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Thematic course: Chemical bath synthesis of metal chalcogenide films. Part 40.

Influence of hydrochemical deposition conditions of ZnS films by thioacetamide on their thickness and morphology

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Abstract

ZnS thin films are promising as a buffer layer in solar cells; photovoltaic cells, photoelectric sensors, light-emitting diodes are being developed on their basis. In this work, the growth kinetics of ZnS films has been studied during hydrochemical precipitation with thioacetamide from acidic (biphthalate, acetate) and alkaline (ammonia) aqueous solutions. From the biphthalate bath at pH = 2.5-3.0 at 343 K and from the ammonia reaction mixture at 293 K on glass substrates, mirror layers of zinc sulfide with a thickness of up to 250 and 330 nm were obtained, respectively. The maximum thickness of the ZnS films from the ammonia system is achieved by increasing the ammonia content in it to 5 mol/l. For all the ammonia concentrations used, an extreme dependence of the thickness of the ZnS films on the concentration of thioacetamide in the system was established. When precipitating ZnS films from the acetate system, lowering the pH of the solution from 5.0 to 4.5 increases their thickness by a factor of 1.5-2.0. On the kinetic curves of changes in the thickness of the ZnS films during deposition from the biphthalate system, an area is distinguished, which is characterized by the presence of a plateau, which presumably corresponds to the sulfidization process of the zinc hydroxide phase formed at the initial stage of synthesis. The optimal composition of the reaction mixtures and the recommended time of deposition of ZnS films from the studied reaction mixtures are proposed. According to electron microscopy, the main structural elements of the zinc sulfide films precipitated with thioacetamide, regardless of the composition of the reaction mixture, are globular aggregates. The layers precipitated from the biphthalate reaction mixture have more uniform microstructure with a predominant particle size of 30-50 nm. Films obtained from the ammonia reaction mixture are formed from globules with a diameter of from 0.5 to 5.0 μm with particles of ~ 100 nm interspersed. The content of the main elements (Zn, S) in the ZnS films obtained from the biphthalate and ammonia reaction mixtures, according to the data of energy dispersive microanalysis, was 49.48, 50.52 and 50.35, 49.65 at.%, respectively.

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