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THE OPTICAL AND ENERGY PARAMETERS OF $As_{40}Se_{60}$, $As_{40}Se_{30}Te_{30}$, $As_{40}Se_{30}S_{30}$ CHALCOGENIDE GLASSES

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The chalcogenide vitreous semiconductors (CVS) are characterized by unique physical properties, has received special attention in connection with the broad forecast for using these materials in photolithography, holography, and microelectronics [1-3]

The purpose of this paper is to study the optical properties of chalcogenide glasses, with compositions $As_{40}Se_{60}$, $As_{40}Se_{30}Te_{30}$ and $As_{40}Se_{30}S_{30}$.The optical studies provide information on the relationship of the local structure and physical properties. The transmission spectra of the thin film with compositions $As_{40}Se_{60}$, $As_{40}Se_{30}Te_{30}$ and $As_{40}Se_{30}S_{30}$ were measured in the spectral range 190-1100 nm. The optical transmission spectra exhibit interference maxima and minima in the wavelength range 600 ÷ 1100 nm. The spectral dependencies, (T(λ)) have been reestablished in the transparency area to see more clearly the interference fringes. Change of the optical and energy parameters has established by analysis of the optical transmission spectra depending on the chemical composition. It has been shown that optical constants (n_0, k, E_0, E_d, E_g) investigated materials undergo a change depending upon the chemical composition. When half of selenium atoms are replaced by sulfur atoms the numerical values of the coefficients of refractive index (n_0) and extinction (k) for $As_{40}Se_{60}$ composition are decreased, but replaced by tellurium atoms numerical values of the coefficients are increased. A numerical value of the oscillator energy (E_0), oscillator strength (E_d), the band gap (Eg), determined according Tauc methods [4] and the dispersion increases with selenium replaced by sulfur atoms, but decreases by replacing tellurium atoms. Change of the refractive index is apparently due to a change in the molar volume of matter. The participation of sulfur atoms leads to a decrease of the molar volume, but tellurium atoms leads to the growth. In the first case, the polarization ability of a substance is weakened and in the second case, it is amplified, which is reflected in the values of the refractive index. The value of cohesive energy in $As_{40}Se_{60}$ is equal 41.2 kcal/mol. This value is less than in the composition of $As_{40}Se_{30}S_{30}$ (43.15 kcal/mol), more than in the composition of $As_{40}Se_{30}Te_{30}$ (36.95 kcal/mol).Such a change in bond energies and cohesive energy leads to the observed changes in the width of the band gap. It should be noted that a stronger change in the widths of the band gap in comparison with the composition of $As_{40}Se_{60}$ is observed in the composition of $As_{40}Se_{30}Te_{30}$. This different change of band gap apparently due to the fact that the atomic density obtains the highest values in the composition $As_{40}Se_{30}S_{30}$. The results are explained with changes in the degree of disorder and concentration local defects depending on the chemical composition.

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Superimposed equally oriented diffraction gratings formed in As_2S_3 films

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The known chalcogenide amorphous films are suitable materials for formation of composite diffraction structures due to their optical properties and advanced registration parameters. To obtain the multi-beam light diffraction the surface-relief diffraction structures composed of superimposed equally oriented gratings were formed.

Thermally deposited on glass substrates amorphous As_2S_3 films of 1.2 μm thickness were used for producing of diffraction structures. using electron beam recording. Two or three equally oriented diffraction gratings were recorded sequentially at the same location of As_2S_3 film at 23 kV acceleration voltage. In general grating period ranged from 0.8 μm to 4.0 μm. Surface-relief grating structures were formed by chemical etching in KOH water solution. Diffraction efficiencies of gratings were measured in transmission mode at normally incidence of laser beam (λ=0.633 μm). Diffraction patterns produced by various diffraction structures based on superimposed gratings were studied. Each of superimposed gratings produces own set of diffracted beams. For example, the diffraction pattern from structure composed of three superimposed gratings with grating periods of 1.8 μm, 1.9 μm and 2.0 μm is shown. In the case of superimposing of gratings with different grating periods the beating of spatial frequency results in appearance of extra diffracted beams that can be displayed as weak spots in corresponding diffraction pattern. Such beam "hosts" were predicted by modeling of the light diffraction pattern from grating structure using the Angular Spectrum propagation method. It was determined that in the case of optimized conditions of grating structure production the superimposing of gratings