

DSCM P64 EXCITONIC SPECTRA AND BIREFRINGENCE IN TlGaS₂ SINGLE CRYSTALS

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TlGaS₂ crystals belong to triple thallium chalcogenides with well-pronounced lamellar structure. Due to specificity of crystal structure these crystals have a strong anisotropy of physical properties. The authors of Ref. [1] report about a high sensitivity of TlGaS₂ monocrystals in x-ray diapason at energies 25 - 50 keV. The dependence of the crystal conductivity on intensity of x-ray radiation dose has a power character. Raman scattering spectra for different geometries and their temperature dependences for temperatures 77 - 400 K were investigated in TlGaS₂ crystals. The vibrational spectra of reflection in region 50 - 4000 cm⁻¹ were investigated and the polar vibrational LO and TO modes and their main parameters were distinguished. The calculations of relative effective charges of anions and cations in E||a and E||b polarizations show a difference of its ionicity degree along axes a and b [2]. These materials were intensively investigated (see Ref. [2] therein).

The crystals grown by Bridgmann method have 2×1×1 cm size and easy split off. The optical measurements were carried out on computerized spectrometers MDR-2, SPECORD M40 and JASCO-670. The low-temperature spectra were measured on samples mounted on cold-finger of Helium optical cryogenic system LTS-22 C 330.

The structure of TlGaS₂ is described by C_{2h}⁶ space group according crystallographic data. The unit cell has eight formula units. The main motive of structure is formed by tetrahedral polyhedrons Ga₄S₁₀ consist of four tetrahedrons of GaS₄. The structure TlGaS₂ is pseudo-tetragonal since a = b = 10.31 Å, c = 15.16 Å and β = 99.7°. The narrow peak at 2.605 eV due to forming of direct exciton in Brillouin zone center is observed in region of edge absorption at temperature 1.8 K in E||c polarization. Since crystals TlGaS₂ are cleft perpendicular to crystallographic axis c that absorption spectra are measured for two polarizations of light waves E||a and E||b. Absorption spectra of crystals TlGaS₂ were measured in E||a and E||b polarizations at temperatures 9 - 300 K. The excitonic peaks are observed in both polarizations and shifted to higher energies. The temperature shift coefficient of exciton maxima β is equal to 2.4×10⁻⁴ eV/K and 3.5×10⁻⁴ eV/K in E||a and E||b polarizations, respectively. The value of absorption coefficient in excitonic peaks maxima corresponds to 4000 cm⁻¹. The indirect transitions considerably situated at energies 2.3 - 2.5 eV are not observed by us in both absorption spectra and wavelength modulated transmission spectra. The interference was observed in wavelength modulated transmission spectra measured at temperature 14 K at energies E < 2.55 eV.

Ground and excited states of excitons were found out in reflection (R) and wavelength modulated reflection (ΔR/Δλ) spectra of E||a and E||b polarizations. The main parameters of B_{2u} (series A) and B_{3u} (series B) excitons and bands in *k* = 0 were determined. The optical reflection and wavelength modulated reflection spectra of TlGaS₂ crystals in E||a and E||b polarizations at temperatures 14 K and 300 K were investigated. The features associated with direct electron transitions in actual points of Brillouin zone were revealed. The optical functions (n, k, ε₁ and ε₂) indicating about anisotropy of optical parameters and electron transitions for wide energy diapason (2 - 6 eV) were calculated by Kramers-Kronig method from measured optical reflection spectra. Crystals TlGaS₂ deposited between crossed polarizers are isotropic near wavelengths 493 nm (300 K) and 483 nm (14 K). Refractive indices for E||a and E||b polarizations intersect at these wavelengths. The refractive indices intersection was observed and for intrinsic absorption region.

[1] S.B. Vahrusev et al. *JETF Letters*, (1984), **39**(6), 245.

[2] N.N. Syrbu et al. *Semiconductors*, (1992), **26**(2) 232.