A Flexible Strain Sensor of $La_{0.7}Sr_{0.3}MnO_3$/Mica with a Wide Working Temperature

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Abstract

Flexible strain sensor has captured a lot of attention since it was proposed. Many efforts have been focused on adopting new materials or developing novel structures to detect strain, temperature and even to realize multi-function. The reliability of flexible strain sensor in harsh environments such as at low and high temperatures, however, has so far received few attentions because traditional bendable or stretchable substrates, including polyethylene terephthalate (PET), polyimide (PI), polydimethylsiloxane (PDMS), paper, silk, and cotton, cannot withstand high temperature. The poor thermal stability limits their potential applications in harsh conditions such in interstellar prob, polar exploration, petrochemical, and metal smelting.

In this work, we fabricated a flexible strain sensor consists of a $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) film on top of a 4.5 μm thick mica substrate, This cost-effective and environment friendly strain sensor shows excellent mechanical bending properties, high durability (up to 9 hours) and fast response time (0.1 s). Most importantly, it can work in a broad temperature range from extreme low temperature down to 20 K to high temperature up to 773 K. The device structure and the main results are shown in the following Figure 1. The flexible strain sensor based on the flexible LSMO/mica hetero-structure shows great potential applications for flexible electronics using at extreme temperature environment in the future.

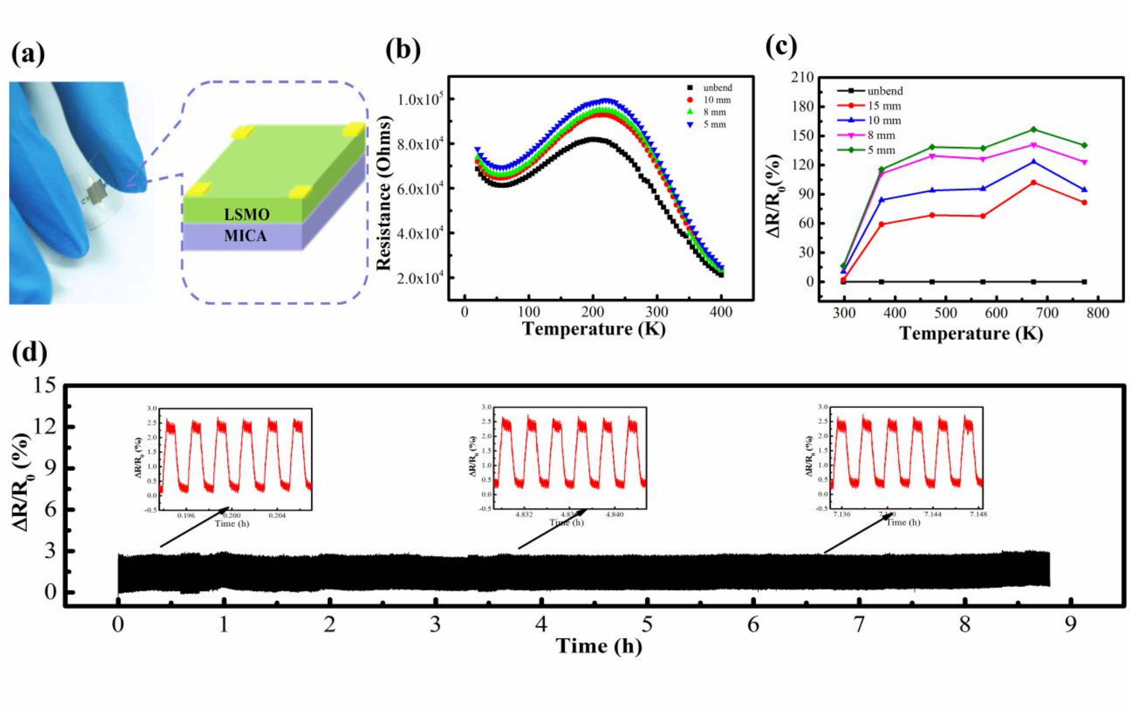

Figure 1: (a) Schematic diagram of the flexible sensor. (b) Resistance versus temperature under different radius of curvature. (c) Temperature-dependent resistance change rate under different bending state. (d) Aging experiment of the strain sensor for 9 hours bending-unbending time with a bending radius of 8 mm. The three inset figures show some typical cycles at the initial, middle, and ending stages of the testing process, respectively.

References

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