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Development of Highly Sensitive Room Temperature Gas Sensor using rGO-ZnO Nanohybrid

[1]Sunipa Roy*, [2]Swapan Das, [3]C.K. Sarkar

[1]Department of Electronics and Telecommunication Engineering, Guru Nanak Institute of Technology, Kolkata 700 114, India,

[2]IC Design and Fabrication Center, Department of Electronics and Telecommunication Engineering, Jadavpur University, Kolkata 700 032, India

[3]Department of Electronics and Telecommunication Engineering, Jadavpur University, Kolkata 700 032, India; and Physics Department, IIEST, Shibpur, Howrah711103, India

Progress of heterojunction based sensor by graphene (or its derivative) and metal oxides at nanoscale offered a new paradigm in the sensor study due to its high carrier mobility, lower gas adsorption/desorption energy, extended specific surface area and atomic scale detection ability of these hybrid structures. Tapping of valence band and conduction band at six different places makes the Graphene a low resistivity material which is the serious bottleneck in the field of gas sensor. The problem was delicately managed by incorporating its derivative i.e. reduced graphene oxide (rGO). Due to the presence of numbers of defect in rGO, it provides an improved amount of gas interaction sites which ultimately decrease the conductivity on the whole, at the same time preserving the high mobility and other exciting features of graphene. In recent years, to enhance the features of semiconducting metal oxides as well as rGO, the two materials were hybridized to optimize the different sensing parameters such as response magnitude, response time, recovery time, stability and also selectivity.

We report on development of room temperature hydrogen sensor based on zinc oxide nanoflakes (ZnO NFs) prepared by chemical deposition technique and reduced graphene oxide (rGO) prepared by electrochemical exfoliation technique. ZnO was deposited on a SiO2 (wet oxidation) coated p-Si substrate by dip coating technique. A heterojunction was fabricated by depositing rGO layer on top of ZnONFs. The configuration of ZnO NFs was verified by XRD spectra. The formation of rGO was confirmed by Raman spectroscopy. The surface morphology of ZnONFs, rGO and the interface between ZnO and rGO, all were characterized by field emission scanning electron microscopy (FESEM). Detail sensor study of the n- ZnO/p-rGO heterojunction was performed by taking two lateral catalytic metal (Pd-Ag) contacts deposited on the rGO layer. The response time of 19 s and the corresponding recovery time of 39 s were obtained for 100 ppm H2 in air at room temperature. The sensing mechanism was presented through a simplified energy band diagram.

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