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Optical Properties of TlInSe$_2$<AU> Single Crystals

Authors : Gulshan Mammadova

Abstract : This paper presents the results of studying the surface microrelief in 2D and 3D models and analyzing the spectroscopy of a three-junction TlInSe$_2$<Au> crystal. Analysis of the results obtained showed that with a change in the composition of the TlInSe$_2$<Au> crystal, sharp changes occur in the microrelief of its surface. An X-ray optical diffraction analysis of the TlInSe$_2$<Au> crystal was experimentally carried out. Based on ellipsometric data, optical functions were determined - the real and imaginary parts of the dielectric permittivity of crystals, the coefficients of optical absorption and reflection, the dependence of energy losses and electric field power on the effective density, the spectral dependences of the real (σ_r) and imaginary (σ_i) parts, optical electrical conductivity were experimentally studied. The fluorescence spectra of the ternary compound TlInSe$_2$<Au> were isolated and analyzed when excited by light with a wavelength of 532 nm. X-ray studies of TlInSe$_2$<Au> showed that this phase crystallizes into tetragonal systems. Ellipsometric measurements showed that the real (ε_1) and imaginary (ε_2) parts of the dielectric constant are components of the dielectric constant tensor of the uniaxial joints under consideration and do not depend on the angle. Analysis of the dependence of the real and imaginary parts of the refractive index of the TlInSe$_2$<Au> crystal on photon energy showed that the nature of the change in the real and imaginary parts of the dielectric constant does not differ significantly. When analyzing the spectral dependences of the real (σr) and imaginary (σi) parts of the optical electrical conductivity, it was noticed that the real part of the optical electrical conductivity increases exponentially in the energy range 0.894-3.505 eV. In the energy range of 0.654-2.91 eV, the imaginary part of the optical electrical conductivity increases linearly, reaches a maximum value, and decreases at an energy of 2.91 eV. At 3.6 eV, an inversion of the imaginary part of the optical electrical conductivity of the TlInSe$_2$<Au> compound is observed. From the graphs of the effective power density versus electric field energy losses, it is known that the effective power density increases significantly in the energy range of 0.805–3.52 eV. The fluorescence spectrum of the ternary compound TlInSe$_2$<Au> upon excitation with light with a wavelength of 532 nm has been studied and it has been established that this phase has luminescent properties.

Keywords : optical properties, dielectric permittivity, real and imaginary dielectric permittivity, optical electrical conductivity
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