Supplementary Information

Eco-Friendly Wood Sponge-Based Multifunctional Pressure and Temperature Sensor for Electronic Skin

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Total number of figures: 5 (Figure S1-S5)

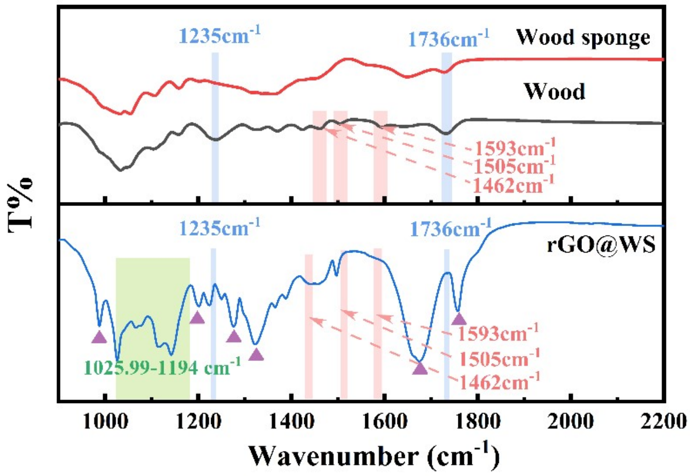

Fig. S1. FT-IR spectra of the wood, wood sponge and rGO@WS.

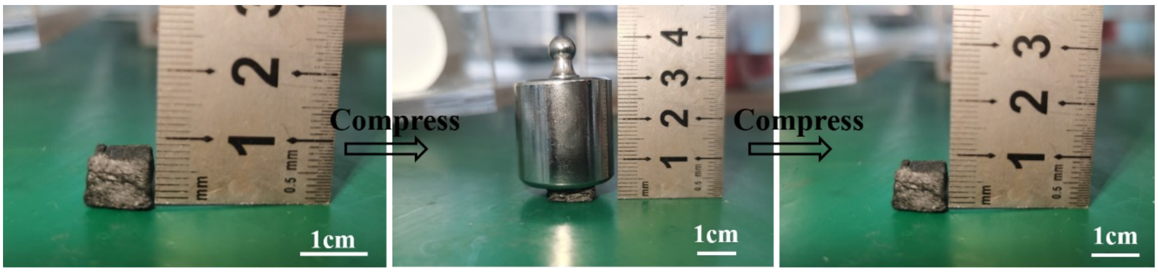

Fig. S2. The compress property of rGO@WS.

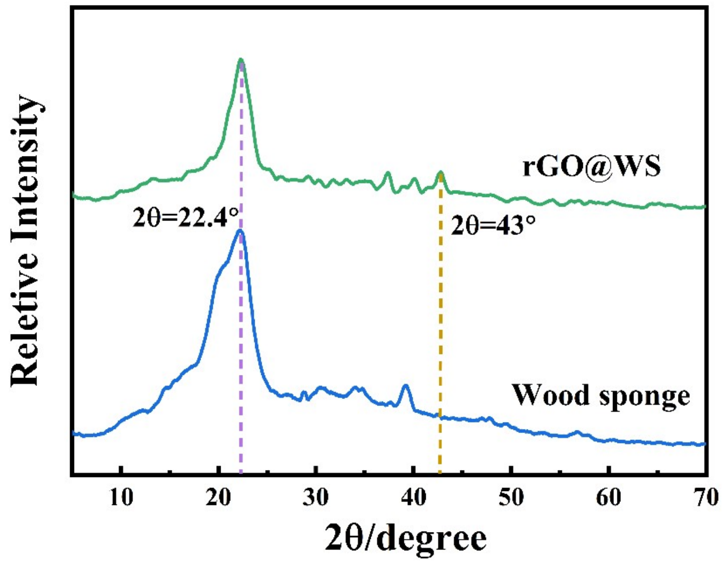

Fig. S3. The XRD patterns of wood sponge and rGO@WS.

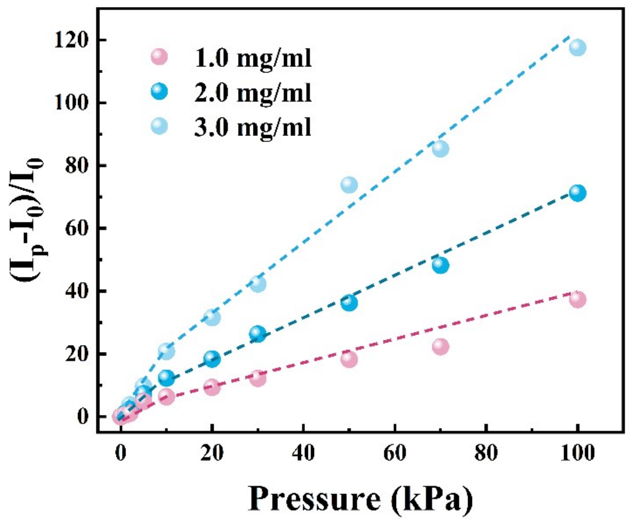

Fig. S4. The sensitivity curves of rGO@WS sensors under different rGO content.

We prepared GO solutions with different concentrations (1.0, 2.0 and 3.0 mg/ml) to reduce it and vacuum impregnated each of the three wood sponges in the solution for the same amount of time to control the amount of rGO nanosheets attached to the sponge skeleton. After impregnation, the impregnated sponges were freeze-dried, and the top and bottom surfaces of the sponges were pasted with conductive copper foil and silver-plated nylon to make the sensors. And then the pressure response curves were tested, and the results of the tests are shown in Fig. S4. It can be seen that the sensitivity of the sensor increases with the increasing rGO content.

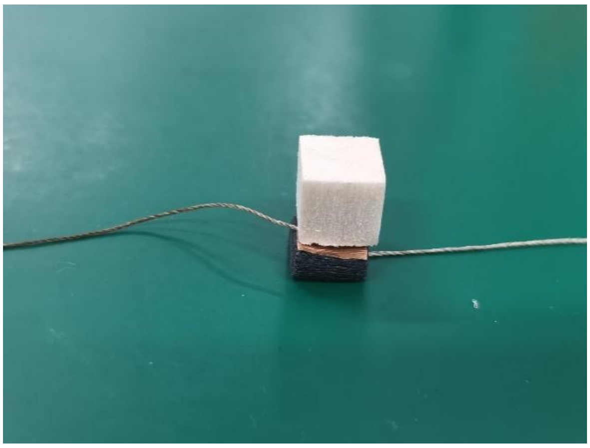

Figure S5. The minimal detection limit tested by a light wood.

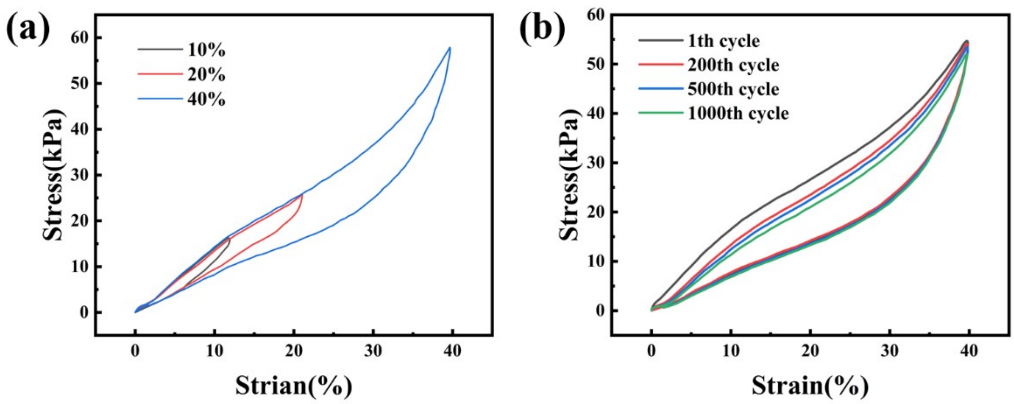

Fig. S6. The compressive stress-strain curves of rGO@WS. (a) Compressive stress-strain curves at different strains of 10, 20 and 40%. (b) Compressive stress−strain curves at 40% strain for 1000 cycles.

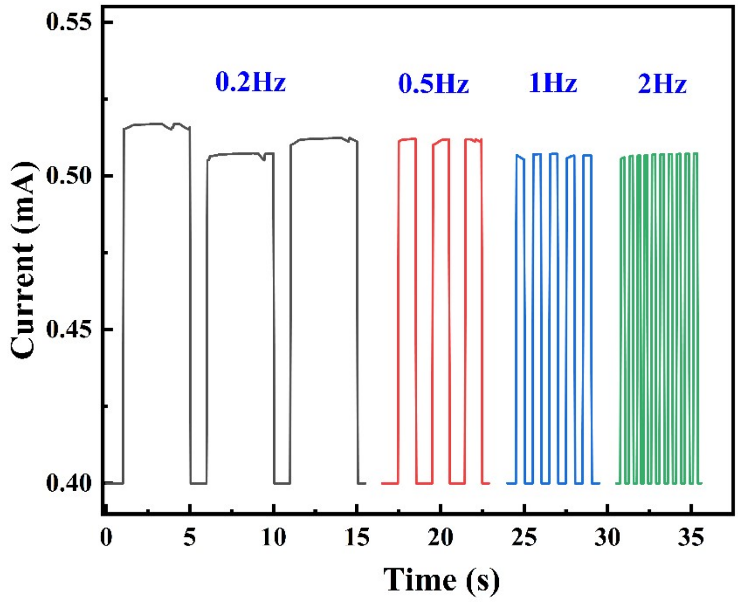

Fig. S7. The frequency-independent stability of rGO@WS.

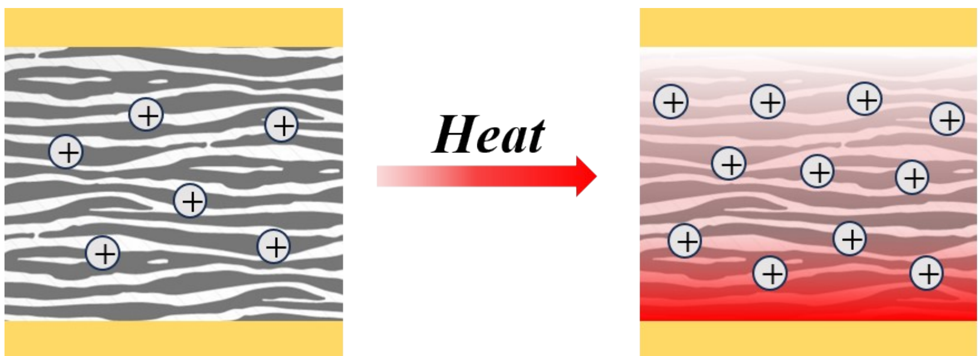

Figure S8. The working mechanism of thermoelectric effect.

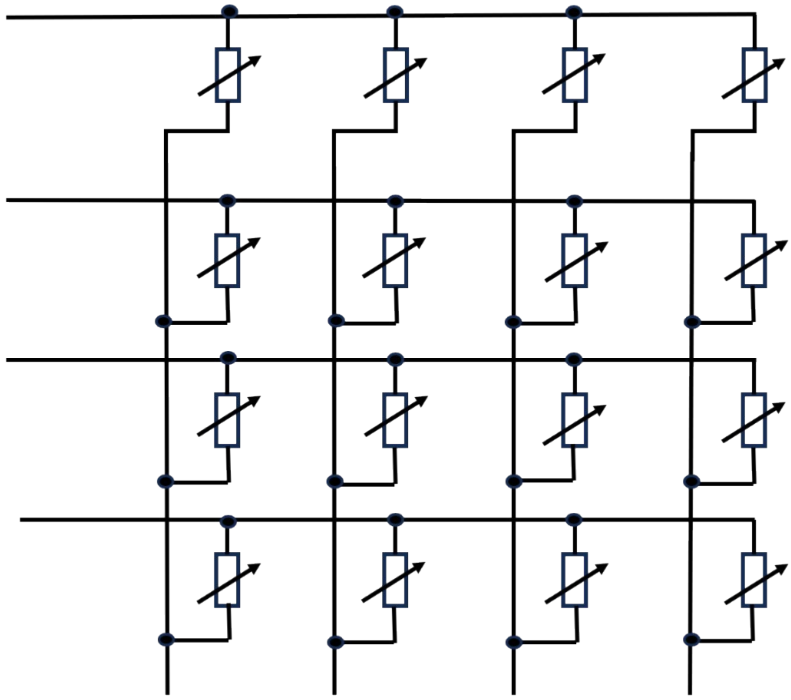

Figure S9. The equivalent circuit diagram of this pressure array.

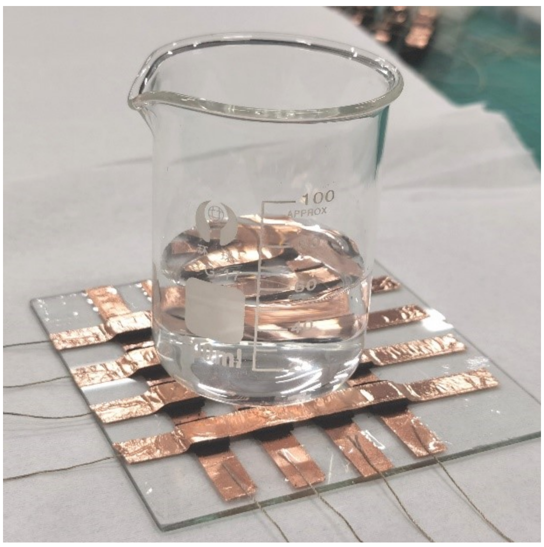

Figure S10. The pressure and temperature test of the rGO@WS sensing array.

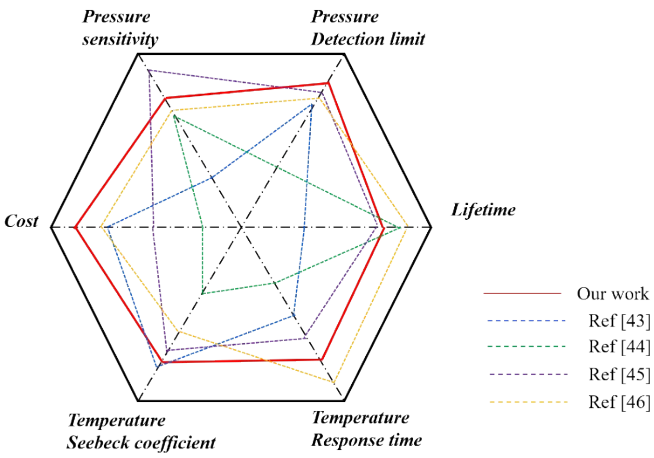

Fig. S11. The comparison of performance, cost and lifetime with other sensors.

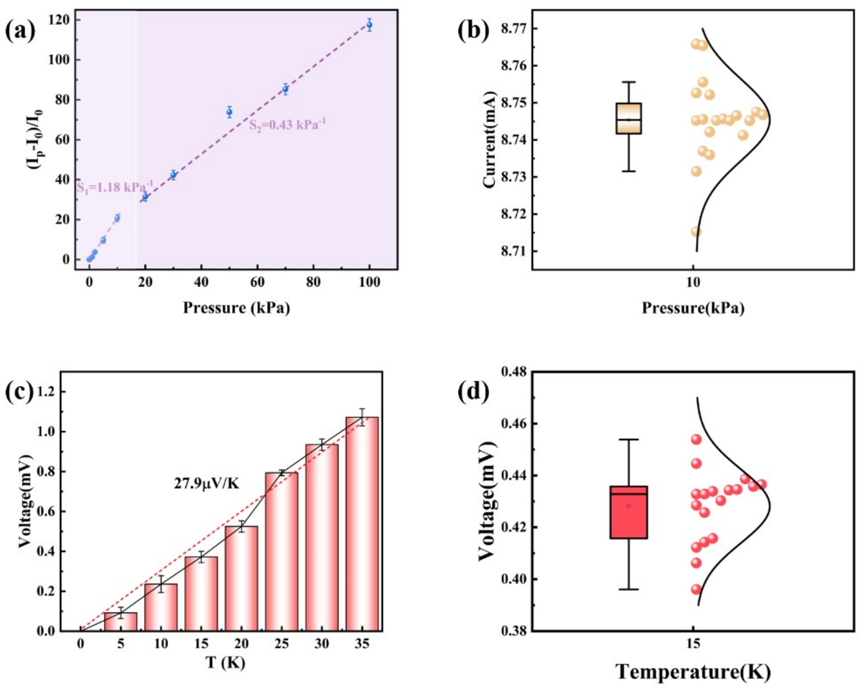

Fig.S12. The error analysis of pressure and temperature performance. (a)Repeated measurement of the sensitivity curve with error bar. (b)Repeated measurement of the generated current under 10kPa. (c) Repeated measurement of the seebeck coefficient with error bar. (d) Repeated measurement of the generated voltage under 5K.

We also tested the stability of the pressure and temperature sensing performance (as shown in Fig. S12). Fig. S12a shows that the sensitivity curves of repeated tests are almost the same. The current response of the sensor under 10 kPa pressure is tested repeatedly in Fig.S12b, and the results show that the error of the current response is also very small. Fig.S12c shows the corresponding test of the temperature of the sensor, and the seebeck coefficient calculated by the repeated measured data is the same. Fig.S12d is a repeated test of the thermal voltage generated by the sensor at a temperature difference of 15 K between the upper and lower surfaces. The test results show that the error is small. These fully demonstrate that the rGO@WS sensor has good stability.

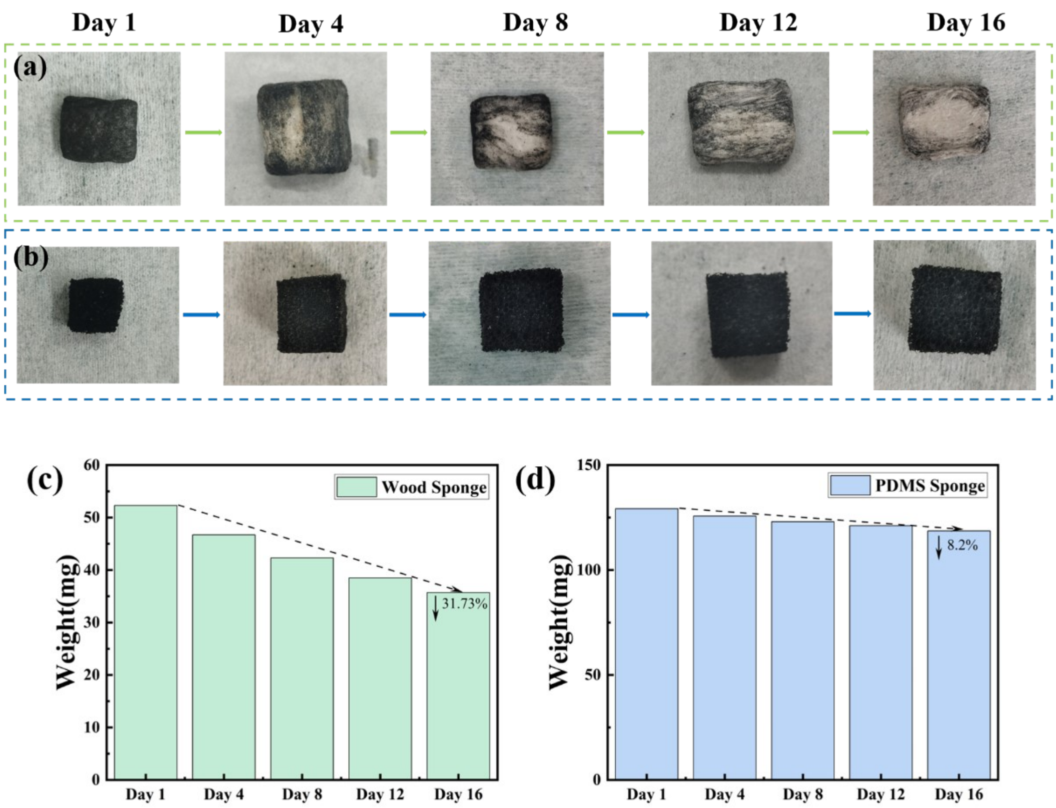

Fig. S13. The appearance of (a) wood sponge, (b) PDMS sponge during the degradation process. The weight of (a) wood sponge, (b) PDMS sponge during the degradation process.

Table S1. The comparison of sensing performance with other sensors.

Sensing material	Measurment range (kPa)	Response time (ms)	Sensitivity (kPa^{-1})	Low detection limit (Pa)	Ref
MXene/PANI sponge	0-23	80	0.3106	256.3	[40]
rGO/polyaniline wrapped sponge	0-27	~96	0.152	<5k	[41]
PU/MWCNTs	0-350	-	0.125	150	[42]
Ag/MXene/Sponge	0.14-2.83	69.5	0.90	140	[43]
rGO/Wood sponge	0-100	110	1.18	123	Our work