CHALCOGENIDE BASED SENSITIVE LAYERS FOR WORK FUNCTION GAS AND HUMIDITY SENSORS

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In recent years a considerable attention has been given to the possibility of using chalcogenide glassy semiconductors as the sensitive layer in chemical sensors for the analysis of industrial solutions [1] and pollutant gases [2]. Normally the changes of the conductivity of these layers as sensitive parameter have been studied. A significant progress in investigating the sensing properties of these materials can be realized by means of Kelvin probe measurements. The piezoelectrically driven Kelvin probe is a simply and fast technique to monitor the variation of surface potential during adsorption and desorption of gases from environment [3, 4]. The KP equipment allows to measure the relative change of work function, $\Delta\Phi$, of the chalcogenide layer in the presence of a carrier gas and during the exposure to a gas mixture of interest.

In this work the authors report about characterization of chalcogenide based thin films, as a materials for gas – sensing applications. The sensing behavior of the As-S-Te-Ge films was tested with environmental pollutant gases such as NO_2, CO, O_3 and atmospheric humidity using the Kelvin probe technique at room temperature. A significant sensitivity has been observed for nitrogen dioxide. The detection range for NO_2 was between 0.85 – 1.9 ppm in ambient air. The response and the recovery time are rapid with good reproducibility and high sensibility. The work function measurements showed, that chalcogenide semiconductors in question are well suited materials for the detection of not only small concentrations of NO_2, but also for humidity sensing. The relative humidity of 45% induces the work function change $\Delta\phi$ approximately 200 mV at room temperature. The response and the recovery time (τ_{90}) is only a few minutes.

Our results include the scanning electron microscopy and X-ray diffraction investigations of sensitive films. We suggest that effect of water vapour is due to simple physical adsorption, whereas effect of oxygen and nitrogen is the consequence of “week” chemisorption of these molecules on the film surface. The NO_2 sensing mechanism involves “strong” chemisorption due to interaction between odd electrons of nitrogen dioxide molecules and lone – pair electrons of chalcogenide films.

As all measurements were performed at room temperature the real gas sensing applications are considered.

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