FABRICATION AND ETHANOL SENSING CHARACTERISTICS OF ZnO NANOWIRE GAS SENSORS

Dr. Rakesh Kumar Yadav, Dept. of Chemistry

Dr. C.V. Raman University, Bilaspur

Abstract

Given the success of ZnO nanowires synthesis in mass production, microelectromechanical system technology and ethanol-sensing features were used to manufacture ZnO nanowires gas sensors. At a working temperature of 300 ° C, the sensor displayed elevated sensitivity and quick reaction to ethanol gas.

Key words: ZnO nanowires, microelectromechanical, sensitivity.

Introduction

In latest years, one-dimensional nanostructures like carbon nanotubes[1], [2], Si nanowires, ZnO nanobelts, have drawn a good deal of attention owing to their excellent potential applications, such as solid-state gas sensor[3] components with excellent ability to overcome basic constraints owing to their ultra-high surface-to-volume ratio. Lately, gas sensors are manufactured using an individual carbon nanotube, S_nO_2 and $I_{n2}O_3$ nanowire. These sensors have outstanding reaction and recover features, but are not suitable for mass manufacturing SnO2 nanobelt piles have recently been used as a gas sensing material that overcomes the trouble of handling a single nanobelt / nanobelt.

Methodology

To reduce power consumption, ZnO nanowire gas sensors are manufactured on the silicon-based membrane inserted with Pt interdigitating electrodes. A heater, is also embedded with our previous production of WO_3 thin film gas sensor. The silicon-based membrane was prepared with the following steps:

1. Pt. heater and temperature sensors were sputtered on Si_3N_4 / SiO_2 /Si substrates and li patterned by various lift off methods;
2. The plasma-enhanced chemical vapor deposition SiON film, 1 mm thick, was placed as the insulating layer;
3. Sputtering the interdigitating electrode on the SiON layer; and
4. The 1.431.4 mm2 window in the area was formed by the KOH solution backside etching of silicon.

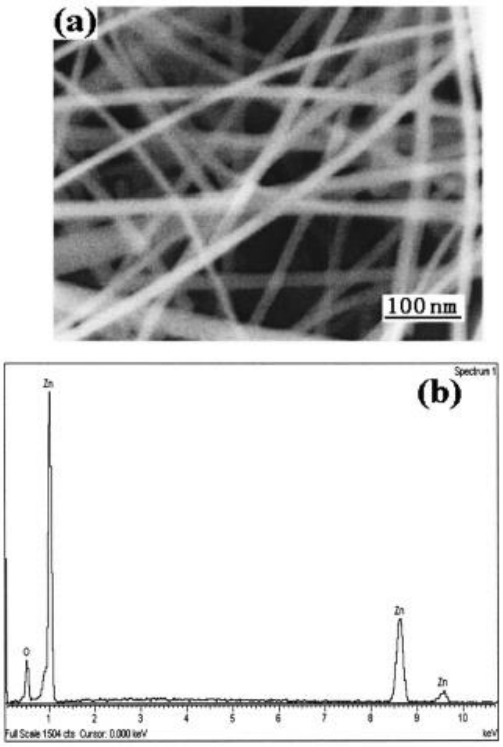

FIG. 1. (a) SEM image of the as-synthesized nanowires, and (b) energy-dispersive x-ray fluorescence (EDX) pattern of the synthesized sample.

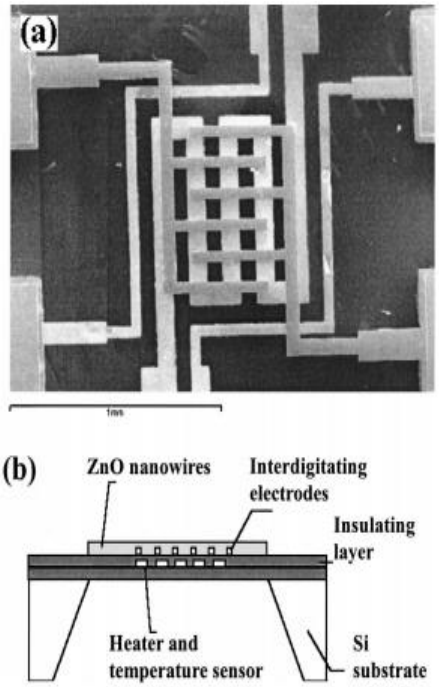

FIG. 2. (a) Top-view SEM image of the fabricated substrate embedded with Pt interdigitating electrodes and Pt heater, and (b) 3D schematic of the fabricated sensor structures.

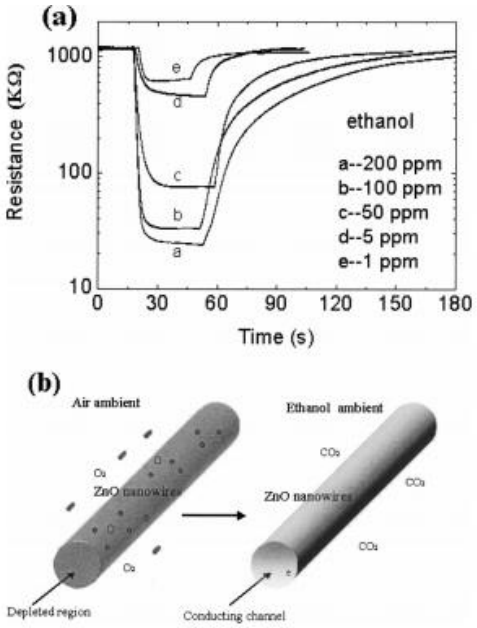

FIG. 3. (a) Response and recovery characteristics of ZnO nanowires upon exposure to ethanol with a concentration of 1–200 ppm at 300 °C, and (b)

Conclusion

The sensors for ZnO nanowire were manufactured using MEMS technology. The characteristics of ethanol gas are carefully studied. At a working temperature of 300 ° C, high sensitivity and quick response time were discovered. These findings show that ZnO nanowires can be used to make extremely delicate gas sensors as the gas sensing material.

References

[1] N. Naotoshi, "Chemistry of the Carbon Nanotubes," *Kobunshi*, 2005.

[2] M. Melchionna and M. Prato, "Functionalization of carbon nanotubes," in *Nanocarbon-Inorganic Hybrids: Next Generation Composites for Sustainable Energy Applications*, 2014.

[3] G. Korotcenkov, "Metal oxides for solid-state gas sensors: What determines our choice?," *Materials Science and Engineering B: Solid-State Materials for Advanced Technology*. 2007.