Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl19

Optically Induced Diffraction Grating on the Film of Polyurethane Bearing an Azobenzene Chromophore

Dong Hoon Choi [a], Jae Hyung Kim [a], Young Kwan Cha [a] & Hyun Taig Hong [a]

[a] College of Environment and Applied Chemistry, Kyung Hee University, Kyungki, 449-701, Korea

Version of record first published: 24 Sep 2006

To cite this article: Dong Hoon Choi, Jae Hyung Kim, Young Kwan Cha & Hyun Taig Hong (2001): Optically Induced Diffraction Grating on the Film of Polyurethane Bearing an Azobenzene Chromophore, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 371:1, 273-276

To link to this article: http://dx.doi.org/10.1080/10587250108024739

Mol. Cryst. and Liq. Cryst., 2001, Vol. 371, pp. 273-276

Optically Induced Diffraction Grating on the Film of Polyurethane Bearing an Azobenzene Chromophore

DONG HOON CHOI, JAE HYUNG KIM, YOUNG KWAN CHA and HYUN TAIG HONG

College of Environment and Applied Chemistry, Kyung Hee University, Kyungki 449-701, Korea

Polyurethane bearing an aminonitroazobenzene was synthesized for fabricating the diffraction grating on the film surface. Two beam coupling method was employed for fabricating the diffraction grating. The dynamics of diffraction grating was studied in term of the variation of the diffraction efficiency. The long-term stability of the diffraction efficiency was also investigated.

Keywords azobenzene; polyurethane; diffraction grating

INTRODUCTION

Polymers containing azobenzene moieties have drawn much interest in the field of optical data storage, nonlinear optical, and holographic applications. Erasable gratings formed in the films of azobenzene-containing polymers have been studied extensively since they were first reported by Todorov et. al.[1,2]. A number of researchers also have

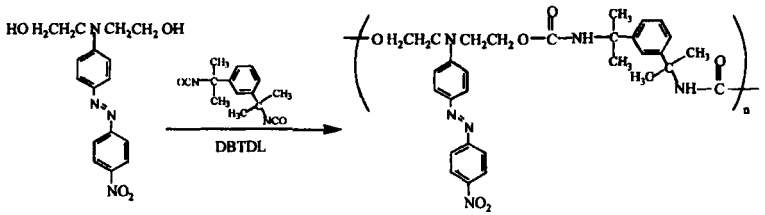
investigated the photo-induced anisotropic behavior through *trans-cis-trans* photoisomerization and molecular rearrangement under a linearly polarized light. Photo-anisotropic materials like the azobenzene-containing polymers respond to variations in both the intensity and polarization state of the total electric field. Recently, surface relief gratings (SRG) have been fabricated in side chain azo polymer film through repeated *trans-cis-trans* isomerization upon exposure to the excitation light with an interference pattern[3-5].

In this work, we report on the properties of the photosensitive polyurethane for fabricating the diffraction grating controlled by a coupled linearly polarized visible light (λ=532nm). The stability of the diffraction efficiency was also investigated using the inscribed polyurethane film.

EXPERIMENTAL

Thin films of the synthesized polyurethane were spin-coated onto glass slides using 20-wt% tetrachloroethane solution to prepare 1.5-2.0 μm thick films. The thickness was measured by using the surface profilometer (Tencor P10). The spin-coated films were dried in a vacuum oven at 90°C for 48 hours.

The two linearly polarized laser beams at 532 nm fabricated diffraction gratings with an intensity of 65 mW/cm^2. Laser beams with +45° and -45° polarizations were used. The diffraction efficiency of



SCHEME 1. Synthesis of the photosensitive polyurethane.

the 1st-order diffracted beam from the gratings in transmission mode was probed with a linearly polarized low power He-Ne laser beam (5 mW) at 633 nm.

RESULTS AND DISCUSSION

We synthesized polyurethane bearing an aminonitroazobenzene as a pendent group (See Scheme 1). The polymer was soluble in common organic solvent. The polymer has T_g around 103°C, which was determined by DSC. Optically transparent films of the polyurethane were obtained from a solution of tetrachloroethane.

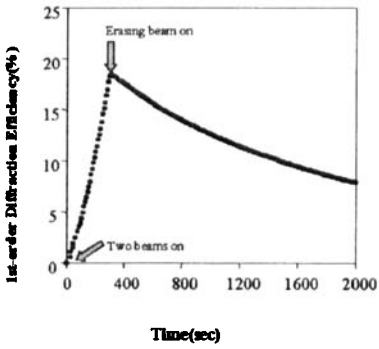


FIGURE 1. Dynamic behavior of diffraction efficiency.

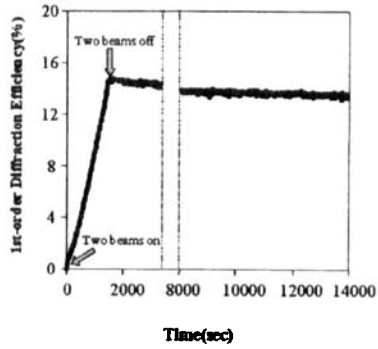


FIGURE 2. Long-term stability of the diffraction efficiency.

We have observed that stable surface relief gratings could be fabricated on the polymer film at room temperature. In Figure 1, we could observe the variation of diffraction efficiency under writing and erasing process. Under the polarizations(±45°) of the coupled beams we used herein, the interference patterns have both intensity modulation and polarization variation. It is more difficult to remove the diffraction gratings under irradiation of a linearly polarized light(45°). The oriented polarizable chromophores and hence the polymer is subjected to an electric force field in the light pattern resulting in the surface

relief grating formation. Regular grating structures with large surface modulation depth(165 nm) were observed.

In Figure 2, we also could observe the long-term stability of the gratings formed under the irradiation of the two beams. We blocked the coupled beams before tracing the relaxation of the diffraction efficiency. 93% of the signal remained even after 4 hours. Shortly, the polarizations of the two-coupled beams($\pm 45^{\circ}$) induced quite high diffraction efficiency and the stability was observed to be relatively high.

CONCLUSION

In this study, we presented the photo-induced diffraction grating formation of the polyurethane containing azo groups in the side chain. The polymer was amorphous and soluble in polar solvents. Upon exposure to an interference pattern of polarized excitation beams significantly below T_g, surface relief gratings with a high surface modulation depth could be fabricated on the polymer film. The value and the stability of the diffraction efficiency were observed to be relatively high under two-beam coupling.

Acknowledgement

This work was supported by Kyung Hee University (Jayugongmo 2000).

References

[1]. T. Todorov, L. Nikolova, N. Tomova, *Appl. Opt.*, **23**, 4309 (1984).

[2]. T. Todorov, L. Nikolova, N. Tomova, *Appl. Opt.*, **23**, 4588 (1984).

[3]. N.K. Viswanathan, S. Balasubramanian, L. Li, S. K. Triphathy, J. Kumar, *Jpn. J. Appl. Phys.*, **38**, 5928 (1999).

[4]. D.Y. Kim, L. Li, X.L. Jiang, V. Shivshankar, J. Kumar, S.K. Triphathy, *Macromolecules*, **28**, 8835 (1995).

[5]. L. Andruzzi, A. Altomare, F. Ciardelli, R. Solaro, S. Hvilsted, P.S. Ramanujam, *Macromolecules*, **32**, 448 (1999).