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Thematic course: Chemical bath synthesis of metal chalcogenide films. Part 34.

Dopant influence on functional properties of chemical bath deposed PbS films

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Abstract

Lead sulfide thin films are widely used in optoelectronics, being one of the most photosensitive materials in visible and near IR–spectral range (0.4-0.3 μm). One of the perspective ways of their synthesis is chemical deposition from aqueous solutions. Wherein doping additives are used for sensitization of deposed films. Influence of dopants (magnesium, calcium, copper(II) cadmium, gallium, iron(II) salts), which were added to the reaction mixture, on morphology, elemental composition and photoelectrical characteristics of chemical deposed PbS films is considered in article. According to the results of differential thermodynamic calculation of effective metal sulfides-dopants and lead sulfide solubility products, made an assumption about induction period enlargement due to addition to reactor with deposing PbS films magnesium, calcium and iron(II) salts. In turn, addition of copper(II), cadmium, and gallium salts increasing process speed of the emergence of solid PbS phase through heterogeneous mechanism due to relatively low solubility product values of their sulfides. 200-300 nm and having good adhesion to sitall substrate polycrystallic lead sulfide films were obtained by chemical bath deposition. Films are formed by particles with characteristic size from 20 to 60 nm. Kinetic research of transformation lead salt into sulfide in ammonium citrate system containing doping additive of calcium chloride showed its inhibition of PbS solid phase formation process. This process accompanied by induction period enlargement. PbS films were deposed in reaction mixture with concentration of magnesium, calcium, copper(II), cadmium, gallium, iron salts equal up to 10^{-3} mol/L. Measuring photoelectric characteristics of this films showed marked sensitizing effect of magnesium, calcium, gallium doping additives to visible IR-spectral range. This dopants increase volt-watt film sensitivity by 3-4 times.

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