# ANALYSIS OF SPECTRAL DEPENDENCE OF TRANSMISSION COEFFICIENT OF TITANIUM DIOXIDE FILMS ON TRANSPARENT SUBSTRATE

A. V. KHANEFT[1], L. V. SOTNIKOVA [1,2]

[1]Kemerovo State University, Kemerovo, Russia
[1,2]FRC of Coal and Coal Chemistry SB RAS

We obtained weakly absorbing titanium dioxide (anatase) films of different thicknesses on a glass substrate [1, 2]. The spectral dependences of transmittance coefficients of the glass substrate and the system glass substrate – titanium dioxide film in the wavelength range 350 – 900 nm were determined. The dependences of the transmission coefficient of the film-substrate system on the wavelength of light have pronounced alternating maxima and minima due to light interference. Fig. 1 (curve 1) shows the experimental dependence of the transmission coefficient $T$ of the five-layer titanium dioxide film-glass substrate system.

The thicknesses of the anatase films were determined. The thickness of the five – layer titanium dioxide film $h_2 = 279.67$ nm. Interference orders for anatase films of different thicknesses were determined. Calculations of the spectral dependence of the transmission coefficients for the films $TiO_2$ have been carried out using the formulas obtained by A. S. Valeev [3]. Fig. 1 (curve 2) shows the calculated dependence of the transmission coefficient of the system of five-layer titanium dioxide film – glass substrate. Fig. 1 shows that the smaller the ratio of the titanium dioxide film thickness to the light wavelength ( $h_2 / \lambda$ ), the better the results of calculations of the transmission coefficient dispersion agree with the experiment (Fig. 1).
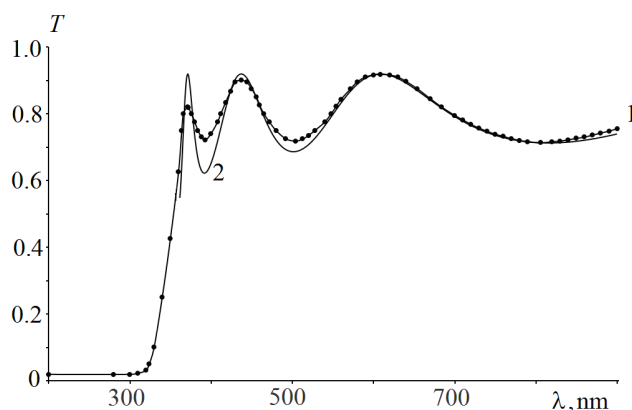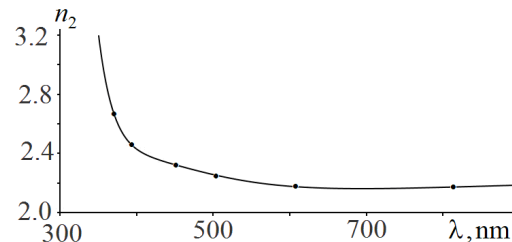


Fig. 1.

Fig. 2.

Fig. 1. Transmission coefficient of the system five – layer titanium dioxide film – glass substrate: 1 – experiment; 2 – calculation.
Fig. 2. Dependence of refractive index of titanium dioxide film on wavelength.

Using the Cauchy series, an empirical formula for the dependence of the refractive index of the titanium dioxide film on the wavelength was obtained. The results of calculations of the refractive index dispersion are shown in Fig. 2. At $\lambda \geq 600$ nm, $n_2$ reaches a plateau. This effect is known for ionic crystals [4].

## REFERENCES

[1] A. Yu. Stepanov, L. V. Sotnikova, A. A. Vladimirov, A. V. Khaneft, E. V. Prosvirkina, F. V. Titov, D. V. Dyagilev, " Formation and study of optical properties of thin films TiO₂-Ag and TiO₂-AgI", Polzunov Bulletin, no. 3, pp. 53-57, 2014 [in Russian].

[2] T. A. Larichev, V. M. Pugachev, A. A. Vladimirov, L. V. Sotnikova, A. Y. Stepanov, Y. N. Dudnikova, T. S. Manina. "Investigation of the structure and dispersion of photoactive nanocrystal TIO₂ powders", Journal of Structural Chemistry, pp. 1152-1159, vol. 55, no. 6, 2014, DOI: 10.113/S0022476614060250.

[3] A. S. Valeev, "Determination of optical constants of thin weakly absorbing layers", Optics and Spectroscopy, vol. 15, no. 4, pp. 500-511, 1963 [in Russian].

[4] M. Garbuny. Optical physics, Academic Press, New York and London, 1965.