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Thematic course: Chemical bath synthesis of metal chalcogenide films. Part 31.

Kinetic study of chemical co-deposition of lead and cadmium sulfides by thiocarbamide

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Abstract

Attention to $Cd_xPb_{1-x}S$ solid solution films has increased recently. They are challenging functional materials for optic and nanoelectronics, sensor engineering, and solar power engineering due to control of their electro physical properties. Among all the methods of producing $Cd_xPb_{1-x}S$ solid solution films, scientists prefer method of chemical deposition from aqueous medium because it excludes complex expensive equipment, heating to high temperatures and high-pressure atmospheres. Literature analysis shows that prevailing method is a compound approach to chemical deposition of solid solution thin films based on lead and cadmium sulfides. In the studies of thin film synthesis scientists from the Ural research school suggested kinetic thermodynamic method of prediction of individual metal chalcogenides chemical deposition. The kinetic study of PbS and CdS individual phases formation showed that kinetic curves have S-type shape that is typical for autocatalytic process where solid phase surface of corresponding sulfide plays the role of catalyst. In ammonium-citrated bath kinetic of PbS, CdS and $Cd_xPb_{1-x}S$ solid phase formation was studied in the conditions of controlled area of interphase surface that was presented by classified glass powder, preliminary covered with the layer of lead sulfide, cadmium sulfide or solid solution film based on them. It was determined that PbS film has higher catalytic effect, the lowest – the layer of CdS, $Cd_xPb_{1-x}S$ solid solution film has an intermediate position. By the kinetic study of co-deposition of lead and cadmium sulfides by thiocarbamide in the conditions of spontaneous solid phase formation, we derived formal kinetic equation of conversion speeds of lead and cadmium salts into PbS and CdS. The equations allow predicting compositions of $Cd_xPb_{1-x}S$ solid solutions based on the speed ratio. The experiment showed that the compositions of synthesized solid solution films $Cd_xPb_{1-x}S$ ($x \leq 0.22$) differ from calculated ones nothing more than 10-12%.

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