Enhanced Mechanical and Electrical Properties of Starch-Based Hydrogels Incorporating Polyacrylic Acid and MXene for Advanced Wearable Sensors in Sign Language Recognition

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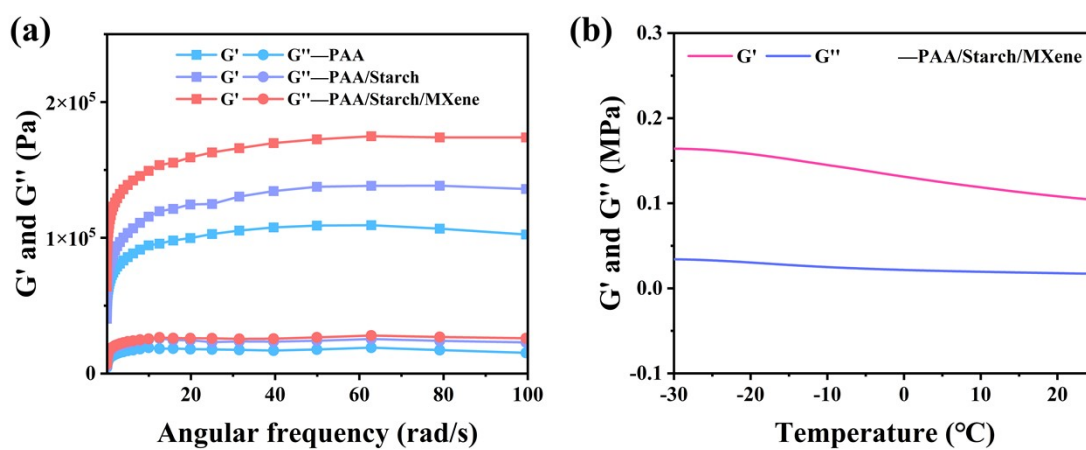
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Figure S1 Defromations of the the PAA/Starch/MXene organohydrogel with compressing and releasing states.
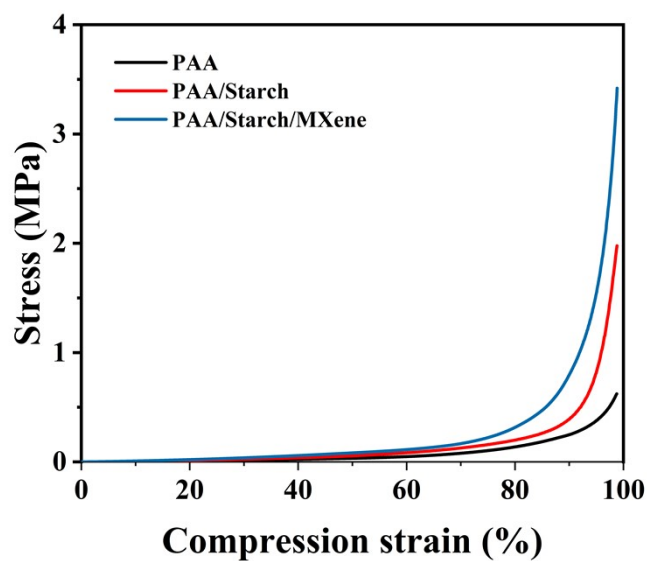
Figure S2 Compressive stress-strain curves of PAA, PAA/Starch and PAA/Starch/MXene organohydrogels.


Figure S3 (a) Frequency scanning curve of PAA, PAA/Starch, and PAA/Starch/MXene organohydrogels; (b) Storage modulus (G') and loss modulus (G'') of the PAA/Starch/MXene organohydrogel as a function of temperature.
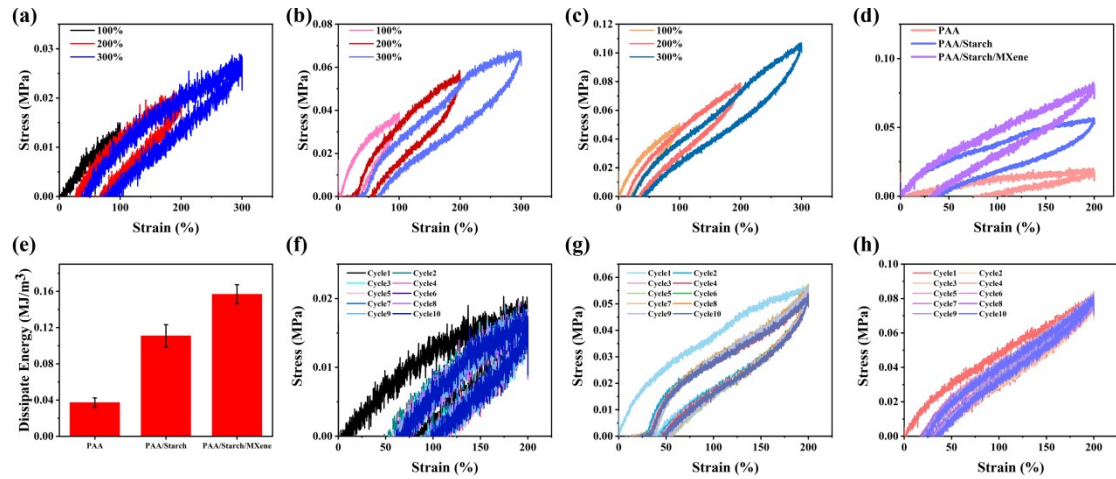
Figure S4 Loading-unloading curves of (a) PAA (b) PAA/Starch and (c) PAA/Starch/MXene organohydrogel at different strain of 100-300%; (d) Loading-uploading curves of the organohydrogels at the same strain of 200%; (e) Calculated dissipate energy from Figure S3d; Successive cyclic loading-unloading curves at a maximum strain of 200% without intervals for (f) PAA (g) PAA/Starch and (h) PAA/Starch/MXene organohydrogels.
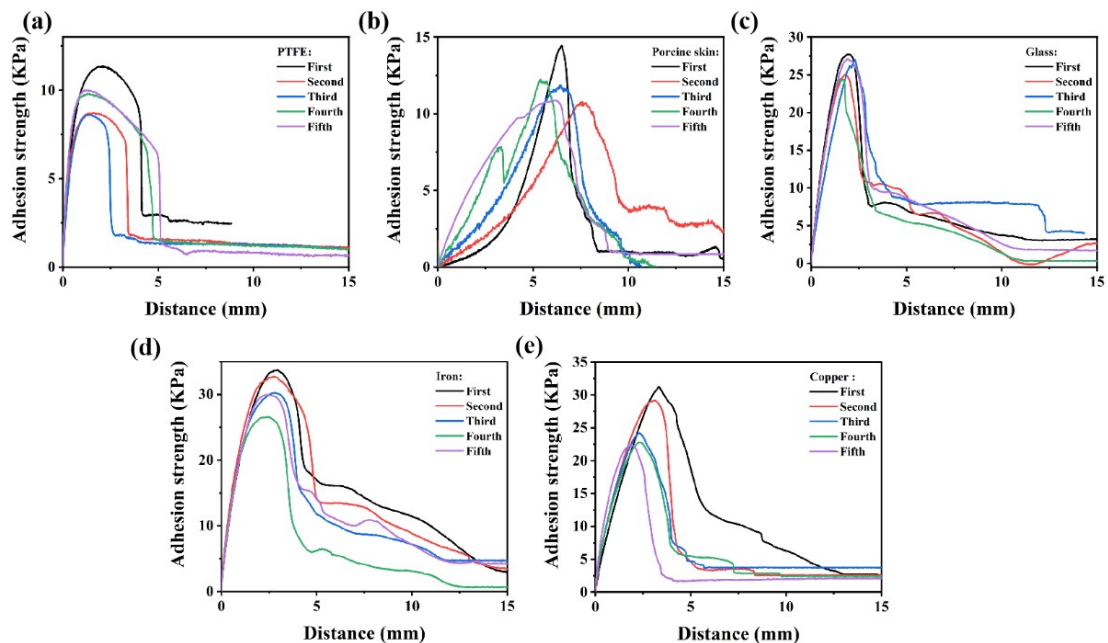
Figure S5 Repeatable adhesion behaviors of the different substrates tested by cyclic tensile adhesion tests. (a) PTFE. (b) Porcine skin. (c) Glass. (d) Iron. (e) Copper.
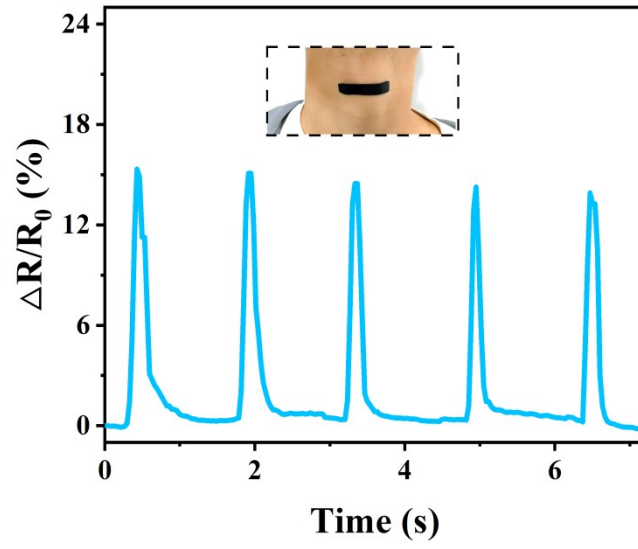
Figure S6 Real-time relative resistance changes for the detection of throat swallowing.
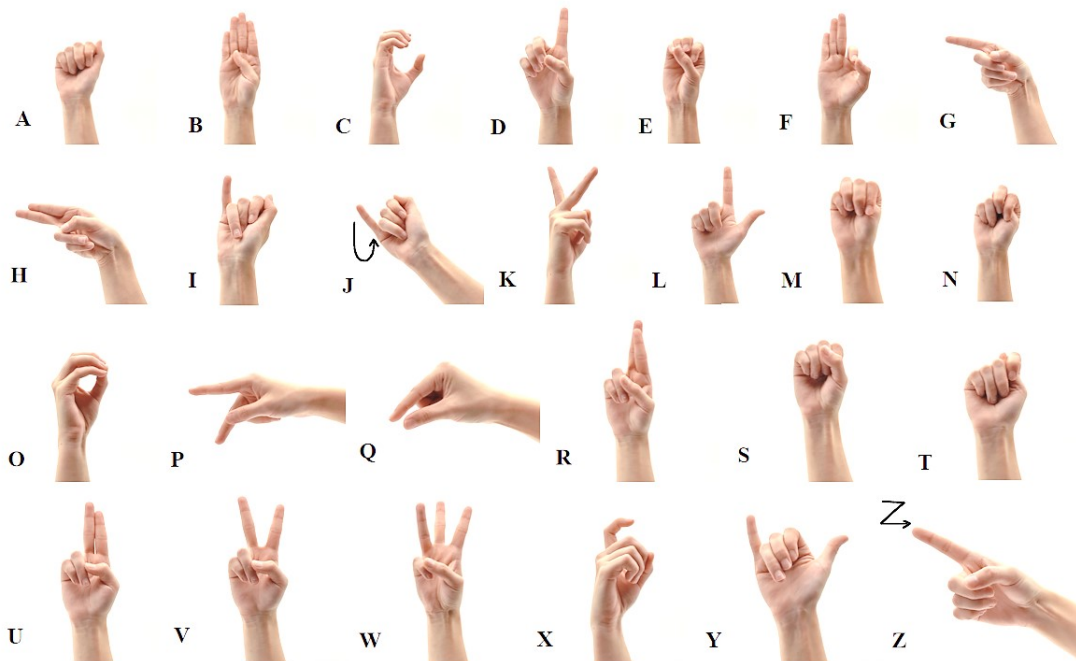
Figure S7 Gestures corresponding to 26 English letters.
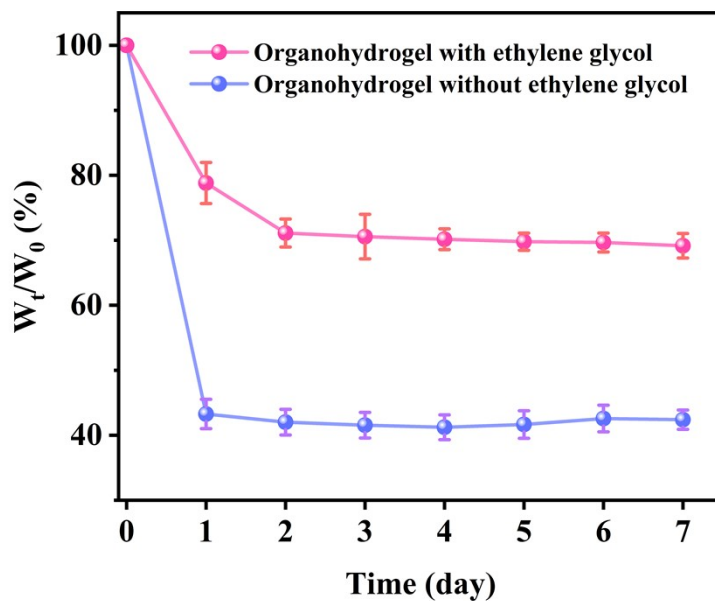
Figure S8 Weight change curve of organohydrogel with ethylene glycol and without ethylene glycol over time.

Table S1 Sample compositions of the organohydrogels

Sample	AA /g	Starch /g	MXene /mL	Ethylene Glycol /mL	MBA /mg	H_2O /mL	APS /mg
PAA	4	0	0	3	4	7	5
PAA/Starch (0:7)	4	0	1.5	3	4	5.5	5
PAA/Starch (1:7)	4	0.5714	1.5	3	4	5.5	5
PAA/Starch (2:7)	4	1.1428	1.5	3	4	5.5	5
PAA/Starch (3:7)	4	1.7142	1.5	3	4	5.5	5
PAA/Starch/MXene (0 mg/ml)	4	1.1428	0	3	4	7	5
PAA/Starch/MXene (1.5 mg/ml)	4	1.1428	1.5	3	4	5.5	5
PAA/Starch/MXene (2.5 mg/ml)	4	1.1428	2.5	3	4	4.5	5
PAA/Starch/MXene (3.5 mg/ml)	4	1.1428	3.5	3	4	3.5	5
PAA/Starch/MXene (4.5 mg/ml)	4	1.1428	4.5	3	4	2.5	5
PAA/Starch/MXene (5.5 mg/ml)	4	1.1428	5.5	3	4	1.5	5

PS: Concentration of MXene is 10 mg mL^{-1}

Table S2 Comparison of comprehensive performances of the reported starch-based hydrogels

Hydrogels	Fracture strain (%)	Fracture stress (MPa)	Toughness (MJ m^{-3})	Workable strain range (%)	Gauge factor	Self-adhesive ability	Anti-fatigue ability	Freezing tolerance (℃)	Ref.
Starch/PVA/AlCl$_3$/[Emim]Ac	567	0.52	1.42	400	5.93	N/A	N/A	-20	[1]
P(Am-DMC)-CMS	411	0.217	0.43	400	5.73	N/A	Yes	N/A	[2]
St-PVA-GO-IL	657.5	0.64	2.08	500	6.04	N/A	Yes	-20	[3]
STH	135	0.06	N/A	50	0.98	Yes	Yes	N/A	[4]
Starch/PVA/EG/TA/CaCl$_2$	606.8	1.1	2.56	500	2.51	N/A	N/A	-32.2	[5]
Starch/PVA/glycerol/CaCl$_2$	790	0.53	1.99	400	3.42	N/A	N/A	-29.8	[6]
MMs-DN	1615	0.483	N/A	400	3.7	N/A	Yes	-40	[7]
AA/Starch 98 %	1290	0.023	N/A	500	5.6	Yes	Yes	N/A	[8]
SPAE	567	0.53	N/A	400	5.93	N/A	N/A	-20	[9]
PAA/Starch/MXene	1237	0.34	2.40	880	14.19	Yes	Yes	-30	this work

N/A is donated as 'not available' in the references.

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