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Suspended Nickel Oxide Nano-Beam and Its Heterostructure Device for Gas Sensing

Authors : Kusuma Urs M. B., Navakant Bhat, Vinayak B. Kamble

Abstract : Metal oxide semiconductors (MOS) are known to be excellent candidates for solid-state gas sensor devices. However, in spite of high sensitivities, their high operating temperatures and lack of selectivity is a big concern limiting their practical applications. A lot of research has been devoted so far to enhance their sensitivity and selectivity, often empirically. Some of the promising routes to achieve the same are reducing dimensionality and formation of heterostructures. These heterostructures offer improved sensitivity, selectivity even at relatively low operating temperatures compared to bare metal oxides. Thus, a combination of n-type and p-type metal oxides leads to the formation of p-n junction at the interface resulting in the diffusion of the carriers across the barrier along with the surface adsorption. In order to achieve this and to study their sensing mechanism, we have designed and lithographically fabricated a suspended nanobeam of NiO, which is a p-type semiconductor. The response of the same has been studied for various gases and is found to exhibit selective response towards hydrogen gas at room temperature. Further, the same has been radially coated with TiO_2 shell of varying thicknesses, in order to study the effect of radial p-n junction thus formed. Subsequently, efforts have been made to study the effect of shell thickness on the space charge region and to shed some light on the basic mechanism involved in gas sensing of MOS sensors.

Keywords : gas sensing, heterostructure, metal oxide semiconductor, space charge region
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