Electronic Supplementary Material (ESI) for Soft Matter.

Supporting Information

Multiple Physical Crosslinked Highly Adhesive and Conductive Hydrogel for Human Motion and Electrophysiological Signal Monitoring

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Experimental section

Material

Polyvinyl alcohol (PVA) is supplied by Sinopharm Chemical Reagent Co., Ltd. Acrylamide (AM), acrylic acid (AA), N, N'-Methylenebis (acrylamide) (MBAA) and $CaCl_2$ were purchased from Aladdin Reagent (Shanghai) Co., Ltd. Fumed SiO_2 and Lithium Phenyl(2,4,6-trimethylbenzo) Phosphinate (LAP) is supplied by Adamas.

Preparation of ICHgel

0.2gPVA was added to 2ml water, stirred magnetically at 95℃ for 30min, then 1g AM was added slowly, 0.1g AA and 2.5mg MBAA were added to the solution after full dissolution, and finally 120mg F-SiO_2 was added to the mixed solution and stirred continuously for 30min to form a uniform solution. Then 10mg LAP was added to the solution, and $CaCl_2$ with a mass fraction of 20wt% was slowly added to form a precursor solution after stirring. Then the mixed solution is poured into the mold prepared in advance. Finally, the solution is placed under ultraviolet light (λ=405 nm wavelength, with an intensity of 8 W) for 10min to form ICHgel

Characterization and measurements

The infrared spectra were obtained by a Fourier-transform infrared (FT-IR) spectrometer (Vertex 70, Bruker), collecting at wavenumbers ranging from 4000 to 400 cm^{-1}at a resolution of 4 cm^{-1}. The crystalline properties of the ICHgel were characterized by X-ray diffraction (DY5261/Xpert3, CEM, America) at room temperature and the 2 theta was ranging from 5° to 80°. The conductivity of ions of ICHgel was studied by electrochemical impedance spectroscopy (EIS). The specimens of different components with dimensions of 10 mm × 10 mm × 1 mm were clamped between two nickel mesh electrodes, and the tests were conducted on an electrochemical workstation (CHI760e). The ionic conductivity σ was calculated using the following equation: $\sigma=L/RA$. In this formula, L represents the thickness of the sample, R is the bulk resistance obtained from the EIS plot, and A is the area of the sample. The sample is cut into a dumbbell shape and then used to test the mechanical properties. The mechanical performances test was performed on a universal material tester (AG-X plus, SHIMADZU, Japan) with a 100N load cell. To investigate ICHgel's (specimen measuring 40mm× 10mm× 2 mm) response to dynamic signals, we used a digital source meter (Keithley 2450, Tektronix Co., USA). The sensitivity factor (GF) of ICHgel can be calculated by the following formula: $GF=\Delta R/\varepsilon R_0$. In this formula, ΔR represents the relative change in resistance, R_0 is the initial resistance value, and ϵ was the strain.

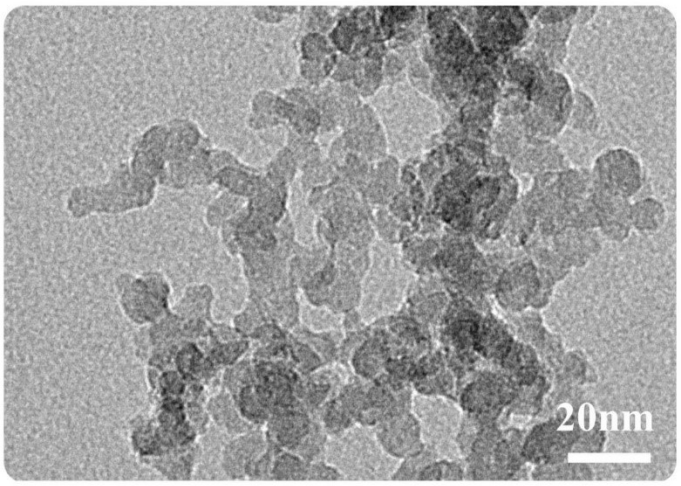

Figure.S1 TEM image of F-SiO2 nano-powder.

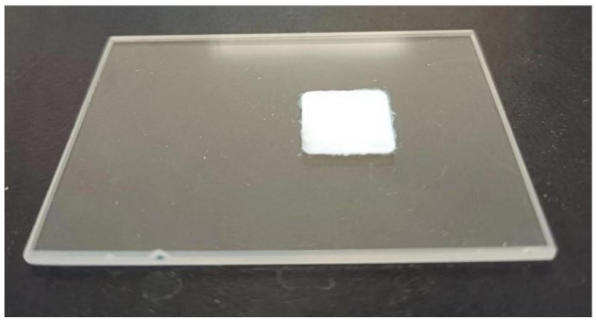

Figure.S2 Optical image of F-SiO2 nano-powder.

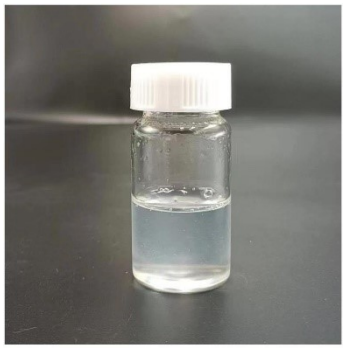

Figure.S3 Optical image of ICHgel precursor.

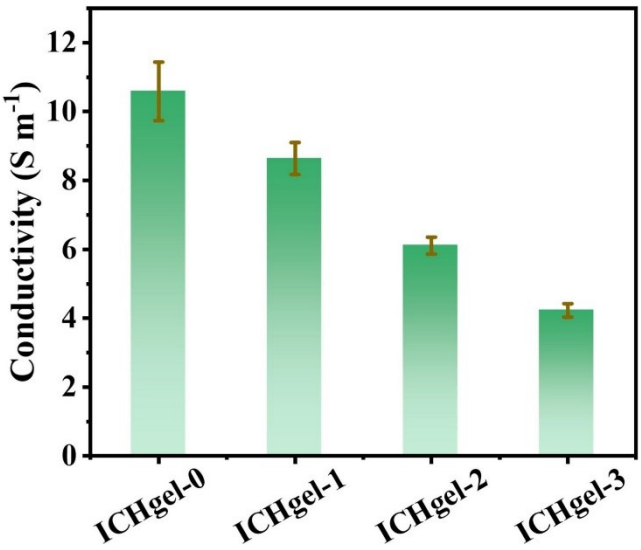

Figure.S4 Conductivity of ICHgel with different F-SiO_2 content.

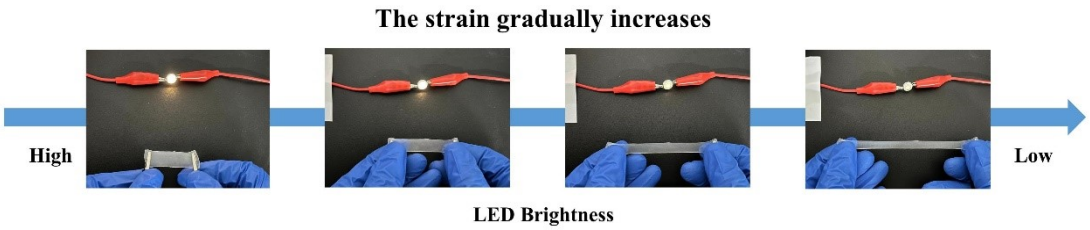

Figure.S5 ICHgel series LED, and the brightness decreases with the increase of tensile strain

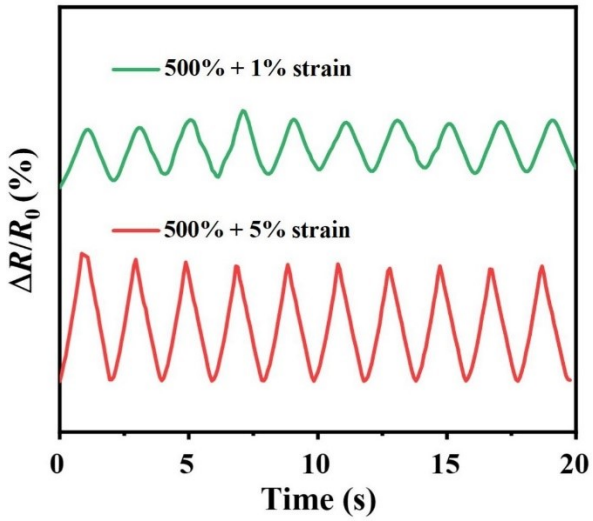

Figure.S6 $\Delta R/R_0$ values corresponding to 1% and 5% strains stretched at 500% pre-strain

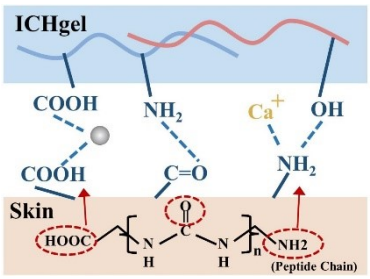

Figure.S7 Mechanism schematic illustrating the outstanding adhesion between ICHgel and skin.