ABOUT THE INTERNAL TRANSMISSION AND ABSORPTION COEFFICIENT AS A FUNCTION OF WAVELENGTH IN ELECTROOPTIC SINGLE-CRYSTALS

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We study the spectral properties of some samples of nonlinear single crystals of the MH_2EO_4 composition ($M = NH_4^+$, K^+, Rb^+, Cs^+ and $E = P$, As). The transmission of samples, obtained by Z-cutting from crystals grown from an aqueous solution and a further processing, was determined by spectral analysis. The dependence of the internal transmission and calculated absorption coefficient on wavelength in the range $200 \div 600$ nm for some samples of KH_2PO_4 and $NH_4H_2PO_4$ single crystals is shown.

Introduction

Potassium dihydrogen phosphate (KDP) is probably the best known and most used crystal in laser technology. Crystals of KDP are used for frequency-conversion operation in high-power laser systems [1].

KDP, ADP crystals, and their deuterated crystals have electrooptical properties being used in nonlinear optical devices.

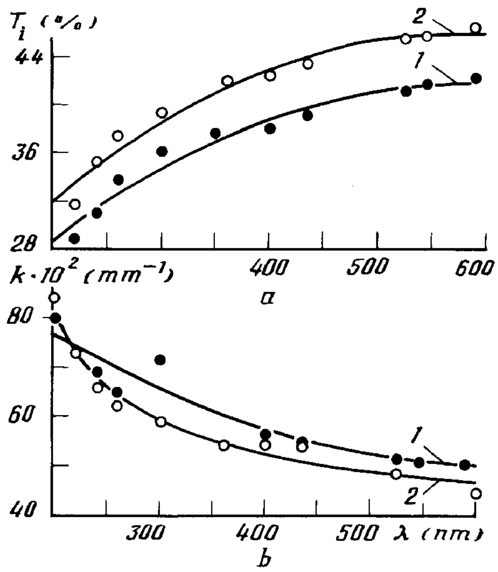

Fig.1. Dependence of internal transmission (*a*) and absorption coefficient (*b*) on wavelength for the KDP samples: *1* – sample 1, *2* – sample 2

Working method

KDP and ADP single crystals grown from an aqueous solution [2, 3] were mechanically processed and studied. Because they are soluble in water, the crystals were Z-cutted using the damp cutted method [4].

The quality assuarance of the detached slices was realized by mechanical grinding and bringing to optical transparency by polishing.

For the samples given in Table, the spectral curves of transmission were plotted with the help of a SPECORD UV-VIS spectrometer. From these curves, the transmission values for various wavelengths were read, and the intermal transmission and absorption coefficient for each sample were calculated.

Results

The propagation direction of light through the samples was Z, so that the ordinary refractive indices at 10 wavelengths from 200 to 600 nm were calculated using the Herzberger-type dispersion formula:

$$n = A + BL + CL^2 + D\lambda^2 + E\lambda^4, \tag{1}$$

where:

$$L = \frac{1}{\lambda^2 - 2.8 \cdot 10^6} \tag{2}$$

with λ in angstroms.

The values for the A, B, C, D, E coefficients at 24,8 °C were taken from [5]. The curves for the dependence of the internal transmission on wavelength for the analyzed samples are plotted in Fig.1. Fig. 1,*a* shows these dependences for the KDP samples.

Sample	Substance	Thickness l (mm)
Sample 1	KH_2PO_4	1,70
Sample 2	KH_2PO_4	1,58
Sample 3	$NH_4H_2PO_4$	2,45
Sample 4	$NH_4H_2PO_4$	4,14

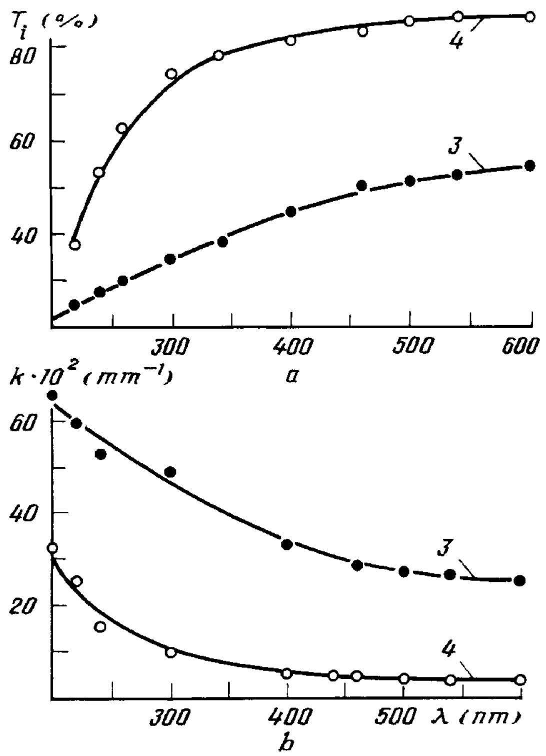

Fig.2. Dependence of internal transmission (*a*) and absorption coefficient (*b*) on wavelength for the ADP samples: *3* — sample 3; *4* — sample 4

The absorption coefficient is:

$$k = -\frac{\ln T_i}{l}. \qquad (3)$$

The dependence of that coefficient on wavelength for the KDP samples is shown in Fig. 1,*b*.

The dependence of the internal transmission on wavelength for the ADP samples is shown in Fig. 2,*a*. The absorption coefficient for the ADP samples is calculated by (3). Its dependence on wavelength in the working range for the considered ADP samples is shown in Fig. 2,*b*.

Conclusions

1. We observe an increase of the internal transmission and a decrease of the absorption coefficient with wavelength in all the electrooptic single crystals considered.
2. From the shown graphics, we can determine the internal transmission for any wavelength in the working range.
3. It is possible to determine the ordinary refractive index for the Z-cutted crystals in the case of a perpendicular propagation of light through samples and then to calculate the absorption coefficient.
4. The method allows the subsequent determination of the absorption coefficient for these samples in the considered wavelength range.

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