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Entitled

FABRICATION OF ORGANIC-INORGANIC HYBRID NANOCOMPOSITE BASED SENSOR FOR H_2S GAS DETECTION

by

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Abstract

Low power consumption, low limits of detection, and low cost are the compelling demands in the world of gas sensors development that motivate the search for new materials. Recently, gas sensors based on organic-inorganic nano-composite materials have attracted much attention due to their high performance and low working temperatures in comparison with the commercial sensors for Hydrogen sulfide (H_2S) gas. The development of H_2S gas sensors is vital because H_2S is one of the major air pollutants produced in large quantities in petroleum/natural gas drilling and refining. H_2S gas is extremely toxic, corrosive, and potentially lethal at low concentrations. The focus of this thesis project is to fabricate new gas sensors with high sensitivity and low working temperatures in order to reduce the power consumption. The aim of this work is basically to develop H_2S gas sensors with enhanced flexibility, low operating temperature, and high sensitivity and selectivity. The proposed sensor is fabricated based on the integration of nanotechnology and conducting polymer technology. Indeed, the sensor is fabricated using metal oxide semiconducting nanoparticles (NPs) such as Tungsten Oxide (WO_3) and Copper Oxide (CuO), embedded in a newly developed organic polymer (Chitosan) with engineered conductivity. The metal-oxide nanoparticles are mixed with the organic solution at certain concentrations to produce the sensing elements membranes using casting method. The electrical and gas-sensing properties of the organic-inorganic hybrid membranes formed by the casted doped-solution have been investigated. The results of this study show that the proposed sensors possess very good sensing properties and a reasonable average response time, which is in good agreement with previously reported work in the field of H_2S gas sensing applications. The best response of all the sensors to H_2S gas is obtained at 40°C, yet a reasonable response is noticed at low operating temperatures of 20°C. This reduction in operating temperature saves the power consumed by the heater to heat up the sensor. In addition to the aforementioned qualities, the sensors are characterized by their ease of fabrication, flexibility, good detection limit, and low-power consumption. Thus, this sensor has a promising potential to be utilized for monitoring H_2S gas in many industrial premises.

Keywords: H_2S sensor, toxic gas, sensor-based methods, sensor response time, WO_3, CuO.