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Photoabsorption effect in the thin films of the CdPbS solid solutions

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Abstract

In this work, we have attempted to detect the photoadsorption effect using various photoactivation sources of semiconductor layers of $Cd_xPb_{1-x}S$ solid solutions that are sensitive to the presence of nitrogen dioxide in air. For this purpose, $Cd_xPb_{1-x}S$ films (up to 600 nm thick) were synthesized from the citrate – ammonia reaction system by the chemical bath deposition (CBD) on glass and sitall substrates. Using XRD analysis, we determined the structure and composition of $Cd_xPb_{1-x}S$ solid solutions. It was found that all films crystallize in the cubic structure *B*1 of lead sulfide. Taking into account the content of the substituting component in the samples and comparing it with the equilibrium phase diagrams of the PbS-CdS system, we concluded that the obtained solid solutions are strongly supersaturated in nature. The cadmium content in the PbS lattice increases in films deposited on sitall and glass from 3.9 to 5.9 and from 4.3 to 5.4 at.% with an increase in the deposition time from 60 to 120 minutes, respectively. It must be noted that their crystallinity degree increases with increasing deposition time. The size of the particles forming the layers was determined by SEM microscopy. The predominant crystallite diameter is 250-300 nm. The sensory properties of films of $Cd_xPb_{1-x}S$ solid solutions with respect to the presence of nitrogen dioxide with a concentration of 100 mg/m^3 in air were studied using preliminary photoactivation by various sources with a radiation wavelength from 420 to 1000 nm. For the first time, a positive photoadsorption effect was revealed for CBD produced films of $Cd_xPb_{1-x}S$ solid solutions. The preliminary photoactivation of the films with a blue lamp (760–1000 nm) for 9–13 minutes allows the film to increase the response to NO_2 more than doubled. A high relaxation rate of $Cd_xPb_{1-x}S$ -based sensor elements after contact with nitrogen dioxide was shown to be 4–10 minutes, which allows to reuse it.

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