New functionalities of SnO_2-based materials under the application of stress and voltage

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Abstract

Defects in semiconductors dominate their optical and electronic properties [1,2,3,4]. In this studies, we manipulated lattice defects in a single-crystal SnO_2 microrod artificially by the application of mechanical stress and voltage [2,3]. Creation and annihilation of lattice defects leads to noble reversible and nonvolatile semiconductor-insulator transitions. Defect healing is caused by local Joule heating. Flexible and functional oxide devices will be one of key technologies in future computer and IT fields.

Fabrication of unique oxide core/shell structures leads to new functionalities, which can not be achieved in individual oxide structures. Here we show humidity and strain sensing properties in β-Ga_2O_3/amorphous-SnO_2 core/shell structures [4,5]. Large thermal switchable properties of the device originate from thermodynamics in physisorption of H_2O molecules on a SnO_2 surface. The high humidity senescing and large gauge factor ($(\Delta R/R)/\varepsilon = -41$) will produce novel functional devices in future life and health fields.

References

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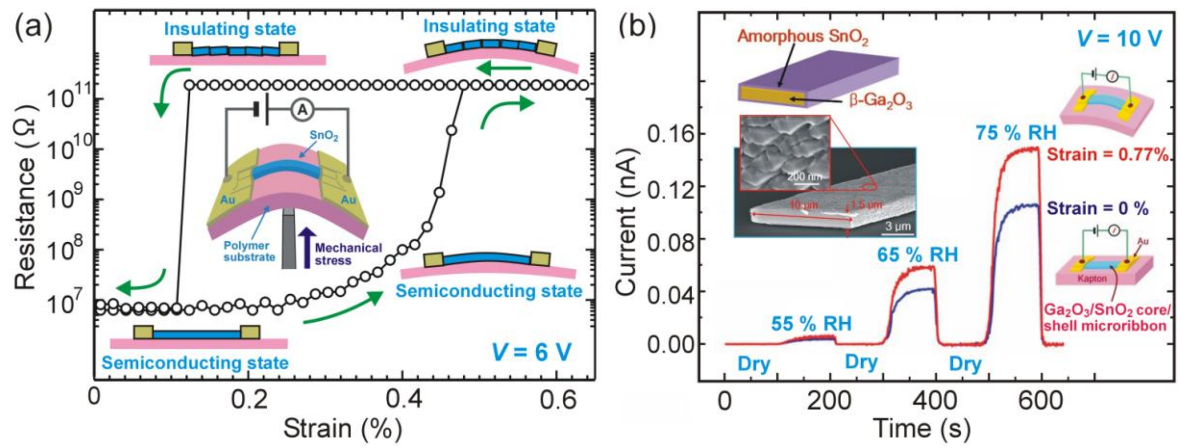

Fig.1 (a) Reversible and non-volatile semiconductor-insulator transition of a single-crystal SnO_2 microrod device on a flexible substrate at V = 6 V as a function of strain at 300 K. Lattice defects created by the strain are healed by local Joule heating under the application of appropriate voltage. (b) Enhancement of humidity sensing properties of β-Ga_2O_3/amorphous-SnO_2 core/shell microribbon devices on a flexible substrate as a response to the change of relative humidity (RH) and mechanical strain at 300 K.