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Zinc Oxidethin film as H_2S Gas Sensor

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Abstract - The zincoxide thin film has been produced & examined as a sensing element forH2S gas detection. Dip coating was used to create the zinc oxide thin films. By varying the concentration of test gases, the gas sensing characteristics of zinc oxide thin films forH2S, LPG, & NH3 gases were investigated. The produced zinc oxide thin films are a potential material for high-sensitivity semiconductor gas sensors for dangerous gases such as H2S.

Keywords - zinc oxide, thin film, H_2S, gas sensor

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INTRODUCTION

H2S is a poisonous & combustible gas generated in sewage treatment plants, coal mines, & the oil & natural gas sectors. It is widely utilised in the chemical industry, research facilities, & as a process gas in manufacturing of heavy water. At these low levels, it is necessary to detect H2S. Low amounts of this gas may be detected by spectral and fluorescence analyses [2, 3], but these sensors are expensive and huge. Semiconductor gas sensors have shown to be a low-cost and practical alternative for monitoring gas species, as have metal oxide sensors based on SnO2, ZnO.

Semiconductor gas sensors have shown to be a low-cost & simple solution for monitoring gas species, & sensors based onmetal oxides such as SnO2,ZnO have been reported to detect H2S gas in the ppm range [4,5]. Low-concentration sensors have recently been identified [6,7].

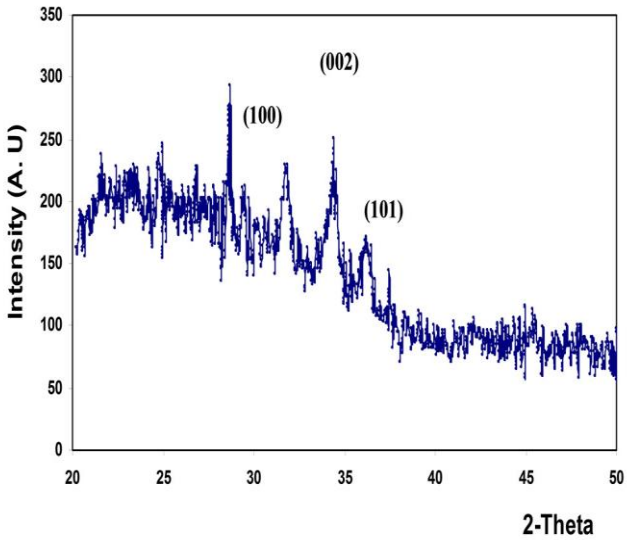
With a large excitation binding energy (60 meV) and a wide band gap (3.4 eV), zinc oxide (ZnO) has received a lot of attention for its electronic and photonic applications like ultraviolet (UV)/blue light-emitting devices, solar cells, piezoelectric devices, acousto-optical devices, and chemical sensors [8] and [9,10]. The development of gas sensors to detect volatile and harmful gases is now crucial due to concerns about environmental pollution and the safety demands of business and daily life. Because of its great electrochemical stability, non-toxicity, doping adaptability, and inexpensive cost, ZnO has been regarded a viable material for gas sensors. Because the detecting properties of a sensor are heavily dependent on form & dimensionality of the sensing material, several ZnO nanostructures have been manufactured & researched during last decade.

EXPERIMENTAL METHODS

Dip coating was used to deposit films on glass substrates (microscope slides). Before deposition, the substrates were washed using newly made chromic acid, followed by a detergent solution & distilled water. The precursor solution was produced in distilled water with a 0.1Mconcentration of high quality zincacetate (Zn (CH3COO)2) and swirled continuously for 1 hour at room temperature. This solution was placed in a beaker, and the pH was kept at 8. Another beaker is filled with hot water at 750oC. The cleaned glass plate was initially submerged for a few seconds in Zinc acetate solution before being immersed in hot water solution. This procedure is performed 50 times.

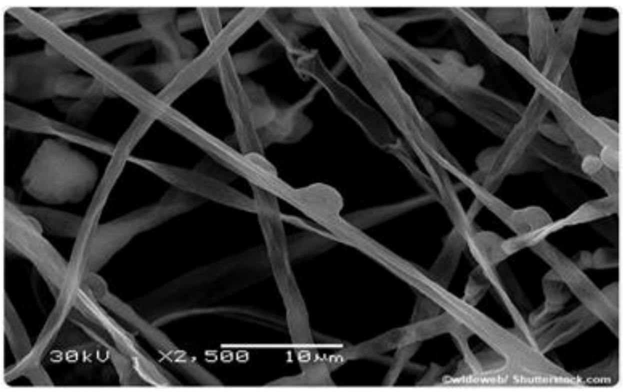
RESULTS & DISCUSSION

The XRD pattern of sample shows that films are polycrystalline in nature showing the lattice planes (100),(101) and (002) planes corresponds to that of ZnO.

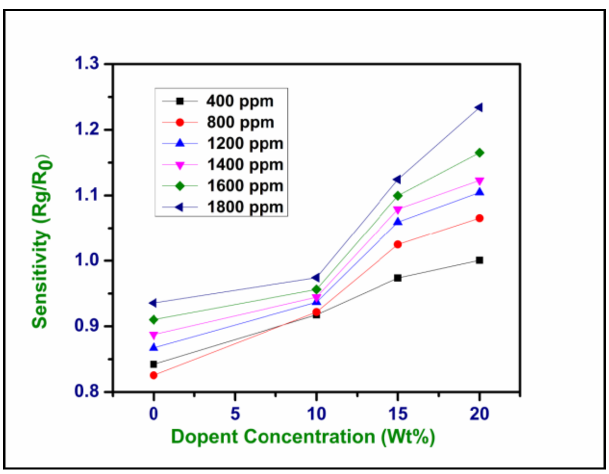


SCANNING ELECTRON MICROSCOPY

The SEM micrograph of ZnO is shown in figure above which shows flake like structure all over the plane surface.



GAS-SENSING STUDIES



The sensing properties of pure ZnO have been observed at room temperature (28^0C). It is found that the sensitivity variations with: (1) increase in H_2S gas concentration for pure ZnO nano composites sensitivity gets increased.

CONCLUSION

The structural, morphological, optical, & gas sensing characteristics of ZnO nanorods were investigated in this work. The ZnO nanorods are created using a simple dip coating process. The nanorods' structural analysis revealed a hexagonal wurtzite structure. For 30k resolution, flower-like bunches are formed, but for 60kresolution, the crystalstructure is rod-likein FESEM findings. The diameter of rod spans from 20nm to 93nm, with a maximum length of 961 nm discovered. The band-gapof ZnO synthesised with zincnitrate as a precursor and sodium hydroxide as a reducing agent was calculated using an absorption spectra. It was discovered to be 3.37 eV. This value is exactly the same as the advertised value. The thick films were made by screen printing & ranged in thickness from 25m to 35m. The nanocry stalline ZnO-based sensor had the best response to H2S gas.

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