

Thematic course: Chemical bath synthesis of metal chalcogenide films. Part 32.

Chemical bath deposition of *n*-type thin films of HgSe by sodium selenosulfate

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Abstract

Thin films of binary semiconductor compound HgSe are of interest as materials for basic research due to its unusual band structure, as well as for practical use as IR detectors, IR emitters, tunable lasers, ultrasonic and gas sensors, catalysts, reflective materials, transducers of solar energy. Existing methods of producing semiconductor HgSe layers include physical and chemical principles. It is noted that chemical precipitation of mercury selenide with sodium selenosulfate, which excludes the formation of metal cyanamide, is promising method. Based on the idea of the reversible nature of the hydrolytic decomposition of sodium selenosulfate in aqueous solutions, a thermodynamic analysis of the conditions for the deposition of the main ZnSe and impurity Zn(OH)₂ solid phases was carried out in the alkaline systems “Hg(NO₃)₂ – NH₄SCN – Na₂SeSO₃” and “Hg(NO₃)₂ – NH₄SCN – NH₄I – Na₂SeSO₃” (pH = 8.9), and their boundary conditions of formation were established. The possibility of controlling the process of hydrochemical deposition of a film of mercury selenide, in particular, the preparation of nanocrystalline selenide of mercury by introducing an additional ligand, ammonium iodide, was experimentally shown. An REM study of the HgSe surface morphology revealed that the film from rhodanide reaction mixture is uniform and dense and has a bimodal distribution of particle size with maxima in the 60-80 nm and 140-160 nm ranges, globules are formed from smaller spherical particles.

There is a trimodal distribution in the rhodanide-iodide reaction system, size of particles increase in each maximum. The range is 140-160 nm for the first maximum, 220-240 nm for the second, and 300-320 nm for the third. EDX analysis established the non-stoichiometric content of basic elements (Hg: Se = 50.8; 49.2 at.%). In the HgSe film deposited from the rhodanide reaction mixture the introduction of ammonium iodide NH₄I to the mixture leads to a slight decrease in the composition of the mercury film to 50.20 at.%, a decrease in the selenium content to 47.14 at.% and the appearance of iodine in the amount of 2.66 at.%. According to the Hall EMF sign, mercury selenide films has the *n*-type of conductivity.

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