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**Abstract**

**Full Text**

**PHYSICAL CHEMISTRY**

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## **THE USE OF THE IRREVERSIBILITY OF ADSORPTION OF OPTICAL SENSITIZERS**

*(Presented by Academician A. N. Terenin, 3 March 1958)*

In individual cases the irreversibility of adsorption of optical sensitizers on silver bromide has been observed <sup>(1,2)</sup>. A more detailed study of desorption was carried out in <sup>(3)</sup>. Renwick <sup>(4)</sup> and Potter <sup>(5)</sup> independently patented a method for preparing photographic material with a variable degree of contrast. The patented layers are a mixture of sensitized and nonsensitized emulsions. The contrast of the image obtained on such a photographic layer will vary depending on whether all the emulsion grains participate in the construction of the image (exposure to white light) or only part of them (exposure to light corresponding to the sensitization region of one of the emulsions included in the mixture).

On the basis of <sup>(3)</sup>, we attempted to obtain an emulsion layer with two independent sensitization regions. Independent sensitization to different regions of the spectrum opens the possibility of obtaining new photographic layers, for example, single-layer color ones.

The method of investigation was as follows. Two emulsions were mixed, one of which was sensitized to red rays and the other to green rays, and the mixture was poured as a single layer onto a plate.

If the dye is irreversibly adsorbed on the emulsion grains and is not redistributed among them, then it should be expected that, upon exposure of such a photographic layer to light whose wavelength corresponds to the sensitization region of one of the emulsions, an image can be obtained only at the expense of the grains of this emulsion, while the other emulsion entering into the mixture will remain unexposed. This proposition was checked spectrosensitometrically.

**Fig. 1.** Adsorption isotherms of dyes: **I** —3,3'-diethyl-4',5'-diphenyl-4-keto-5(3''-ethyl-6'',7''-tetramethylenebenzthiazolinylidene-2''-α-phenylethylidene)thiazolinothiazoloquinanine iodide; **II** —3,3'-dimethyl-9-ethyloxycarboquinanine iodide

The experiments were carried out with an ordinary factory-made iodide-bromide silver positive emulsion of the "Unibrom" type. One part of the emulsion was sensitized to the red region of the spectrum with the dye 3,3'-diethyl-4',5'-diphenyl-4-keto-5(3''-ethyl-6'',7''-tetramethylenebenzthiazolinylidene-2''-α-phenylethylidene)-thiazolinothiazoloquinanine iodide. Two parts were

Fig. 1. Adsorption isotherms of dyes: I —3,3'-diethyl-4',5'-diphenyl-4-keto-5(3''-ethyl-6'',7''-tetramethylenebenzthiazolinylidene-2''- $\alpha$ -phenylethylidene)thiazolinothiazoloquinanine iodide; II — 3,3'-dimethyl-9-ethyloxcarbocyanine iodide

Figure 1: Fig. 1. Adsorption isotherms of dyes: I —3,3'-diethyl-4',5'-diphenyl-4-keto-5(3''-ethyl-6'',7''-tetramethylenebenzthiazolinylidene-2''- $\alpha$ -phenylethylidene)thiazolinothiazoloquinanine iodide; II —3,3'-dimethyl-9-ethyloxcarbocyanine iodide

Fig. 2. Curves of spectral sensitivity

Figure 2: Fig. 2. Curves of spectral sensitivity

sensitized with the orthochromatic dye 3,3'-dimethyl-9-ethyloxcarbocyanine iodide.

The adsorption of the dyes used on pure silver bromide was investigated beforehand<sup>(3)</sup>.

Figure 1 presents the adsorption isotherms of the dyes studied. Both dyes, in definite amounts, are irreversibly adsorbed on ...

silver bromide, as a result of which the isotherms do not pass through the origin. The conditions for sensitizing the emulsion must be such that only the irreversibly adsorbed amount of dye remains on the AgBr grains.

For sensitization, alcoholic dye solutions of concentration  $1 \cdot 10^{-4}$  mole were used. To 10 ml of the prepared emulsion were added 0.05 ml of 3,3'-dimethyl-9-ethyloxcarbocyanine iodide and 0.03 ml of 3,3'-diethyl-4',5'-diphenyl-4-keto-5(3''-ethyl-6'',7''-tetramethylbenzthiazolinylidene-2''- $\alpha$ -phenylethylidene)-thiazolinothiazolocyanine iodide.

For removal of excess dye from the gelatin and from the emulsion grains, each of the sensitized emulsions was subjected to alcoholic coagulation.

Plate No. 1 was uniformly exposed to green light. Plate No. 2 was uniformly exposed to red light. Both plates were developed in a Metol-hydroquinone developer for 5 min. Thus, on the first plate the grains of the emulsion sensitized to the green region of the spectrum were developed, and on the second—the grains of the emulsion sensitized to the red region.

### Fig. 2. Curves of spectral sensitivity

Metallic silver was removed from both plates. Consequently, plate No. 1 should have retained a panchromatic emulsion, and plate No. 2—an orthochromatic one.

On both plates and on a third, control plate, spectrosensitograms were exposed through a yellow light filter; these were then subjected to the treatment custom-

ary for sensitometric tests. From the spectrosensitograms the spectral sensitivity was determined (see Fig. 2).

The control plate was sensitive to green and red rays (the curve  $\lg S_\lambda = f(\lambda)$  has two maxima:  $\lambda = 530 \text{ m}\mu$  and  $\lambda = 640 \text{ m}\mu$ ). Plate No. 1 retained sensitivity to red rays, while its sensitivity to green rays fell very sharply, since, evidently, before exposure of the spectrosensitogram only the panchromatic emulsion remained on it. On plate No. 2 the sensitivity to green rays remained unchanged, while the sensitivity to red rays fell.

The results obtained show the possibility of creating a layer of silver-bromide emulsion containing two kinds of grains: those sensitized to red rays and those sensitized to green rays. On such a photographic layer it is possible, depending on the wavelength of the acting light, to obtain images due to each kind of sensitized grain. In addition, the results obtained are proof of the existence of irreversible adsorption of sensitizers on silver bromide.

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*Note: Figure translations are in progress. See original paper for figures.*

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