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Chalcogenide-based chemical sensors for atmospheric pollution control*

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Abstract: 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 films was tested with environmental pollutant gases such as NO_2, CO, and SO_2. A significant sensitivity has been observed for nitrogen dioxide. The detection range for NO_2 was between 0.95–1.9 ppm in ambient air. The response and the recovery time is rapid, with good reproducibility and high sensibility. All the measurements were performed at room temperature. Gas-sensing applications are considered.

INTRODUCTION

Semiconductor gas sensors are most attractive because they are compact, sensitive, low-cost, and have low power consumption. Furthermore, the films should be achieved through relatively simple and reproducible preparation. Unfortunately, it is not so easy to get sensors where all mentioned advantages are combined. In order to achieve these properties, new sensing materials are required to exhibit different performances than the state of the art [1].

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 [2] and pollutant gases [3]. Significant progress can be obtained by investigating the changes of the conductivity of these layers as sensitive parameter.

The conductivity measurements are one of the oldest and one of the most sensitive methods used in surface physics. Adsorption processes, as well as alternatures of the surface structure, cause pronounced resistance changes. Various techniques for its studies such as photoelectric, thermoionic, or contact potential difference (Kelvin probe) methods, can be used [4].

In the present paper, the authors report about the response of thin films based on chalcogenide semiconductors of the ternary system As–S–Te to low NO_2 concentrations. In addition to this, it has been shown that these sensors exhibit a small sensitivity to other pollutant gases in air, such as SO_2 and CO.

EXPERIMENTAL

Ingots of As–S–Te were obtained by the melt-quenching method from pure Te, As, and Ge in evacuated quartz ampoules. Chalcogenide-based sensitive layers were prepared by thermal vacuum deposition onto glass substrates. It was performed under a working pressure of 10^{-5} Torr. The velocity of the film

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