We have thus observed in monoclinic ZnP_2, near the edge of the ground-state band, a line structure of the absorption spectrum, assumed to be due to exciton localized on paired isoelectronic centers. It follows from the singularities of the observed spectrum that the crystal splitting of the valence band amounts to 0.0497 eV.

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SPATIALLY INHOMOGENEOUS FILTERS FOR THE ULTRASOFT X-RAY REGION

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To separate the 50 - 2000 Å radiation region it is proposed to use filters of uneven thickness obtained by sputtering aluminum on a collodion substrate. The operating principle of such filters is analogous to that of the spatially inhomogeneous filters used in the far infrared.

The region most difficult to investigate in plasma spectroscopy is that of ultrasoft x-radiation (UXR) (50 - 2000 Å). This is due to the fact that plasma radiation in this region has usually low intensity and the absorption of the UXR in the receiver windows is large. In addition, the useful signal must be separated against the background of strong ultraviolet radiation of the plasma. Therefore even if receivers without windows are used, filters in the form of aluminum or beryllium films are placed ahead of the detector [1]. Such films, however, absorb also the UXR.

An anomalous transparency of very thin aluminum films (less than 200 Å thick) to UXR was noted but not explained in [2]. We became interested in this fact. Additional investigations have shown that such properties are possessed by structures of uneven thickness.

We have decided to test such structures for use as filters to separate the UXR region of the spectrum from a high-power background of ultraviolet radiation. Just as in [2], such filters were prepared by sputtering aluminum on a collodion substrate 1000 Å thick. During the initial stage of sputtering (at a rate 100 Å/min in a vacuum on the order of 10^{-5} Torr), a structure of uneven thickness was produced in the form of aluminum crystallites that have not grown together. An electron-microscope picture of such a film is shown in Fig. 1[1)]. At larger masses of sputtered aluminum, the structure thickness became more uniform.

We measured the transparency of the filters by the transmission method. In the wavelength region $\lambda < 100$ Å we used for this purpose radiation from an x-ray tube; the signal was registered with a proportional counter. For $\lambda > 1000$ Å we used microwave radiation from a low-pressure discharge. The required spectral interval was separated with a VM-1 monochromator. The signal was registered with an FEU-39 photomultiplier with a scintillator of sodium salicylate. Unfortunately, for lack of an x-ray spectrograph, we could not measure

1)We are grateful to V.N. Rozhanskii (Crystallography Institute, USSR Academy of Sciences) for the electron-microscopic investigations.

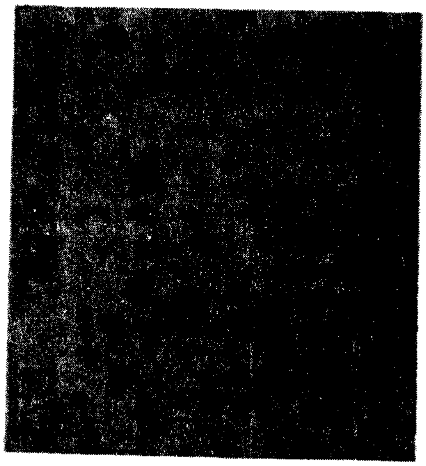

Fig. 1

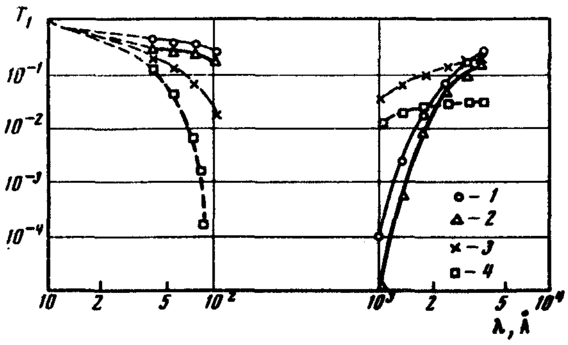

Fig. 2

Fig. 1. Electron-microgram of film filter with sputtered structure. The dark spots are the facets of the aluminum crystallites.

Fig. 2. Transmission of inhomogeneous and homogeneous aluminum structures in the ultrasoft x-ray and ultraviolet regions: 1) two superimposed films with structure shown in Fig. 1, 2) three superimposed films with structure shown in Fig. 1, 3) film with near-homogeneous structure. 4) film with homogeneous structure.

the transmission of the films in the region 100 Å < λ < 1000 Å.

Typical transmission curves of our inhomogeneous films and the homogeneous films usually used for filtering are shown in Fig. 2. We see that the inhomogeneous films absorb the ultraviolet much more strongly and are much more transparent to UXR. By superimposing several films on one another it is possible to obtain convenient filters whose frequency properties are adjusted by the number of films and by the thickness of the sputtered structure.

In the interpretation of the transmission curves of our films, we paid attention to their qualitative agreement with the transmission curves of so-called capacitive grids used in the far infrared [3]. Capacitive meshes (henceforth called B structures) are filters with a structure that complements a reticular structure (A structure). The geometry of the A and B structures and their typical transmission curves (curves 1 and 2) are shown in Fig. 3. Just as in Fig. 2, one can separate for these structures three characteristic spectral intervals. In the wavelength range $g/\lambda \gg 1$, the structures A and B operate like gray filters, and their transmission is determined by the geometric transparency of the filter. In the range $g/\lambda \sim 1$, the structure A has maximum transmission and the structure B minimum transmission. At $g/\lambda \ll 1$ the structure A attenuates the incident radiation almost completely, and the structure B transmits it almost completely. These results, however, pertain to ideally conducting screens, and cannot be extended automatically to the UXR region, where there are no data on the complex dielectric constant of aluminum. Since a theoretical analysis of the influence of the properties of the material of inhomogeneous structure on their transmission is a rather complicated matter, we have investigated this question experimentally in the far infrared. The procedure for preparing such structures was borrowed by us from [3, 4]. The transmission of the structures in the wavelength band 25 - 330 μ was measured with an FIS-3 spectrometer. Typical measurement results are shown in Fig. 3 (curves 3 and 4). We see that the transmission depends strongly on the ratio a/g and is

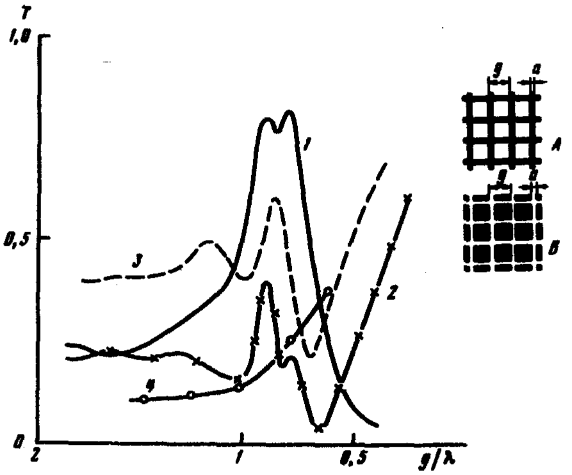

Fig. 3. Geometry and transmission curves of structures A and B (the dark areas represent the conductor). 1) Type A, nickel, a/g = 0.3, g = 50 μ, 2) Type B, aluminum, a/g = 0.3, g = 50 μ, substrate - lavsan polyester 5 μ thick. 3) Type B, aluminum, a/g = 0.5, g = 50 μ, substrate - lavsan 5 μ thick. 4) Type B, aquadag, a/g = 0.1, g = 500 μ, substrate - paper 70 μ thick.

practically independent of the absorbing and reflecting properties of the material. This allows us apparently to state that there is a deep analogy between the transmission of the structure in the UXR and the far infrared regions. It follows also that in the UXR region one can use also structures of type A to cut off the long-wave background of the plasma. The procedure for preparing such structures is described in [5]. The filters proposed by us for UXR are essentially band filters. Both the individual filters A and B and their combinations can be useful in a number of problems of spectral plasma-discharge diagnostics.

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DISPERSION OF NONLINEAR SUSCEPTIBILITY OF TeO_2 SINGLE CRYSTAL IN THE OPTICAL REGION

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By registering the second harmonic (SH) of light, we measured in the interval 0.35 - 0.53 μ the dispersion of the nonlinear susceptibility of TeO_2, in which SH generation is forbidden according to the Kleinman relation.

Kleinman's relation results from an analysis of the symmetry properties of the nonlinear-susceptibility tensor d_{ijk}, which is responsible for second harmonic (HS) generation in crystals. In the general case, without allowance for the crystal symmetry, d_{ijk} is symmetrical with respect to permutation of only two indices: $d_{ijk} = d_{ikj}$. Kleinman has proposed that far from the crystal absorption bands, when the dispersion of the nonlinear susceptibility can be neglected, d_{ijk} is symmetrical with respect to permutation of three indices: $d_{ijk} = d_{kih} = d_{kji} = \ldots$. This symmetry relation proposed by Kleinman