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– Contribution –

Sensitivity of nanostructured tellurium films to low - reactive gases

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Electrical conductivity and impedance spectra of nanostructured tellurium thin films have been investigated in different gaseous media. The films were fabricated by thermal vacuum deposition of pure tellurium (purity 99.999 %) onto Pyrex glass or oxidized silicon substrates. It is shown that the grain dimensionality and properties of the grown Te films are determined either by the growth rate or post-deposition treatment. As shown by SEM, AFM and XRD, the rate of deposition most strongly influences the microstructure of the films and their gas sensing properties. The increase of the deposition rate results in the transformation of the microcrystalline structure of the film to a nanostructured one, or even to an amorphous state. It is pointed out that the nanostructured tellurium films exhibit sensitivity at room temperature not only to nitrogen dioxide [1] or hydrogen sulfide [2], but also to combustible and low - reactive gases such as H_2 and CO_2. Figure 1 reports the complex impedance spectra of nanostructured thin Te films upon exposure to molecular H_2, but figure 2 shows the dynamic response toward carbon dioxide, at room temperature. Analyses of impedance spectra in complex interpretation allowed evaluating the characteristic frequency, time constant, resistance and capacity of the film in these target gases, as well as their dependencies on aging and temperature. It is shown that the resistance first increases then decreases with temperature increase, which is due to a competition between the rates of adsorption – desorption processes and temperature increasing of conductivity, because of semiconductor properties of tellurium film.

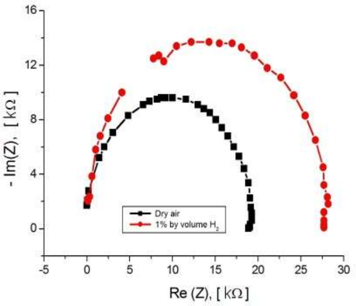

Fig. 1: Nyquist diagrams of nanostructured Te films in different environments

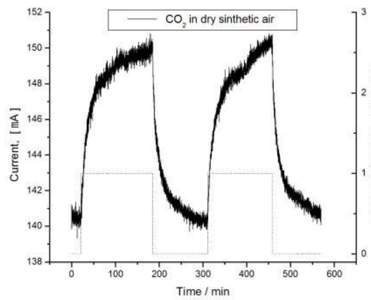

Fig. 2: Dynamic response to carbon dioxide at room temperature

Keywords: Nanostructured tellurium films; Gas sensors; H_2; CO_2.

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