Supporting Information

A wearable hydrogel-based EEG patch device for human fatigue assessment

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Table S1. Comparation of the mechanical and electrical properties of the PPA with others hydrogel

Component		Adhesion property (@skin)	Electrical properties	Mechanical properties			Reference
				Tensile stress	Tensile strain	Young modulus	
S1	PAA/PEDOT: SCNF	28 kPa	0.41 $S \cdot m^{-1}$	150 kPa	770%	18 kPa	ACS Nano 2024, 18, 27420-27432
S2	PAA-NHS/ PEDOT: PSS	120 kPa	3 mC cm^{-2} 200 Ω@1kHz	550 kPa	~55%	430 kPa	Adv. Funct. Mater, 2026, e27184
S3	P(BA-co-MA)/CAGE	/	11.6 $mS \cdot m^{-1}$ 4.62kΩ@0.1kHz	~50 kPa	~380%	31.92 kPa	Adv. Mater. 2026, 38, e23019
S4	PAM/gelatin/ LMs	104.7 kPa	71.2Ω@0.1kHz	366.54 kPa	1643%	~100 kPa	Nano-Micro Letters. 2025, 17, 281
S5	PAA/DMAPS /EG	~100 kPa	125 $mS \cdot m^{-1}$ ~100 Ω@1kHz	1.4 MPa	1800%	1kPa~1 Mpa	Adv. Funct. Mater, 2025, 35, 2424965.
S6	PAM/TA/Na^+	2.8 kPa	96.4 $mS \cdot m^{-1}$ ~5 kΩ@1kHz	31.1 kPa	1300%	2.36 kPa	ACS Appl. Mater. Interfaces, 2025, 17, 37231-37242
S7	PTA/PVP/LMs	576 J/m^2	~10 kΩ@1kHz	~130 kPa	>15000 %	175.8 kPa	Adv. Funct. Mater, 2025, 35, 2501130.
S8	PVA/P(AM-AA)/Li^+	16.48 kPa	1.05 $S \cdot m^{-1}$	31.1 kPa	>500%	~200 kPa	Chem Eng J, 2025, 519: 165446.
S9	P(AM-co-AA)/TA/SPE	270.8 kPa	8.08 $S \cdot cm^{-1}$ 150 Ω cm^2	87.06 kPa	>1000%	60.2 kPa	Adv. Funct. Mater, 2026, 36, e11531.
S10	PVA/H_3PO_4/PEDOT: PSS	/	~5 kΩ@10 kHz	100 kPa	~717%	~12.6 kPa	Adv. Health. Mater, 2026, 2026, e05753.
S11	PLMA/CNC/ PAA-Fe^{3+}	552.54 $J \cdot m^{-2}$	/	39.41 kPa	809.45%	7.99 kPa	Cell Rep. Phys. Sci, 2025, 6, 11.
S12	PAM/CSC/AGNs/Na^+	/	50 $S \cdot cm^{-1}$ 150 Ω cm^2	~40 kPa	1000%	~10 kPa	Nano Research, 2025,18, 94907616.
S13	Gelatin/GA/ Li^+-Na^+	3.36 $mJ \cdot cm^{-2}$	0.03 $S \cdot m^{-1}$ 18.2 kΩ@0.1kHz	50 kPa	750%	65.7 kPa	Small, 2025, 21, 2407996.
S14	PAM/BC/ LMs	221.77 $J \cdot m^{-2}$	450 $S \cdot m^{-1}$	437.9 kPa	691%	41.2 kPa	ACS Sens, 2026, 11, 2195-2206.
S15	PSB/PEDOT: PSS/Na^+	50 kPa	9 $S \cdot m^{-1}$ 239 kΩ@1kHz 3 mC cm^{-2}	30 kPa	700%	1.74 kPa	Biomacromolecules, 2025, 26, 7959-7973.
S16	Gelatin/ChCl	4.37 $N \cdot m^{-1}$	0.96 $mS \cdot cm^{-1}$	~50 kPa	200%	40 kPa	npj Flex Electron, 2025,

S17	PVA/CS/PEDOT: PSS	/	4.7 kΩ@10Hz 26 mS·m^{-1} 0.94 MΩ@1Hz	25 kPa	325%	~20 kPa	9, 121 Mater. Today. Chem, 2026, 53, 103524
S18	PVA/PPy	25 kPa	210 mS·cm^{-1} 10 kΩ@10Hz	99.67 kPa	360%	~40 kPa	Colloid Interface Sci, 703, 139173
S19	PAA/CS/ MXene/Zn^{2+}	28.7 kPa	2.73 S·m^{-1}	48.7 kPa	641%	5 kPa	Nano Energy, 2024, 126, 109586
S20	PAM/DMA/ PEDOT	14.2 kPa	0.01 S·m^{-1}	~30 kPa	>1300%	3.9 kPa	ACS Nano, 2025, 19, 7755-7766
	PAA/PVA/ Na^{+}	3.2MPa	98.3 Ω·cm²@1kHz 5.52 mC·cm^{-2}			5.7 kPa	This work

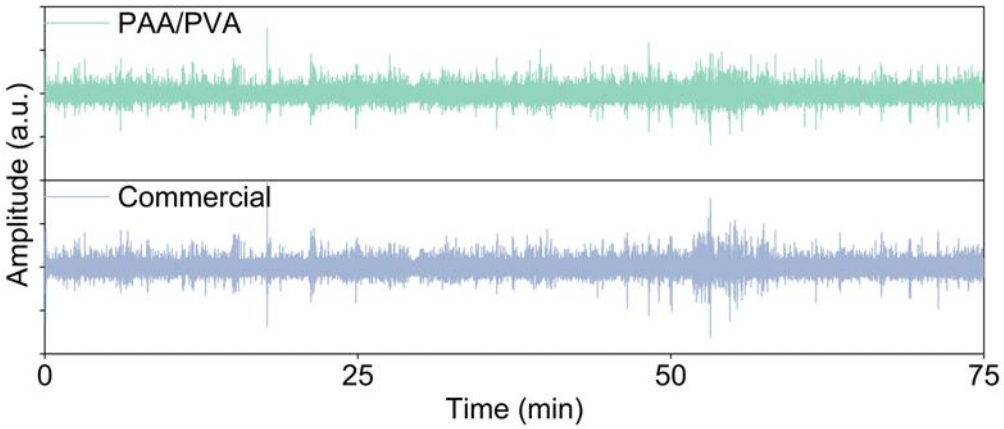

Fig. S1. Comparative EEG signal acquisition results between the developed PPA/carbon hydrogel electrode and a commercial Ag/AgCl EEG electrode under identical experimental conditions.

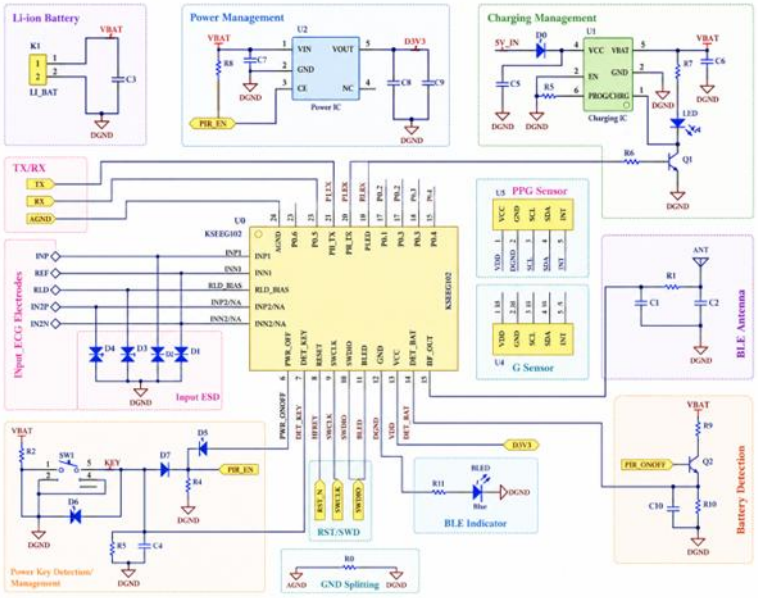

Fig. S2. Schematic circuit architecture and hardware composition of the wearable EEG monitoring system, including the signal acquisition module, signal processing module, wireless transmission module, and power management unit.