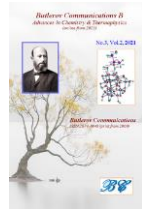
BUTLEROV HERITAGE

Butlerov Communications B
Advances in Chemistry & Thermophysics
ISSN 2074-0948 (print)

2021. Vol.2, No.3, Id.5.
Journal Homepage: https://b-journal.butlerov.com/



Thematic section: Thermodynamic Research.
Subsection: Technology of the Inorganic Substances.

Full Paper

The Reference Object Identifier – ROI-jbc-B/21-2-3-5
The Digital Object Identifier – DOI: 10.37952/ROI-jbc-B/21-2-3-5
Received 19 November 2021; Accepted 22 November 2021

Analysis of ionic equilibria and determination of the boundary conditions for the formation of solid solutions in the PbS–NiS system

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Keywords: ionic equilibria, boundary conditions of formation, hydrochemical deposition, thin films, lead sulfide, nickel sulfide, doping.

Abstract

The most attractive materials for solving the main problem of electronics have become diluted magnetic semiconductors, which are non-magnetic semiconductors in which some of the lattice atoms are replaced by atoms of magnetic transition metals. One of the promising materials that can be used for this purpose is narrow gap thin film PbS doped with nickel. The exchange interaction of electrons from partially filled d-shells magnetic ions of Ni with band charge carriers of the main semiconductor, PbS, can significantly change the properties of the latter and lead to the appearance of new phenomenon that can be promising for practical applications. Therefore, to determine the conditions for the formation of solid solutions $Ni_xPb_{1-x}S$, the analysis of ionic equilibria in the reaction system «$Pb(CH_3COO)_2$ – $NiCl_2$ – Na_3Cit – NH_4OH – N_2H_4CS» into sulfides. It was found that in the area of intense decomposition of thiourea (pH 11.8-12.2), the hydroxy-citrate complex of lead and ammonia complexes of nickel predominate. To assess the conditions for the deposition of the main and impurity phases (metal hydroxides and cyanamides) by thermodynamic calculations taking into account the sizes of critical nuclei, the boundary conditions and formation regions of PbS, NiS (α, β and γ modifications), $Ni(OH)_2$, $Pb(OH)_2$ in the studied reaction mixture. The calculation results are presented in the form of three-dimensional graphical dependences in the coordinates “indicator of the initial concentration of the metal salt – pH of the solution –

concentration of the ligand". On the basis of the calculations and preliminary experiments, the compositions of the reaction mixtures for carrying out the chemical deposition of films were formed. Chemical deposition at a temperature of 353 K for 90 minutes on glass substrates from the studied reaction mixture were obtained homogeneous NiPbS layers with a thickness of 260 to 360 nm.

For citation: Ekaterina S. Borisova, Andrey V. Pozdin, Larisa N. Maskaeva, Vyatcheslav F. Markov. Analysis of ionic equilibria and determination of the boundary conditions for the formation of solid solutions in the PbS–NiS system. *Butlerov Communications B*. **2021**. Vol.2. No.3. Id.5. DOI: 10.37952/ROI-jbc-B/21-2-3-5

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