Highly stretchable strain sensors based on conductive graphene/poly(styrene-butadiene-styrene) nanocomposites

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Abstract

In recent years, the field of flexible electronics has been booming derived from the demand for human health and medical equipment. Even now there are many kinds of flexible sensors made of graphene, carbon nanotubes, conductive particles such as conductive silver wires, the stretchable strain sensor with high sensitivity, quick response, low hysteresis, large strain and good repeatability still needs to be explored [1]. Herein, we have developed a new stretchable sensor based on graphene(G) nanocomposites, achieving detections of pulse and finger touch. The sensing element is fabraicated by a mixture of 5 wt% graphene prepared by electrolyzing graphite sheet method and non-conductive poly(styrene-butadiene-styrene) (SBS).

The fabrication process of G/SBS-Ecoflex strain sensor (GSES) is shown in Figure 1. Figure 1a illustrates that 31.39 mg graphene was added to a solution of 4 ml xylene and the mixture was dispersed using ultrasonic treatment for 30 mins. After addition of 600 mg SBS, the resulting mixture was ultrasonically treated for 30 mins and allowed to rest for 2 h (Figure 1b). Then, the G/SBS mixture was poured into the mold and cured at 80 ℃ (Figure 1c). Finally, the sliced G/SBS nanocomposites film was led out and encapsulated in soft Ecoflex-0010, forming a GSES device (Figure 1d).

Figure 2a illustrates the cross-sectional scanning electron microscopy (SEM) images of the G/SBS nanocomposites. It is observed that graphene and SBS homogeneously dispersed with each other. There is a strong interfacial interaction between graphene and SBS owing to the effective π-π interactions between graphene and the phenyl groups of SBS [2, 3]. Figure 2b presents the G/SBS nanocomposites film before encapsulation with Ecoflex. The developed GSES device was shown in the insert on corner. Figure 3 shows the characterization results of GSES for application in human health monitoring. Figure 3a illustrates that the proposed GSES device can effectivity monitor radial artery pulse in real-time. Figure 3b represents the fabricated GSES device can recognize finger touch with a short response time. In these above characterizations, the resistance of the GSES device was measured with a Keithley 2410.

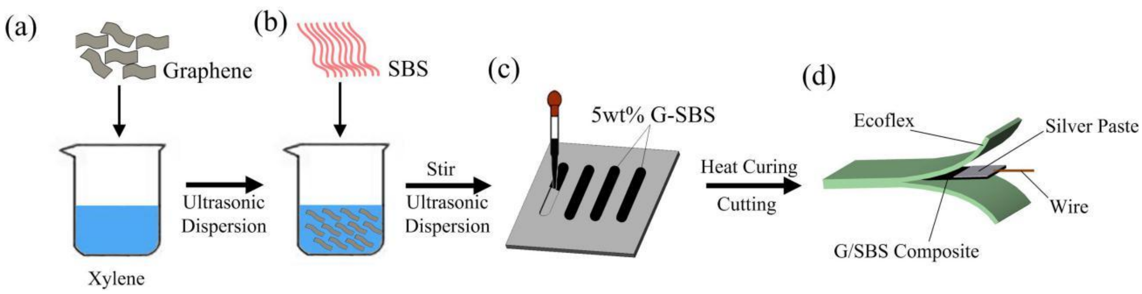

Figure 1: Schematic illustration of the fabrication process of the G/SBS Ecoflex strain sensor.

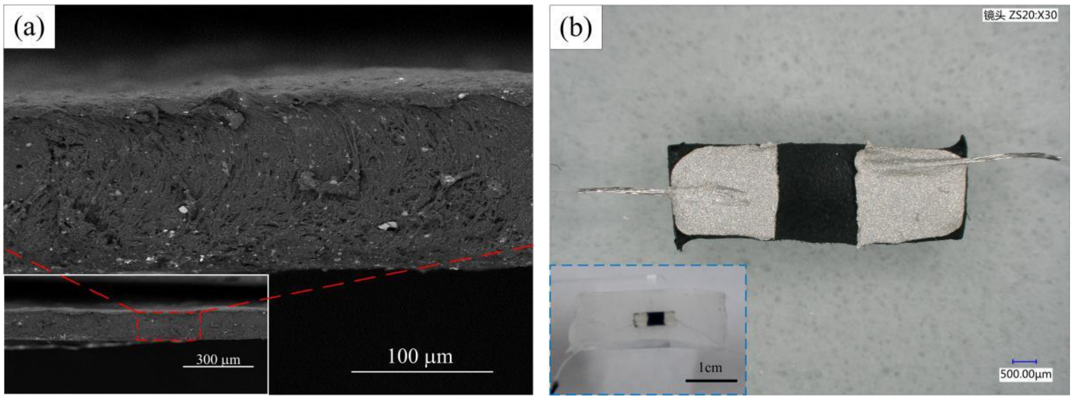

Figure 2: (a) Cross-sectional SEM images of G/SBS nanocomposites. (b) The optical images of G/SBS nanocomposites and developed GSES device (inset).

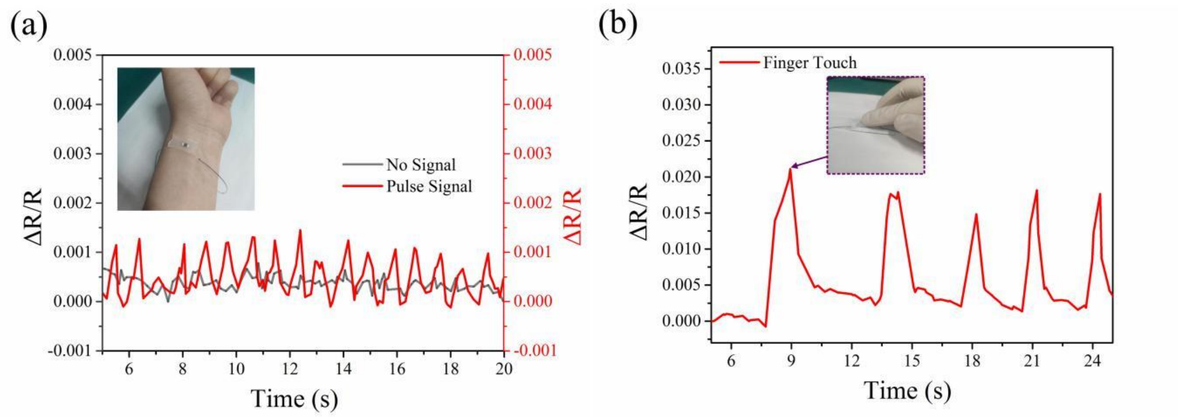

Figure 3: Characterization results of the GSES for (a) real-time radial artery pulse monitoring and (b) recognition of finger touch.

References

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