EXCITONIC POLARITONS IN $ZnAs_2$

V.V. Zalamai[1], N.N. Syrbu[2], I.G. Stamov[3]
[1]*Institute of Applied Physics, Academy of Sciences of Moldova, Chisinau, Republic of Moldova;*
[2]*Technical University of Moldova, Chisinau, Republic of Moldova;* [3]*T. G. Shevchenko State University of Pridnestrovie, Tiraspol, Republic of Moldova;*
*E-mail: zalamaiv@phys.asm.md

Exciton polaritons of $ZnAs_2$ nanocrystals were investigated. Parameters of singlet excitons (A) with $\Gamma_2^-(z)$ symmetry and orthoexcitons (B) $2\Gamma_1^-(y)+\Gamma_2^-(x)$ were determined. Spectral dependences of normal and anomaly dispersions of refractive index were calculated from interferential reflection and transmission spectra. It was shown, that A and B excitonic series were due to by hole V_1 and electron C_1 bands. The values of effective masses of electrons ($m_c^* = 0.10m_0$) and holes ($m_{v1}^* = 0.89m_0$). It was revealed that the hole mass m_{v1}^* changes from $1.03m_0$ to $0.55m_0$ at temperature increasing from 10 K to 230 K and the electron mass m_c^* does not depend on temperature. The integral absorption A ($eV \bullet cm^{-1}$) for states n = 1, 2 and 3 $\Gamma_2^-(z)$ excitons obeys to the dependence $A_n \approx n^{-3}$ it is characteristic for S-type exctionic functions. Temperature dependences of ground states integral absorption for $\Gamma_2^-(z)$ and $\Gamma_2^-(x)$ excitons differ. The ground states C and D excitons formed by V_3 - C_1 and V_4 - C_1 bands were found out and its parameters were determined.

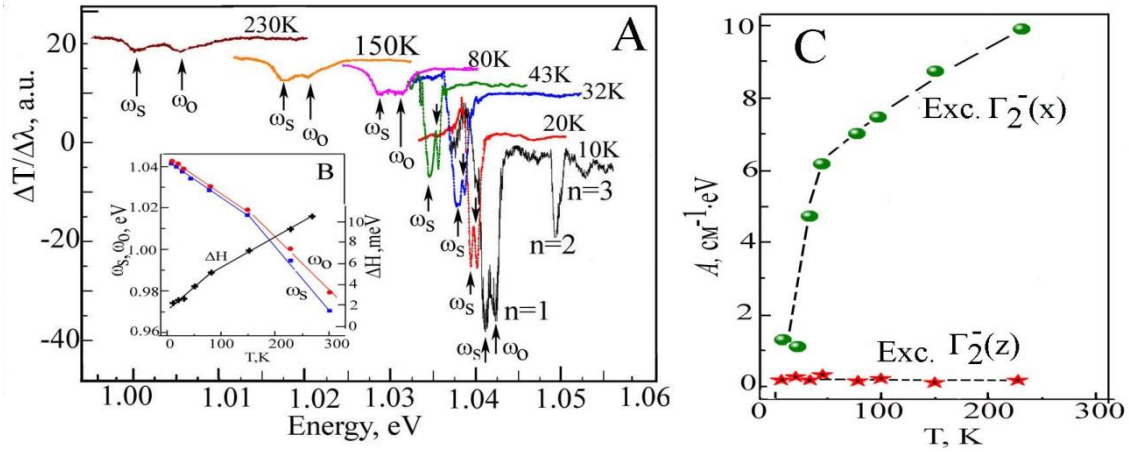

Fig. 1, A - Wavelength modulated transmission spectra ($\Delta T/\Delta\lambda$) of $ZnAs_2$ crystals of 17 μm thickness measured in E⊥c polarization. B - Temperature dependence ω_s, ω_0 and half-width absorption band ΔH. C - Temperature dependence of integral absorption of excitons $\Gamma_2^-(z)$ and $\Gamma_2^-(x)$ ground states (n = 1).

Contours of wavelength modulated transmission spectra ($\Delta T/\Delta\lambda$) in E⊥c polarization shift to long-wavelengths with temperature increasing, fig. 1, A. Simultaneously the bands minima ω_s and ω_0 move apart energetically and its half-width (ΔH) changes, fig. 1, B. A ω_s, ω_0 and ΔH change gradient change in temperature range 100 - 130 K, what is evidence of different temperature shift coefficients of bands responsible for $\Gamma_2^-(z)$ and $\Gamma_2^-(x)$ exctionic lines. Quantitative estimates of integral absorption A ($eV \cdot cm^{-1}$) have been made for absorption coefficients received form Kramers-Kronig analysis of reflection spectra for n = 1, 2 and 3 $\Gamma_2^-(z)$ excitons. The integral absorptions A are equal to 0.104 $eV \cdot cm^{-1}$, 0.002 $eV \cdot cm^{-1}$ and 0.001 $eV \cdot cm^{-1}$ for excited state for n = 1, n =2 and n = 3 lines, respectively. This quantity measurements of integral absorption coefficient A for exctionic series $\Gamma_2^-(z)$ shows that the integral absorption for lines n series subordinates to dependence $A_n \approx n^{-3}$ that is typical for exciton envelope function of S-type. The integral absorption (A) for n = 1 line of $\Gamma_2^-(x)$ excitons changes in the range 1.44 - 10 $eV \cdot cm^{-1}$ at temperature variation form 10 K to 230 K (see Fig. 1, C).