lecular layers are formed very easily. Some drops of the solution in benzol of cadmium salt of arachide acid are placed on water surface, after some time the benzol vaporizes and on the water surface remains the monomolecular layer. If a clean microscopic glass is plunged in the water then it will be covered on both sides with monomolecular layer. When repeatedly plunged and carefully taken out, the glass will be covered with the next and next layer. In this way, there can be some 500 layers formed, one upon another, and thus a "layer crystal" with parallel and equidistant planes may be composed. The distance between the planes is about 26.5 Å when using CdC_{20}.

If a surface of a well reflecting mirror is covered with monomolecular layers forming steps and then on the steps is deposited another monomolecular layer, e. g. fluorizing pigment, then we get arrangement in which the pigment molecules will be placed at known distances from the mirror, at distances that are the multiple of dimensions of molecules forming the steps, in this case the multiple of 26.5 Å.

Since the intensity of fluorescence is proportional to the square of the vector of light of the stimulated wave and since the molecules of fluorizing pigment can be deposited on steps formed by CdC_{20} at distances smaller than wave-length, it is possible to investigate the intensity of light vector at points remote from one another less than the wave-length. Using the weak solution of the pigment makes it possible to deposit the single fluorizing molecule on the top of the steps and thus to observe emission or absorption of light by a single molecule. So far, there is not another method known that would allow us to carry out such measurements.

The above method gives the possibility to observe the standing light wave in a much more refined way than in the famous experiments performed in 1890 by Wiener. The method allows us as well to repeat, with better resolution, the experiments carried out by Goos and Handchen in 1947, in which the effect of light wave shift in the total internal reflection was shown. The above method is also more precise than any other method in application to quantum yield of fluorescence and to measurements of fluorescence relaxation time.

Taking into account what was said above, it seems that the method of monomolecular layers has broken a technological barrier on the way to full understanding of "white noise" usually called the visible light.

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Optical Constants Determination in Thin Films with the Help of a Photometric Method

1. Introduction

Modern design of thin films coatings with the help of computers requires an exact knowledge of the refractive indices and absorption constants of the layers in the respective spectral range. These parameters depend to certain extent upon both the quality of the materials used for film production and the technological process applied. Therefore, independently the numerous data published in the literature here we deter-

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mined the optical constants for the materials used most frequently. In the work presented we apply a iterative method proposed by Walejew [1], which enables a quick estimation of the refractive indices and absorption coefficients by using the corresponding nomograms. The absorption coefficient determines global losses in the layer being the consequence of both scatter and absorption. The optical parameters of a thin film have been evaluated for extremal transmission of the layer deposited on a substrate made of materials characterized by different but known indices of refraction.

2. Experimental Data

We have determined the optical parameters of the ZnS layers as well as the refractive indices for both the magnesium fluorite MgF_2 and cryolite Na_3AlF_6. These materials were supplied by the Balzers-Lichtenstein firm and were specially prepared for the vacuum evaporation. All the layers were produced in a Ba 510 Balzers vacuum unit by thermal evaporation from the molybdenum heaters in the vacuum ($2-4\cdot10^{-5}$ Tr). The measurements of transmission were made with the help of a Unicam SP700 spectrometer. The zinc sulphide layers were deposited on a substrate made of fused quartz and of optical glass at the room temperature as well as when heating the substrate up to the temperature 200 °C with the evaporation rate (80—120) Å/s. The respective refractive indices and absorption coefficients are presented in Fig. 1. No essential differences in both the refractive indices and absorption for the layers deposited on cold or heated substrate have been noticed.

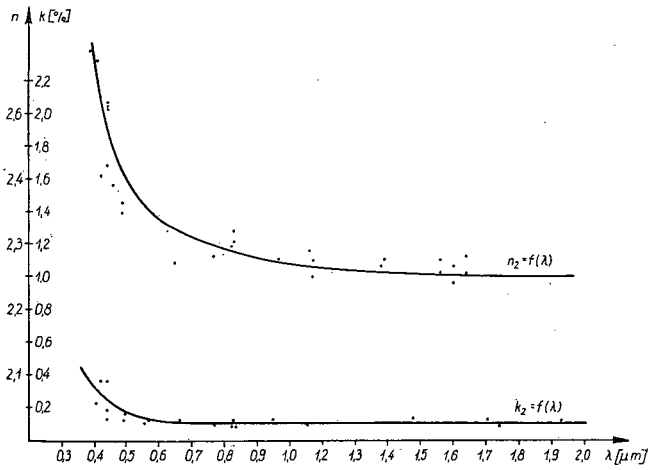

Fig. 1. Refractive index and absorption coefficient versus, wavelength for ZnS layer

The layers of magnesium fluorite and cryolite were deposited on different sorts of optical glass. The results obtained for the cryolite deposited on a "cold" substrate with the evaporation rate (50—80) Å/s are collected in Fig. 2, while those obtained for magnesium fluorite deposited on a substrate heated up to

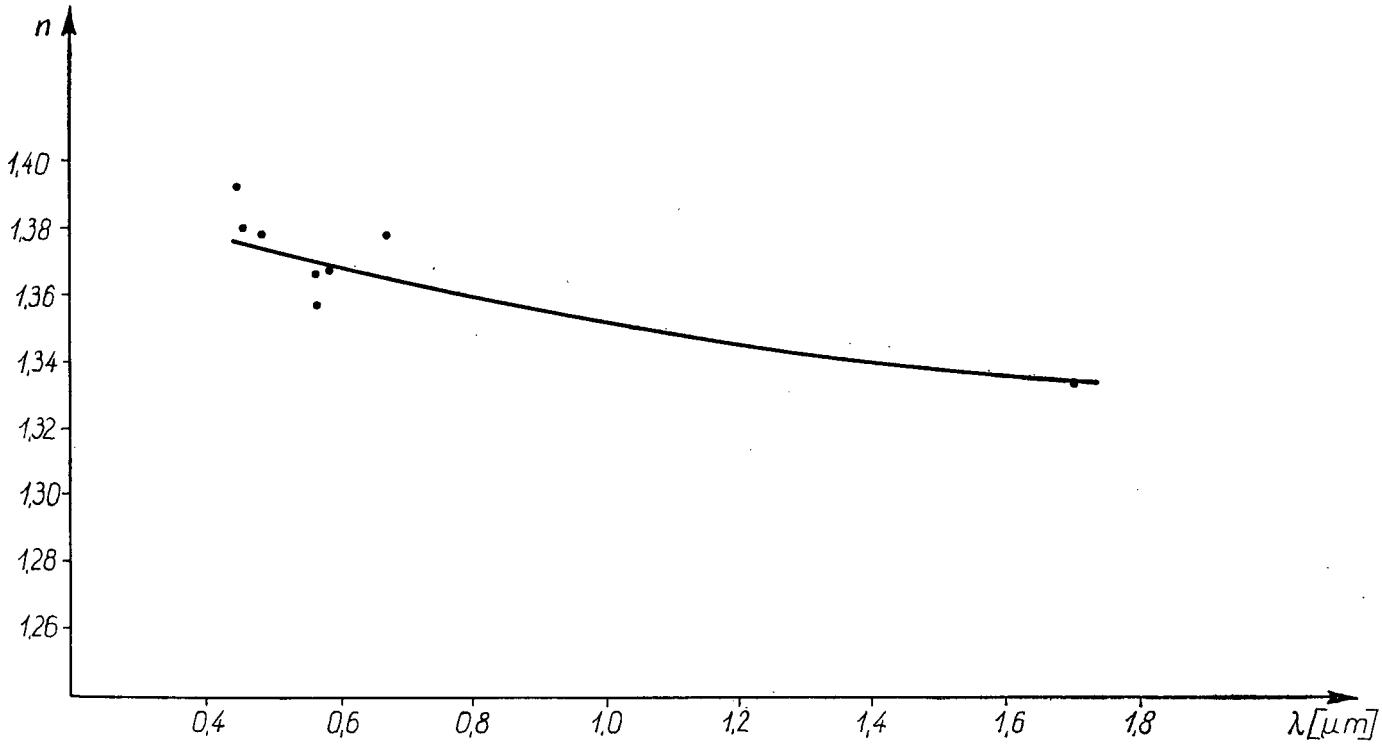

Fig. 2. Refractive index for Na_3AlF_6 versus wavelength

the temperature 200 °C with the evaporation rate (30—50) Å/s are presented in Fig. 3.

3. Discussion of Results and Conclusions

The average values of both the refractive indices and the absorption coefficient of the layers being under study are in accordance with those given by other authors. A considerable dispersion of the results obtained for particular samples may be explained by instability of some evaporation process parameters, which are difficult to control as well as by poor accuracy of the spectrometer used for transmition measurements. This accuracy was equal to $\Delta T = 1\%$, which results in errors in refractive index amounting to $n = 0.26$ for layers of refractive index ranging between $n = 2.5$ and $n = 1.5$. The accuracy of the transmition measurements corresponding to the even orders of interference exhibits a particularly great influence on the accuracy of the refractive index determination. When applying the device allowing to measure the transmission with an error not exceeding $\Delta T = \pm 0.1$ permille it is possible to determine by this method the indices of refraction within the range 2—2.5 with the accuracy $n = 0.01$ for the materials of small absorption ($k \approx 0.1\%$).

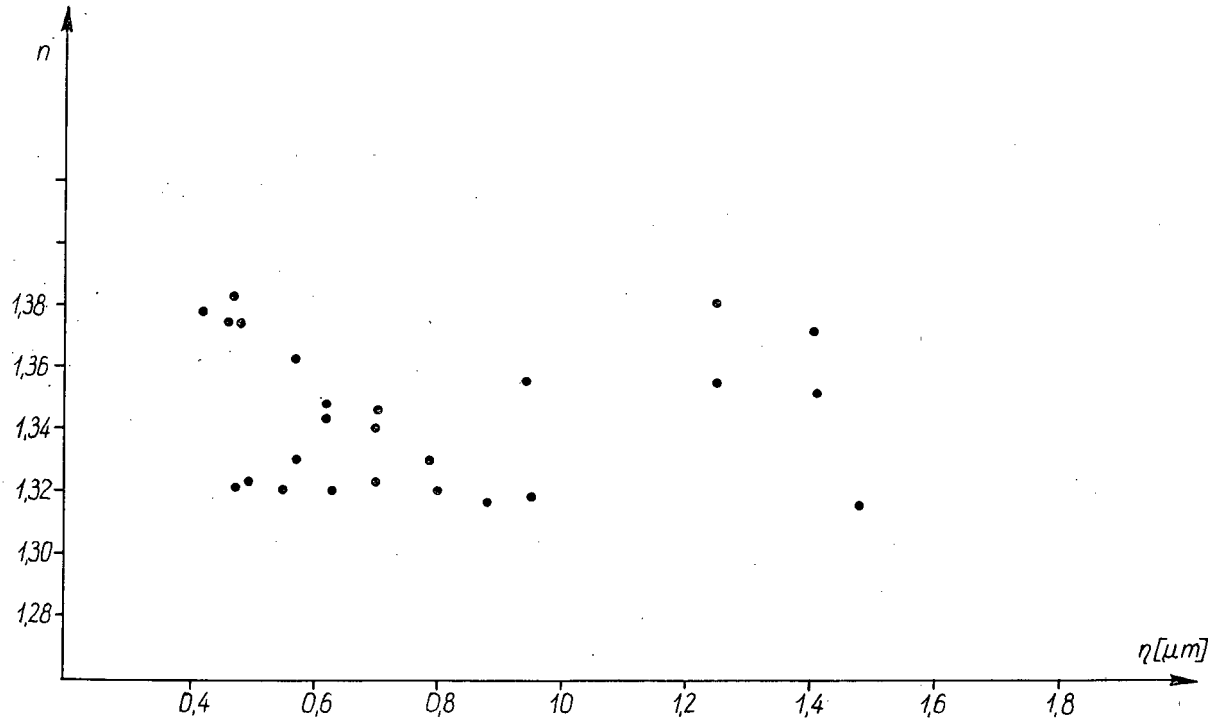

Fig. 3. Refractive index for MgF_2 layers versus wavelength

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