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KINETIC RESEARCH OF THE CHEMICAL DEPOSITION OF THE PBS SOLID PHASE BY THIOUREA

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Abstract. Along with the thermodynamic assessment of the conditions for the formation of the PbS solid phase during chemical deposition with thiourea, which we carried out earlier, the kinetic aspect of its study deserves due attention, which will allow us to get a presentation of the course of process and the growth of lead sulfide film depending on its duration. The main task of kinetic studies is not only to determine the rate of the transformation of a lead salt into a solid phase under conditions of spontaneous nucleation, but also to establish the rate of growth of a thin-film PbS layer.

Kinetic curves of lead salt consumption and PbS film growth from aqueous solutions containing 0,04 mol/l Pb $(CH_3COO)_2$, 0,3 mol/l $Na_3C_6H_5O_7$, 4 mol / L NH_4OH, and 0,58 mol/l $(NH_2)_2CS$ are shown in Figure. 1. The change in the concentration of lead salt was monitored by reverse trilonometric titration at pH = 10 with the indicator eriochrome black T. The deposition of lead sulfide films was carried out on preliminarily degreased glass substrates in sealed reactors at a temperature of 353 K in a TC - TB - 10 thermostat. The thickness of the synthesized PbS films was evaluated using an interference microscope (Linnik microinterferometer) MII-4M with a measurement error of 20%.

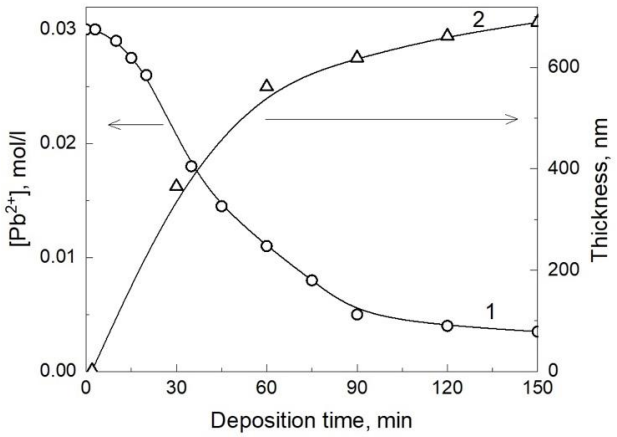

Figure 1 – Kinetic curves of consumption of lead salt (1) and growth of a PbS (2) from aqueous solutions containing $Pb(CH_3COO)_2$, $Na_3C_6H_5O_7$, NH_4OH, NH_4I и $(NH_2)_2CS$.

Technologically important in the chemical deposition of a semiconductor compound is a comprehensive study of the kinetic features of the consumption of lead salt in a reactor and the growth dynamics of thin-film PbS layers. As can be seen from the figure, the kinetic curve is S-shaped (curve 1), i.e. there is an induction period, the duration of which is ~ 5 min. The reaction rate of the interaction of lead ions with thiourea in an alkaline medium (curve 2) proceeds at a rate of 2 × 10−4 mol / (L min). After 110-120 min, the process of converting the lead salt to sulfide reached equilibrium. The most intense growth of the semiconductor layer thickness is observed in the first 30 minutes of synthesis to ~ 380 nm with an average rate of ~ 12.7 nm / min. Further exposure of the sitall substrate in the reaction mixture at 353 K for two hours leads to the growth of the film at a lower rate of ~ 2.7 nm / min to a thickness of ~ 700 nm.