Chemical Sensor using Pt –loaded ZnO Thick Film

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ABSTRACT: CPowders of nanostructured were prepared using ultrasonic atomization technique. These powders were characterized using XRD, SEM, EDAX and TEM. The average grain size was observed to be near about 20 nm. Thick films of this powder were prepared using screen printing technique. Platinum is loaded on nanostructured ZnO films using dipping pure ZnO films into an aqueous solution of chloroplatnic acid for different intervals of time. The detection of the pure and Pt-loaded nanostructured ZnO thick films was tested on exposure of hazardous chemical i.e simulants of CWA such as, dimethyl methyl phosphonate, 2-chloroethyl ethyl sulfide and 2-chloroethyl phenyl sulfide. Both the pure and Pt-ZnO thick films showed higher response to DMMP.

INTRODUCTION

Hydrogen sensing of thick films of nanoparticles of pristine, 0.2, 1.0 and 2.0 atomic percentage of Pt concentration doped ZnO were investigated. ZnO nanoparticles doped with 0.2–2.0 at.% Pt were successfully produced in a single step by flame spray pyrolysis (FSP) technique using zinc naphthenate and platinum(II) acetylacetonate as precursors dissolved in xylene. The particle properties were analyzed by XRD, BET, SEM and TEM. Under the 5/5 (precursor/oxygen) flame condition, ZnO nanoparticles and nanorods were observed. The crystallite sizes of ZnO spheroidal and hexagonal particles were found to be ranging from 5 to 20 nm while ZnO nanorods were seen to be 5–20 nm wide and 20–40 nm long. ZnO nanoparticles paste composed of ethyl cellulose and terpineol as binder and solvent respectively was coated on Al2O3 substrate interdigitated with gold electrodes to form thin films by spin coating technique. The thin film morphology was analyzed by SEM technique. The gas sensing properties toward hydrogen (H2) was found that the 0.2 at.% Pt/ZnO sensing film showed an optimum H2 sensitivity of ~164 at hydrogen concentration in air of 1 volume% at 300 °C and a low hydrogen detection limit of 50 ppm at 300 °C operating temperature.

Semiconductor sensors are widely used for gas sensing. One research interest in this field is the search for materials that exhibit high sensitivity and fast response times. Recently, semiconducting nanostructures have earned attention due to their huge surface-to-volume ratios. However, the band-gap energy of semiconductor is directly related to its preparation method. Wang and coworkers reported that size and composition induced band-gap change in nanostructured compound of II–VI semiconductors i.e. when the particle size decreased, the band-gap energy increased.