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

Analysis of Film Characteristics of Long Alkyl Chain-Contained 6-Nitro Spiropyran Fabricated by LB and Spin-Coating Method

Junhong Min [a], Se Young Oh [a], Jeong-Woo Choi [a] & Won Hong Lee [a]

[a] Dept of Chem. Engn., Sogang Univ, Seoul, 121-742, Korea

Version of record first published: 04 Oct 2006

To cite this article: Junhong Min, Se Young Oh, Jeong-Woo Choi & Won Hong Lee (1998): Analysis of Film Characteristics of Long Alkyl Chain-Contained 6-Nitro Spiropyran Fabricated by LB and Spin-Coating Method, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 316:1, 189-192

To link to this article: http://dx.doi.org/10.1080/10587259808044488

Mol. Cryst. Liq. Cryst., 1998, Vol. 316, pp. 189–192
Reprints available directly from the publisher
Photocopying permitted by license only

Analysis of Film Characteristics of Long Alkyl Chain-Contained 6-Nitro Spiropyran Fabricated by LB and Spin-Coating Method

JUNHONG MIN, SE YOUNG OH, JEONG-WOO CHOI,
and WON HONG LEE
Dept of Chem. Engn., Sogang Univ, Seoul 121-742, Korea

The photochromic properties of the films consisted of 6-nitro spiropyran with long alkyl chain were investigated as the fabrication method of films. The long alkyl chain-contained 6-nitro spiropyran films fabricated by spin coating method and by Langmuir-Blodgett technique also showed its native optical property. The photochromism of Langmuir-Blodgett films and spin coating films of 6-nitro spiropyran with long alkyl chain were investigated with various fabrication conditions of Langmuir-Blodgett films and spin coating method. The J-aggregate of 6-nitro spiropyran in the Langmuir-Blodgett films and in the spin coating films were occurred. The j-aggregate of 6-nitro spiropyran film by the spin-coating method was disappeared by the long irradiation of UV light.

Keywords: J-aggregate; spiropyran; Langmuir-Blodgett; spin-coating

INTRODUCTION

Spiropyran compounds are one of the most important classes of photochromic materials. Much of studies have been done focused on the photochromic properties of the spiropyran alone or complexes with polymers in solid states.

The Langmuir-Blodgett (LB) technique is widely applied to solidify the spiropyran due to the advantages capable of controlling molecular orientation, molecular density, and film thickness[1,2]. But, the fabrication process of film by Langmuir-Blodgett technique is too complicate to apply the spiropyran commercially and the measurement of the optical properties of their films is difficult because the films by Langmuir-Blodgett technique is very thin. So,

the need of the fabrication method of films containing the characteristics of the Langmuir-Blodgett films are emerged.

In this paper, the Langmuir-Blodgett techniques and the basic method for the coating films, spin coating, are used for the fabrication film with the long alkyl chain-contained spiropyran. The photochromic phenomena of the Langmuir-Blodgett films are investigated for the air-water interface and solid state. In the films by the spin coating method, the effect of the long alkyl chain on the photochromic properties of films are observed. The optical properties of the spin coating films are compared with that of the films by Langmuir-Blodgett technique.

EXPERIMENTAL DETAILS

The 6-nitro spiropyran with long-alkyl chain was synthesized by Gruda's method[3]. The experiments for LB film deposition were performed with Langmuir trough (Nima, Model 2022, UK) under UV irradiation. Spiropyran film was deposited on a quartz up to 10 layers. For the spin coating film, 12μL of spiropyran with long-alkyl chain in chloroform (0.5M) was dropped on the quartz slides rotating with 2000 rpm for 40 sec with the photoresist spiner (Headway Research Inc., Model 1-EC-101DR790, U.S.A.). The spiropyran films were dried for 30 min at 60°C.

RESULTS AND DISCUSSION

Figure 1(a) represents the π-A curve of spiropyran at an air-water interface under UV light irradiation. The molecular area of spiropyran (12Å^2) at zero pressure in the π-A curve was smaller than that after 5 hour of UV light irradiation. It is considered that the area occupied by head group of spiropyran was increased due to the reaction of 'ring opening' occurred during the irradiation of UV light.

Figure 1(b), (c) and (d) represents the AFM topographies of spiropyran film monolayer fabricated by horizontal dipping LB technique with various UV light irradiation time. In Figure 1(b), the spiropyran film before UV light irradiation had the rod-type aggregate of spiropyran. But, as UV light

irradiated, the size of aggregate was reduced. It is considered that the photoreaction, 'ring opening', by UV light irradiation affects the interaction between molecules of spiropyran.

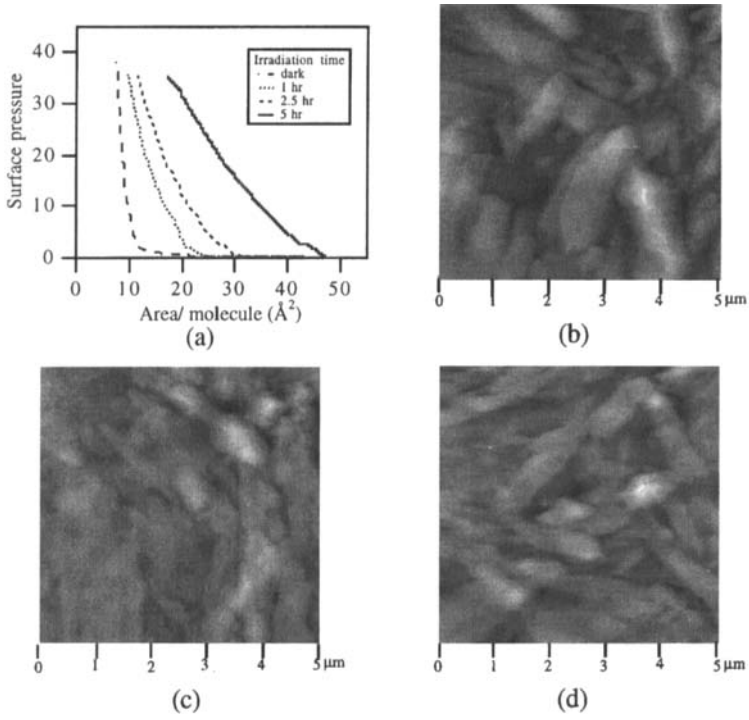

FIGURE 1. The effect of UV irradiation on the monolayer of spiropyran at air-water interface (a); AFM image of spiropyran films for the various UV irradiation time : (b), 0 hr; (c), 1 hr; (d), 5 hr.

As shown in Figure 2(a), the J-aggregate in the spiropyran films fabricated by the spin coating technique was occurred similar to that by LB technique (Data are not shown). While UV light was irradiated on the spiropyran film, the peak of absorbance spectrum was shifted from 59.5 Å to 54.8 Å. But the peak value of absorbance was decreased. It can be considered that the J-aggregate (59.5 Å) resulted from uniform molecular orientation to the radial direction by the film rotation disappeared due to the rearrangement by the ring opening of spiropyran, which induces the increase

of randomness of molecular orientation. The molecular orientation may occur because the shape of a spiropyran molecules with the long alkyl chain (C16) is rod-type with large aspect ratio. The maximum change of absorbance was about 0.4 in spiropyran films by the spin coating technique. Figure 2(b) represents that the absorbance of the double layer of spiropyran by the spin coating technique was changed by UV light irradiation. While UV light was irradiated on the spiropyran film, the peak of absorbance spectrum was shifted from 56.5 Å to 54.8 Å with the increase of absorbance peak value, comparing to the phenomena of monolayer of spiropyran as shown in Figure 2(a). This small J-aggregate of double layer might be due that the position on which the droplet was dropped to form the second layer was different from that for the first layer of spiropyran, which result in a different orientation bewteen two layers. The absorbance change(0.4) of double layer was similar to that of monolayer.

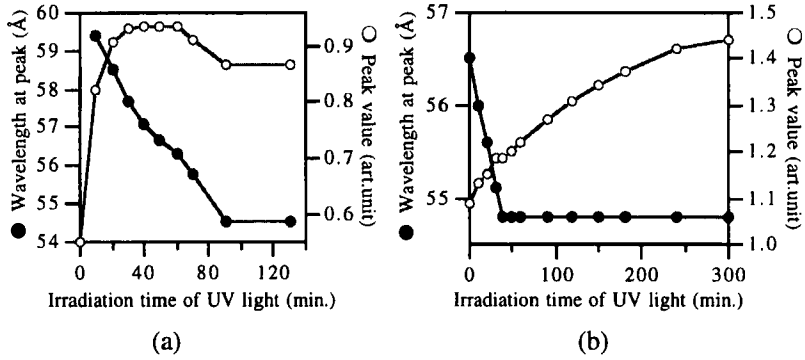

FIGURE 2. The effects of the irradiation time of UV light on the absorbance spectra of spin coating films : (a) monolayer; (b) double layer.

Acknowledgments
This work was supported by grants from Korea Science and Engineering Foundation (KOSEF : 95-0502-02-01-3)

References

[1.] E. Ando, J. Hibino, T. Hashida, and K. Morimoto, *Thin Solid Films*, **160,** 279 (1988).
[2.] C. Lenoble and R. S. Becker, *J. Phys. Chem.*, **90,** 62 (1986).
[3.] I. Gruda and R. M. Leblanc, *Can. J. Chem.*, **54,** 576 (1976).