Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Wirelessly Multi Stimuli-Responsiveness Ultra-Sensitive and Self-healable Wearable Strain Sensor Based on silver quantum dotes of 3D Organo-Hydrogel Nanocomposite

Hend A. Alkabes, Samar Elksass, Khaled El-Kelany, and Maged El-Kemary*

Institute of Nanoscience & Nanotechnology, Kafrelsheikh University, Kafr Elsheikh, 33516, Egypt

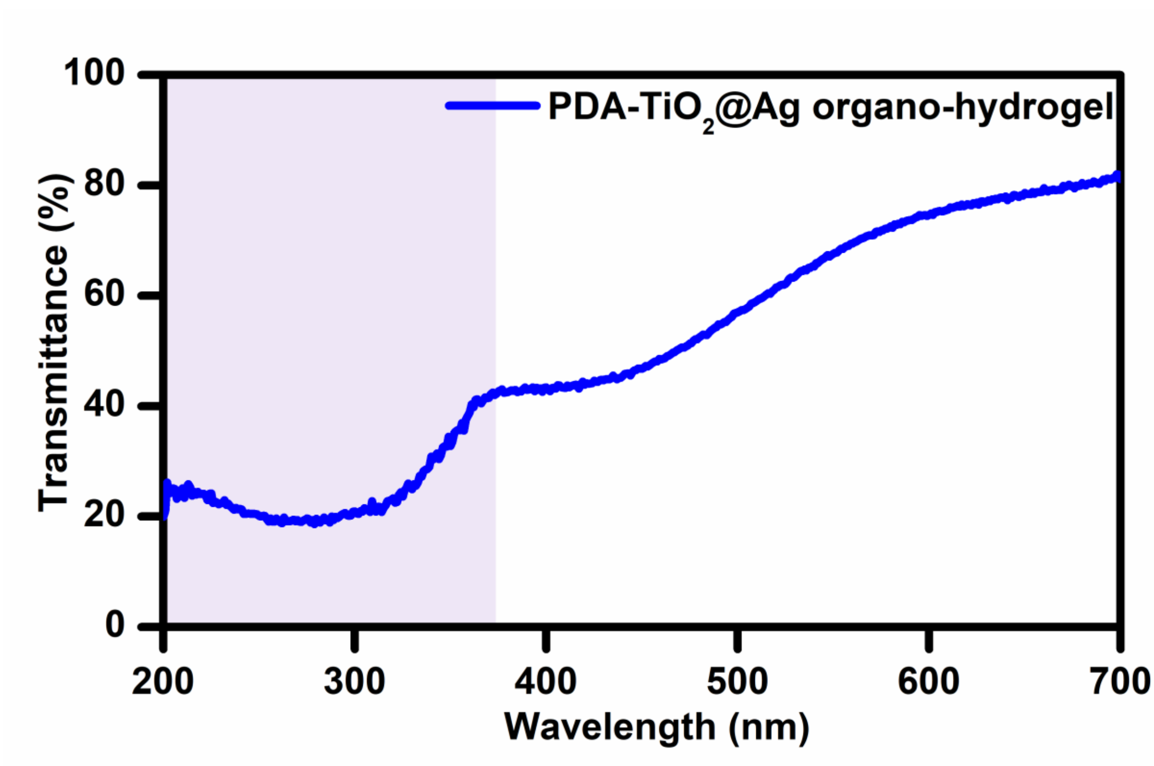

Figure S1. The transmittance of PDA-TiO_2@Ag organo-hydrogel in the range of UV-visible light.

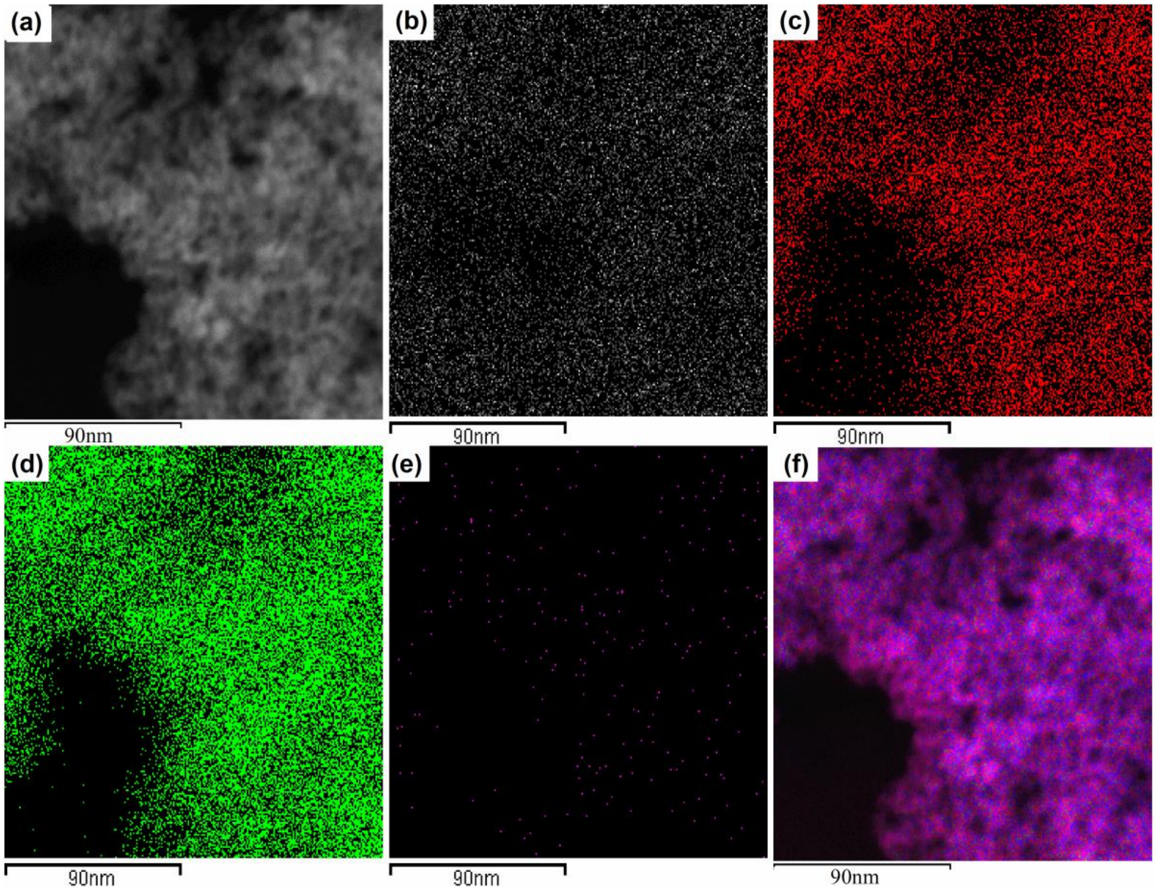

Figure S2. High-angle annular dark-field imaging (HAADF) and elemental mapping of PDA-TiO_2@Ag (a) HAADF image, (b) Carbon. (c) Oxygen. (d) Ti. (e) AgQDs. (f) image of mixed element from mapping of PDA-TiO_2@Ag.

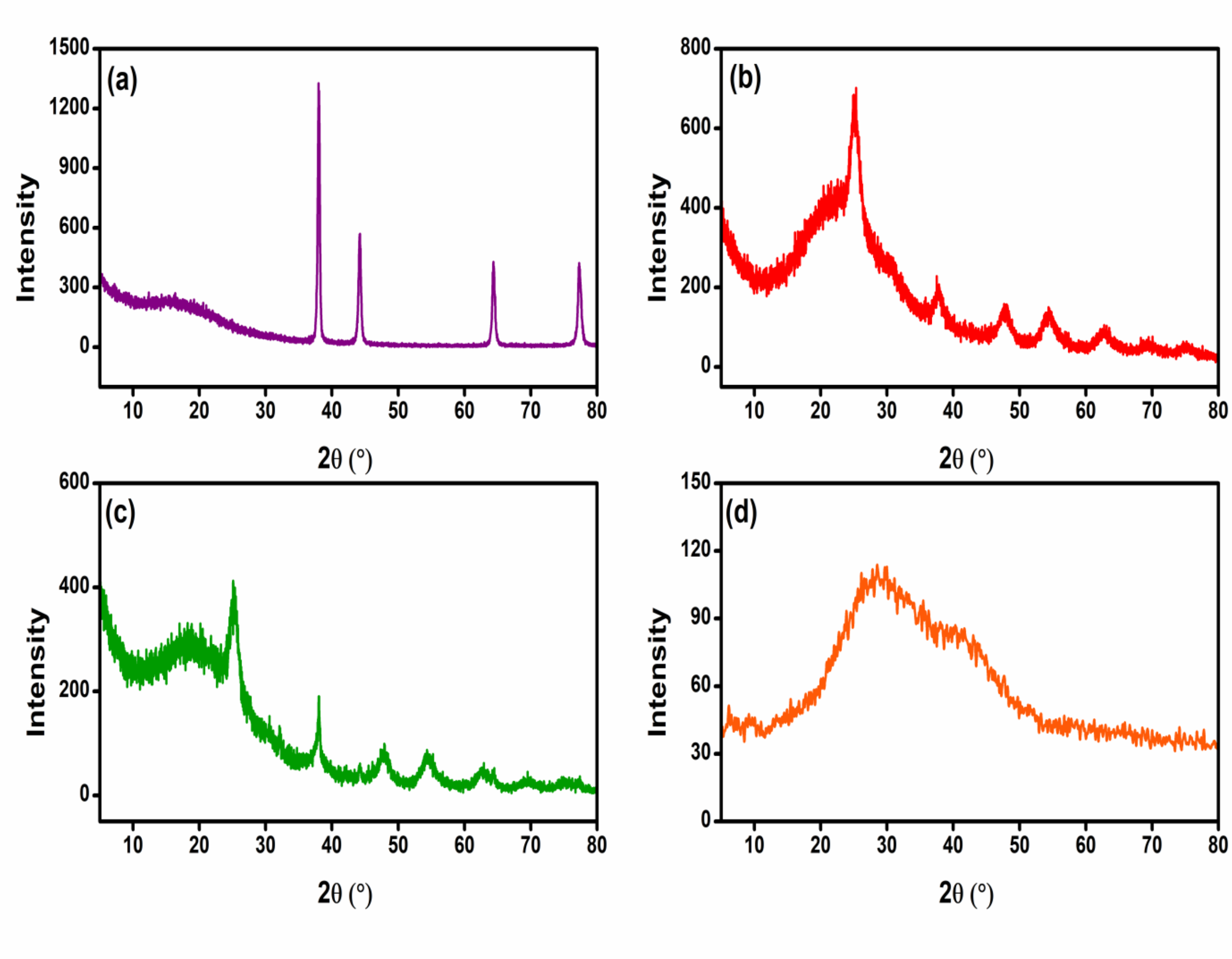

Figure S3. XRD patterns of (a) AgNWs. (b) PDA-TiO_2. (c) PDA-TiO_2@Ag. (d) PDA-TiO_2@Ag organo-hydrogel.

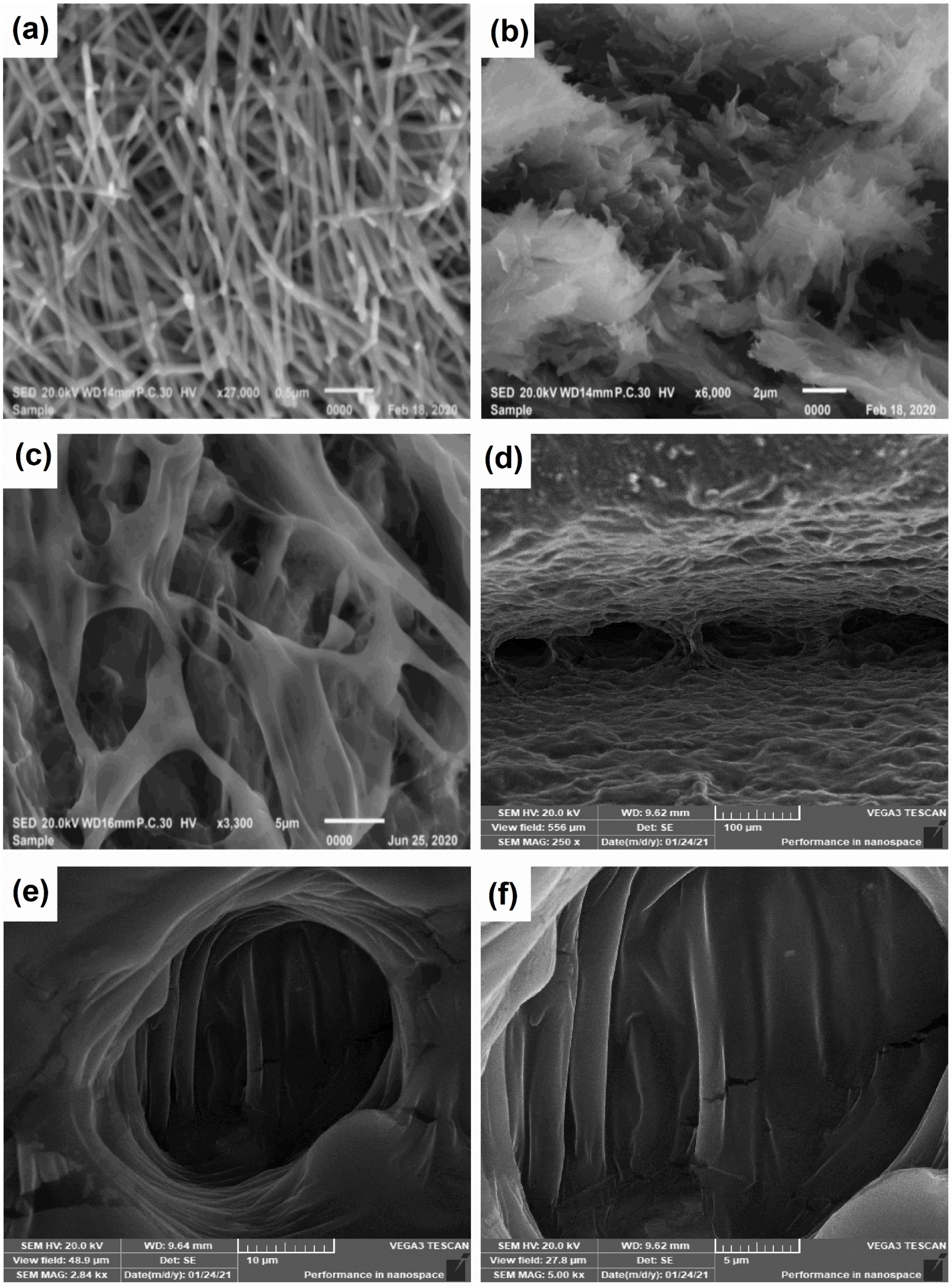

Figure S4. SEM images of (a) AgNWs. (b) NCFS gel. (c) PDA-TiO_2 organo-hydrogel. (d) Top view of PDA-TiO_2@Ag organo-hydrogel. (e,f) Side view of PDA-TiO_2@Ag organo-hydrogel with different magnification.

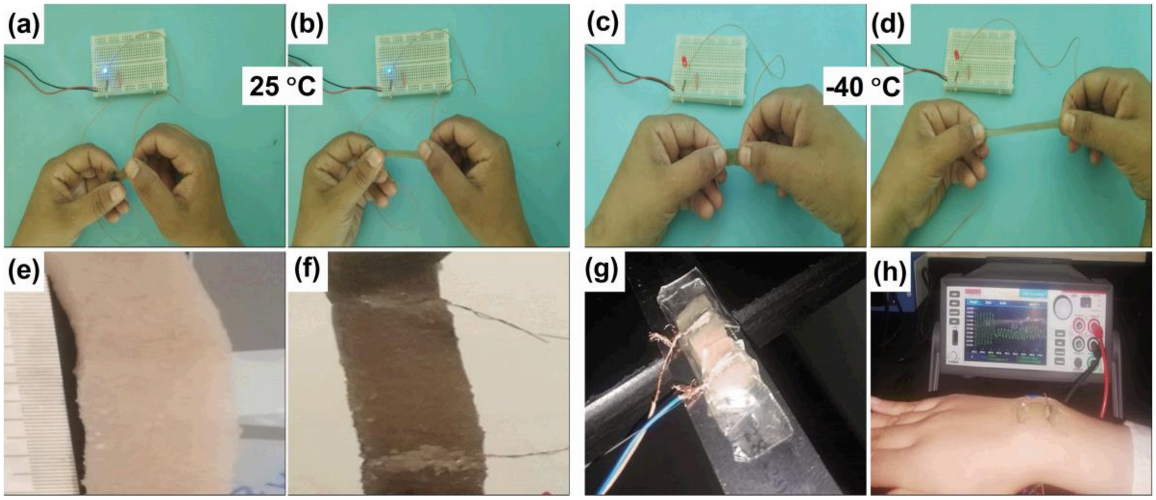

Figure S5. The mechanical and electrical properties of PDA-TiO_2@Ag organo-hydrogel *via* stretching and connecting with LED lamp circuits at two different temperatures (a,b) At 25 °C. (c,d) At -40 °C. (e,f) Slightly color change of PDA-TiO_2@Ag organo-hydrogel before and after stored in air for several months, respectively. (g,h) PDA-TiO_2@Ag organo-hydrogel after sandwiched between two layers of VHB tape for several months with original color.

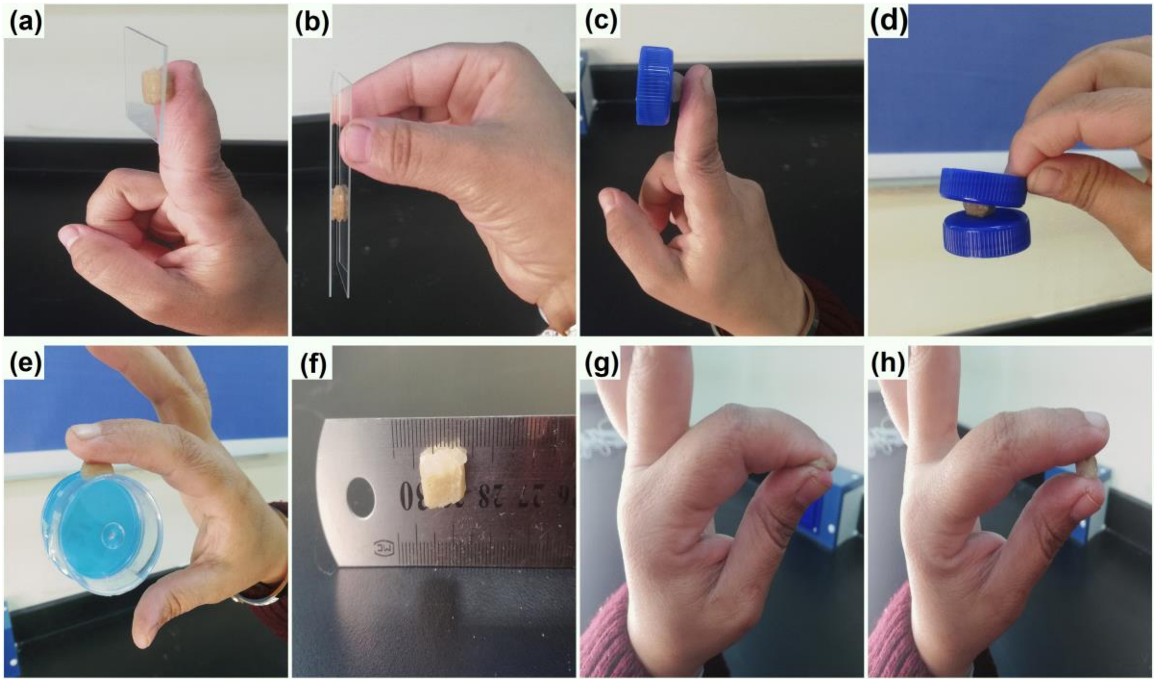

Figure S6. (a-h) The directly adhesion of PDA-TiO_2@Ag organo-hydrogel to different materials as glass, plastic, metal, and human skin, respectively.

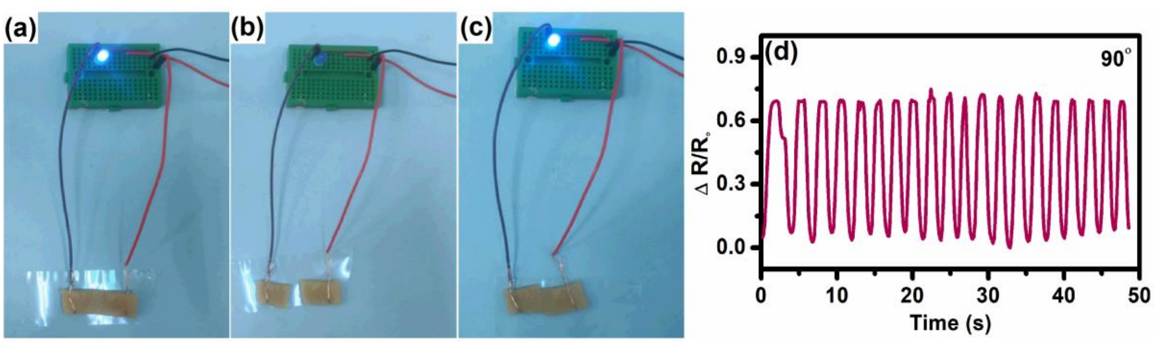

Figure S7. The electrical properties of PDA-TiO_2@Ag organo-hydrogel after self-healing (a-c) The LED circuit with PDA-TiO_2@Ag organo-hydrogel before and after self-healing, respectively. (d) The relative resistance change of PDA-TiO_2@Ag organo-hydrogel with wrist motion at binding angle 90° after self-healing.

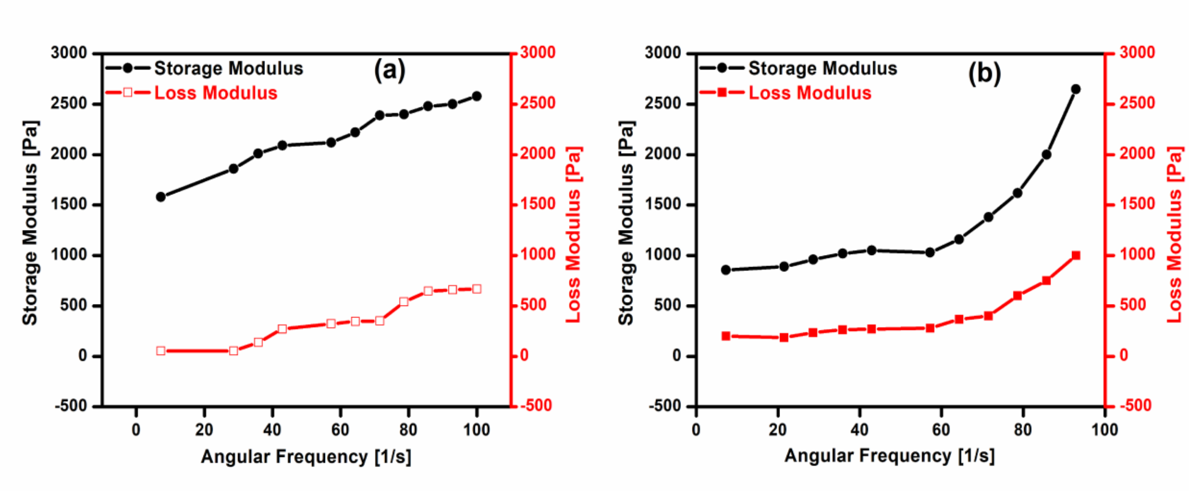

Figure S8. (a,b) The modulus of elasticity and the gelation of PDA-TiO_2 organo-hydrogel and PDA-TiO_2@Ag organo-hydrogel at 37 ˚C via frequency-dependent oscillatory rheology, respectively, the modulus of elasticity and loss modulus increased with frequency.

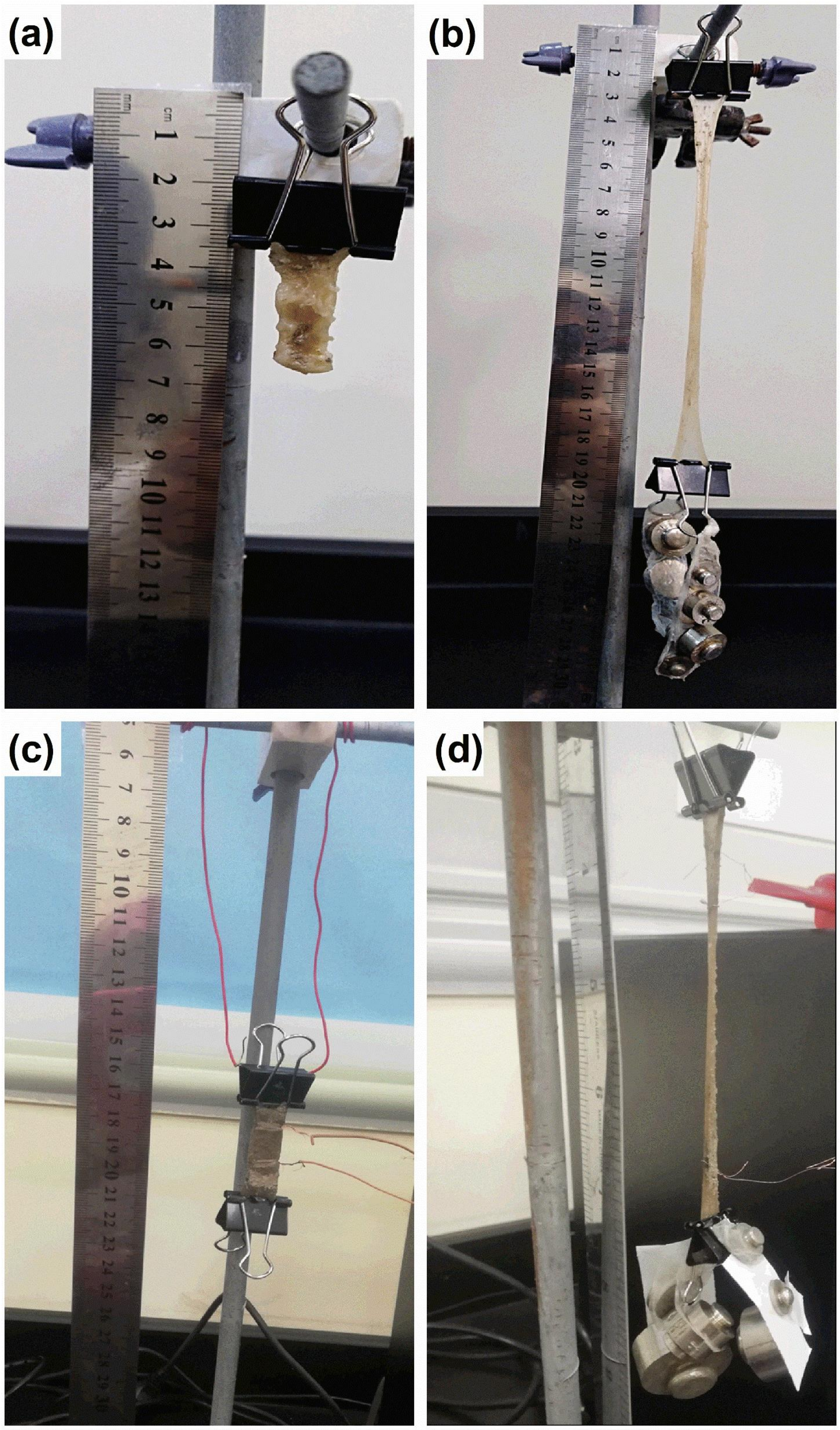

Figure S9. Images for increasing the elongation with increasing the weight (a,b) PDA-TiO_2 organo-hydrogel. (c,d) PDA-TiO_2@Ag organo-hydrogel.

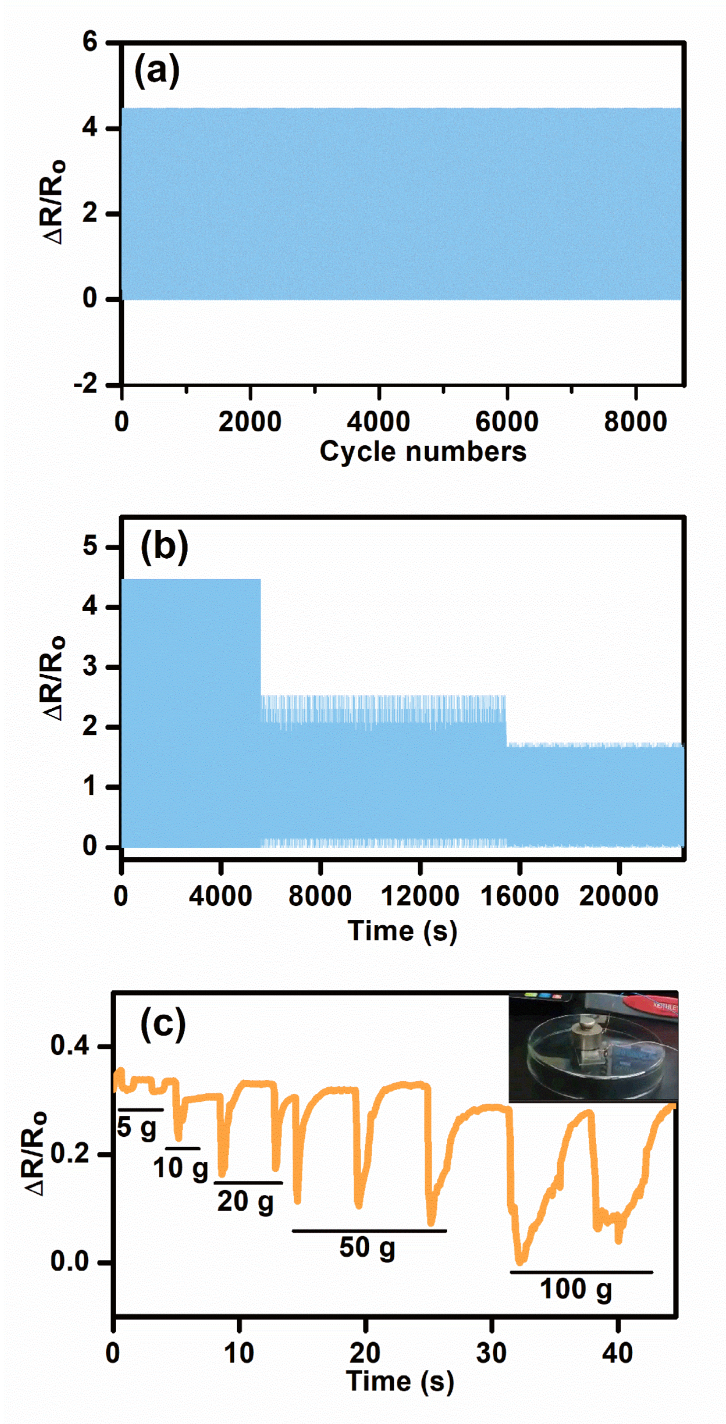

Figure S10. (a) The relative resistance change of PDA-TiO_2@Ag organo-hydrogel at strain 400% with numbers of cycles. (b) The relative resistance change of PDA-TiO_2@Ag organo-hydrogel with time under different motions. (c) The relative resistance change of PDA-TiO_2@Ag organo-hydrogel under different compression (5-100 g).

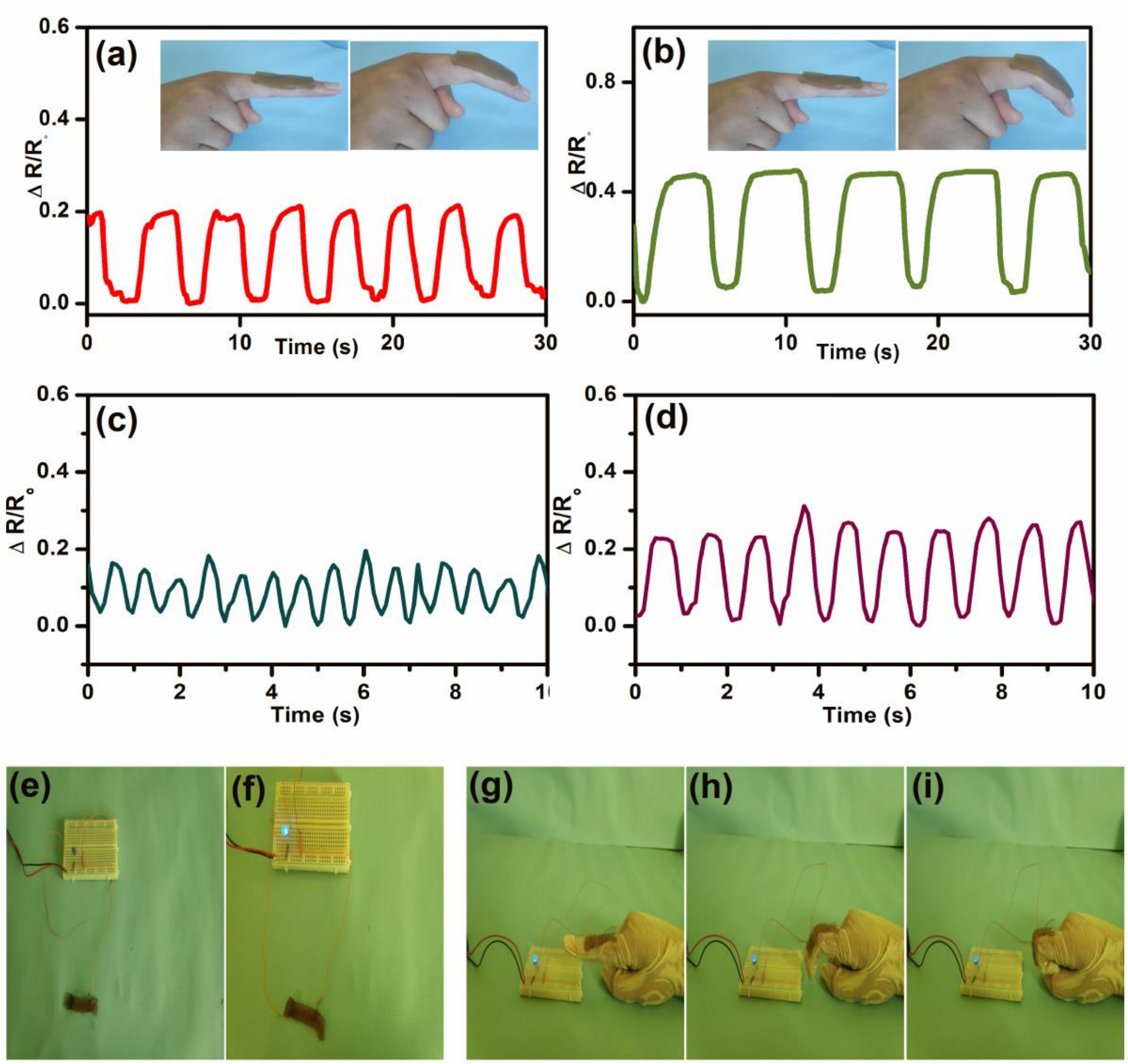

Figure S11. (a,b) The relative resistance change of the PDA-TiO_2@Ag organo-hydrogel with different finger bending angles which fixed onto finger. (c,d) The relative resistance change of the PDA-TiO_2 organo-hydrogel with different finger bending angles which fixed onto finger. (e,f) The images of PDA-TiO_2@Ag organo-hydrogel attached to a circuit with a LED lamp, which light up once the circuit is connected. (g-i) Show the images of PDA-TiO_2@Ag organo-hydrogel strain sensor fixed onto finger connected with LED lamp; the LED lamp brightness changes according to finger binding angles.

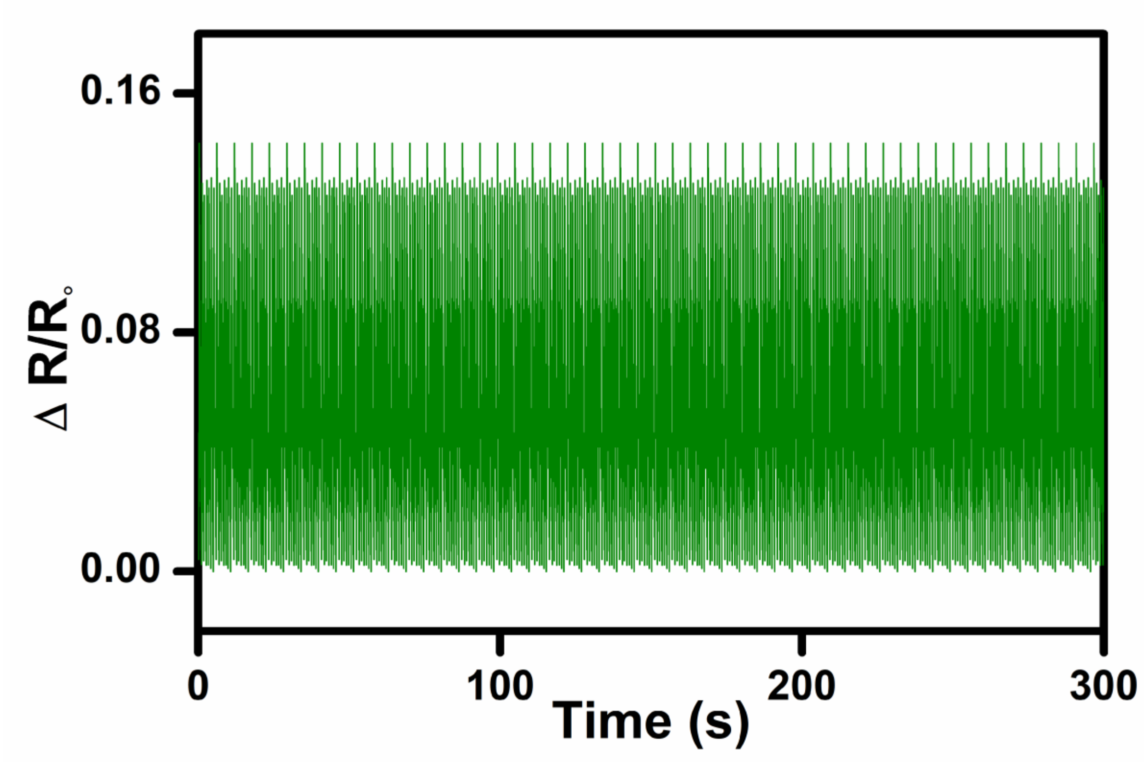

Figure S12. The relative resistance change of PDA-TiO_2@Ag organo-hydrogel based on heart beats with more time.

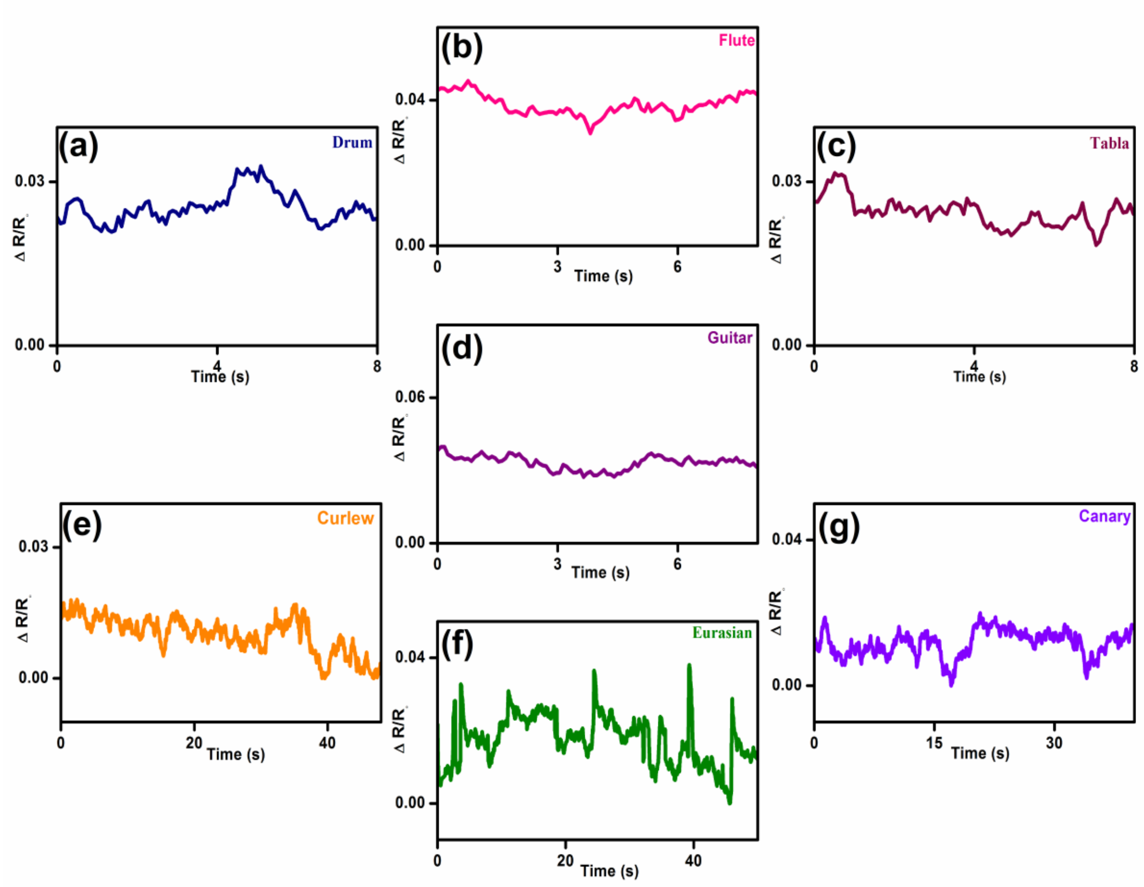

Figure S13. The relative resistance change of PDA-TiO_2@Ag organo-hydrogel based on Bluetooth speaker for different kinds of instruments (a) Drum. (b) Flute. (c) Tabla. (d) Guitar. The relative resistance change of PDA-TiO_2@Ag organo-hydrogel based on Bluetooth speaker for different kinds of bird's (e) Curlews. (f) Eurasian hoopoe. (g) Canary sounds.

Movie S1 self-healing

Movie S2 LED a circuit with sensor

Movie S3 detecting the heart beats

Movie S4 recognition of vocal cords vibrations

Movie S5 prototype