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EFECTUL CONCENTRAȚIEI AZOCOLARANTULUI ASUPRA MODIFICĂRII BIREFRINGENȚEI FOTOINDUSE

THE EFFECT OF AZODYE CONCENTRATION ON BIREFRINGENCE MODIFICATION

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Rezumat. *Birefringența fotoindusă este un parametru important pentru azopolimeri fotosensibili. În această lucrare prezentăm rezultatele măsurării prin polarimetrie a birefringenței în pelicule subțiri de polimer Poly-n-epoxipropilcarbazol-co-Solvent Yellow 3 (PEPC_co_SY3) obținute prin metoda de acoperire cu tije. Vă propunem posibila explicație a rezultatelor noastre.*
Cuvinte-cheie : *Birefringență, azocolorant, azopolimer*

Abstract. *Photoinduced birefringence is important parameter of photosensitive azopolymers. In this paper we present the results of polarimetry measurement of birefringence in Poly-n-epoxypropylcarbazole-co-Solvent Yellow 3 (PEPC_co_SY3)polymer thin films obtained by rod-coating method. We propose the possible explanation of our results.*
Keywords : *Birefringence, azodye, azopolymer*

Introduction

Photoinduced birefringence modification is an important phenomenon in materials science and optical technology. One of the most widely studied materials for photoinduced birefringence modification is azopolymers, in which azodye undergoes a trans-cis isomerization process causes a change in the molecular alignment and so the absorption, reflectance and refractive index of the material. [1,2]. While the photoinduced birefringence modification of azodye has been widely investigated, the effect of azodye concentration on this process is not well understood.

In this paper, we aim to investigate the effect of azodye concentration on the photoinduced birefringence modification process in PEPC-co-SY3. We present our experimental approach to measuring the birefringence changes induced by different concentrations of azodye in azopolymer thin film.

Material and methods

As described in our previous work [3], the photo-sensitive azopolymer was produced through the polymerization of poly-n-epoxypropyl carbazole (PEPC) with the azodye solvent yellow 3 (SY3) chromophore.

Using the rod-coating technique illustrated in Figure 1a, the solution was applied onto a substrate, to get uniform and thin layers. The thickness was measured using MII-4 microinterferometer.

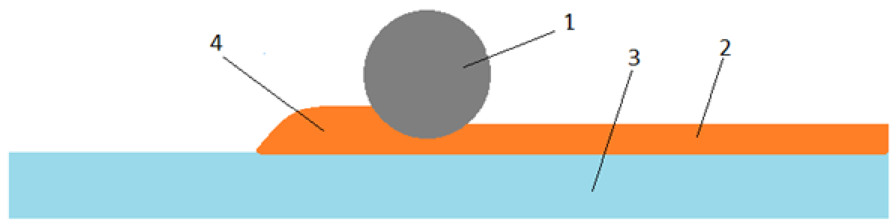

Fig. 1a. The rod-coating technique. 1 - rod, 2 - thin films of azopolymer, 3 - substrate, 4 - azopolymer solution

The optical arrangement utilized for measuring photoinduced anisotropy in thin polymer films. Our setup involved two lasers: a non-actinic He-Ne laser with a wavelength of 632 nm, which was unpolarized and multimode, and a single-mode DPSS laser with a wavelength of 473 nm. The He-Ne laser beam was polarized using a Glan-Thompson calcite polarizer with an extinction ratio of 100,000:1. The Soleil-Babinet compensator was employed as a continuously variable zero-order retarder wave plate, adjusted to function as a λ/2 waveplate with an orientation of 45º ±0.05º and an ellipticity of ±0.05º, as indicated in Figure 1b . It is worth noting that the compensator ensured uniform retardance across the beam aperture at the selected setting. The He-Ne beam, passing normally through the sample surface and directed towards the polarimeter, was used to measure the anisotropy induced by the second DPSS laser beam. This second beam had a λ/2 wave plate with a wavelength of 473 nm, mounted inside a stepper motor rotative mount K10CR1, which resulted in step-by-step polarization state rotation. The optical expander BE5x was used to expand the laser beam on the sample surface, thereby achieving quasi-uniform intensities distribution.

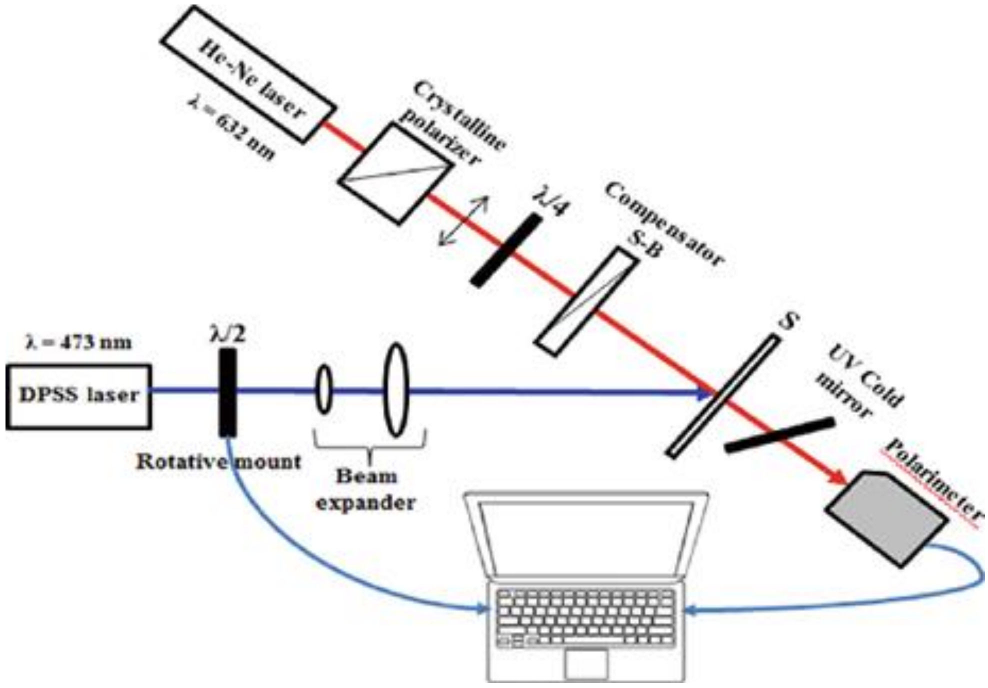

Fig. 1b. Optical scheme for polarimetry measurement

Results and discussions

A set of five thin films, each with varying thickness and concentrations, were produced. Table 1 provides the specific measurements for thickness and concentrations of each film.

Table 1. Concentration, name and thickness of the samples

10 wt%	20 wt%	30 wt%	40 wt%	50 wt%
SY11	SY12	SY13	SY14	SY15
250.13 nm	273.15 nm	293.4 nm	267.13 nm	287.46 nm

Photoinducted birefringence was calculated from formula :

$$\mathbf{\Delta}\mathrm{n} = \frac{\lambda}{2\pi \mathrm{d}} \arctan\frac{\mathrm{S}_3}{\mathrm{S}_2} \quad (1)$$

where λ – wawelength, d –thickness ,S_2 - the Stokes parameter describes the predominance of $+45^{o}$ over -45^{o} and S_3 - the Stokes parameter describing the predominance of right-handed circular polarization over left-handed circular polarization. Figure 1c shows the angle dependences of the photoinduced birefringence when the polarization plane is rotated from 0 to 180^o for the studied samples.

From the figure 1c one can see that the maximum Δn is at 10 wt% of azodye, while the minimul Δn is at 20 wt%. It can be explained that birefringence depends not only the concentration of azodye but the thickness of thin film (see eq1).

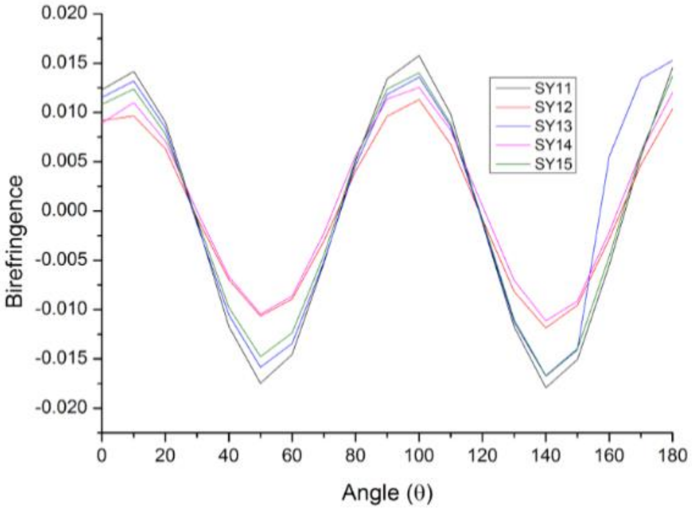

Fig. 1c. Angle dependese of the photoinducted birefringence

Conclusions

The photoinduced birefringence in PEPC_co_SY3 azopolymer depends on concentration of azodye SY3 and the thickness of thin films of the sample.

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