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Involvement of Contact and Surface Phenomena in Nanolayered Amorphous Te Films for Toxic Gas Detection at Room Temperature

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Abstract

A fast responding NO2 sensitive device operating at room temperature has been realized using the nanolayered amorphous Te (a-Te) grown onto insulating wafer of silicon dioxide (SiO2) between Pt contact electrodes with larger thickness in a planar arrangement. The structure of the fabricated sensor has been investigated by AFM and SEM but its characterization was realized via studying the current - voltage characteristics, dynamic response, long – term stability and effect of humidity. Explanation of obtained results is given in terms of a model based on simultaneous involvement of contact and surface phenomena for the gas sensing. As the Pt electrode work function (5.43 eV) exceeds the respective value of a-Te (5.03 eV) the ohmic contacts are formed and the current flow is controlled exclusively by bulk resistance of a-Te nanolayer that is known to be controlled by type and concentration of toxic gas of the ambiance. Wherein, as the energetic forbidden gap of a-Te (0.33 eV) is less than the work function difference between contacting materials, at the contacts can arise the degenerate regions of p-type metallic Te, as well as geometric contact gaps originated from microscopically roughness. The gas adsorption inside these contacts gaps leads to increasing the portion of the semiconducting a-Te nanolayer turned into metal of p-type Te and consequently to a fast increasing of the current.

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Keywords: nitrogen dioxide sensitive devices, sensors, semiconducting nanolayers, gas sorption

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