Large-area, Highly Sensitive MoS_2/Graphene Tactile Sensors and Their Performance for Electronic Skin Applications

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Abstract

Recently, tactile sensors, in the form of conformal and embedded devices, have attracted great research interest because of their various applications, from electronic skin (E-skin) to health care monitoring systems. For these reasons, various strain sensing material based tactile sensors have reported flexible or high-performance tactile sensors with good sensitivity. However, despite high sensitivity with respect to external strain, these sensors have several drawbacks: high hysteresis, non-linearity, and poor repeatability.[1,2] In contrast, semiconductor material-based tactile sensors give high sensitivity and excellent reliability. Two dimensional (2D) material, MoS_2 semiconductor has recently attracted attention because of their outstanding mechanical and optical transmittance, high gauge factor, and tunable band gap. Here, we present an ultrathin conformal, MoS_2-based tactile sensing array covering an area of 2.2 cm x 2.2 cm. We integrated the sensor with a graphene electrode and interconnect to achieve good mechanical flexibility and optical transmittance in the visible color range. The gauge factors of sensor were determined to be -72.5±1.9 and -56.5±4.8 under the compressive strain and the tensile strain, respectively. This sensor shows high sensitivity, good uniformity, and linearity even after 1000 loading cycles. In addition, it provides excellent mechanical flexibility over strain of 1.98% and better than 80% transparency. Our ultrathin tactile sensor fabricated on a transparent plastic substrate of 72.3 nm presented stable performance even on unusual substrates such as leather and a human fingertip.

References

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[2] M. L. Hammock, A. Chortos, B. C. K. Tee, J. B. H. Tok, Z. Bao, Adv. Mater. **25** (2013) 5997.

Figures

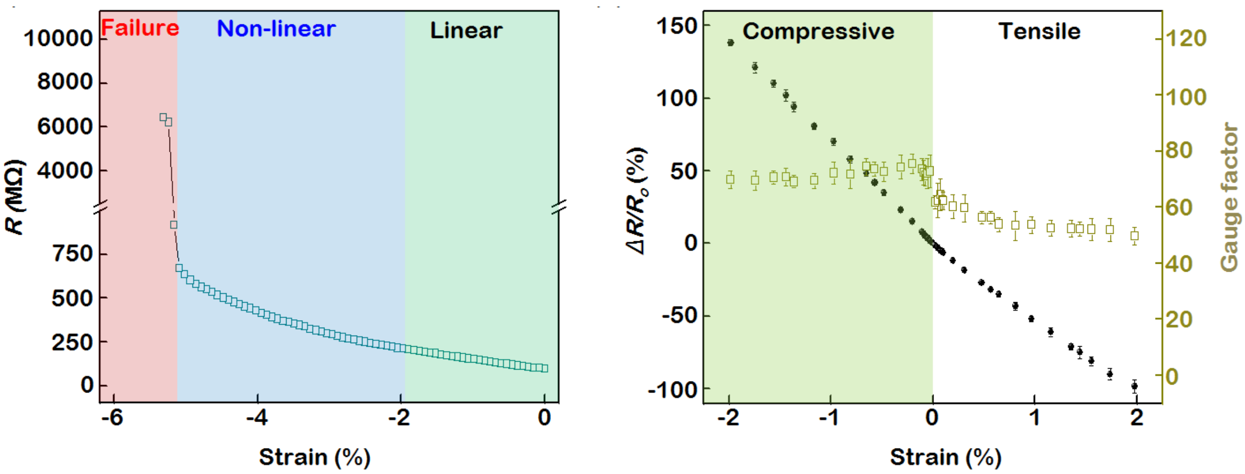

Figure 1. Electrical characterization of MoS_2 tactile sensor