ZnO:Na Nanostructure: A highly sensitive room temperature and oxygen-free environment carbon dioxide gas sensor

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Abstract

CO_2 is considered as one of the primary greenhouse gases in the Earth's atmosphere, Nevertheless, monitoring the content of the CO_2 in the environment and emissions is important. There is a highly significant need for CO_2 sensors for space and commercial application, as well. Those applications include low-false-alarm fire detection which detect chemical species indicative of a fire (e.g., CO_2 and CO). In this work, we are focusing on the carbon dioxide chemiresistive sensor under practical environment, i.e., atmospheric pressure, oxgygen free environment and room temperature by ZnO and ZnO: Na wrinkle network structure. The structural, optical, electrical properties using scan electron microscope and X-ray diffraction of the prepared film were studied. Sensor parameters such as dynamic response, response magnitude, response time and recovery time were studied at room temperature for different concentrations of CO_2 gas. The detection limit of the sensor from the sensor's signal processing performance was calculated to be 0.42 sccm. The dynamic response curves for ZnO and ZnO: Na for gas volumes of 20, 30, 40, and 50 cm^3 of CO_2 for 5 minutes in an inert environment at room temperature have been demnostrated. It can be observed for both cases that upon exposure to CO_2, the increased resistance of the ZnO film confirmed its n-type semiconducting behavior. For such new technique of gas sensing in room temperature, the sensor response mechanism can be attributed to direct charge transfer on metal conductivity with additional electron hopping effects on intertube conductivity through physically adsorbed molecules between the network nanostructur, another reson is the smaller particle size and thus larger surface-to-volume ratio of ZnO:Na in addition to the small band gap which enable ZnO: Na sensor to operate at room temperature.

Biography

Mohamed A Basyooni had completed his MSc from Nanophotonics and Applications (NPA) Lab, Department of Physics, Faculty of Science, Beni-Suef University. Currently, he is pursuing PhD in nanocomposites for satellie and space applications.

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