Supporting Information

Superhydrophobic fluorinated PDMS composite for wearable strain sensor with excellent mechanical robustness and liquid impalement resistance

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S1 Preparation of the fluorinated crosslinker

We conceded that the fluorinated PDMS was inspired by the fluorinated epoxy [1]. The reaction between TEOS and PDMS-OH with DBTL as the catalyst has been widely used to prepare elastomer [2]. As the TEOS is easy to react with other compounds [3], the potential reaction mechanism between the TEOS and heptafluorobutyric acid can be shown in the Figure S1a. Then, the fluorinated PDMS can be prepared following the reaction shown in Figure S1b.

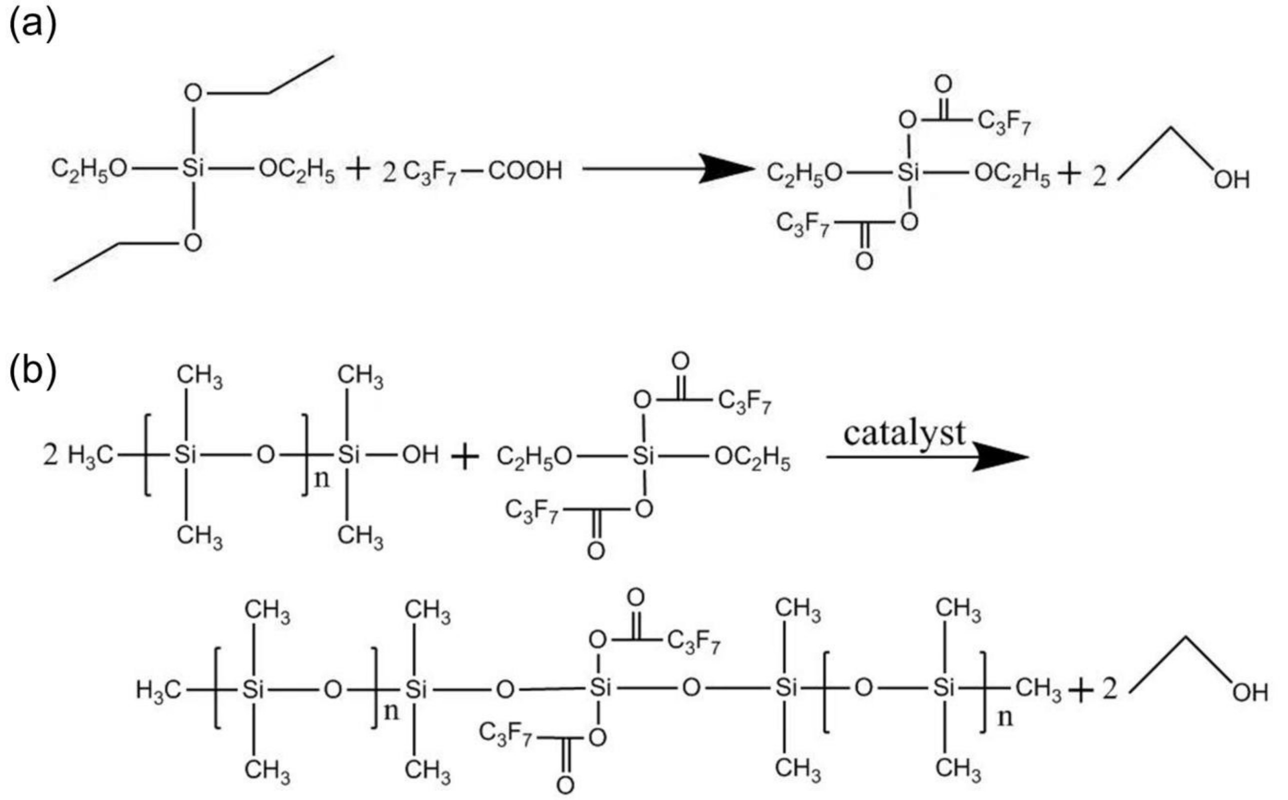

Figure S1. (a) The reaction between the TEOS and the heptafluorobutyric acid. (b) The formation mechanism of the fluorinated PDMS.

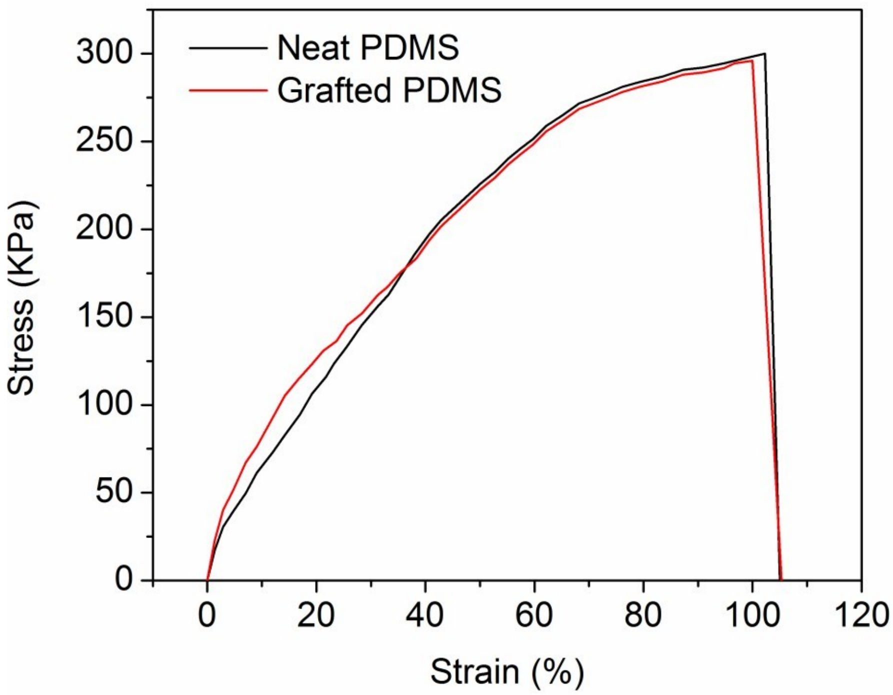

Figure S2. Stress-strain curves of the neat PDMS and grafted PDMS.

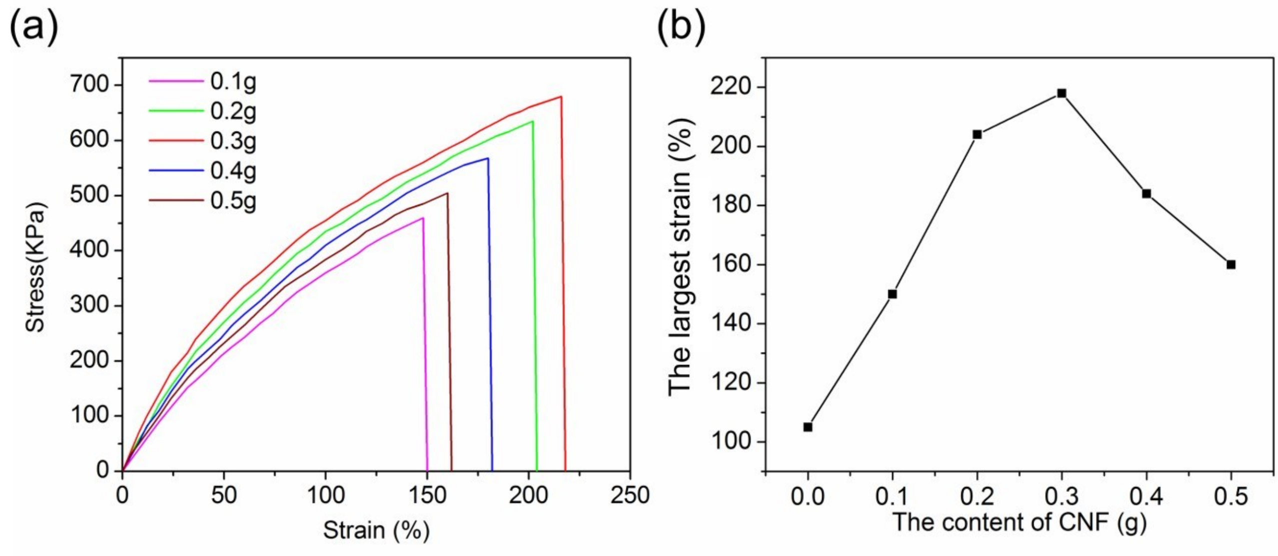

Figure S3. (a) Stress-strain curves of the sample after blending different content of CNF. (b) The largest strain of the sample as a function of the bleneded CNF.

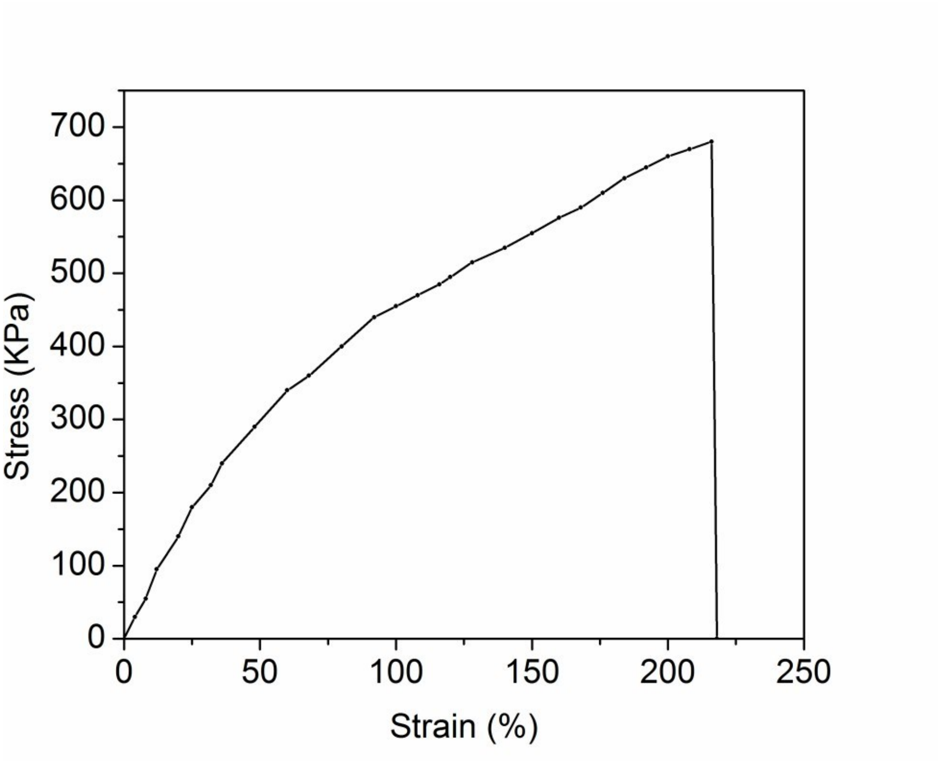

Figure S4. Stress-strain curves of the graphene superhydrophobic composite which sprinkled CNT powders onto the sample after blending 0.3 g CNF

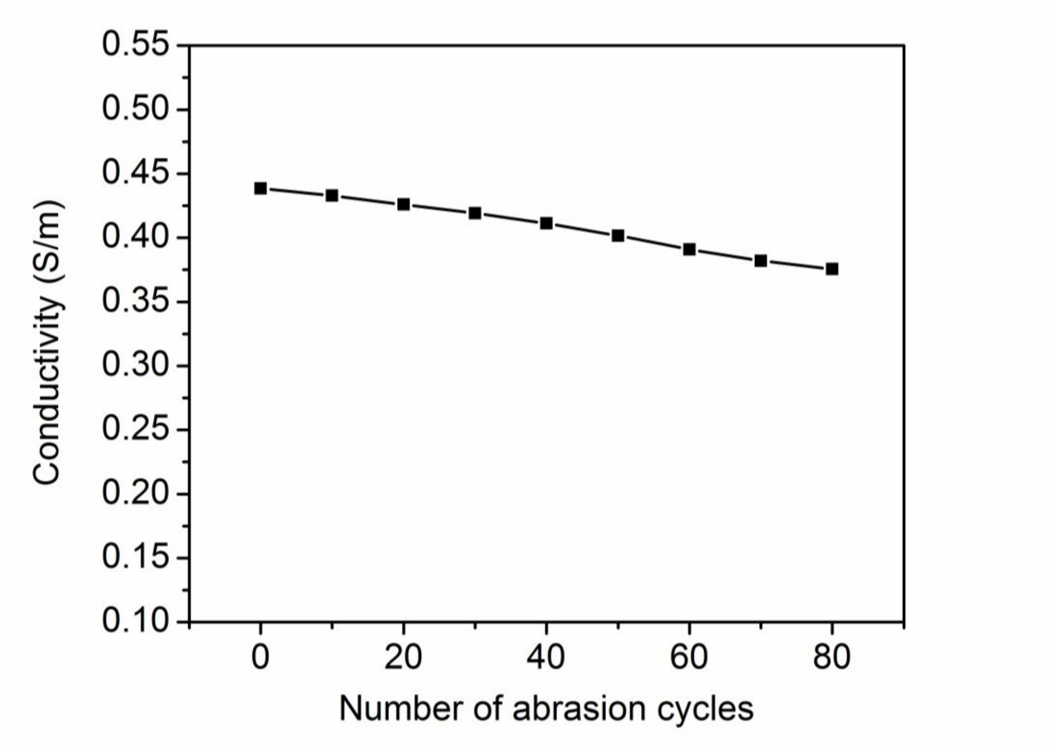

Figure S5. The conductivity of the as-prepared superhydrophobic sample after sandpaper abrasion.

Table S1. The conductivity of the sample after being immersed in different liquids for 24 h.

	original	NaCl	pH=1	pH=4	pH=7	pH=10	pH=14
Conductivity (S/m)	0.436	0.426	0.388	0.408	0.430	0.399	0.389

S6 The underlying mechanism behind the sensing behaviour

From the accumulated knowledge until now, the working mechanism of the piezoresistive strain sensors made from CNT/polymer nanocomposites can be mainly attributed to the following three aspects:

(a) significant variation of conductive networks formed by CNTs, e.g., loss of contact among CNTs [4, 5];

(b) tunneling resistance change in neighboring CNTs due to distance change [6-9];

(c) piezoresistivity of CNTs themselves due to their deformation [9, 10].

In this research, the piezoresistive behaviour of strain sensor were mainly come from the conductive network. When the strain sensors are stretched out, re-orientation and re-positioning of CNTs reduce the number of conductive network, and then increases the base resistance of the strain sensors (Figure S6).

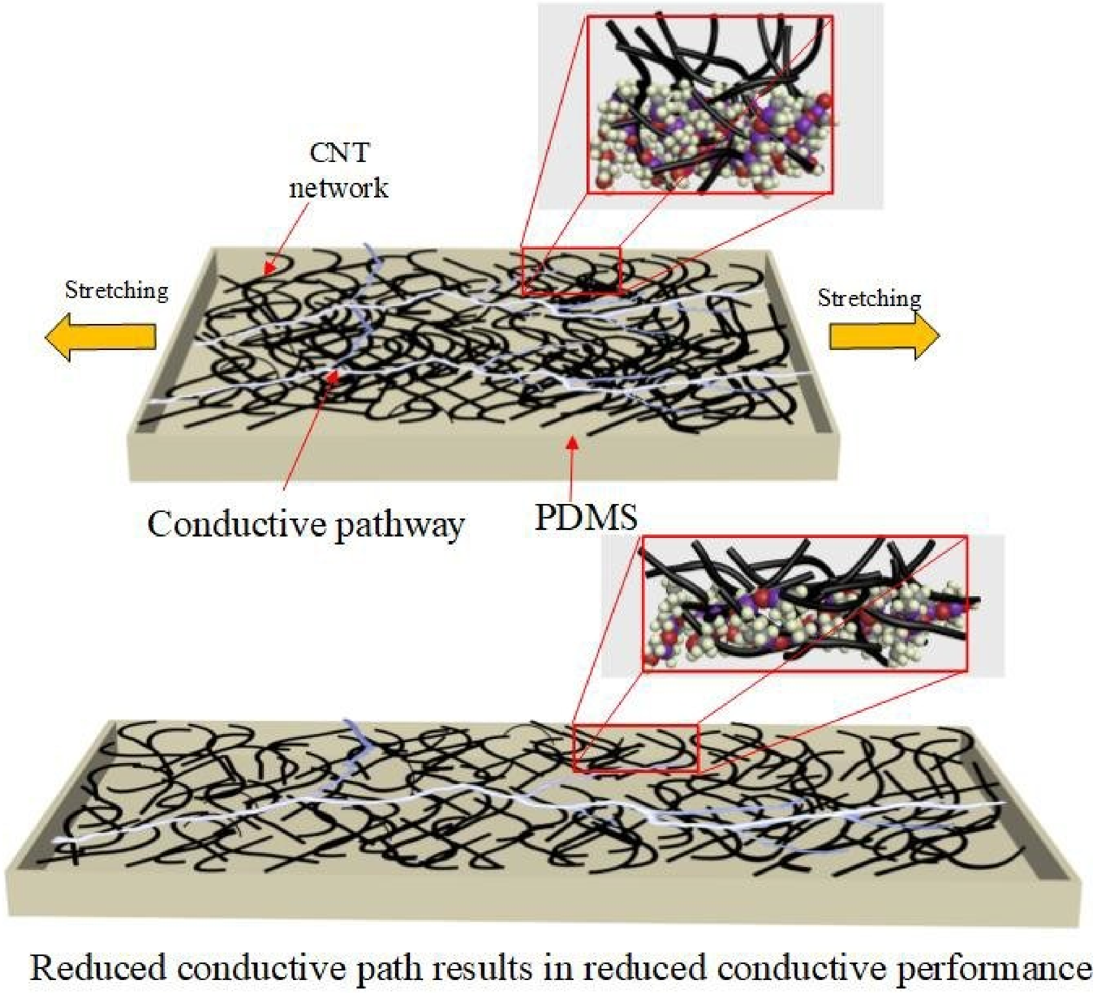

Figure S6. Structure and basic working principles of the CNT/PDMS strain sensor.

S7 Response time

The response time of the sensor is another crucial factor. In this research, the response time was measured according to the method shown in reference [11]. As shown in the inset of Fig. S8, this graphene superhydrophobic sensor shows immediate response time of ~330 ms under tension condition, which was comparable with recent values of other nanocomposite sensors (300-3800 ms) [11, 12]

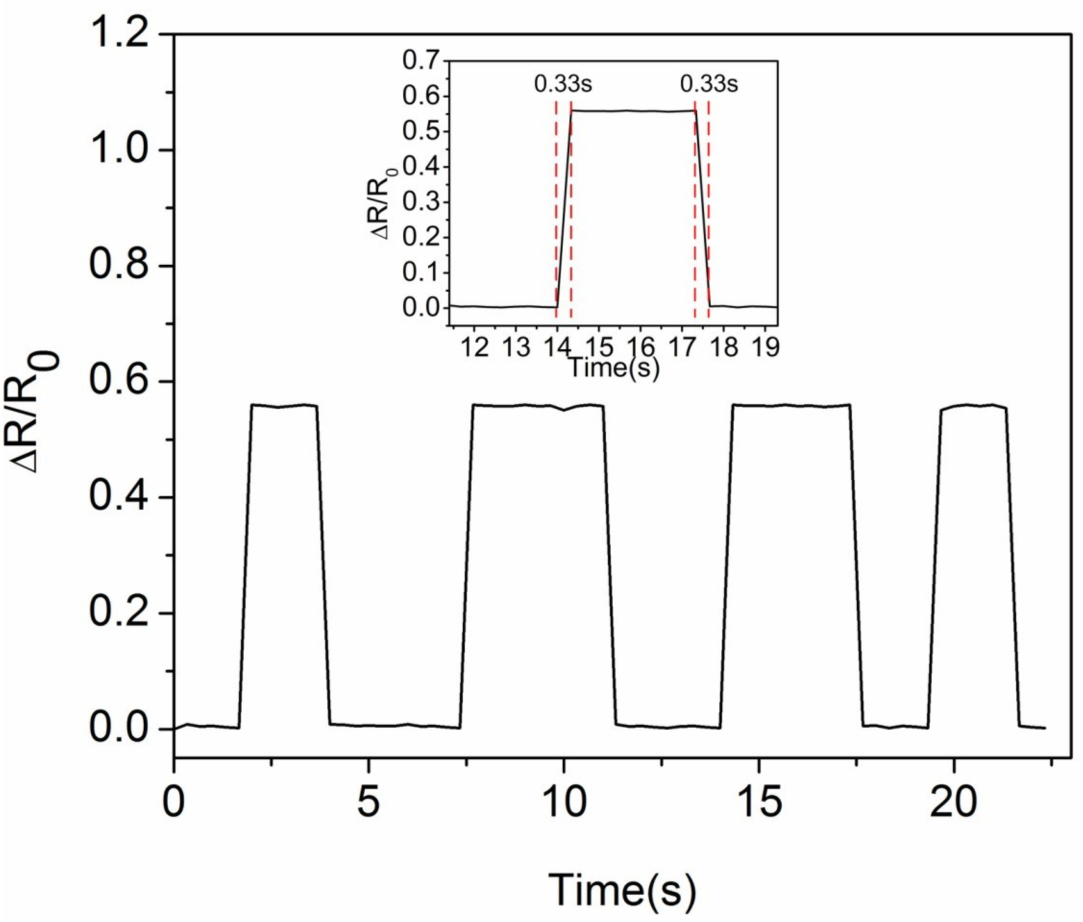

Figure S7. Electrical response of the graphene composite that was subjected to periodic tensile force The inset is one enlarged peak showing the rise-time.

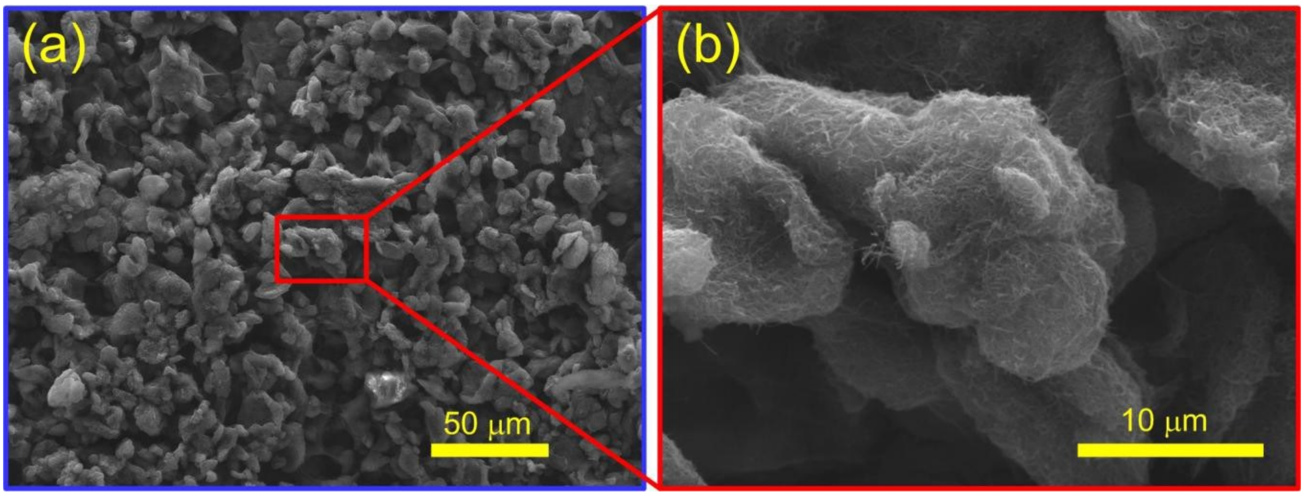

Figure S8. The SEM image of the CKFS sample after 10000 cyclic loading.

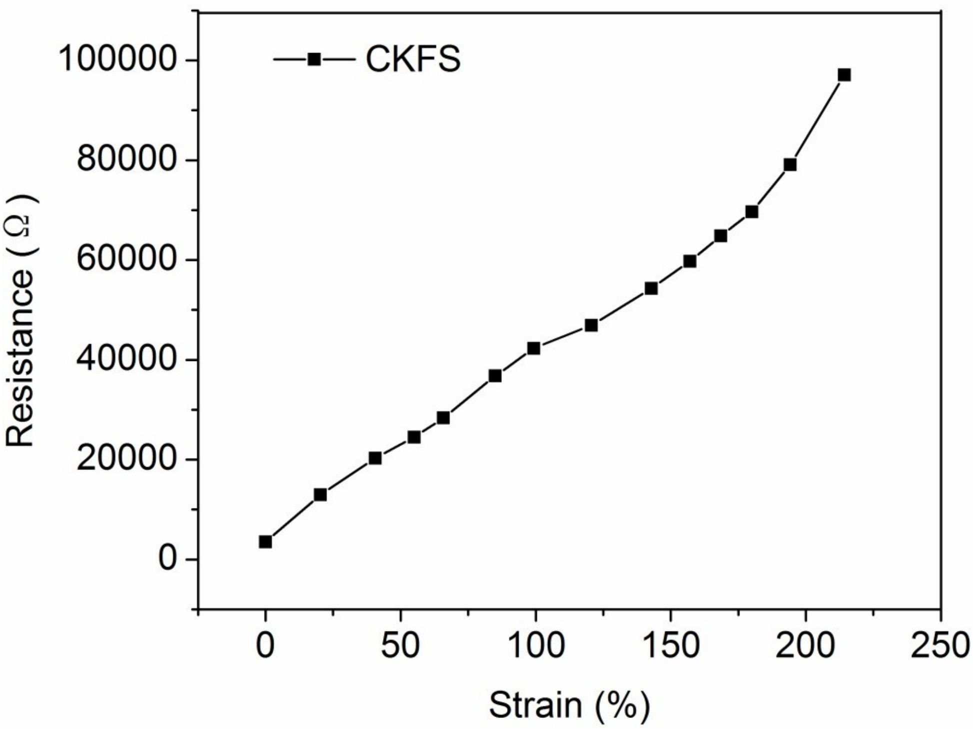

Figure S9. Resistance variation of the CKFS sensor versus strain.

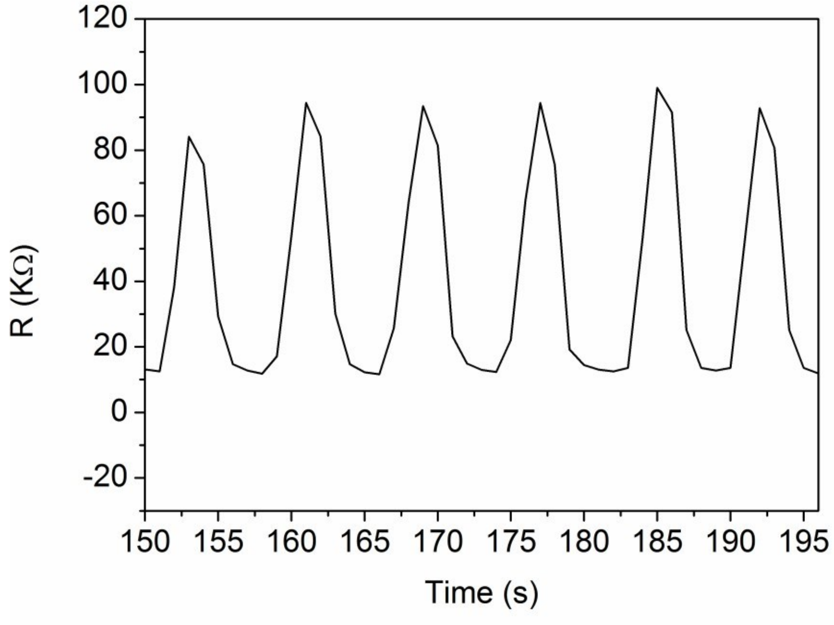

Figure S10. Real-time variation of the resistance when the CKFS-based sensor was applied to detect neck bending.

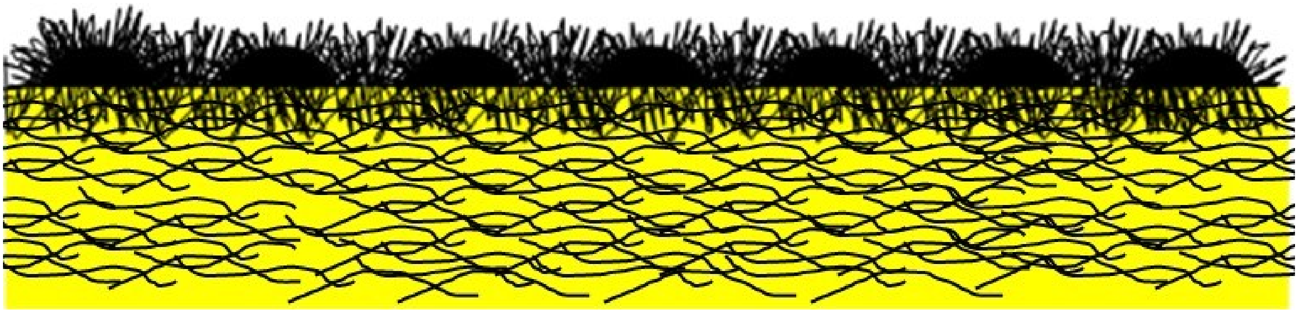

Figure S11. The structure illustration of the CKFS sample.

Supplementary References

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