# Holographic anisotropy of molecular glassy films

**Ozols, V. Kokars, P. Augustovs, K. Traskovskis, and D. Saharov**

Riga Technical University, Faculty of Material Science and Applied Chemistry,
Azenes iela 14/24, LV-1007, Riga , Latvia
**email:** aozols@latnet.lv

## Summary

Photoinduced anisotropy is experimentally studied in three molecular glassy films synthesized in our Faculty and containing diphenylamine based azochromophores in comparison with an chalcogenide a-$As_2S_3$ film. Novel holographic method was applied in both transmission and reflection modes.

## Introduction

Azobenzene-containing organic materials and chalcogenide inorganic materials have found numerous applications in optoelectronic devices, especially for holographic information recording [1]. In our previous studies of azobenzene and chalcogenide films we have experimentally found that quite efficient polarization dependent recording is possible in both classes of materials [2]. Thus the question of recording anisotropy arises.The aim of this study was to carry out direct real-time photoinduced anisotropy (PA) studies using novel holographic scheme The idea of this scheme is borrowed from the paper [3] and transformed for more convenient measurements in both transmission and reflection modes (Figs. 1,2).

## Experiments and results

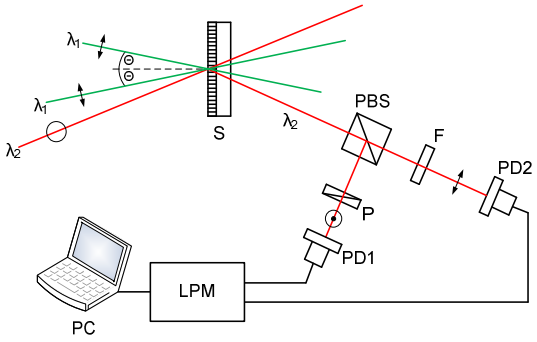


Fig.1. Experimental setup for transmission mode measurements.

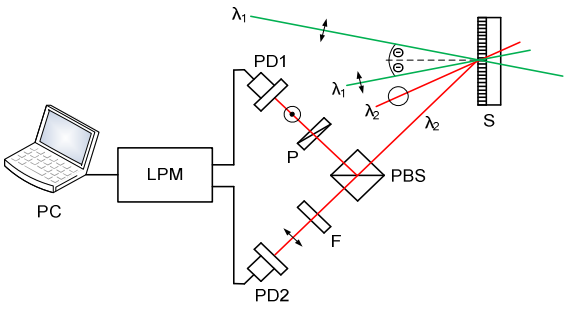


Fig.2. Experimental setup for reflection mode measurements.

Experimental setups for PA measurements in transmission and reflection mode are shown in Figs.1,2. The following notations are used: S-sample, $\lambda_1$=532nm is the wavelength of two *p*-polarized recording beams, $\lambda_2$=632.8 nm≈633 nm is the wavelength of circularly polarized readout beam, PBS – polarization beam splitter enabling *s*- and *p*-polarized diffracted light in the output, F-filter used to equal the transmitted *s*- and *p*-polarized light intensities without the sample, P-linear polarizer

used to improve the *s*- polarization degree, PD1 and PD2-photodetectors, LPM – laser power meter.

We have experimentally studied three molecular glassy films: {4-((4-nitrophenyl)diazenyl)-N-(4-((4-nitrophenyl)diazenyl)phenyl)-N-(2-trityloxy)ethyl) benzeneamine (shortly K-D-24), 4-((2-chloro-4-tritylphenyl)diazenyl)-N-(4-((2-chloro-4-tritylphenyl)diazenyl)phenyl)-N-(2-(trityloxy)ethyl) benzene amine (shortly K-D-25) , 4,4'-(2-(trityloxy)ethylazanediyl)bis(4,1-phenylene)bis(diazene-2,1-diyl)dibenzonitrile (shortly K-D-32) } and, for comparison, an a-$As_2S_3$ film. Molecular glassy films with the thickness of about 1 μm were spin-coated onto the glass substrates.

PA was characterized by *s*- and *p*-polarized diffracted power difference (DPD), $P_s - P_p$ , and by anisotropy contrast $A = (\eta_s - \eta_p)/(\eta_s + \eta_p)$, $\eta_s$ and $\eta_p$ being the diffraction efficiencies for *s*- and *p*-polarized light. DPD exhibited markedly different kinetic behaviour in transmission and reflection modes. There was a negative minimum in transmission mode in all samples (Fig.3), and a growth with oscillations up to saturation in reflection mode (Fig.4). Small initial DPD maxima were specific to a-$As_2S_3$ film. The highest PA was found in K-D-24 film in transmission mode ($A$=-0.23) and in K-D-25 film in reflection mode ($A$=0.49).

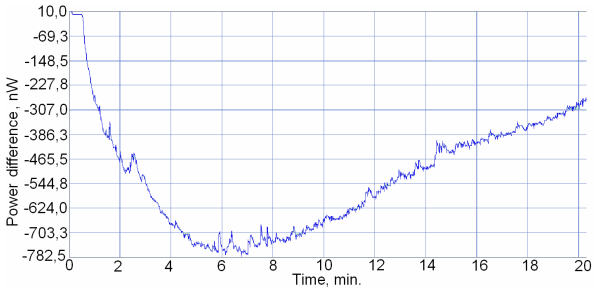


Fig.3. Diffracted power difference $P_s - P_p$ (nW) versus time (minutes) in the case of K-D-25 sample. Transmission mode.

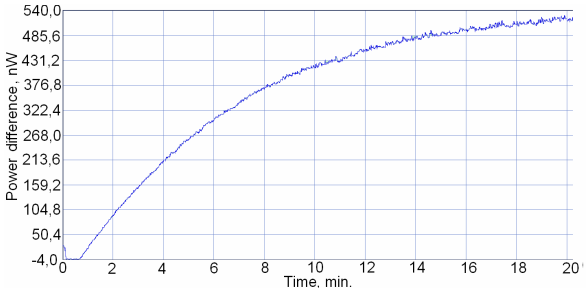


Fig.4. Diffracted power difference $P_s - P_p$ (nW) versus time (minutes) in the case of K-D-25 sample. Reflection mode.

## Conclusions

PA time dependences notably differ for a-$As_2S_3$ film and for molecular glassy films. Several differences can be found also between different molecular glasses. Holographic recording efficiency and PA do not correlate. The PA time dependences measured by DPD are different in transmission and reflection modes. In transmission mode, PA of molecular glasses is due to the photoinduced volume processes including *trans-cis* photoisomerization , chromophore orientation and mechanical stress modulation. All these processes lead to a photoinduced birefringence. Surface relief HG recording and polarization-dependent reflection are responsible for PA in reflection mode.

## References

[1] K.Schwartz, *The Physics of Optical Recording* (Springer-Verlag, Berlin, 1993)
[2] A.Ozols, V.Kokars, P.Augustovs, I.Uiska, K.Traskovskis, D.Saharov, *Centr.Eur.J.Phys.* **9**, 547, 2011
[3] A.Ogiwara, H.Kakiuchida, M.Tazawa, H.Ono, *Jap.J.Appl.Phys.* **46**, 7341, 2007