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The Influence of the Lead Acetate Water Solution Temperature Background used for Synthesis of $Cd_xpb_{1-X}s$ Films, on their Sensor Properties for No_2

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Summary

The results of the water solution heating influence research of an initial component salt on the sensory properties of thin films CdxPb1-xS are presented. For the comparative evaluation, structure and functional properties the films synthesis was carried out from the reactionary mixtures with use a reagent that had undergone thermal treatment and the initial one. The influence of the initial heating of an salt aqueous solution on a thin film morphology is revealed at the content a nitrogen dioxide in air 105ppm, the relative change in ohmic resistance has reached 3,4. The dependence of a heating effect influence of initial PbAc2salt on the response of sensory elements is shown. The reversible character of gas adsorption process was investigated, which provides it possible to create reusable chemical sensors based on a CdxPb1-xS solid solution.

Keywords: Chemical semiconductor sensors; $Cd_xPb_{1-x}S$ thin films; Nitrogen dioxide

Introduction

Great interest, in connection with the modern level of development of the industry and technologies, represents a decrease in harmful effects on humans and the environment. Today, one of widespread pollutants of the atmosphere is nitrogen oxide. The nitrogen oxide, although is a natural component of the atmosphere, accounts for the most part of nitrogen oxide anthropogenic emissions. It accounts for about 6% of global warming due to the intensive artificial nitrogen fertilizers use and combustion of fossil fuel in internal combustion engines are the share. There is a question-how to control emissions and observance with standards. The registering devices are developed for this question solution. They can be divided proceeding from the work principle into the masses, thermal, electrochemical, electric, optical, magnetic, sensitive to change, etc. [1-4].

In a large amount of literature attention is paid to sensory elements on the basis of ZnO, SnO_2, TiO_2 and etc. [5-9]. However, these sensor elements operate at high temperatures, have a complex design. The most perspective of sensory elements is adsorptive-sensing elements due to their selectivity, simplicity of creation and low cost. The purpose of this work was assessment of preliminary heating influence of an $PbAc_2$ salt aqueous solution on structure, a response to NO_2 of a the hydrochemically precipitated the $Cd_xPb_{1-x}S$ solid solution films.

Experimental

For assessment the temperature influence of heating the initial $PbAc_2$ salt aqueous solution on ability to detect nitrogen dioxide, the aqueous solution of $PbAc_2$ salt was heated to 313K, held within 30min. After then, within 30min., waited for temperature alignment of a heated aqueous solution with environment temperature. Subsequently, thin films were deposited at a temperature of 353K on ceramic substrates within 120min. from a citrate-ammonia reaction mixture, with an initial $PbAc_2$ concentration is 0,2M. On the basis of the received thin films sensor elements with the sensing platform 5×5mm^2 were made. As electrical contacts nickel was electrochemical applied on a sensor element. When performing work was used nitrogen dioxide with initial concentration in the air environment 105ppm. The temperature of the gas-air mixtures was 295K, atmospheric pressure.

Resultand Discution

The films deposition occurs in the course of competing reactions lead sulfides formation and cadmium at interaction

of their salts with Thiocarbamidum [10]. In Figure 1 shows the response of the film to nitrogen dioxide at a concentration of 105ppm with a preliminary thermal treatment of an aqueous solution of $PbAc_2$salt (1) and an aqueous solution of salt, not undergone treatment (2). It was established that the molecules $NO_2$are adsorbed on the surface of the studied semiconductor films, reduce their ohmic resistance.

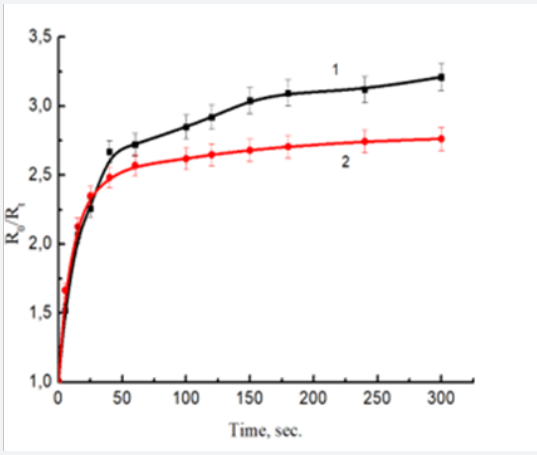

Figure 1: The response of sensory elements on the basis of thin films of $Pb_xCd_{1-x}S$ with a pretreatment to 313K and aging of 30 min. of the PbAc2 aqueous salt and without it (2).

It can be concluded from Figure 1 that preliminary heating of the $PbAc_2$ aqueous salt influences strengthening the sensory properties of the solid solution $Cd_xPb_{1-x}S$ to nitrogen dioxide detecting. Also we conducted the researches on assessment of a response selectivity which are not given in this article in the presence of such accompanying gases as O_2, CO_2, H_2 which showed that their contribution to the signal value in most cases does not exceed 3% in the conditions of excess of their contents over NO_2 by 10^3-10^4 times.

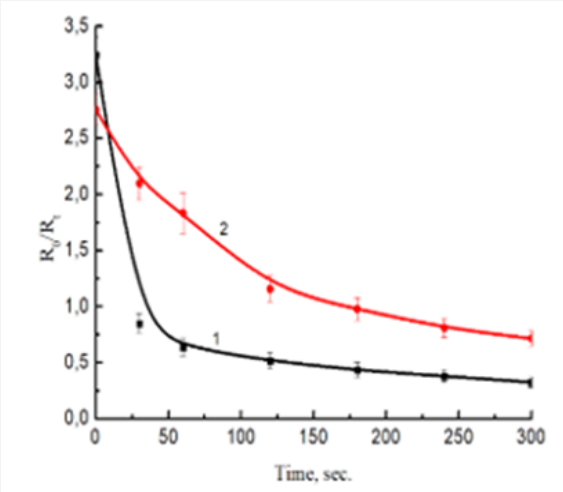

Figure 2: The regeneration of sensory elements based on PbxCd1-xS thin films with a pretreatment to 313K and aging of 30 min. of the aqueous salt of PbAc2(1) and without it (2).

For chemical sensors an important indicator is also their regeneration. In Figure 2 dependences the sensors regeneration after interaction with nitrogen dioxide to concentration 105ppm with the preliminary thermal treatment of the $PbAc_2$ salt aqueous solution (1) and an aqueous solution of salt that has not undergone treatment (2). As can be seen, the preliminary thermal treatment of an $PbAc_2$ salt aqueous solution also favorably affected touch elements regeneration. The complete recovery of the sensor elements resistance is reached for for sample 1 after 30min., for sample 2-about 2-3 hours. The reversible nature of the adsorption process makes it possibility of creation on the basis of the studied films of reusable chemical sensors.

Conclusion

In work were investigated influence of a preliminary thermal treatment of an aqueous solution of $PbAc_2$ salt on sensory and regenerative properties of the sensory elements made of a $Cd_xPb_{1-x}S$ solid solution thin films. It was revealed that the layers received with use of an aqueous solution of the $PbAc_2$ salt which underwent heating to 313K and sustained at this temperature of 30min. have the greatest response than the initial value of 2.7 to 3,5. The relative accuracy in the definition of nitrogen oxide sensory elements made ± (5-10)%. The reversible character of the NO_2 adsorption process provides a possibility to create on the based on the $Cd_xPb_{1-x}S$ films under study reusable chemical sensors differing in selectivity of a response.

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