

# Spectral photosensitization of optical anisotropy in poly(vinyl cinnamate) solid films

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**Abstract.** We observed possibilities and properties of sensitized photo induced optical anisotropy formation in amorphous poly (vynyl-cinnamate) films (PVCi) and its derivant poly (vynyl-4-methoxy-cinnamate) (PVMCi) under polarized light, including the one which is not absorbed by the supermolecules of the polymeric material. The effect of the induced optical anisotropy involves transferring the energy of electronic excitation from the donor molecules (Michler's ketone or 2-benzoyl-methylene-3, methyl- $\beta$ -naphthosol) to the scavenger's molecules - PVCi or PVMCi) and photo-topochemical ring formation of cinnamate units in polymeric supermolecules. The discovered photo-induced anisotropy in solid PVCi and PVMCi films provides sensitized photo orientation of low-molecular thermotropic liquid crystals.

**Key-words:** photo-induced optical anisotropy, double refraction, poly (vynyl-cinnamate) photosensitization.

## 1. Introduction

The goal of current work is to analyze the formation of sensitized photoinduced optical anisotropy in amorphous poly(vynyl-cinnamate) films (PVCi) and in its derivant poly(vynyl-4-methoxy-cinnamate) (PVMCi) [1-3] under the influence of polarized light as well as to find physical mechanisms of this process so that it could improve the materials efficiency in different optics and optical information processing tasks [4-6].

## 2. Results and Discussion

The initial kinetics sections of POA formation within PVMCi layers, sensitized by BNT naphthotiazoline are shown in fig. 1 a–c for different wave-lengths when  $\lambda_{\text{exp}} = 436, 405$  and  $365$  nm. The radiation with a wave-length of  $436, 405$  nm is absorbed only by BNT molecules and the latter wave-length lies within the maximum BNT absorption ( $\sim 400$  nm). As can be seen in fig. 1a and 1b, in PVMCi (curve 1) no POA is formed without a sensitizer. When activated with the wave-length of  $365$  nm, where the UV radiation is absorbed by both components, the formation speed has its maximum without any sensitizer (fig.1c, curve 1). In this case, if the sensitizer concentration increases, the POA formation speed decreases substantially (curve 2 and 5). This phenomenon has an inverse trend when the wave length is  $436$  nm, which is presented in substantial increase of photo-induced double refraction (DR) together with the BNT concentration increase in the PVMCi layer (fig.1a curve 2 and 5). For the radiation at  $405$  nm the effect of DR induction speed increase (fig.1b, curve 2 and 3) can be



observed only with low concentration  $\sim 0.5 - 1.0\%$  and decreases when the concentration gradually grows (fig.1b, curves 4 and 5).

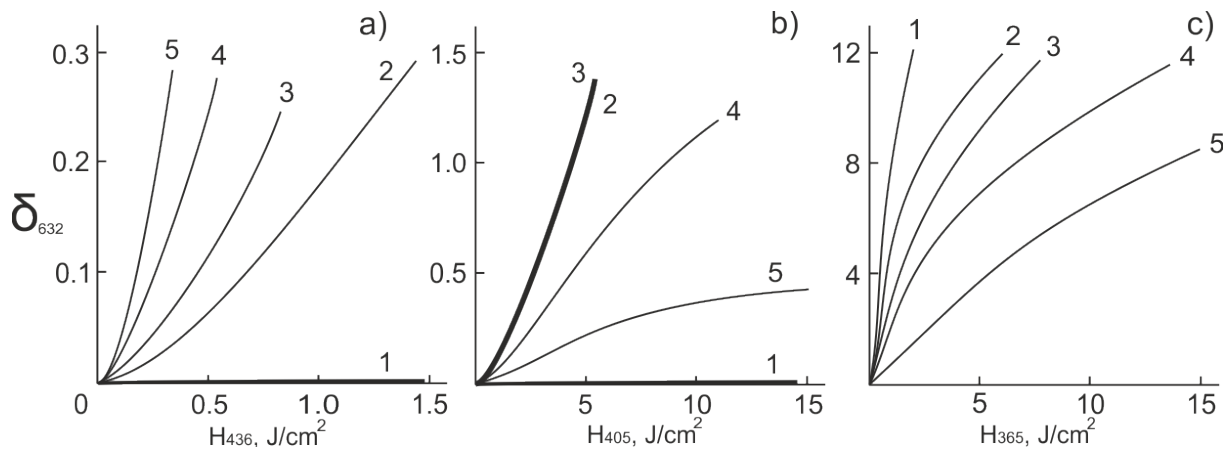


Fig.1. The initial kinetics sections of photo-induced phase retardation  $\delta_{632}$  within PVMC layer with BNT addition with concentration of 1-0%; 2-0.5%; 3-1.0%; 4-2.0%; 5-4.0% as energy function  $H_{\text{exp}}$  with radiation  $\lambda_{\text{exp}}$  – (a) 436 nm, (b) 405 nm и (c) 365 nm.

An unsensitized PVCi layer (fig.2, curve 1), as well as the similar PVMC level, doesn't absorb with the wave-length more than 400 nm and, as the result, doesn't create POA effect under the radiation of  $\lambda_{\text{exp}}=405$  nm. It appears only with sensitizer, and moreover, the speed and the value of the induced phase retardation increases due to the increased Michler's kethon (MK) sensitizer concentration in the layer.

In PVMC film without the sensitizer and with the radiation of  $\lambda_{\text{exp}}>400$  nm (curve 1 in figure 1a and 1b the POA effect is missing, i.e. each reaction component doesn't create any POA effect by itself. PVCi doesn't absorb with the wave-length more than 405 nm, and MK sensitizer's molecules are photochemically stable.

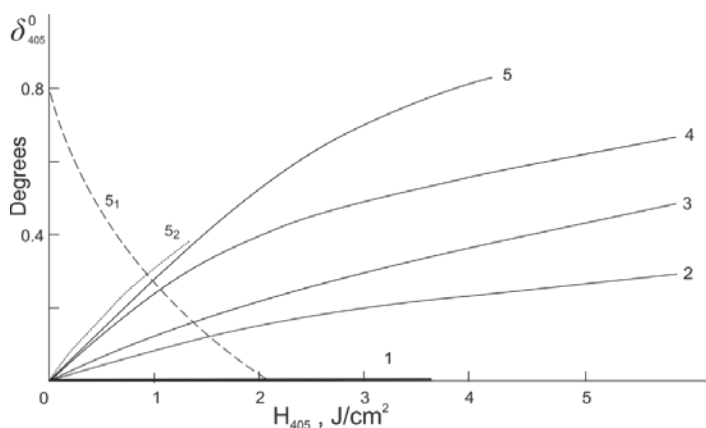


Fig.2. Photo-induced phase retardation kinetics  $\delta_{405}$  in PVCi layer with MK addition with the concentration of 1-0%; 2-0.5%; 3-1.0%; 4-2.0%; 5-4.0% as energy function with radiation of  $\lambda_{\text{exp}} = 405$  nm.

The induced anisotropy can be optically "erased" as shown in figure 2 curve 5<sub>1</sub> and restored as in fig.2 curve 5<sub>2</sub>.

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