Thematic Section: Research into New Technologies. **Full Paper**
Subsection: Inorganic Chemistry. *Reference Object Identifier* – ROI: jbc-01/18-54-4-119
The Digital Object Identifier – DOI: 10.37952/ROI-jbc-01/18-54-4-119
Submitted on March 17, 2018.

Thematic course: Chemical bath synthesis of metal chalcogenide films. Part 37.

Chemical bath deposition of ZnSe films with sodium selenosulfate

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Keywords: ionic equilibriums, boundary conditions for deposition, chemical bath deposition, sodium selenosulfate, thin films, zinc selenide.

Abstract

Zinc selenide is one of the most perspective materials for creating electroluminescent structures and lasers on its base which irradiate from blue to infrared specter range. Among existing methods of obtaining semiconductor ZnSe layers the most perspective is chemical bath deposition method which excludes unnecessity in high temperature heating, use of complex and expensive equipment for creation of deep vacuum. Analysis of ionic equilibriums in the system "$ZnCl_2 – H_2O – Na_3Cit$" showed that more than 99% of zinc ions in the solution with pH range $0 \le pH \le 9$ exist in the form of complex with citrate-ion $ZnCit^-$ and other complex forms of zinc are almost absent. With pH = 10.0-12.5 about 50% of zinc exist in solution in the form of neutral hydroxo complex $Zn(OH)_2$. Concentration of $Zn(OH)_4^{2-}$ complex in solution prevails with pH > 13. Thermodynamic estimation of boundary conditions of zinc selenide solid phase formation in the reaction system "$ZnCl_2 – Na_3C_6H_5O_7 – NH_2OH{\cdot}HCl – NaOH – Na_2SeSO_3$" allowed to conclude that with pH = 10-12.5 the formation of $Zn(OH)_2$ solid phase on sitall substrate is possible. This new surface acts as nucleation center for ZnSe solid phase condensation. Due to it, experimental check of possibility to depose zinc selenide with sodium selenosulfate was carried out in neutral range of pH = 6-7. As a result of carried out experiment of chemical bath deposition from the presented reaction mixture zinc selenide films of orange color and having good adhesion to sitall substrate were obtained. Thickness of deposed films reached 800 nm in dependence on deposition conditions. Energy-dispersive elemental analysis established content of main elements in layers, which was on the average for Zn (51.64±1.0 at. %) and Se (48.36±1.0 at. %). It says about lack of halogen in layers in comparison with formula composition. Possibly, it is related with zinc oxygen-containing phase formation $Zn(OH)_2$, which can be predicted in calculation. Shown, that freshly deposed zinc selenide layers have *p*-type conductivity which was established by thermoelectric power sign.

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