STUDY OF PHOTOELECTRON SPECTRA As (Sb) -Se-J SYSTEMS

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The paper presents a study of the peculiarities of photoelectron spectra in the region of incident photon energies 5-11.3 eV, obtained by the method of delay potential, of some compounds based on As (Sb) -Se-J in the crystalline and vitreous state, respectively, denoted by letters (k) and (a). All the presented compounds crystallize into similar structures in the form of -As (Sb) -Se- chains with a similar type of bonds between atoms, which makes it possible to trace the influence of atoms in the construction of the electronic structure of compounds.

The results of the research are shown in Table 1 for the excitation levels of the conduction band, which are denoted by the letters P_i, and Table 2 for the energy levels of the valence band, which are denoted by the letters A_i, respectively. Energy counts were performed from the Fermi level E_F. The accuracy of energy level determination is not worse than ± 0.1 eV.

Table 1 Features of energy levels of the conduction band of compounds As (Sb) -Se-J

Сполуки	E_F, eV	Енергії зони провідності, eV							
		P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8
As_2Se_3-a [1]	4,8	-	5,30	5,55	6,00	-	-	-	-
As_2Se_3-a	4,8	5,20	5,40	5,50	6,05	-	-	6,90	-
As_2Se_3-к	4,8	5,20	5,30	5,60	6,00	6,20	6,70	6,90	7,00
Sb_2Se_3-a [2]	4,8	-	-	-	5,90	-	-	6,90	7,40
Sb_2Se_3-к [2]	4,8	-	5,30	-	6,10	-	6,70	-	-
AsSeJ-a	4,8	-	5,40	5,50	6,05	-	-	-	-
SbSeJ-a	4,8	-	5,40	-	-	-	-	-	-

Table 2. Features of energy levels of the valence band of compounds As (Sb) -Se-J

Сполуки	E_V, eV	Енергії зони провідності, eV						
		$-A_1$	$-A_2$	$-A_3$	$-A_4$	$-A_5$	$-A_6$	$-A_7$
As_2Se_3-a [1]	1,0	-	-	3,10	-	-	-	-
As_2Se_3-a	1,0	2,60	2,95	3,20	3,60	3,75	3,90	4,50
As_2Se_3-к	1,0	2,60	3,00	3,35	3,60	3,80	3,90	4,55
Sb_2Se_3-a [2]	-	2,30	-	-	-	-	-	-
Sb_2Se_3-к [2]	1,1	2,70	-	-	-	3,70	-	4,40
AsSeJ-a	1,0	-	-	-	-	-	-	-
SbSeJ-a	1,0	-	-	-	-	-	-	-

Analysis of the presented data shows that the replacement of As atoms by Sb and the introduction of J atoms does not lead to a change in the position of the detected levels, but only to a decrease in the density of states, both conduction band and valence band. For AsSeJ and SbSeJ, the energy distribution curves of photoelectrons by energy represent the peak of scattered electrons on which no features of the electronic structure of the valence band were observed. The same Fermi level is observed for all the presented compounds, which may indicate a special contribution to the formation of the energy structure of the upper valence band and the conduction band by Se atoms. The change in the states of the compounds does not lead to significant changes in the position of the energy levels and is within the accuracy of the experiment ± 0.1 eV. The conduction band of the

investigated compounds is more structured. The paper uses data from works [1, 2] for comparison, which are in good agreement with the obtained results

Levels E_V are determined from the curves of the spectral distribution of photoemission - correspond to the position of the top of the valence band. As can be seen from Table 2, the position of the top of the valence band in all investigated compounds is formed at one energy close to 5.8 eV, only in Sb_2Se_3-k shifted by 0.1 eV below. The study of the spectral distribution of photoelectrons in the threshold region made it possible to estimate the value of the "tails" of the density of localized states in the band gap ΔE for As_2Se_3-a, they are ≈0.4 eV, for Sb_2Se_3-a ≈0.7 eV, for AsSeJ-a ≈0.4 eV. The accuracy of determining ΔE is not worse than ± 0.1. The value of ΔE for vitreous compounds largely depends on the production technology. Indirect optical transitions are possible in the threshold region of photoemission**.**

1. Коломиец Б.Т., Корнев К.П.,Коченмировский А.С. Фотоэмиссионные исследования стеклообразных полупроводниковых систем As-Se-Te, As-Sb-Se, As-S-Se/ - Физика и Химия стекла. 1982, т. 8, № 6, с.736-739.
2. Hurych Z., Davis D., Burek D., at al. Photoemission studies of crystalline and amorphous Sb_2Se_3. – Phys. Rev. 1974, 9, № 10, p.4392-4404.