Contributed Talk

Birefractive Effects in Crystals and Quantum Wells

Victor Zalamai[1], Nicolae Syrbu[2]

[1] *Institute of Applied Physics, Chisinau, Rep. of Moldova*
[2] *Technical University of Moldova, Chisinau, Rep. of Moldova*

Double refraction or **birefringence** is an effect of the light splitting into two components in anisotropic media. If a light ray falls perpendicular to the surface of the crystal, then on this surface it splits into two rays. The first ray continues to propagate directly, and is called ordinary; the second ray is diverted to the side, and is called extraordinary. It was first discovered by the Danish scientist Rasmus Bartholin on a crystal of Iceland spar (calcite) in 1669.

When light waves propagate along the **c** axis in ZnP_2 crystals of D_4^8 symmetry, optical activity (rotation of the polarization plane of light waves) is observed. In directions perpendicular to the optical axis **c**, it is absent. In these directions, the crystal has a linear birefringence. The refractive indices for the polarizations E||a and E||b intersect at a wavelength of 612 nm (λ_0). This point is named isotropic point or isotropic wavelength. At a temperature of 9 K, the wavelength λ_0 is shifted to the short-wave region in accordance with the temperature coefficient of the displacement of the absorption edges for the polarizations E⊥c and E||c. Such a crystal is a phase plate in which two light waves propagate with different velocities.

$CdGa_2S_4$ crystals possess a natural optical activity. The symmetry of the crystal $CdGa_2S_4$ (the space group S_4) is such that the optical activity along the **c** axis is absent and manifests itself only in directions perpendicular to this axis, where it is weak in comparison with linear birefringence. For this reason, it is possible to observe the gyrotropy in its pure form.

The anisotropy of the optical spectra at 300 and 10 K of $ZnAl_2Se_4$ crystals doped with cobalt is investigated. The intersection of the spectral dependences of the refractive index for ordinary and extraordinary light waves (isotropic wavelengths - λ_0, λ_{01}, λ_{02} and λ_{03}) is found in the region of electronic transitions from the levels of Co^{2+} ions and in the depth of the absorption band (λ_{04}, λ_{05}, λ_{06} and λ_{07}). It is established that the spectral dependence $\Delta n = n(E \perp c) - n(E \| c)$ intersects the zero axis for all values of isotropic wavelengths, both in the transparency region and in the depth of the absorption band. The bands of the reflection spectra of crystals in parallel and crossed polarizers at isotropic wavelengths have a half-width of ~ 7-15Å. The absorption coefficient at isotropic wavelengths varies from 10 to 10^3 times. On $ZnAl_2Se_4$ crystals doped with cobalt, narrow-band filters for various wavelengths can be created.

Reflective spectra had been researched in $In_{0.3}Ga_{0.7}As$ quantum layers, modulated by the reflection and transmittance wavelength at P, P (S, S) and 45^o, 45^o (135^o, 135^o) light-wave polarizations at an incident angle near to the normal and Brewster ones. Isotropic wavelengths λ_0 - 1.137 μm (1.09 eV), λ_{02} - 1.11 μm (1.12 eV) and λ_{03} – 0.932 μm (1.09 eV) had been revealed. The refractive indexes n for P, P (S, S) and 45^o, 45^o (135^o, 135^o) are intersecting for these wavelengths and theirs difference $\Delta n = n_{PP} - n_{SS}$ ($\Delta n = n(45^o) - n(135^o)$) intersects the null axis. The isotropic wavelength (λ_0) is shifted towards the long wavelength region at Brewster angle in reference to the case of perpendicular incidence of light (ц = 7^o) on the QW surface.