Electronic Supplementary Material (ESI) for Materials Advances.

Supporting Information

Stretchable and Calibratable Graphene Sensors for Accurate Strain Measurement

1. Sensing graphs for stretchable elastomer/graphene strain sensors.

Figure S1 reveals plots for a typical stretchable PDMS/graphene strain sensor.

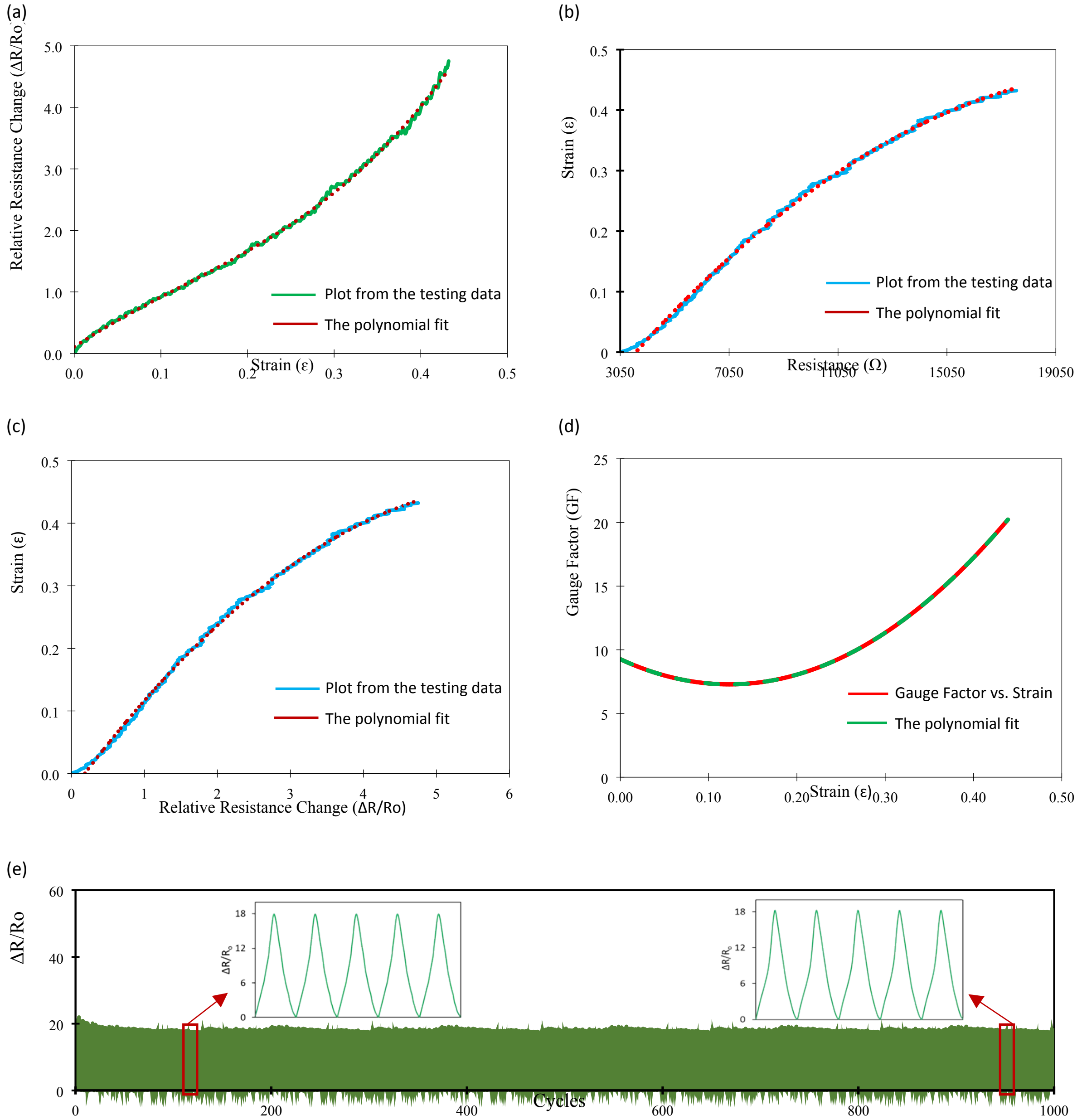

Figure S1 (1) A stretchable PDMS/graphene strain sensor graphs with 0.17% strain resolution: (a) sensitivity graphs, (b) strain vs. resistance, (c) the inverse of sensitivity graph, and (d) the gauge factor vs. strain. (2) 1,000 loading and unloading cycles for a stretchable EPDM/graphene strain sensor graphs: (e) at 0-68% strain.

2. Performance and Calibration of a PDMS/graphene Sensor

Figure S1.1 contains the performance graphs for a PDMS/graphene sensor with 43% stretchability. The sensor can be calibrated because its sensitivity graph (Figure S1a) is almost monotonic with high linearity of over 99.8% and strain resolution of 0.17%. The polynomial function (1) for the input-output data in Figure S1b can be interpreted by an electrical circuit.

$$\varepsilon = -10^{-9}R^2 + 6 \times 10^{-5}R - 0.1989 \qquad (1)$$

In comparison, the polynomial function (2) for the input-output data in Figure S1c is more complex and thus needs a more complex electrical circuit for calibration.

$$\varepsilon = -0.0126(\Delta R/R_o)^2 + 0.1577(\Delta R/R_o) - 0.0287 \qquad (2)$$

The gauge factor is the first derivative of the function for a sensitivity graph, which is equation (3). Its numerical value of gauge factor is in the range of 7.5–20 in Figure S1d.

$$GF = 129.84R\varepsilon^2 - 32.026\varepsilon + 9.2615 \qquad (3)$$

The graph of 1,000 loading-unloading cycles at 0–68% strain is shown in Figure S1.2, and the slightly wavy upper limit indicates imperfect cyclic consistency. A small discrepancy was observed by comparing the peaks between starting and the final cyclic regions, and this may pose an effect on the sensor to be used as a gauge for high accuracy and precision.