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PHOTOTHERMOPLASTIC FILMS FOR HOLOGRAPHIC RECORDING

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Among the photographic materials recently experiencing intensive development for recording information in holographic form, photothermoplastic (FTP) film consisting of a base, conducting layer and a layer consisting of a mixture of an organic photosemiconductor -- poly-*N*-vinyl carbozole -- and a thermoplastic material of a copolymer of styrene with divinyl (PVK-TP) is of great interest [1]. /149*

The PVK-TP composition does not have adequately high electrophotographic sensitivity (EFCh), so two methods are now used effectively to increase this system's EFCh: 1) introduction of assorted electron-acceptor impurities into the PVK-TP composition [2]; 2) a layer of amorphous selenium 0.01-0.2 μm thick is applied between the conducting layer and the PVK-TP composition layer, which is from 1 to 6 μm thick [3, 4]. The EFCh of the PVK-TP composition is increased when an additional layer of amorphous selenium is introduced because of injection of photogenerated charge carriers from the selenium layer into the PVK-TP composition layer under the influence of an electric field. Since PVK-TP has only *p*-type conduction, the conditions of the transport of vacancies from the layer of amorphous selenium through the PVK-TP layer are fulfilled for a negative surface charge.

It should be noted that FTP film based on Se-PVK-TP has a narrow spectral distribution of EFCh, corresponding to the spectral distribution of EFCh of amorphous selenium [5].

FTP films were prepared in the following manner: a layer of

*Numbers in the margin indicate pagination in the foreign text.

amorphous selenium was applied on a nickel-metalized Lavsan substrate by thermal evaporation at a substrate temperature of 40°C and a residual pressure in the chamber of about 10^{-5} mmHg.

Impurities of Te, As, and Sb were added during the spraying /150 of the amorphous selenium to sensitize it. The total content of impurities in the selenium did not exceed 10%. Henceforth the layer of Se with Te, As, and Sb impurities shall be designated Se*.

PVK-TP composition from a toluene solution was applied to the injected layers of Se and Se* (in a 1:1 ratio). The EFCh of the photothermoplastic films was determined by the kinetics of the light decay of the potential using LG-31- (λ = 0.44 μm) and LG-38-type (λ = 0.63 μm) lasers. The sensitometric characteristics were determined using the procedure cited in [6].

Sensitization of Se using the above impurities leads to an increase in EFCh and expansion of the EFCh spectral range. The table shows the EFCh values according to criterion $\Delta U/U_0$ = 0.1 (U_0 is the initial charge potential) for films Se-PVK-TP and Se*-PVK-TP, and, for comparison, for PVK-TP activated by trinitrofluorenone (TNF).

FTP film	EFCh, m^2/J	
	$\lambda = 0.63$ μm	$\lambda = 0.44$ μm
PVK-TP-TNF	0.7	10
Se-PVK-TP	0.001	60
Se*-PVK-TP	8.0	400

Figure 1 shows the characteristic curves of the relationships of diffraction efficiency (DE) η and relative change of potential $\Delta U/U_0$ to exposure H for λ = 0.63 μm and λ = 0.44 μm. The spatial

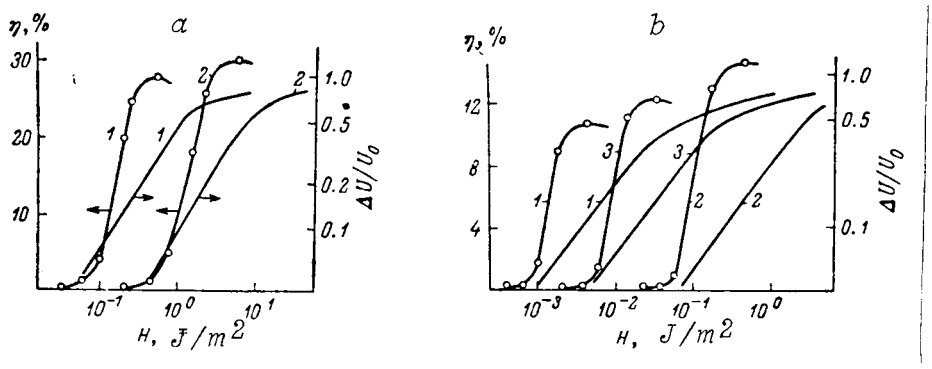

Fig. 1. Dependence of diffraction efficiency on relative change of potential $\Delta U/U_0$ and exposure H for FTP films at λ = 0.63 μm (a) and λ = 0.44 μm (b).

1 -- Se (Te, As, Sb)-PVK-TP, 2 -- PVK-TP-TNF, 3 -- Se-PVK-TP.

frequency was 250 mm^{-1} at a PVK-TP thickness δ = 2 μm. /151

As we can see from Fig. 1a, at λ = 0.63 μm the dependence of DE for films Se*-PVK-TP and PVK-TP-TNF (3%) is practically the same and the maximum value of DE is close to the maximum 33.9% [7]. At λ = 0.44 μm (Fig. 1b) the value of DE is substantially lower than at λ = 0.64 μm for all types of FTP films.

The reduction of maximum DE value may be associated with increase in light diffusion in the PVK-TP layer with decrease in λ, which leads to decrease in the degree of contrast of the interference bands.

As Fig. 1 shows, to generate deformation in this FTP film composition we need to change the potential on the order of 0.05 from the initial value U_0 (in our case, U_0 = 400 V), which is 20 V.

Figure 2 shows the dependence of η on spatial frequency f at λ = 0.63 μm, which implies that introduction of an additional

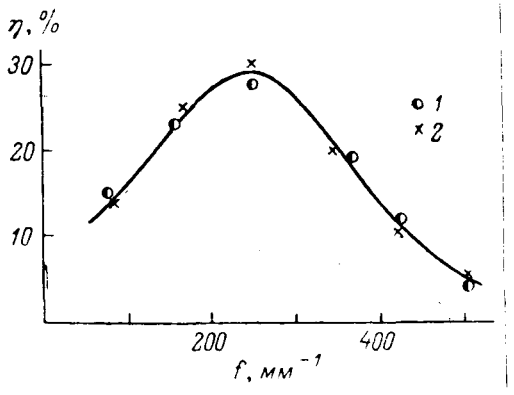

Fig. 2. Dependence of diffraction efficiency η on spatial frequency f at λ = 0.63 μm. 1 -- Se*-PVK-TP, 2 -- PVK-TP-TNF.

injection layer has practically no effect on the form of relationship $f(\eta)$. The optimal spatial frequency for FTP film 2 μm thick is 250 mm^{-1}, which corresponds to the theoretical ideas about thermoplastic deformed layers. The resonance spatial frequency is defined as $f = 1/2\delta$, where δ is the thickness of the thermoplastic layer.

The above results imply that introduction of an injection layer of Se and Se* allows increasing EFCh without marked reduction in DE value and virtually without change in resolution.

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16. Abstract

The paper examines the electrophotographic and sensitometric characteristics of poly-N-vinyl carbazole photothermoplastic films sensitized by an amorphous Se sublayer. It is shown that the photosensitivity of the material can be improved and its spectral range can be expanded by sensitization of amorphous Se with additions of Te, As, and Sb; this can be accomplished without a significant reduction in diffraction efficiency and resolving power.

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