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A skin-matchable, recyclable and biofriendly strain sensor enabled by hydrolyzed keratin-assisted hydrogel

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Table S1 Recipes of all hydrogels

Hydrogel	PVA (g)	NaCl (g)	HK (g)	H_2O (mL)
PVA	5.3	0	0	30
$PVA/NaCl_{1.71}$	5.3	3	0	30
$HK_{3.2}/PVA/NaCl_{1.71}$	5.3	3	1	30
$HK_{6.3}/PVA/NaCl_{1.71}$	5.3	3	2	30
$HK_{9.1}/PVA/NaCl_{1.71}$	5.3	3	3	30
$HK_{11.8}/PVA/NaCl_{1.71}$	5.3	3	4	30
$HK_{11.8}/PVA/NaCl_{1.14}$	5.3	2	4	30
$HK_{11.8}/PVA/NaCl_{0.57}$	5.3	1	4	30
$HK_{11.8}/PVA/NaCl_{0.14}$	5.3	0.245	4	30

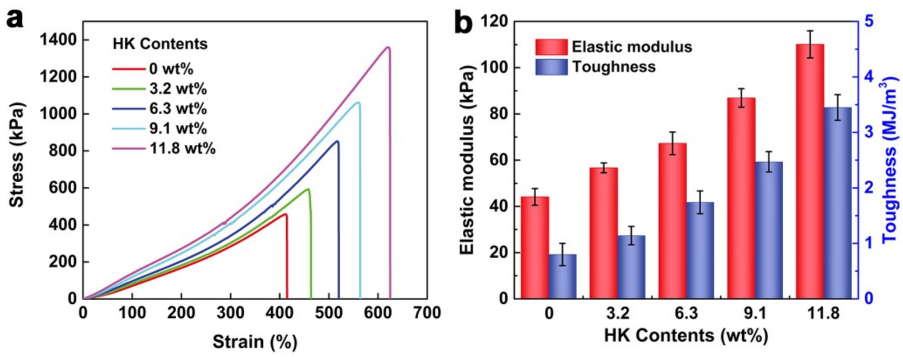

Figure S1 The effect of hydrolyzed keratin content on the tensile strength of HK/PVA/$NaCl_{1.71}$ hydrogel.

When the concentration of NaCl was fixed at 1.71 M, the tensile strength, elastic modulus and toughness were gradually increased with the HK content ranging from 0 to 11.8 wt%. And the maximum stress, elastic modulus and toughness were 1360 kPa, 110 kPa and 3.45 MJ/m^3 as the concentration of HK reached 11.8 wt%. The main reason was that abundant hydrogen bonds were generated between PVA chains and HK.

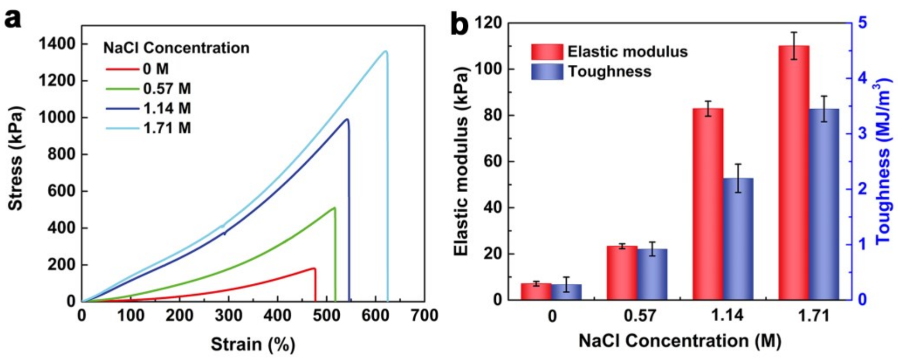

Figure S2 The effect of NaCl concentration on the tensile strength of $HK_{11.8}$/PVA/NaCl hydrogel.

The tensile stress, elastic modulus and toughness were increased with increasing the NaCl concentration at the HK content of 11.8 wt%, ascribing to the formation of denser physically cross-linked network induced by stronger salting-out effect.

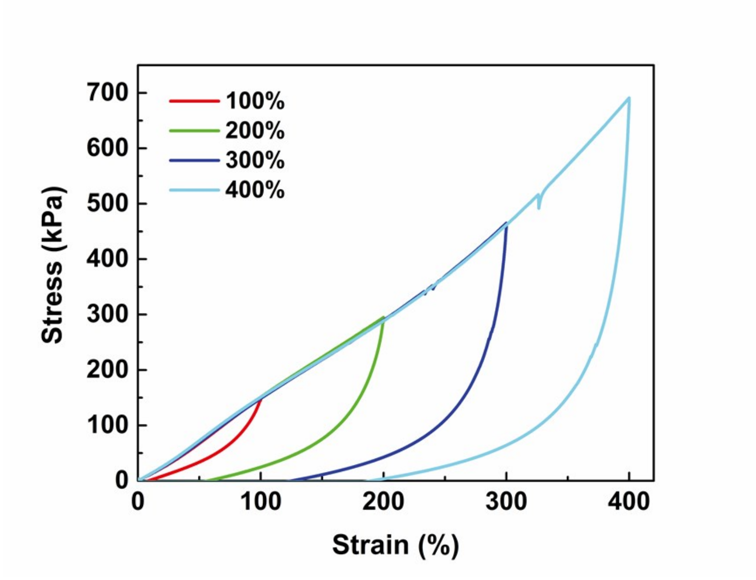

Figure S3 The loading-unloading curves of $HK_{11.8}$/PVA/$NaCl_{1.71}$ at the strain of 100%, 200%, 300% and 400%.

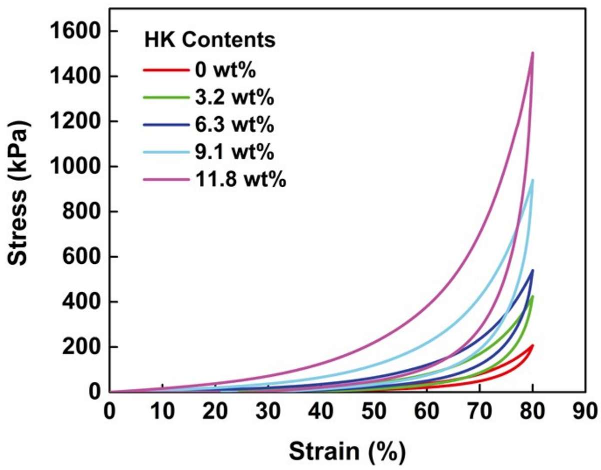

Figure S4 The influence of hydrolyzed keratin content on the compressive strength of HK/PVA/$NaCl_{1.71}$ hydrogel.

The compressive strength of HK/PVA/NaCl hydrogel at the NaCl concentration of 1.71 M improved with the increase of HK content, which was due to the formation of abundant hydrogen bonds.

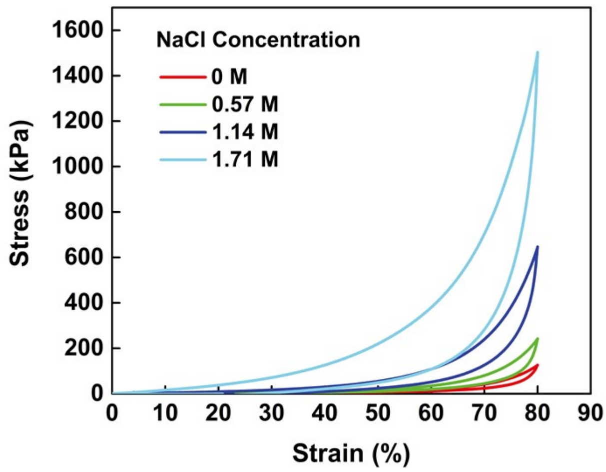

Figure S5 The influence of NaCl concentration on the compressive strength of $HK_{11.8}$/PVA/NaCl hydrogel.

With the increase of NaCl concentration, the compressive strength of $HK_{11.8}$/PVA/NaCl hydrogel was increased, attributing to the enhanced salt-inducing effect.

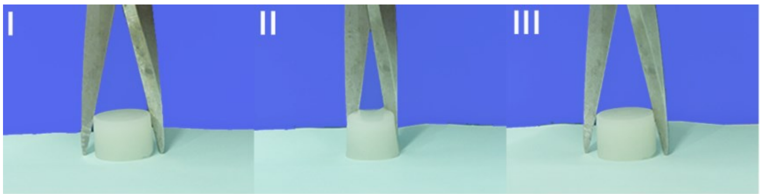

Figure S6 The hydrogel could withstand the cutting of scissors.

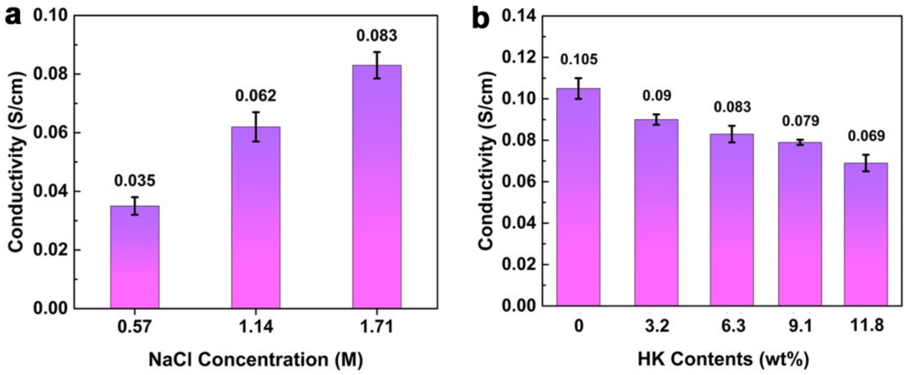

Figure S7 (a) The conductivity of $HK_{6.3}$/PVA/NaCl hydrogels as a function of NaCl concentration; (b) The conductivity of HK/PVA/$NaCl_{1.71}$ hydrogels as a function of HK contents.

The PVA/NaCl/HK hydrogels exhibited excellent conductivity due to the existence of free ions from NaCl. From Figure S7a, the conductivity of hydrogel trended up from 0.035 to 0.083 S/cm when increasing the concentration of NaCl. However, as shown in Figure S7b, the hydrogel displayed a downward trend as the increase of hydrolyzed keratin, attributing to the restricted ion migration from high cross-linking density of hydrogel.

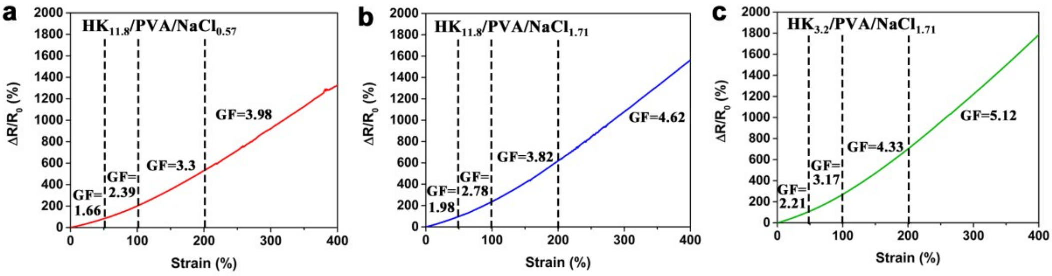

Figure S8 The effect of NaCl concentration and hydrolyzed keratin content on the sensitivity of HK/PVA/NaCl hydrogel-based sensor.

As shown in Figure S8, the gauge factor of the hydrogel sensor increased with the increase of NaCl at the HK content of 11.8 wt%, and decreased with the increase of HK at the NaCl concentration of 1.71 M. However, the degree of change in gauge factor was not obvious.

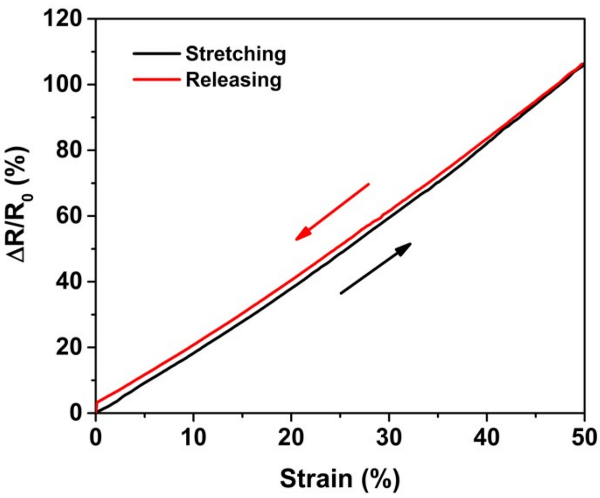

Figure S9 Hysteresis of the hydrogel-based sensor at the strain of 50% after a stretching-releasing process.

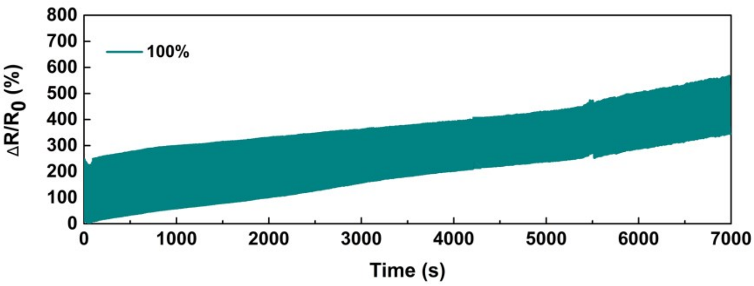

Figure S10 The hydrogel sensor could endure 1000 continuous stretchable cycles at the strain of 100%.

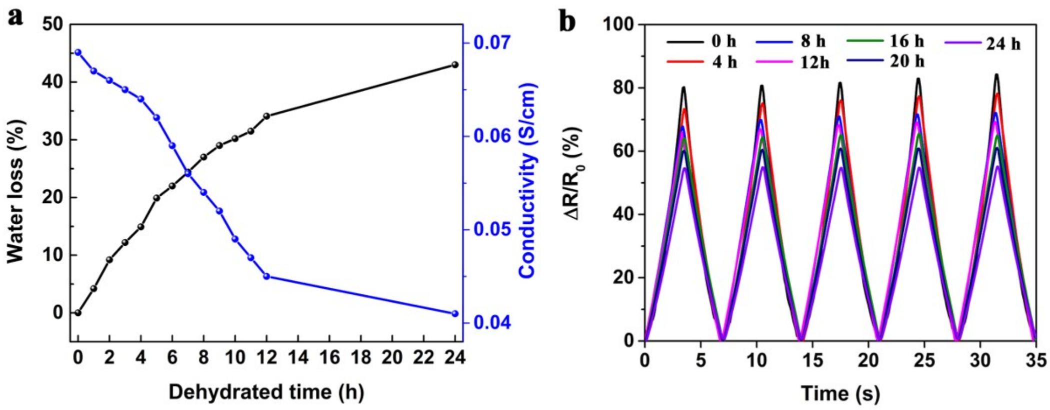

Figure S11 (a) The conductivity of hydrogel decreased gradually with the extension of dehydration time; (b) The sensing performance of hydrogel sensor at the strain of 40% with the extension of dehydration time.

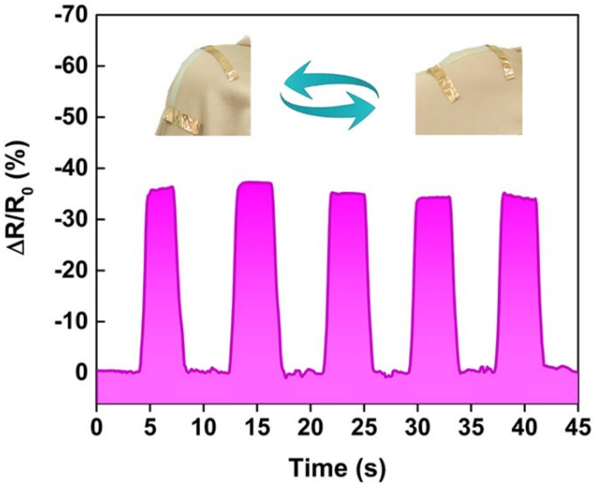

Figure S12 Relative resistance changes of hydrogel sensors for lifting shoulder.

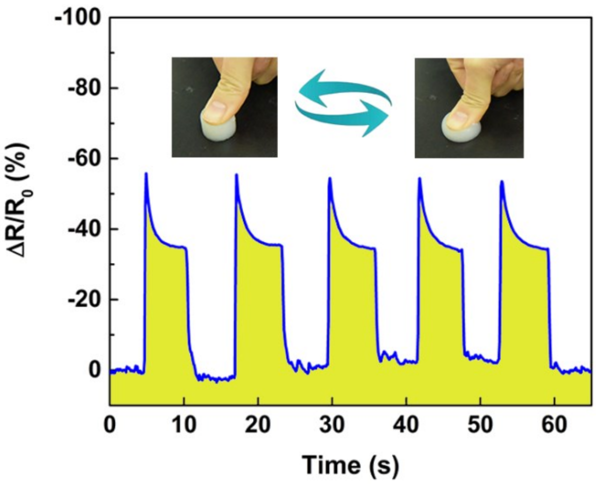

Figure S13 Relative resistance changes of hydrogel sensors for pressing by finger.

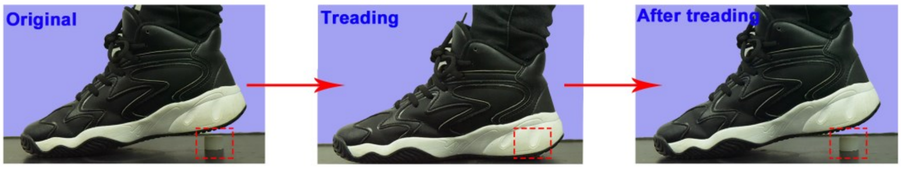

Figure S14 Exhibition of hydrogel treaded by the tester.