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Synthesis of New Dichroic Dyes with Negative Dichroism for a Black Mixture

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Two new dichroic dyes with negative dichroism have been synthesized. For the first time a black mixture with negative dichroism was built up on the base of these dyes. This mixture has good solubility in liquid crystals, big value of dichroism and almost complete absorption in all the visible range of the spectrum.

Keywords: dichroic dyes (DD); black mixtures; dichroism; liquid crystal (LC)

INTRODUCTION

In the developing liquid crystal materials for colored guest-host LC displays mixture of dichroic dyes are generally used. The individual dichroic dyes do not ensure good contrast, due to they have a narrow absorption spectrum. As a result there will always be colored symbols on a slightly colored background, or slightly colored symbols on a colored background^[1-4].

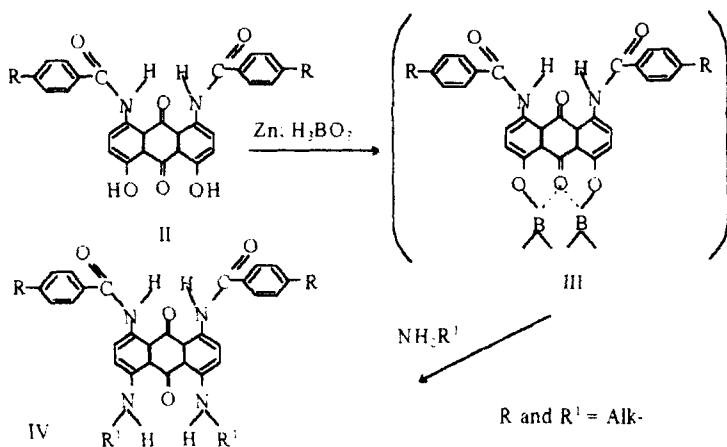
By using of combination of three or more DD with negative (T-type) or positive (L-type) dyes with the maximum absorption wavelengths equal to (420 ± 10) nm, (540 ± 10) nm and (640 ± 10) nm it is possible to obtain either white symbols on black background or black symbols on a white background. Such type of DD mixtures are known as black mixtures, due to the reason that they are absorbing in the all visible range of spectrum. Only black mixtures with positive dichroism are used in the present time^[5-8], while DD black mixture with negative dichroism can find application too.

The known assortment of T-type DD^[9,10] has the maxima absorption wavelength in the interval 560-650 nm. It is not enough for the practical application. In order to extend the absorption range we have synthesized two anthraquinone dyes (IV, VI) with negative dichroism and maxima long-wave absorption equal to 410 nm and 710 nm. This allowed us for the first time to build up DD mixtures with negative dichroism, absorbing in all visible range of the spectrum.

EXPERIMENT

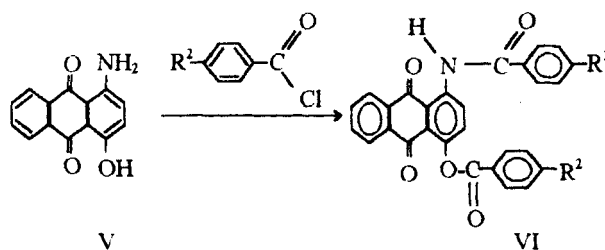
DD (IV) was synthesized from 1,8-diamino-4,5-dihydroxyanthraquinone (I) Aminogroups were acylated by acyl chloride of aromatic acid in *o*-dichlorobenzene. 1,8-diaroylamino-4,5-dihydroxyanthraquinone (II) was isolated, purified by chromatography and used in the synthesis of DD (IV). The product (IV) was obtain according to the scheme 1

Scheme 1



The methods of the substitution of two hydroxy groups by arylamino groups in 1,4-dihydroxyanthraquinone and in 1,8-dihydroxy-4,5-dinitroanthraquinone were describe by M.V.Gorelik^[11]. However the substitution of two hydroxy-groups in the peri-position to aroylamino groups is problematic. We synthesized 1,8-diaroylamino-4,5-dialkylaminoanthraquinone (IV) from the leucobase and the boric complex of 1,8-diaroylamino-4,5-dihydroxyanthraquinone (III). This reaction is carried out in the excess of amine in the presence of boric acid and of the traces of zinc. DD (IV) have $S = -0.32$ and $\lambda_{\max} = 700$ nm. 1-Alkylbenzoylamino-4-alkylbenzoyloxyanthraquinone (VI) was obtained by acylation of 1-amino-4-hydroxyanthraquinone (V) by alkylbenzoic acid chlorides in pyridine. The product (VI) was obtained according to the scheme 2

Scheme 2



DD (VI) have $S = -0.2$ and $\lambda_{\max} = 410$ nm.

RESULTS

We developed for the first time the black mixture with negative dichroism which has a good absorption over entire spectrum of visible light. We used the new dichroic DD (IV) and DD (VI) as well as another dichroic dyes which synthesized earlier^[9].

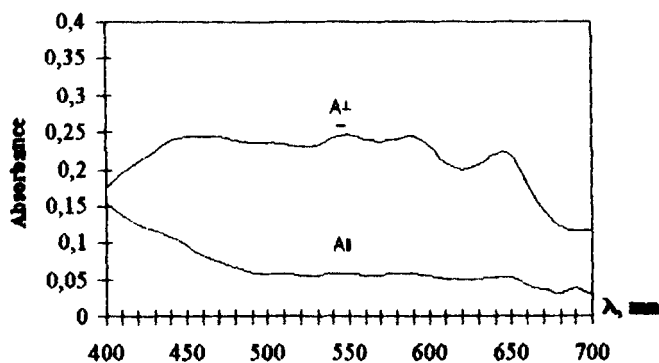


FIGURE 1 The absorbance spectrum for the solution of T-type black mixture in ZhKM-807

Fig.1. represents the absorption spectrum for the solution of the black mixture with negative dichroism in ZhKM-807. This mixture has the uniform absorption from 400 nm to 700 nm. It is necessary to note, this mixture has high solubility in the different LC materials (till 5%) and big value of order parameter ($S \approx -0,36$).

CONCLUSION

The way of synthesis 1,8-diaroyl-amino-4,5-dialkylaminoanthraquinones was elaborated. The black mixture with negative dichroism for the LC materials was built up for the first time. Due to satisfactory value of negative dichroism, good solubility in liquid crystals and uniform absorption in all the visible range of spectrum, this mixture turns out to be useful for manufacturing of liquid crystal displays, based on guest - host effect.

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