

Gradient pretilt angle alignment materials with different photosensitivity for tunable polarization-independent self-aligned LC lens

V.S. Bezruchenko^{1,2}, A.I.A. Muravsky¹, An.A. Murauski¹, A.I. Stankevich², U.V. Mahilny²

¹Institute of Chemistry of New Materials NAS of Belarus, Belarus;

²Physical Department of Belarusian State University, Belarus

Abstract

Alignment materials with different photosensitivity thresholds, capable of changing the pretilt angles from 90° to 0° under UV-B exposure have been developed. Inhomogeneous exposure of alignment layers allows formation of refractive index gradient inside the LC cell. The concept of polarization-independent self-aligned LC lens uniform cell gap and low-voltage driving is presented.

1. Introduction

Several methods of tunable LC lens fabrication have been proposed during the last 40 years [1]. One the promising methods is the patterned alignment layer based on photosensitive alignment materials allowing control of the pretilt angle with inhomogeneous non-polarized UV exposure [2-3]. LC lenses fabrication by patterned alignment is simple and technological owing single cell-gap and two electrodes only, which is the key point to obtain reliable LC devices.

2. Gradient Pretilt Angle Alignment Materials with Different Photosensitivity Threshold

The transition threshold control from 90-0° is carried out by vertical alignment group ratio adjustment of the copolymer composition (Fig. 1).

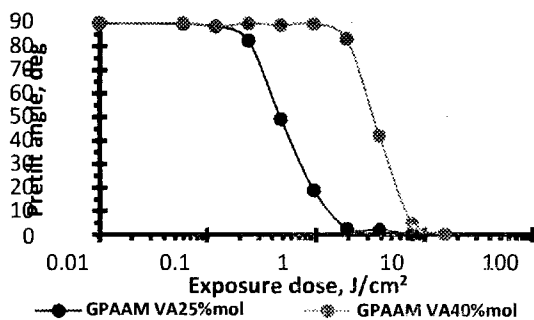


Figure 1: The pretilt angle dependence on UV light exposure dose for 25 and 40% mole of vertical alignment groups

3. Self-alignment of Polarization-independent LC lens based on Adjustment of Alignment Layers Photosensitivity

The polarization-independent LC lens based on gradient pretilt angle alignment materials consists of two polarization-dependent LC lenses with uniform cell gap. Self-alignment is realized through simultaneous exposure of alignment layers with different photosensitivity coated on

both sides of the double-sided ITO glass substrate (Fig. 2).

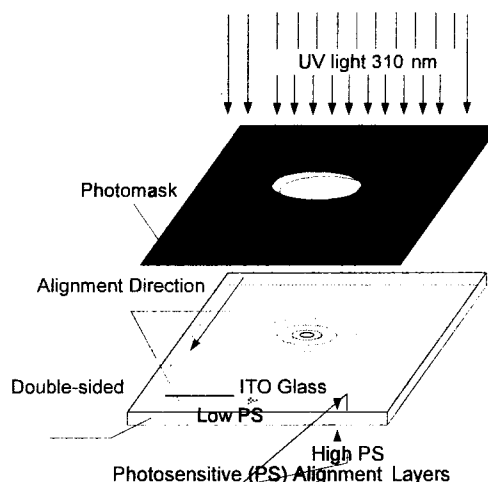


Figure 2: Self-aligning exposure scheme of polarization-independent LC lens

Polarization independence is achieved by perpendicular crossing of the azimuthal alignment direction of the polarization-dependent LC lenses. These LC lenses are controlled in parallel and controlled with low AC voltage levels 0-12V. **Conclusions**

Gradient pretilt angle alignment materials with different photosensitivity threshold are presented. The materials were successfully applied for polarization-independent self-aligned LC lens fabrication.

5. References

- [1] J.F. Algorri, D.C. Zografopoulos, V. Urruchi, J.M. Sánchez-Pena, "Recent Advances in Adaptive Liquid Crystal Lenses" Crystals, Vol. 9(5), pp. 272, 2019.
- [2] V.V. Sergan, T.A. Sergan, P.J. Bos, "Control of the molecular pretilt angle in liquid crystal devices by using a low-density localized polymer network" Chem. Phys. Lett., Vol. 486(4-6), pp. 123-125, 2010.
- [3] V. Biazruchanka et al, "Alignment material for liquid crystal lens and liquid crystal lens system" : Patent US 9513510 B1, 2016