Supplementary Information (SI) for Nanoscale.

Supporting Information

High Performance Polydopamine and Silver Nanoparticles Modified MXene-Based Hydrogel Flexible Strain Sensors for Transfer-Learning Assisted Hand-Written Recognition and Wrist Movement Monitoring

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1. Test detail

1.1 Sensing properties tests of the hydrogel strain sensor

Real-time resistance was recorded using a digital source meter (Keithley2450, Tektronix, Inc., USA). The resistance change can be calculated by the following formula:

$$\Delta R/R_0 = (R_t - R_0)/R_0 \times 100\% \tag{1}$$

Where R_0 and R_t are the resistance without and with strain, respectively.

The strain sensor measurement factor is commonly used to evaluate the performance of strain sensors. The gauge factor (GF) is defined using the following equation:

$$GF = \Delta R/R_0 \times \varepsilon \tag{2}$$

Where $\Delta R$is the change of the resistance before and after tensile, R_0 is the resistance before strain and ε is the strain of the hydrogel. Four sets of hydrogel samples with different concentrations were tested.

1.2 Mechanical properties tests of the hydrogel strain

The mechanical properties of hydrogels were tested with a P300 tensile tester (Dongguan Dongri Co., Ltd., China) at a speed of 50 mm/min. The modulus of elasticity usually expresses the mechanical strength and deformation capacity of hydrogel materials, specifically their stiffness or deformation resistance under tensile or compressive forces. It reflects the elastic recovery characteristics of hydrogel under external force and is a key parameter of hydrogel mechanical properties.The modulus of elasticity is defined using the following equation:

$$E = F/\sigma \tag{3}$$

Where F is the stress and σ is the strain corresponding to the selected stress.The modulus of elasticity is determined from the slope of the initial line of the stress-strain curve.

Figures

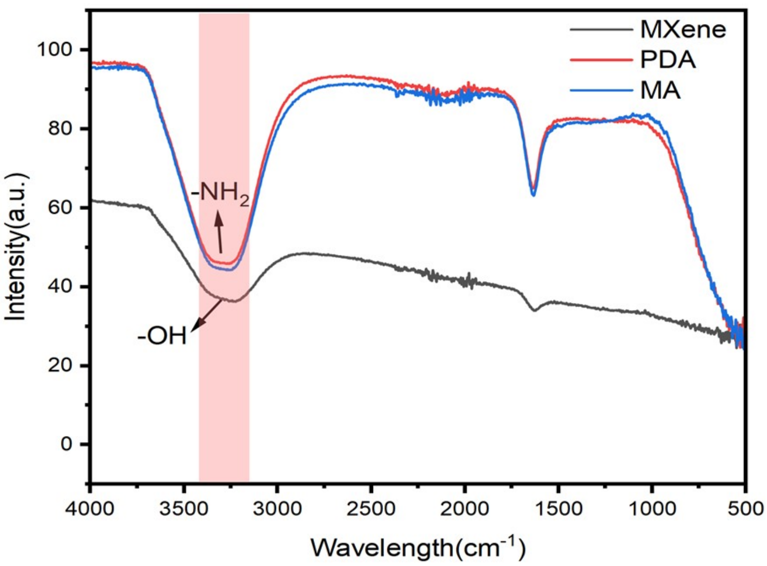

Figure S1. FTIR spectra of pure MXene, PDA, and the MA composite.

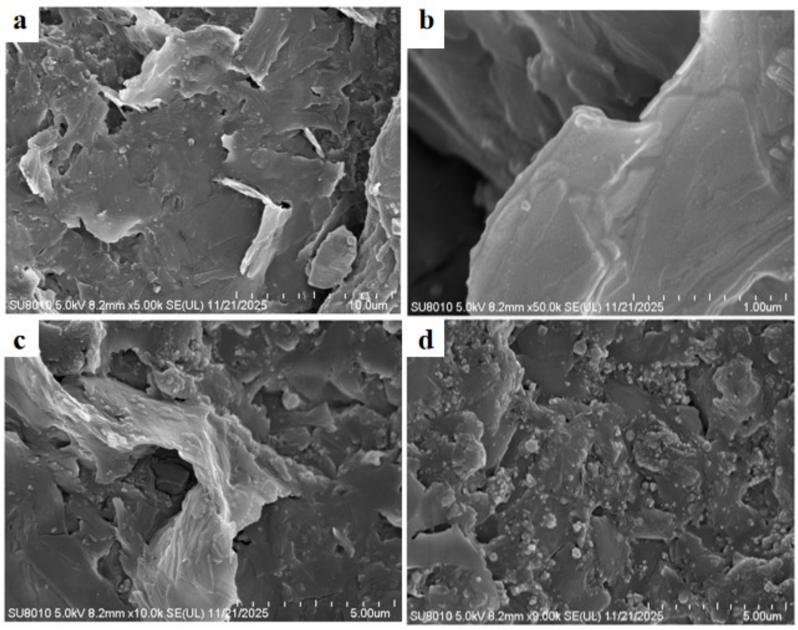

Figure S2. High-resolution FE-SEM images of the MA precursor solution at different magnifications.

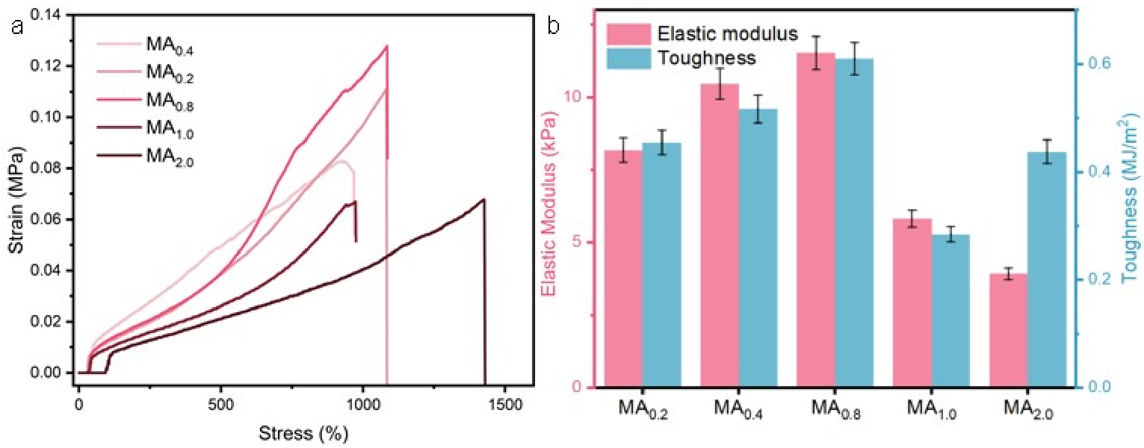

Figure S3. The mechanical properties of different hydrogel sample

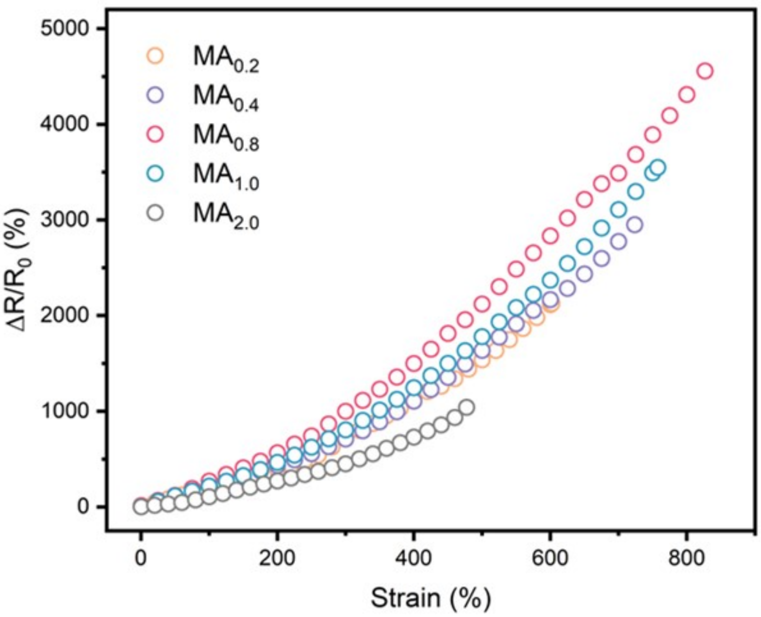

Figure S4. The mechanical properties of different hydrogel samples

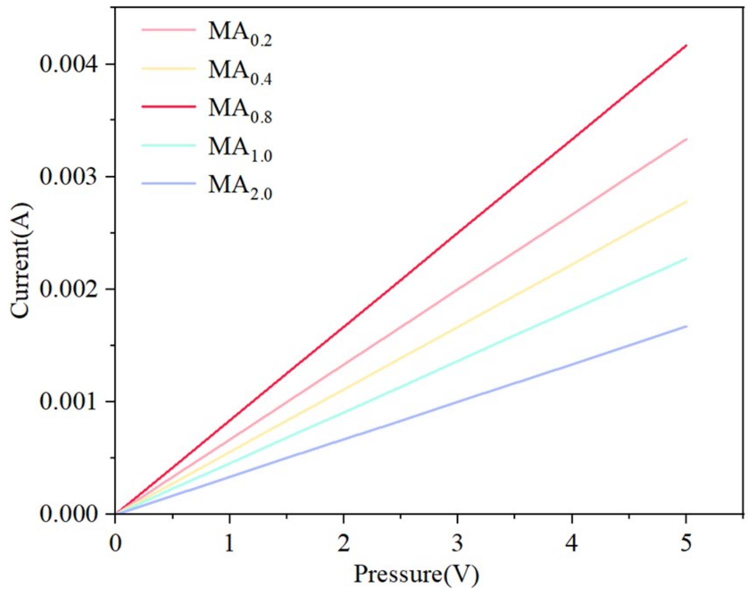

Figure S5. Current-voltage (I-V) characteristics of MAPS hydrogels with different MA contents ($MA_{0.2}$, $MA_{0.4}$, $MA_{0.8}$, $MA_{1.0}$ and $MA_{2.0}$) in the range of 0-5 V.

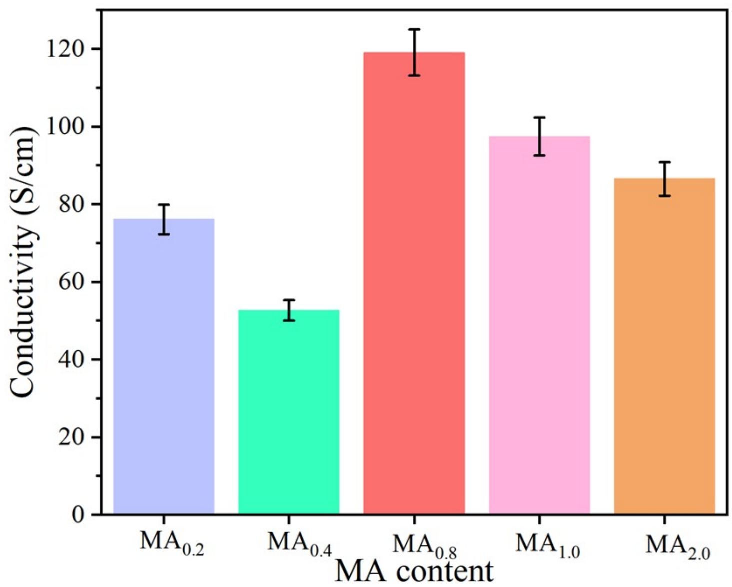

Figure S6. Conductivity of MAPS hydrogels with different MA contents (MA0.2, MA0.4, MA0.8, MA1.0and MA2.0) at room temperature.

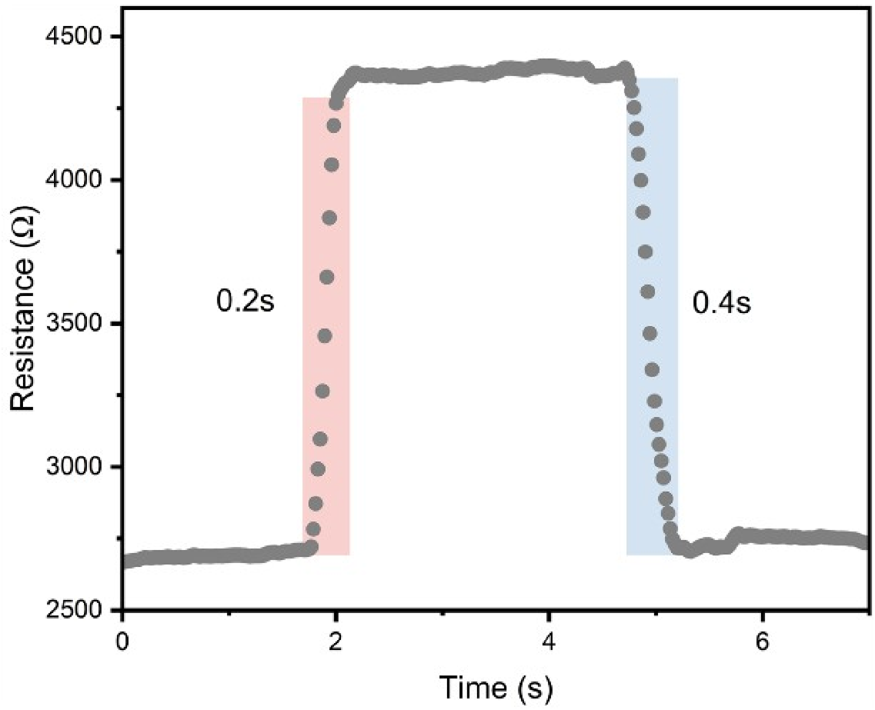

Figure S7. Response time and recovery time

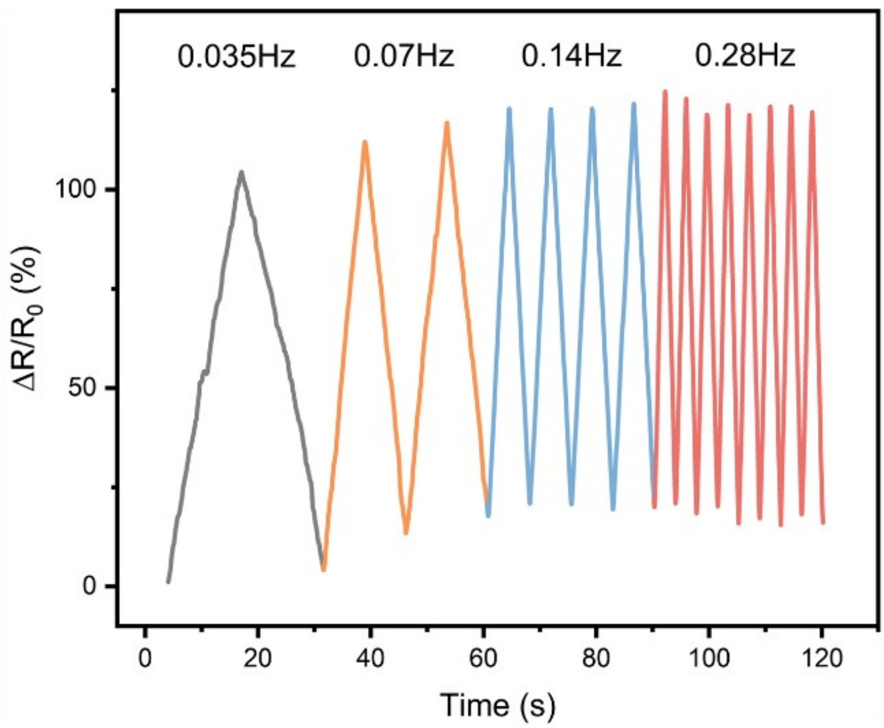

Figure S8. Tensile responses at different frequencies

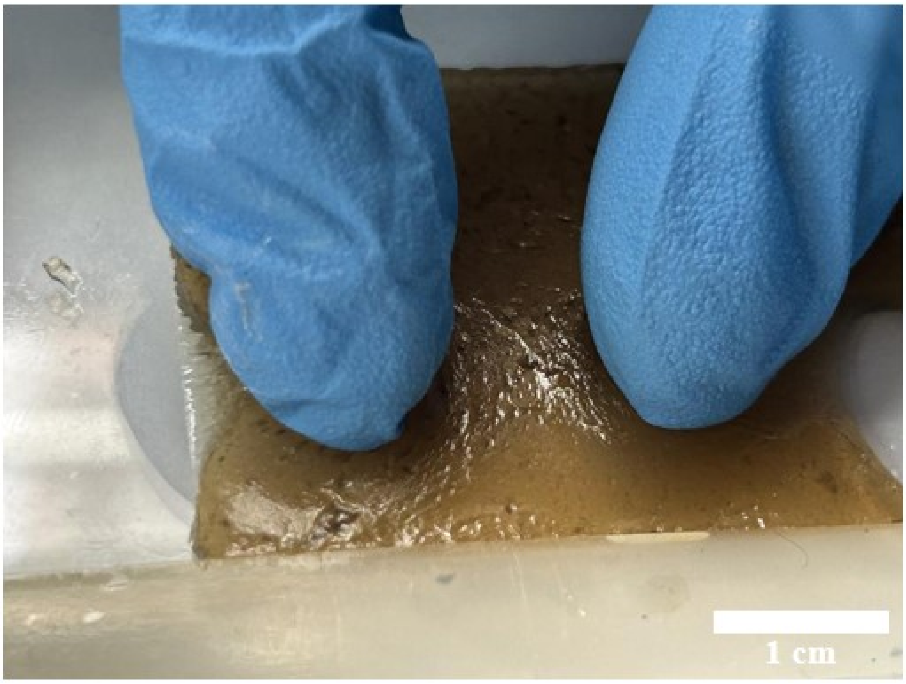

Figure S9. Optical image of hydrogel

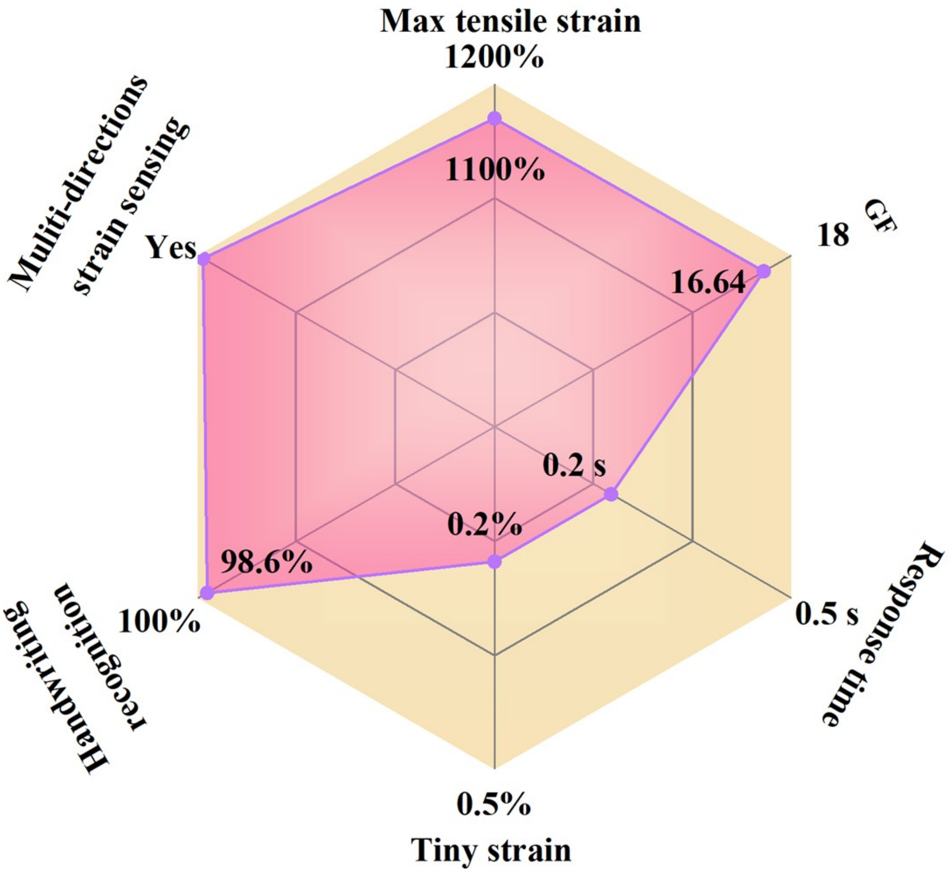

Figure S10. Radargram of the performance of MAPS hydrogel-based sensor

Tables

Table S1 The comparison between MAPS hydrogel sensor and previous reported hydrogel sensors

Component	Maximum Gauge Factor	Tensile strain (%)	Tiny strain(%)	Handwriting recognition	Multi-directional measurement	Reference
MAPS hydrogel	**16.64**	**1100%**	**0.2%**	√	√	**This work**
PVA/TA/Fe^{3+}/MXene hydrogel	×	980%	×	×	×	[41]
PVA/Fe^{3+}/MXene	4.2	850%	×	×	×	[42]
PAM/PEDOT:PSS hydrogel	5.3	1000%	0.5%	×	×	[43]
PDA-CF-PAAm hydrogel	2.67	714%	×	×	×	[44]
PDA-HC hydrogel	4.18	537%	0.5%	×	×	[45]
Ag–PDA/MAC	4.18	500%	1%	×	×	[46]
LM-CHCC	8.6	428%	×	×	×	[47]
PTCM–Glyx	8.21	675%	×	×	×	[48]
MXene-PAA-ACC hydrogel	10.79	450%	0.3%	×	×	[49]
PACG-M hydrogel	3.93	896%	×	×	×	[50]