XXII International Seminar on Physics and Chemistry of Solids

Book of Abstracts

June 17-19, 2020
Lviv, Ukraine

COMPOSITIONAL AND TEMPERATURE DEPENDENCE OF THE REFRACTIVE INDEX OF NEW ARGENTUM-BASED CHALCOGENIDE GLASSES

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According to [1], using a uniaxial model, the coefficient $\beta=dn/dT$ for solids in the region far from the phonon absorption bands ($\lambda > 10 \div 12$ μm) can be represented as a sum of two components:

$$\frac{dn}{dT} = -\frac{6\pi\chi_e}{n}\alpha - \frac{4\pi\chi_e}{n}\frac{1}{\omega_g}\frac{d\omega_g}{dT}\frac{1}{1-\left(\frac{\omega}{\omega_g}\right)^2}$$

where α is the coefficient of linear expansion, χ_e is the electron polarization (susceptibility), ω_g is the frequency of the oscillator. The first component occurs due to the change in the density of matter, the second - due to the temperature change of its electronic structure, that is, the change in the magnitude ω_g.

Given that the parameter $d_{\omega g}/dT$ is generally negative, the components (1) respectively have opposite signs. In the visible spectral region for the ChSG system, the predominant contribution to dn/dT is made by the first component. As the proximal self absorption band ($\omega \rightarrow \omega_g$) approaches, the contribution of the second component increases, and for certain (characteristic) wavelengths λ_0, these components are mutually balanced ($dn/dT = 0$), and for the wavelengths smaller than some limiting λ_0 the second The component determines the sign of the temperature derivative n. In addition, the obtained results indicate that the value of λ_0 depends on the size of the band gap of the glasses under study, or in other words, the smaller ω_g, the greater λ_0. For the studied glasses, the determined values of λ_0 are in the range of 1-3 microns. Among the studied alloys of the Ag-As-S system, only the stoichiometric composition of As_2S_3 takes the value $dn/dT = 0$ with a defined value of λ_0 equal to ~ 0.96 μm. For other compositions, the values $\lambda_0 \rightarrow dn/dT = 0$ are outside the studied region of the spectrum. The negative value of the coefficient dn/dT indicates the fact that in the investigated part of the spectrum, the temperature change of the density of glasses plays a dominant role.

[1] Y.F. Tsay, D. Bendov, S.S. Mitra, Phys. Rev. B. 8(6), 2688 (1973).