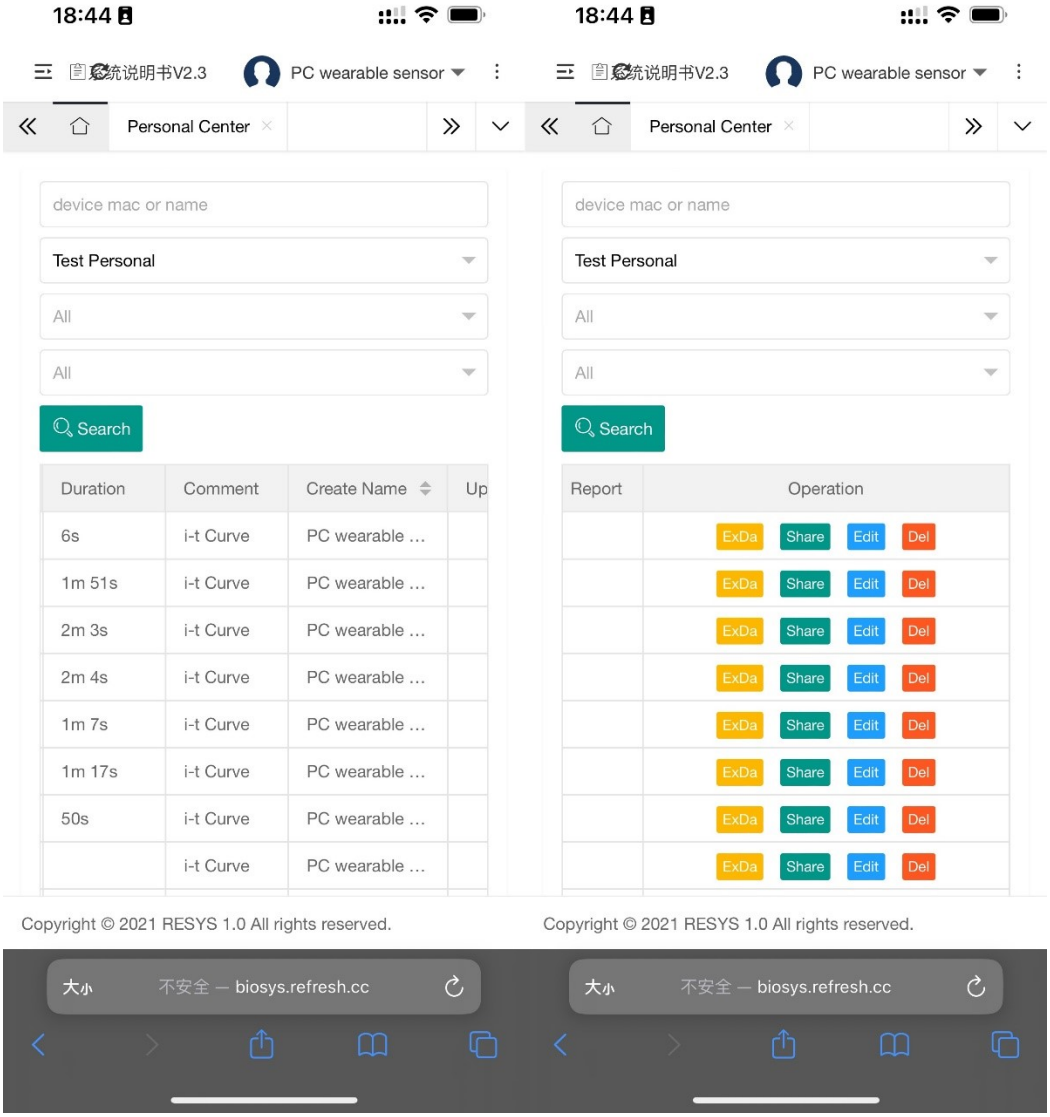

Figure S13. Cloud database of human motion detection.

Supporting Tables

Table S1. The formulation for fabricating various hydrogels with different CNF concentrations.

Samples	CNF [g]	H_2O [g]	AAm [mmol]	SBMA [mmol]	AAc [mmol]	BIS [mmol]	Irgacure 2959 [mmol]	NaCl [mmol]	Named
1	0	8.0	100.0	5.0	5.0	0.1	0.5	2.0	PASA
2	0.04	8.0	100.0	5.0	5.0	0.1	0.5	2.0	$CNF_{0.5}$/PASA
3	0.08	8.0	100.0	5.0	5.0	0.1	0.5	2.0	$CNF_{1.0}$/PASA
4	0.16	8.0	100.0	5.0	5.0	0.1	0.5	2.0	$CNF_{2.0}$/PASA

Table S2. Mechanical properties of different hydrogels.

Samples	Fracture strength	Fracture strain	Recovery ratio	Dissipated energy ratio	Ref.
$CNF_{1.0}$/PASA	1.03 MPa	1034.0%	93.1%	9.52%	This work
PAAm-PAAcNa	0.40 MPa	390.0%	85.0%	85.0%	1
PSBMA/SA-Ca^{2+}	0.73 MPa	400.0%	63.0%	76.3%	2
PAA-CNF-Fe^{3+}	1.37 MPa	1803.0%	95.0%	82.8%	3
WEQ-PA-Fe^{3+}	1.90 MPa	750.0%	87.0%	39.0%	4
SA/P(AAm-co-AAc)/Fe^{3+}	3.24 MPa	1228.0%	62.0%	85.0%	5

Table S3. Color values of CIE chromaticity coordinates of the PC wearable sensor during certain tensile strains (0−50%).

Tensile strains	x	y	L*	a*	b*
0%	0.57	0.33	271.68	269.45	178.26
10%	0.43	0.42	417.56	51.28	233.12
20%	0.33	0.41	409.90	-96.27	116.97
30%	0.30	0.37	416.73	-97.00	39.28
40%	0.24	0.27	391.98	-24.92	133.22
50%	0.26	0.25	199.53	32.70	-80.91

Table S4. Mechanochromic sensitivity of different photonic crystal hydrogels.

Samples	Mechanochromic sensitivity [$nm\%^{-1}$]	Ref.
PC wearable sensor	3.67	This work
PC sensor	2.09	6
PI-skin	1.87	7
Dual-Mode Fiber	1.51	8
PCs sensor	1.50	9

Supporting Movies

Movie S1. Changes of the structural color in PC wearable sensor during stretching and releasing.

Movie S2. Visual and electrical dual-signal output of the integrated wireless PC wearable sensor.

References

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