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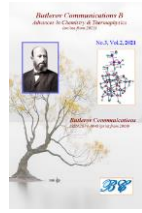

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Thermodynamic probability of formation solid solutions $Mn_xPb_{1-x}S$ by chemical bath deposition

Andrey V. Pozdin,[1] **Anastasia V. Beltseva**,[1]
Larisa N. Maskaeva,[1,2+] and **Vyatcheslav F. Markov**[1,2*]
[1] *Physical and Colloid Chemistry department. Ural Federal University named after the first President of Russia B.N. Yeltsin. Mira St., 19. Yekaterinburg, 620002. Sverdlovsk Region. Russia.*
Phone: +7 (343) 375-93-18. E-mail: larisamaskaeva@yandex.ru
[2] *Chemistry and Combustion Process Department. Ural State Fire Service Institute of Emergency Ministry of Russia. Mira St., 22. Yekaterinburg, 620022. Sverdlovsk Region. Russia. Phone: +7 (343) 360-81-68.*

*Supervising author; +Corresponding author

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Abstract

Currently, semiconductor compounds are being actively studied, in which a connection between electrical and magnetic properties is found; their attractiveness is due to the possibility of using them as an element base for microelectronics, spintronic devices, and sensor sensors. Compounds based on lead and manganese sulfides are of interest as promising materials. It is planned to obtain solid solutions in the PbS – MnS system by chemical deposition from aqueous solutions. In this regard, the development of conditions for the targeted synthesis of this compound is urgent. To determine the conditions for the codeposition of PbS and MnS, we used a computational method for predicting the boundary conditions of their formation developed at the Department of Physical and Colloidal Chemistry of the Ural Federal University and tried on a number of metal chalcogenides. The concentration regions of the formation of PbS and MnS were established in the reaction systems "$PbAc_2$ – $MnCl_2$ – Na_3Cit – NH_4OH – N_2H_4CS" and "$PbAc_2$ – $MnCl_2$ – $C_2H_8N_2$– Na_3Cit – N_2H_4CS" by analysis of ionic equilibria at a temperature of 298 K, which made it possible to establish the formation of both in the pH range favorable for the hydrolytic decomposition of thiourea and the precipitation of lead and manganese sulfides. Based on the calculations, the optimal composition of the reaction mix was determined, and it was experimentally established that the reaction system "$PbAc_2$ – $MnCl_2$ – $C_2H_8N_2$ – Na_3Cit – N_2H_4CS" seems to be the most promising for the preparation of solid solutions $Mn_xPb_{1-x}S$. Therefore, MnPbS films with a thickness of up to ~360 nm were obtained by chemical deposition from a citrate-

ethylenediamine mixture on sitall at a temperature of 353 K for 120 minutes. Electron microscopic studies of the synthesized films have shown that the layers have a homogeneous microstructure, representing well faceted crystallites ~200-300 nm in size. According to the sign of thermopower *n*-type conductivity of freshly deposited MnPbS films was established.

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