Supporting Information

Multifunctional mineral hydrogels: potential in artificially intelligent skin and drug delivery†

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Materials

Polyacrylic acid (PAA) with molecular weight of 100,000 $g \cdot mol^{-1}$ and chitosan (CS) with low molecular weight were supplied by Sigma-Aldrich Co. Calcium chloride anhydrous ($CaCl_2$, AR, 99%) and sodium phosphate dibasic dodecahydrate ($Na_2HPO_4 \cdot 12H_2O$, AR, 99%) were purchased from Aladdin Chemical Co. Kanamycin sulfate (KS) with USP grade was provided from BBI Life Sciences. Dulbecco's Modified Eagle Medium (DMEM), fetal bovine serum (FBS), trypsin-EDTA, and phosphate buffer solution (PBS, pH 7.4) were purchased from Ge Healthcare Life

Science (USA). MTT and antibiotics (100 $U\cdot mL^{-1}$ streptomycin and 100 $\mu g\cdot mL^{-1}$ penicillin) were purchased from Solarbio (Beijing, China). NHDF (normal human dermal fibroblast) cell was got from Suzhou Medical Apparatus Research Institute of Southeast University, China.

Characterization

The porous lyophilized ACP/PAA/CS hydrogel was observed by scanning electron microscopy (SEM) (S-4800, Hitachi, Japan) at a voltage of 10 kV. X-ray diffraction (XRD) data were recorded on Rigaku diffractometer (Japan). FT-IR was performed on a Nicolet 6700 spectrometer with a diamond ATR crystal as the window material. Thermal gravimetric analysis (TG) was carried out on a Netzsch STA449F3 analyzer (Germany) by heating from 0 to 1000 ºC with the heating rate of 10 K/min under air flow. UV spectra were measured on the Jena Specord 50 Plus (Germany).

Rheological properties of the hydrogel were determined using a rotating rheometer (MCR302, Anton Paar) with a frequency sweep mode of 0.1~10 Hzat 25 ºC in the oscillation mode with a fixed oscillatory strain of 1%.The modulus of the hydrogel was also measured at a time sweep mode by recording storage modulus (G′) and loss modulus (G″) with increasing temperature. In this mode, the frequency and stress were constant at 1 Hz and 100 Pa, respectively. And the curves of share rate-shear stress and share rate-viscosity were also assessed.

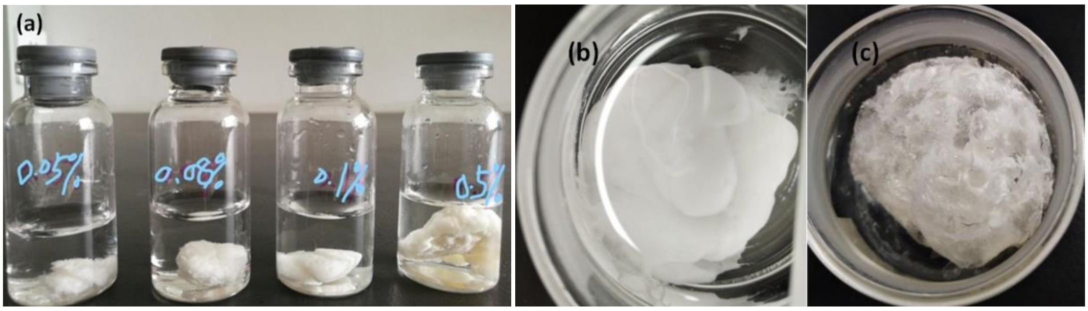


Figure S1. a) The photos of complex with different amount chitosan; b) ACP/PAA/CS hydrogel; c) the frozen-dried hydrogel.

Figure S2. The ACP/PAA/CS hydrogel manipulated into various shapes.

Figure S3. The self-healing performance of ACP/PAA/CS hydrogel.

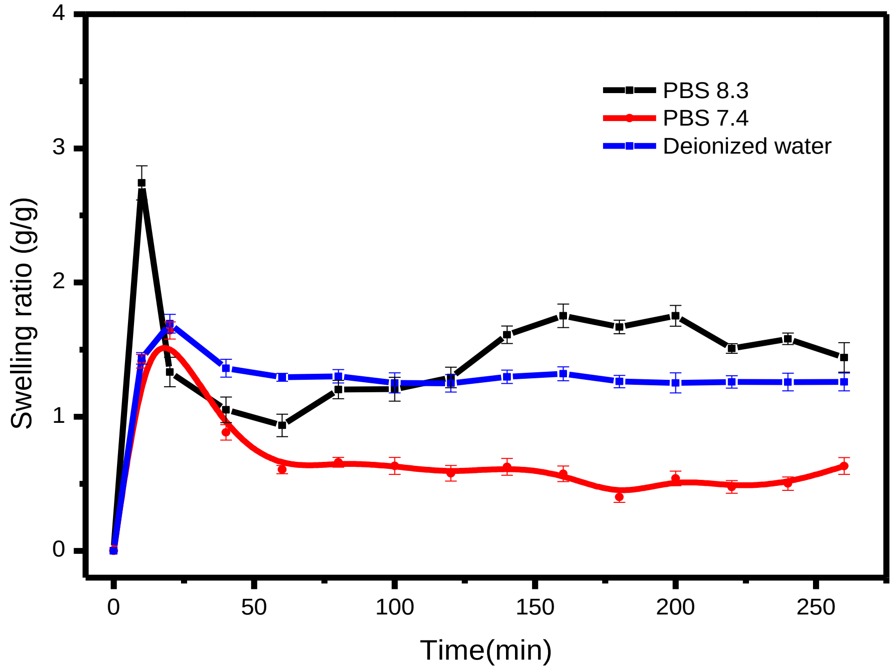


Figure S4. The swelling kinetic of the dried hydrogel sample in deionized water and PBS (pH=7.4 and 8.3) at 25°C.

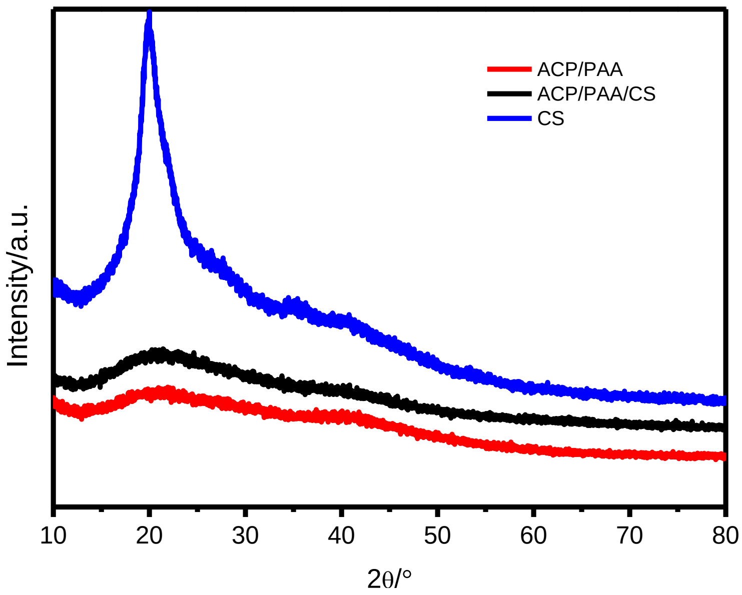


Figure S5. XRD profile of the dried ACP/PAA/CS hydrogel.

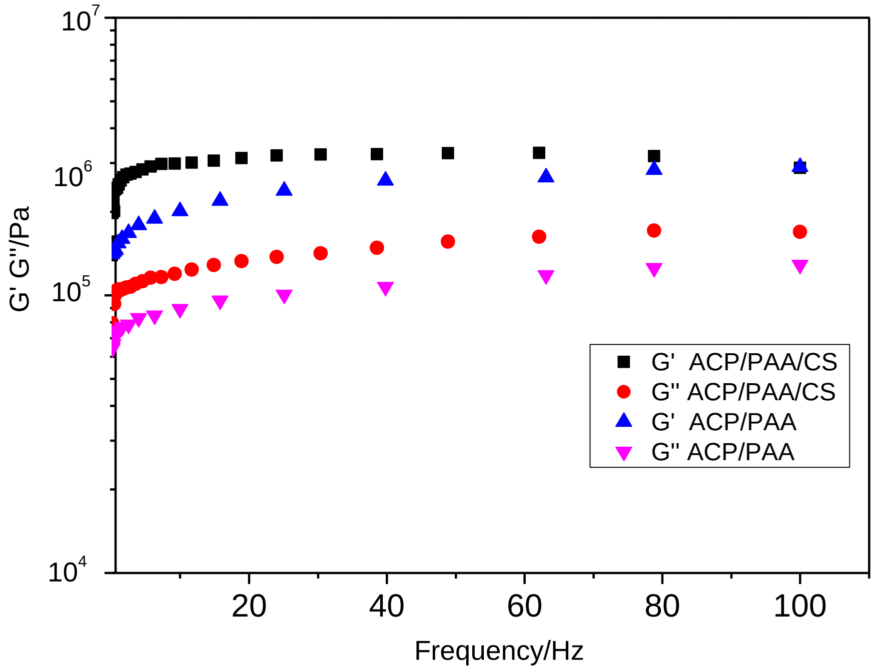


Figure S6 Frequency dependence of storage (G') and loss (G'') moduli of ACP/PAA/CS hydrogel compared with ACP/PAA/hydrogel.

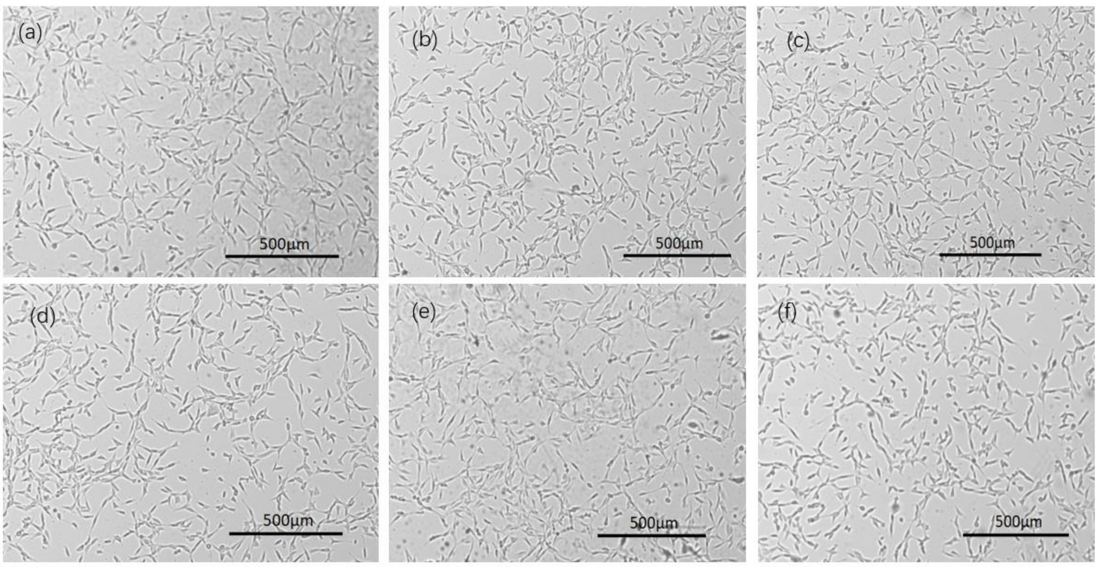
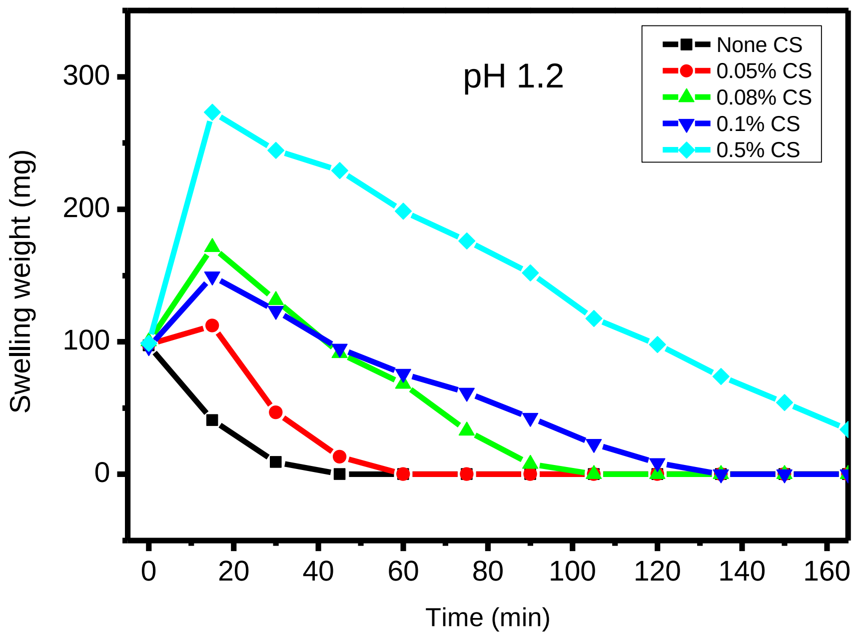
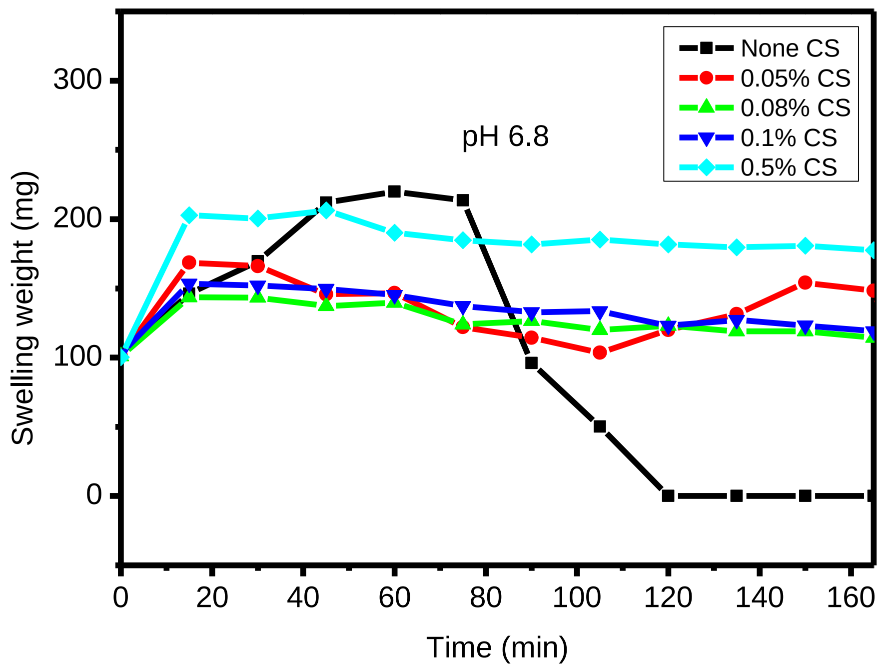


Figure S7. Microscopy images of NHDF cell after 24 h incubation with 0 wt% (a), 20 wt% (b), 40 wt% (c), 60 wt% (d), 80 wt% (e) and 100 wt% (f) of hydrogel extracts.

(a)


pH 1.2
None CS
0.05% CS
0.08% CS
0.1% CS
0.5% CS
Swelling weight (mg)
Time (min)
300
200
100
0
0
20
40
60
80
100
120
140
160

(b)


pH 6.8
None CS
0.05% CS
0.08% CS
0.1% CS
0.5% CS
Swelling weight (mg)
Time (min)
300
200
100
0
0
20
40
60
80
100
120
140
160

(c)

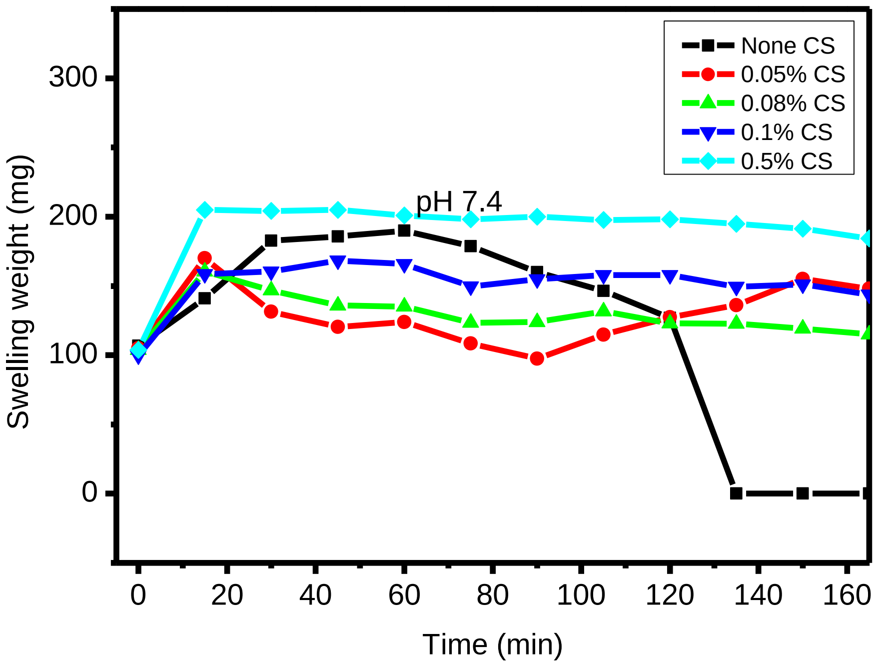


Figure S8. The swelling behavior of the hydrogels with different amount of CS at pH 1.2 (a), pH 6.8 (b) and pH 7.4 (c).

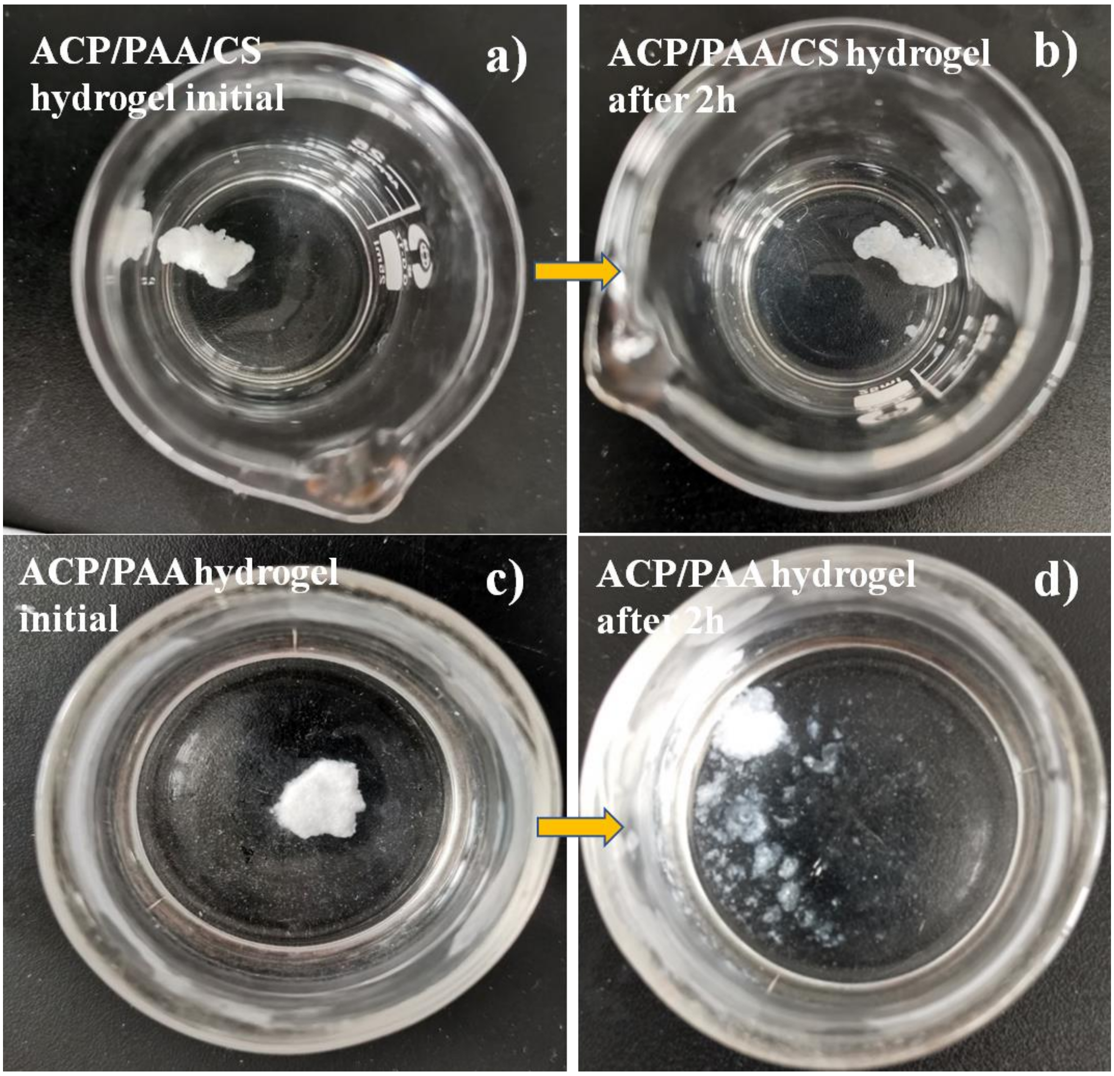


Figure S9 Photos of different hydrogels immersed in solution with pH=7.4. a) The original ACP/PAA/CS hydrogel; b) ACP/PAA/CS hydrogel after 2 h; c) The original ACP/PAA hydrogel; b) ACP/PAA hydrogel after 2 h;

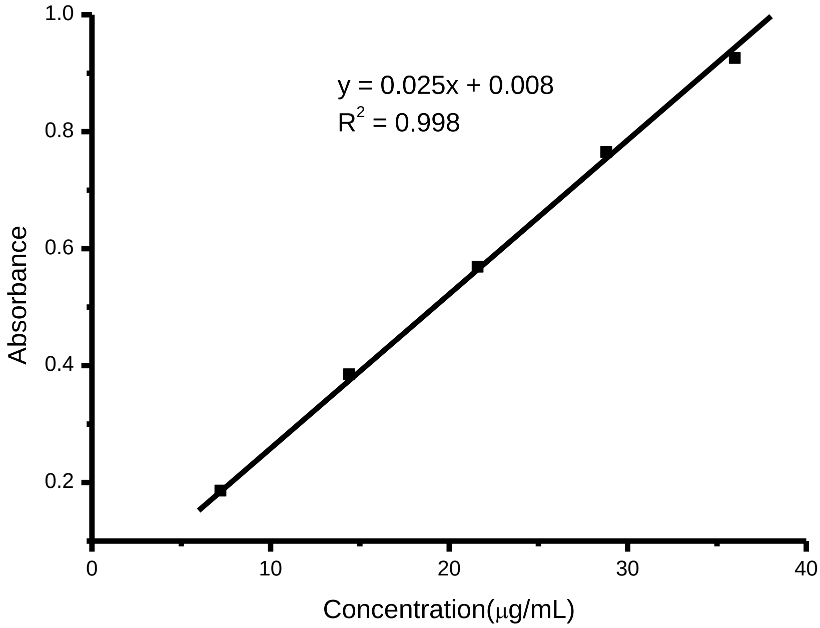


Figure S10. The standard curve of kanamycin sulfate.

Figure S11. The dielectric layer of capacitive-pressure sensor.