SYNTHESIS AND INVESTIGATION OF $Hg_3I_2Se_2$ COMPOUND

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Mercury chalcogenides films are wide-band-gap semiconductor materials that can be used in the fabrication of light emitting diodes, IR-detectors, inexpensive thin film solar cells, gas sensors and other optoelectronic devices.

Chemical deposition from aqueous solutions is one of the most promising methods for films obtaining. This method is well suited for thin films fabrication on large areas of arbitrary shape, since it is technologically simple and cheap.

For HgSe semiconductor films deposition were used the aqueous solutions of mercury nitrate (C = 0.007 M), potassium iodide (C = 0.03 M) as a complexing agent and sodium selenosulfate (C = 0.007 M) as a chalcogenizer. The synthesis duration varied from 24 to 48 hours at 20 °C.

According to X-ray phase analysis was established that films were double-phase and consist of $Hg_3I_2Se_2$ [1] ternary compound (monoclinic modification) and HgSe (cubic modification). The optical light-transmission spectrum has two bendings, which confirm the results of phase analysis. The established values of fundamental absorption edge are 2.61 eV (HgSe) and 2.22 eV ($Hg_3I_2Se_2$).

The atomic ratio of mercury to iodine and selenium of synthesized films are in Table 1. After annealing at 250 °C samples lost the most part of iodine atoms and at 300 °C the decreasing in mercury atomic % was observed, which correspond to the decomposition of mercury selenide.

Table 1

Elemental composition of $Hg_3I_2Se_2$ - HgSe films samples

Sample	Element	Weight %	Atomic %
$Hg_3I_2Se_2$+HgSe (20 ºC)	Hg	59,46	40,17
	I	15,02	16,02
	Se	25,52	43,81
$Hg_3I_2Se_2$+HgSe (250 ºC)	Hg	68,72	46,90
	I	1,74	1,88
	Se	29,54	51,22
$Hg_3I_2Se_2$+HgSe (300 ºC)	Hg	65,68	43,37
	I	1,50	1,57
	Se	32,82	55,06

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1. Minets Yu.V. Phase equilibria in the HgSe–$HgBr_2$–HgI_2 system and crystal structure of $Hg_3Se_2Br_2$ and $Hg_3Se_2I_2$ / Yu.V. Minets, Yu.V. Voroshilov, V.V. Pan'ko, V.A. Khudolii // Journal of Alloys and Compounds. – 2004. – vol. 365. – P. 121–125.