Nanocomposites and nanomaterials

Nanosized Pt/SnO_2 materials for adsorption semiconductor sensors for detection CO in air

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Nowadays increasing pollution of carbon monoxide in air due to transport and industrial emissions is observed. Since CO is a toxic gas, it is necessary to create different devices for detection of carbon monoxide in air. Adsorption semiconductor sensors because of their properties are very useful to use them as a detector of such devices. Sensitivity of the sensor toward carbon monoxide may be enhanced by adding catalysts to increase a rate of an oxidation reaction of CO by oxygen on the surface of a sensitive layer of the sensor. That is why the aim of the work was to obtain Pt/SnO_2 nanomaterials and study their gas sensitive properties to CO.

Nanosized material SnO_2 was prepared by a sol–gel method using $SnCl_4 \bullet 5H_2O$ and ethylene glycol. It was shown by TEM method that particle size of SnO_2 nanomaterial ranged from 5 to 30 nm (an average particle size was 17 nm). Only reflexes of the cassiterite phase were found in the analyzed nanomaterial using XRD method. Sensors with different Pt contents were created on the base of the nanosized tin dioxide nanomaterial by its impregnation with H_2PtCl_6 solutions of different concentrations (0.21×10^{-2} - 35×10^{-2} M). It was found that electrical resistances of the sensors increase with increasing the platinum content in the sensitive material of the sensors. A ratio of the electrical resistance of the sensor in air (R_0) to its electrical resistance in the analyzed gas with concentration of 900 ppm CO in air (R_g) was chosen as a measure of the sensor response ($\gamma = R_0/R_g$).

It was found that introducing platinum additives to the sensor sensitive materials increases the responses of the sensors in a great extent. An extremal dependence of the sensor response on concentration of H_2PtCl_6 solution was found. Besides, it was observed that maximums of the sensor responses were shifted to the region of lower concentrations of the H_2PtCl_6 solutions when temperatures of the sensors were increased. The highest sensors response to CO ($\gamma = 29.1$) is achieved for the sensor obtained by impregnation of nanosized SnO_2 with a solution of 0.84×10^{-2} M H_2PtCl_6 at the sensor temperature corresponding to its heater power consumption of 0.25 W.

A study of the catalytic activities of the sensor nanomaterials showed that their activities increased with increasing quantity of Pt in the content of the materials. The created sensors possess the fast response and recovery time.