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Design and Fabrication of Hydrogen Sulfide (H_2S) Gas Sensor Using PtSi/Porous n-Si Schottky Diode

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In this work, a gas sensor for the detection of H_2S gas based on a PtSi/porous n-Si Schottky diode was fabricated. N-type Si substrates were made porous and Pt was deposited into the pores electrochemically. Pt was annealed and the resulting PtSi/porous n-Si Schottky junction exhibits a breakdown-type behavior in the reverse bias mode. The shifts in their breakdown voltage in the presence of the hydrogen sulfide (H_2S) gas are mapped to the concentration of this gas in the environment. SEM images were taken to analyze the pores' structures. This sensor is able to respond to H_2S gas concentrations down to 10 ppm at room temperature and atmospheric pressure and down to 1 ppm at higher temperatures (50 and 80°C). The response time of this sensor is in the range of 3 to 10 s. The recovery time of the sensor is between 20 to 45 s. The response time and recovery time depend on the H_2S concentration and temperature. Responses of the sensor were tested for different polar (CO) and nonpolar (CH_4) gases for comparison purposes. Only one gas plus nitrogen were allowed to enter the furnace each time and their *I-V* characteristics were determined. The sensor responds differently to these gases. However, the main objective of designing this sensor was to sense the H_2S gas with different concentrations in an environment such as in the petroleum industry where this gas is predominantly present and is used to produce products such as sulfur and sulfuric acid. If there is more than one type of gas in an environment at the same time, the sensor does not determine how much concentration of what gas is present. That is the subject of a future work. The single-electron or Coulomb blockade effect seems to be the most reasonable explanation of the room-temperature sensing capability of this sensor.

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