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Thematic course: Chemical bath synthesis of metal chalcogenide films. Part 41.

Hydrochemical deposition of thin films of cadmium selenide by sodium selenosulfate

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Abstract

The group II-VI semiconductor materials including Cadmium Selenide (CdSe) thin films are widely used in many fields of science and technology, in particular in optoelectronics, nanoelectronics and solar energy. Chemical bath deposition (CBD) represents the simplest and the most available technique for deposition of semiconducting layers. CBD is characterized by deletion of toxic gaseous precursors, operation at low temperature and using of inexpensive equipment. The ionic equilibriums in reaction mixture «$CdCl_2$ – L – Na_2SeSO_3» (L– NH_4OH or $Na_3C_6H_5O_7$ or mixture of NH_4OH and $Na_3C_6H_5O_7$) were calculated in present work. The prevailing cadmium complex compounds were determined in appropriate for CBD of cadmium selenide films pH range. The main complex compounds inhibiting fast formation of cadmium selenide are $Cd(OH)Cit^{2-}$ complex (in citrat- and ammonia-citrat mixtures) and $Cd(NH_3)_5^{2+}$ complex (in ammonia mixture). Also the boundary conditions of forming CdSe and $Cd(OH)_2$ in reaction mixture were determined by thermodynamic calculation based on crystallization factor to estimate the formation conditions of main (CdSe) and impurity ($Cd(OH)_2$) phases. The results of the calculations show that the solid phase of cadmium selenide is possible to form in pH range from 10 to 14. CdSe films were grown by chemical bath deposition on glass substrates at a temperature of 353 K. The thickness of films ranges from 100 to 220 nm. The grain size of films is about 30 nm which was determined by electron microscopic investigations. The elemental composition of cadmium selenide was defined by energy dispersive analysis; the ratio of cadmium and selenium is 1.03 : 1.16. The conductivity of *n*-type was determined by the sign of thermoelectromotive force.

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