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Room temperature gas nanosensors based on individual and multiple networked Au-modified ZnO nanowires

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Abstract

In this work, we investigated performances of individual and multiple networked Au nanoparticles (NPs)-functionalized ZnO nanowires (NWs) integrated into nanosensor devices using dual beam focused ion beam/scanning electron microscopy (FIB/SEM) and tested them as gas sensors at room temperature. Such important parameters as diameter and relative humidity (RH) on the gas sensing properties were investigated in detail. The presented results demonstrate that thin Au/ZnO NWs (radius of

60 nm) have a gas response of I_{gas}/I_{air} of about 7.5–100 ppm of H_2 gas which is higher compared to I_{gas}/I_{air} of about 1.2 for NWs with a radius of 140 nm. They have a low dependence of electrical parameters on water vapors presence in environment, which is very important for practical and real time applications in ambient atmosphere. Also, the devices based on multiple networked Au/ZnO NWs demonstrated a higher gas response of I_{gas}/I_{air} about 40 and a lower theoretical detection limit below 1 ppm compared to devices based on an individual NW due to the presence of multiple potential barriers between the NWs. The corresponding gas sensing mechanisms are tentatively proposed. The proposed concept and models of nanosensors are essential for further understanding the role of noble metal nanoclusters on semiconducting oxide nanowires and contribute for a design of new room-temperature gas sensors.