Supporting Information for

Silver nanowires nets knitted anisotropic aerogel as an ultralight and sensitive physiological activity monitor

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This file includes Figure S1 – S5, Movie S1– S6.

TABLE OF CONTENTS

Chemicals and reagents: Celery were purchased from local market. Polyvinyl Pyrrolidone (PVP) was purchased from Fengchuan Chemical Reagent Technologies Co, Ltd. (Tianjin, China). Silver nitrate ($AgNO_3$, 99%) and silver chloride (AgCl, 99%) were purchased from HengXing Chemical Co, Ltd. (Tianjin, China). Methanol and chloroform was purchased from West Long Chemical Co, Ltd. (Shanghai, China). N, N-dimethylformamide (DMF) was purchased from Biotopped Technologies Co, Ltd. (Beijing, China).

Characterization: The feature of Ag nanowires were characterized by Transmission electron microscope (JEM-2010 type; Japan Electronics Co.) and scanning electron microscope (Zeiss/sigma 300). Near infrared ray laser (NIR, 808 nm) was supplied by Hi-Tech Optoelectronics Co. Ltd., China and the distribution of temperature was recorded by infrared thermal imager (FLUKE, VT02).

Experimental Section

Preparation of the celery aerogel (CA): Celery were cut into appropriate shape and volume (around 2 cm^3) and placed into polytetrafluoroethylene stainless steel autoclaves for carbonization, respectively (180 °C for 12 hours). Next, the celery hydrogels were immersed in hot alcohol (around 60 °C) for 48 hours to remove soluble impurities. Then, the celery hydrogels were immersed in hot deionized water to remove organic solvent. Finally, the remaining celery aerogel (CA) was obtained by freeze drying (FD-A10N-50, Labconco).

Preparation of silver nanowires impregnated aerogels: The celery aerogel (CA) was cut into cuboid (2 cm× 1 cm× 1cm) pieces. 0.34g of polyvinylpyrrolidone (PVP) was added into 20ml ethylene glycol and stirred with magnetically in an oil bath in 170℃. Then, 25mg of AgCl was added for the nucleation of silver seeds. After 5min, 110mg of $AgNO_3$ was added was added into the above mixture drop by drop extremely slow and reacted for 40min. The nanowires were washed with methanol and precipitated by centrifugation at 6000 rpm for 30min and repeated three times.

Preparation of silver-impregnated aerogels: The celery aerogel (CA) was cut into square (2 cm× 1 cm× 1cm) pieces. 1.86g silver nitrate was added into 15ml deionized water. Then, the CA and silver nitrate mixture was stirred with magnetically in an ice bath. 0.83g of sodium borohydride was dissolved into 10ml deionized water. The sodium borohydride solution was added into the above mixture drop by drop extremely slow. Finally, the silver nanoparticles were densely impregnated on the surface of the aerogel. The Ag/CA NPs was taken out and washed with deionized water for twice. These procedures were repeated at least three times.

The pressure-sensitive conductive tests: The pressure-sensitivity of CA/Ag was defined as $S = (\Delta I/I_{off})/\Delta P$,[1] where ΔI was the relative current change, I_{off} was the initial current of the CA/Ag, and ΔP was the difference of the loaded pressure. Figure 3i presented the sensitivity curve of lengthways CA/Ag where two obvious linear regimes as the applied pressure in the "L" direction was increased: a first regime in pressure ranging from 0–2.9 kPa had an S value of 1.09 kPa^{-1}, whereas a subsequent rapid increase regime in $P > 2.9$ kPa had a high S value of 2.76 kPa^{-1}. In comparison, an S value of 0.21

kPa^{-1} was typically calculated for crosswise CA/Ag. The biomass-derived aerogels with similar density exhibit S values lower than 0.2 kPa^{-1}.[2]

3D Printing Process of intelligent response bandage (IRB). The IRB was printed by Fused Deposition Modeling (FDM)-based 3D printer MakerBot Replicator Z18. Flexible and soft printing material, polylactic acid (PLA), was selected as the 3D filament. The temperature of the printing process was 220 °C, and the layer height was 0.1 mm with high resolution.

Effect of photothermal conversion. The effect of photothermal conversion was assessed by recording the temperature when the synthesized Ag nanowires were irradiated by NIR (2W/cm^2). The photothermal conversion efficiency was calculated from the following equation:

$$\eta = \frac{\mathrm{B}(T_{end} - T_0) + C(T_{end} - T)^2 - \mathrm{I}\xi}{\mathrm{I}(1 - \xi)(1 - 10^{-\mathrm{E}\lambda})} \qquad (1)$$

Where B = 1.295 J·K^{-1}·min^{-1}, C =0.00803 J·K^{-2}·min^{-1}, ξ= 0.0411, I is the reflection-corrected laser power, E_λ is the extinction value under the laser irradiation (808 nm), T_{end} and T_0 are the ultima temperature and initial temperature respectively.

Additional information

Ethical statement. Mice purchased from Animal Center of Nanchang University (Nanchang, China). The animals were maintained in a room temperature (20–22°C) and 40–50% humidity. Mice were provided with water and a 12 h light/dark cycle. All animal procedures were performed according to protocols approved by the Institutional Animal Care and Use Committee at Institute of Translational Medicine, Nanchang University (no. 2016NC-020-02) and animal handling followed the dictates of the National Animal Welfare Law of China. All the procedures performed involving human participants were in accordance with the ethical standards of the Affiliated Hospital of Nanchang University. The research has been approved by the Bioethics Committee of Translational Medicine of Nanchang University (permission No. YK/92/2016).

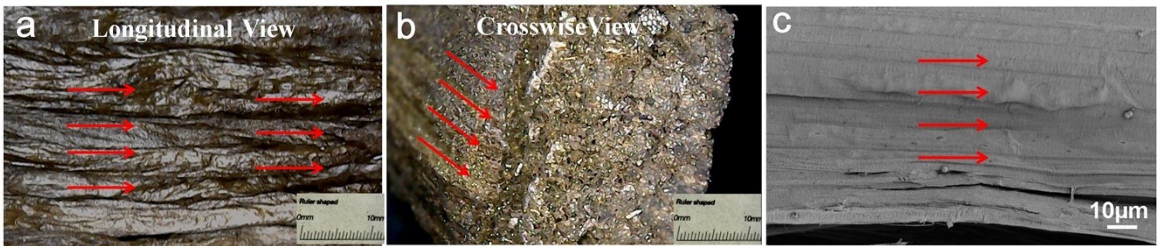

Figure S1. (a-b) The CA of 500 times magnification images through a Digital Microscope. (c) The SEM image of CA.

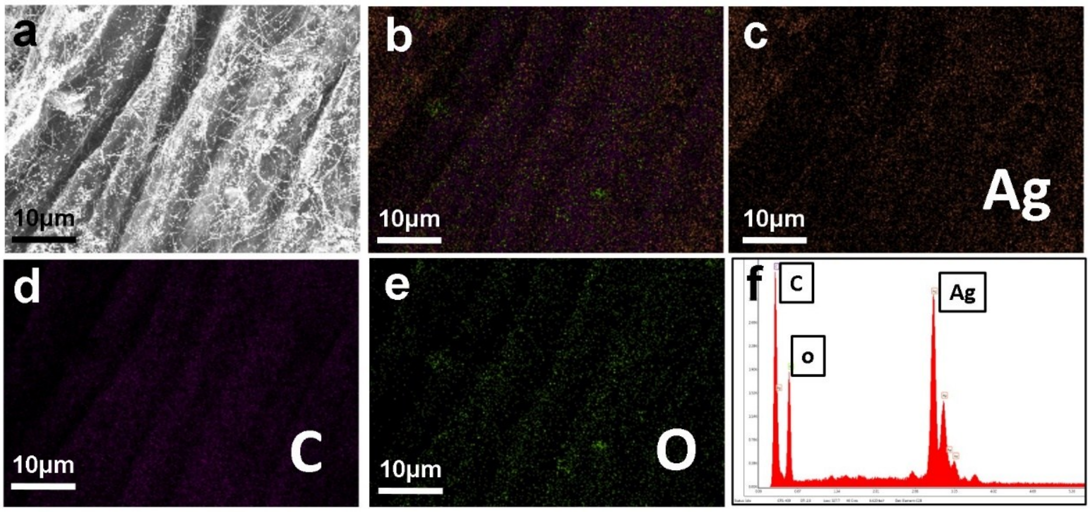

Figure S2. Elemental mapping of CA/Ag.

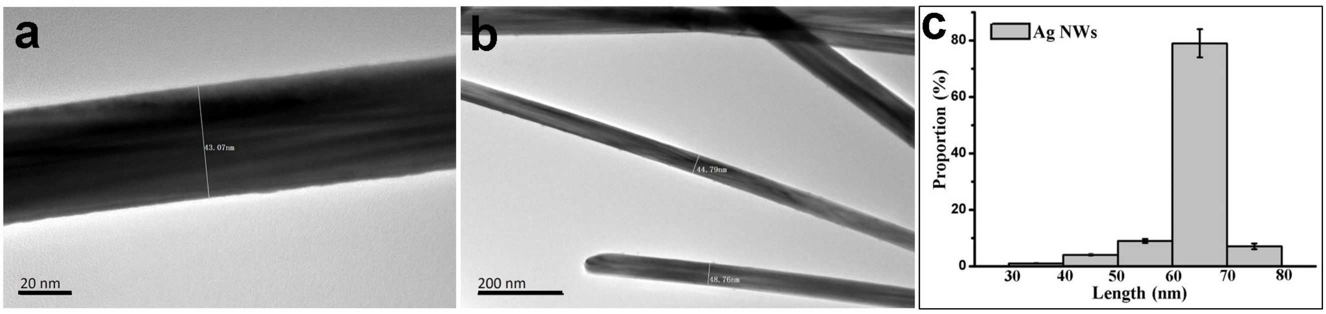

Figure S3. SEM images of (a-b) Ag nanowires. The diameter of the Ag nanowires are precisely controlled in a range of 30−80 nm. (c) The corresponding length distribution statistics of Ag nanowires.

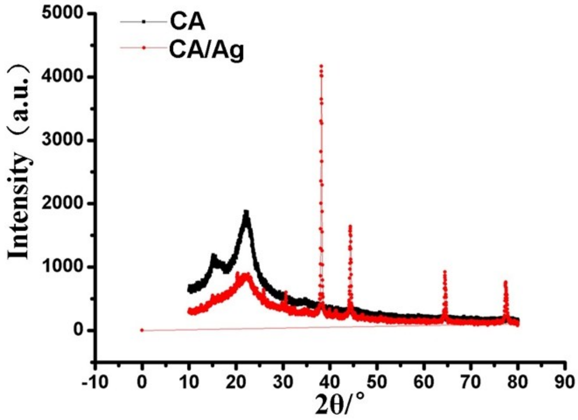

Figure S4. X-ray diffraction patterns of CA and CA/Ag.

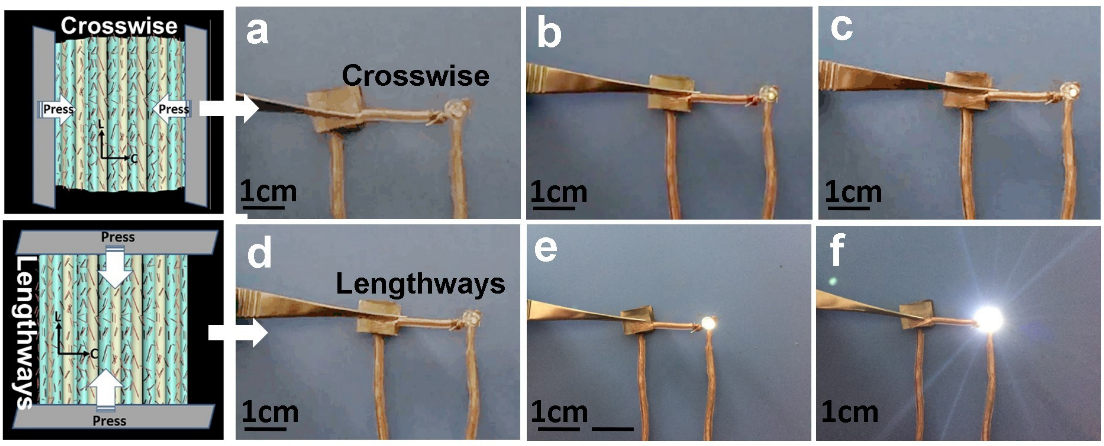

Figure S5. A circuit was connected the CA/Ag with a LED lamp. The brightness of LED could be changed upon compressing and releasing CA/Ag on "C" (a-c) direction or "L" direction (d-f)

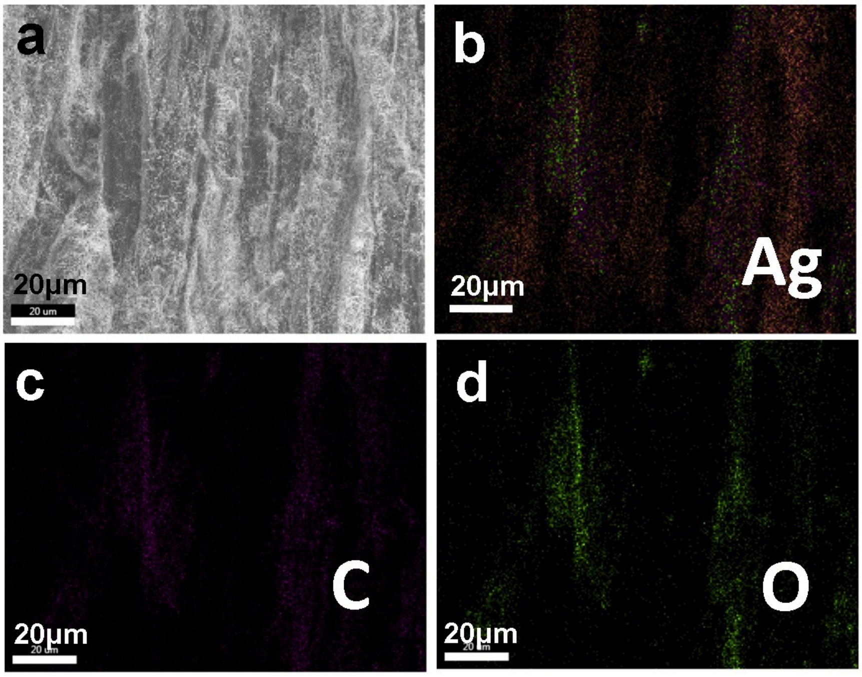

Figure S6. Elemental mapping of CA/Ag NPs.

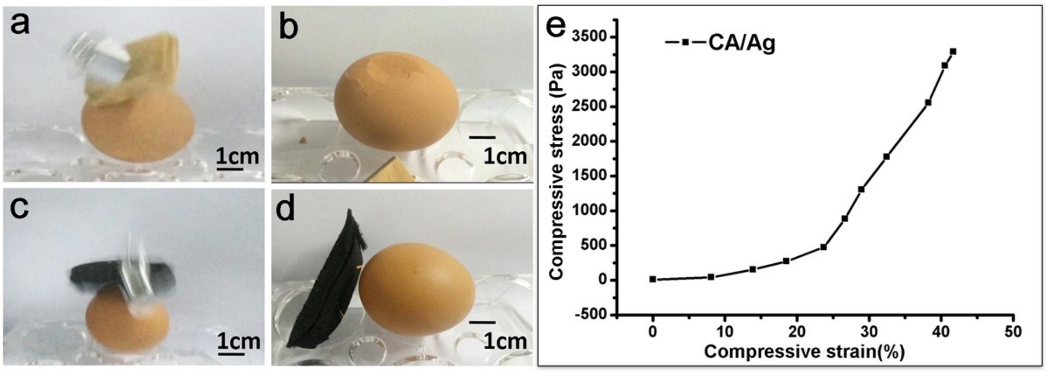

Figure S7. (a-d). The buffering ability comparison between wood and CA/Ag. (e) The stress-strain test with ε of 50%.

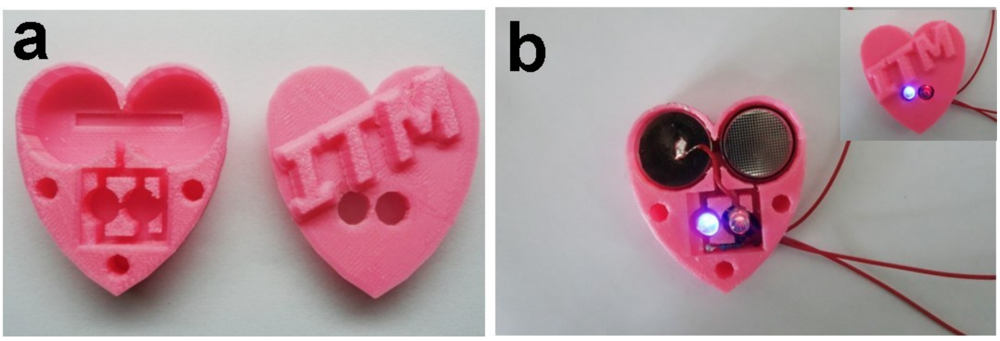

Figure S8. (a) Three dimensional design of the "CA/Ag package" by Rhino software. (b) The internal composition CAP.

REFERENCES

1. R. J. White, N. Brun, V. L. Budarin, J. H. Clark and M.-M. Titirici, *Chemsuschem*, 2014, **7**, 670-689.
2. H.-B. Yao, J. Ge, C.-F. Wang, X. Wang, W. Hu, Z.-J. Zheng, Y. Ni and S.-H. Yu, *Advanced Materials*, 2013, **25**, 6692-6698.