Sensing Properties of Oxide Core-Shell Nanofibers Synthesized by a Novel Two-Step Method

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Core-shell nanomaterials, a type of heterostructured nanomaterial, are expected to be widely used in the areas of catalysis, drug delivery, chemical and bio sensors, etc. As the demand for fabricating various core-shell nanomaterials and nanostructures increases, it is becoming important to develop new methods of synthesizing a wide variety of core-shell nanomaterials in order to modify or improve the properties of monolithic nanomaterials [1-3].

In this work, we propose a novel method of synthesizing oxide core-shell nanofibers by employing electrospinning and atomic layer deposition (ALD) in sequence. Electrospinning is known to be a simple, inexpensive technique to synthesize nanofibers or nanowires in a highly reproducible manner from polymer solutions or melts [4]. ALD is a technique that allows for the growth of smooth and conformal films on the underlying surface with atomic-scale thickness control at low temperatures [5].

The preparation of some different kinds of oxide core-shell nanofibers including TiO_2-ZnO and SnO_2-ZnO core-shell nanofibers using the method will be presented, as an example of its effectiveness. Then, the hybrids in the form of oxide core-shell nanofibers were tested as platform to detect various gas species. Good sensitivity and dynamic repeatability were observed for the sensor, demonstrating that the core-shell nanofibers hold promise for the realization of sensitive and reliable chemical sensors. The methodology proposed in this work is expected to be one of most suitable methods for preparing various kinds of oxide core-shell nanofibers or nanowires.

References:

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Figure :

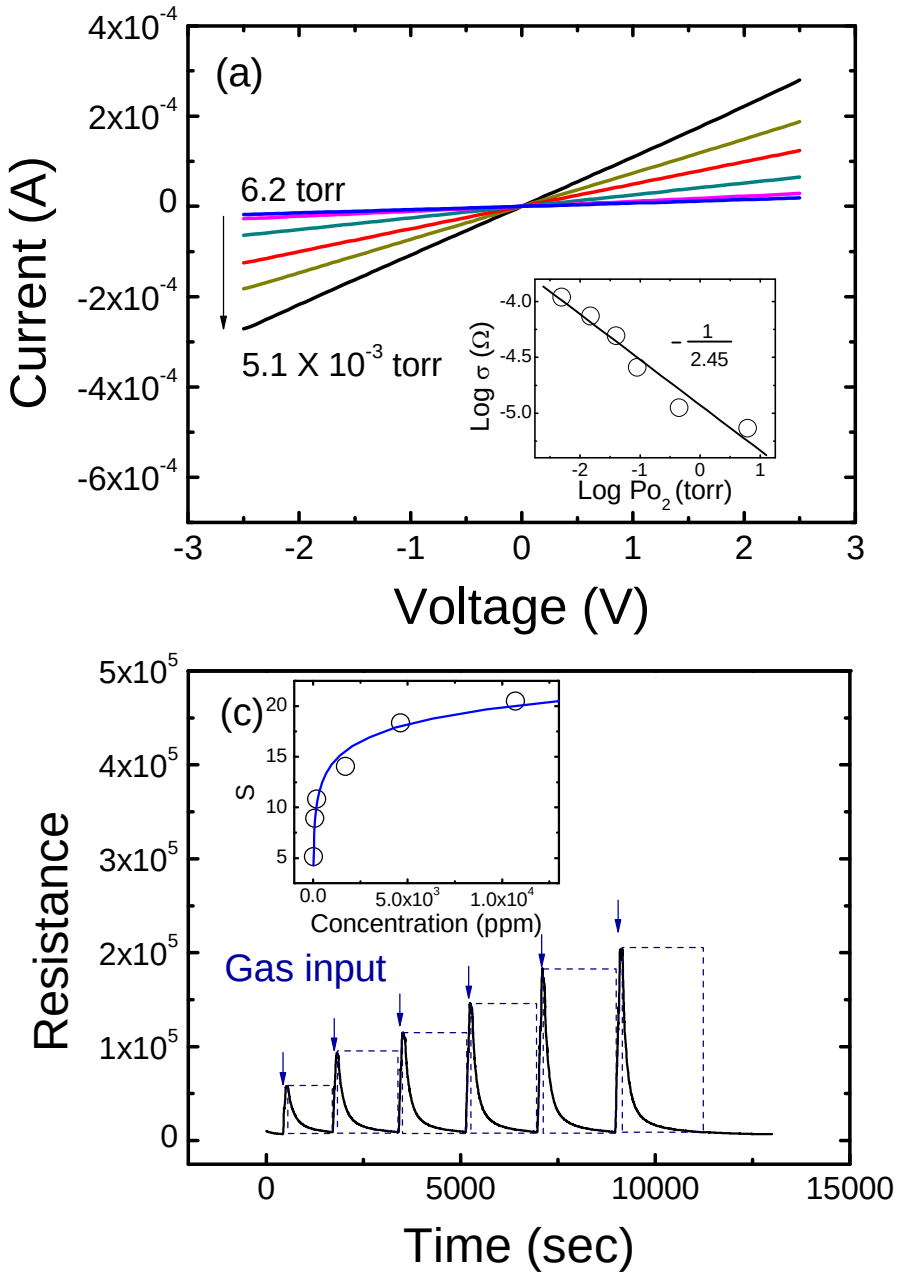

Figure 1 : (a) I-V behavior of the TiO_2-ZnO core-shell nanofiber sensor at various O_2 pressures at 573 K. The inset represents log σ versus log P_{O2}. The slope is -1/2.45, indicating *n-type* conduction is operating in the sensor. (b) Dynamic response of the sensor to oxygen pressure. The inset represents the variation of sensitivity as a function of oxygen pressure.