

DIELECTRIC AND OPTIC PROPERTIES
OF Bi₂Se₃ SINGLE CRYSTALS
INTERCALATED BY IODINE

Y. M. Stakhira, N. K. Tovstyuk

I. Franko Lviv National University,
Chair of Semiconductor Physics
(50, Dragomanova Str., Lviv UA-79005, Ukraine))

S u m m a r y

Influence of system dimension on the polarization properties of the electron subsystem of a layer crystal is studied. The frequency and disperse dependence of permittivity components (or absorption factor and refraction index) is calculated for crystals with different dimensions within the frame of the random phase approximation. The type of frequency dependence is caused by screening effects of the electron-electron interaction in strongly anisotropic crystals with the nonparabolic dispersion law $E(k_x, k_y, k_z) = \alpha(k_x^2 + k_y^2) + t(1 - \cos k_z)$ which allows one to consider: i) 1D-case ($\alpha = 0$) describing the dispersion law of carriers along the anisotropic axis k_z , ii) 2D-case ($t = 0$) describing the carriers moving in the XOY plane, iii) 3D-isotropic case is received from the above one at increasing $t (t \rightarrow \pi^2 \alpha)$, otherwise ($t \ll \pi^2 \alpha$) we deal with a 3D anisotropic case if $\epsilon_F < 2t$ and a quasi-2D-case if $\epsilon_F > 2t$. A frequency alternating oscillation of the permittivity real component of systems with different dimensions is received. The higher the dimension, the lower is its amplitude. The received results are compared with experimental data on a Bi₂Se₃ single crystal intercalated by iodine. It is shown that the theory qualitatively explains the permittivity real component dependence on frequency $\epsilon_1(\Omega)$ at $\Omega > 10^5$ Hz. The lower the dimension, the closer is the calculated value of Ω to the experimental one at which the amplitude of the alternating oscillation occurs, and the greater is the divergence of the received amplitude values. Without taking into consideration the polarization effects caused by the ion subsystem, namely, ion displacement and orientation polarization, the above divergence between experimental and theoretical data takes place.