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Techniques of improving the response magnitude for gas sensors based on ITO films

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Our investigation of the gas sensitive sensor structures based on Schottky barriers and heterojunctions demonstrates a noticeable adsorption sensitivity for the samples with a significant photovoltaic effect. Sensors, in which the sensing element is a nanostructured ITO (In_2O_3+SnO_2) film with an admixture of nickel, often have sufficiently low values of response to gas environment and photo-emf or even no response to light and adsorbate.

The sensors of this type are able to detect various gases at room temperature (T = 300K). However, their sensitivity and selectivity for different analytes are not high enough. So, it seems relevant to attempt an imporovement in performance of these sensors.

Our test samples were heterostructures of ITO film placed onto the silicon substrate. Three samples were investigated based on p-Si(100) KDB-10 substrates with the ITO (90% In2O3 + 10% SnO2) film deposited on top, film thickness being equal to 12 nm: 1) doped with 1% Ni, 2) doped with 5% Ni, 3) without Ni.

Our experimental analysis indicates that a short pre-exposure of our gas sensitive samples with a nanostructured ITO film (with pre-existing low sensitivity to a range of analytes) to high energy photons allows for an order of magnitude increase of their response to adsorption from gas environment and recovery time reduction after its interaction with the analyte.

Also the paper considers the influence of the so-called current spreading over the surface of our sensitive films on the shape of sensor's current-voltage characteristics (CVC). It is shown that applying an additional potential to the auxiliary electrode on the surface of the heterostructure can be helpfull to increase an effective area of the current spreading over the ITO film and thus significantly (dozens of times) increase the value of the adsorption response, for example 20 times in the case of ethanol.