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Sensitivity Improvement of PtSi/Porous Si Schottky Diode Gas Sensors

Mahdi Nazari and Saeid Khatami*

Amirkabir University of Technology, Department of Electrical Engineering,
Hafez Street, Tehran 1591634311, Iran

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In this investigation, PtSi/porous n-Si Schottky diode gas sensors on ⟨100⟩ n-type Si wafers were designed and fabricated, and their sensitivities to various concentrations of certain polar gases such as CO and nonpolar gases such as CO_2 were investigated at room temperature and compared with experimental data reported by others. The main objective of this work was to improve the sensitivity of these sensors to the aforementioned gases. These diodes operate at reverse bias mode at the breakdown region. The presence of certain gases inside the pores changes the breakdown voltages of the diodes, and the shift in the breakdown voltage is mapped into the gas concentration. Sensitivity is enhanced when the produced electric field due to the physical presence of the gas molecules inside pores is large enough to affect the Schottky reverse bias voltage. The porosity level and pores' geometry are determined to be key factors in improving the sensitivities of these sensors. The sensors fabricated in this work were able to sense 80 ppm CO gas and 40 ppm CO_2 gas in air, which were about 10−20 ppm or about 20% smaller than those reported by others. On the basis of the data obtained in this investigation, it is possible that these diodes can respond to much smaller concentrations of CO and CO_2 in air if the porosity level and pores' geometry are optimized.

*Corresponding author: e-mail: khatami@aut.ac.ir