유기막에 UV 배향한 FFS 액정셀의 전기광학특성

한정민[1], 황정연[1], 김병용[1], 한진우[1], 김종환[1], 이상극[1], 오용철[2], 서대식[1*]
연세대학교[1], 광운대학교[2]

A study on Electro-Optical Characteristics of the UV Aligned FFS Cell on the Organic Layer

Jeong-Min Han[1], Jeoung-Yeon Hwang[1], Byoung-Yong Kim[1],
Jin-Woo Han[1], Jong-Hwan Kim[1], Sang-Keuk Lee[1], Yong-Cheul Oh[2], and Dae-Shik Seo[1*]
Yonsei Univ.[1], Kwangwoon Univ.[2]

Abstract : In this study, we investigated the electro-optical (EO) characteristic of fringe-field switching (FFS) mode cell by the two kinds of ultraviolet (UV) alignment method on the organic thin film (polyimide: PI). The suitable organic layers for FFS cell and the aligning capabilities of nematic liquid crystal (NLC) using the in-situ photo-alignment method were studied. An unstable V-T curve of UV-aligned FFS-LCD with conventional photo-alignment method can be achieved. However, a stable V-T curve of UV-aligned FFS-LCD with in-situ photo-alignment method (1h), and V-T curve of UV-aligned FFS-LCD with in-situ photo-alignment method was much stable comparing with that of other UV-aligned FFS-LCD's. As a result, more stable EO performance of UV-aligned FFS-LCD with in-situ photo-alignment method is obtained than that of the other UV-aligned FFS-LCD's.

Key Words : Fringe-field switching (FFS) mode, polyimide (PI), in-situ photo-alignment method, liquid crystal, EO characteristics

1. Introduction

Recently, liquid crystal display (LCD) 's market is expected to grow rapidly. However, LCD's have basically two kinds of problems such as narrow-viewing angle, and slow optical response speed. In order to improve these problems, fringe-field switching (FFS)-LCD [3] was developed. In this study, we have used FFS-LCD because of superior readability and good transmittances [3]. Currently, a rubbing aligning method for LC alignment at FFS-LCD has been used. However, the rubbing method has some drawbacks [4, 5]. Thus, rubbing -less techniques for LC alignment are strongly needed in LCD technology. Thus, the LC alignment and pretilt angle generation using the in-situ photo-alignment method have been reported [18]. We reported NLC alignment by non-polarized ultraviolet (UV) method [19]. This alignment method with non-polarized UV light has the advantage such as applying large sized display panel because linearly polarized UV light needs polarizer equipment.

Therefore, this article reports the electro-optical (EO) characteristics of the UV-aligned FFS-LCD with in-situ photo-alignment method using non-polarized UV exposure on the polyimide (PI) surface.

2. Experimental

The chemical structure of the PI material is shown in Fig. 1. The PI films were coated on indium tin oxide (ITO) coated glass substrates by spin coating. In the conventional photo-alignment method, the polymers were soft-baked at 80 ℃ for 10 min and baked at 250 ℃. The thickness of the PI layer was set at 500 Å. The UV source was a 1000 W Mercury lamp. In the in-situ photo-alignment method, polymers were exposed to obliquely polarized UV during imidization of polyimide at 140 ℃. To measure EO characteristics for FFS-LCD's that were assembled by anti-parallel structure, the cell thickness was 4.0 ㎛. The FFS-LCD fabricated was NB (normally black) mode. The LC cell was filled with a fluorinated mixture type of NLC without a chiral dopant (=8.4, from Merck Co., Ltd.). Also, the rubbing aligned cell was fabricated. EO characteristics of the UV-aligned FFS-LCD's were measured by the LCD-700 (LCD Evaluation System, from Otsuka Electronics Co.).

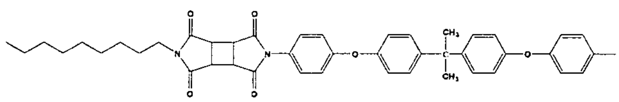

Fig. 1. Chemical structure of the polymer

3. Results and discussion

Figure 2 shows voltage-transmittance (V-T) curve of UV-aligned FFS-LCD's on the PI surface using conventional and in-situ photo-alignment method. An unstable V-T curve of UV-aligned FFS-LCD with conventional photo-alignment method can be achieved. However, a stable V-T curve of UV-aligned FFS-LCD with in-situ photo-alignment method (1h), and V-T curve of UV-aligned FFS-LCD with in-situ photo-alignment method was much stable comparing with that of other UV-aligned FFS-LCD's. As a result, more stable V-T curve of UV-aligned FFS-LCD with in-situ photo-alignment method for 3h is obtained than that of the other UV-aligned FFS-LCD's.

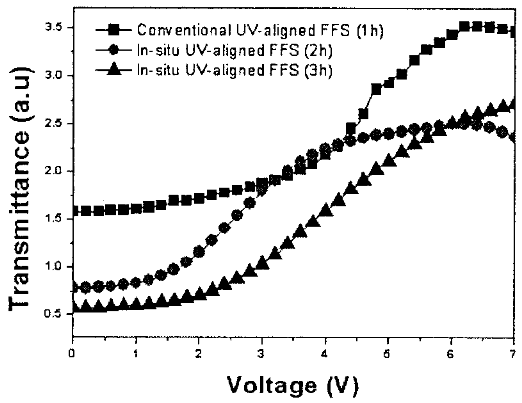

Fig. 2. Voltage-transmittances curve of three kinds of UV-aligned FFS-LCD on PI surfaces.

Figure 3 shows response time (RT) characteristics of three kinds of UV-aligned FFS-LCD'son the PI surface. An optical bounce characteristic of UV-aligned FFS-LCD with conventional photo-alignment method is obtained, and the much light leakage is measured. However, all stable curves on the UV-aligned FFS-LCD's with in-situ photo-alignment method can be achieved as shown in Fig. 3. Also, the light leakage on UV-aligned FFS-LCD is decreased, as increasing UV exposure time. From these results, it is contended, herein, that the in-situ photo-alignment method can be to achieve electro-optical (EO) characteristics. However, the light leakage indicates that UV-aligned FFS-LCD has weak anchoring. Consequently, to better EO performance of the UV-aligned FFS-LCD, we need study about optimizing condition in the in-situ photo-alignment method.

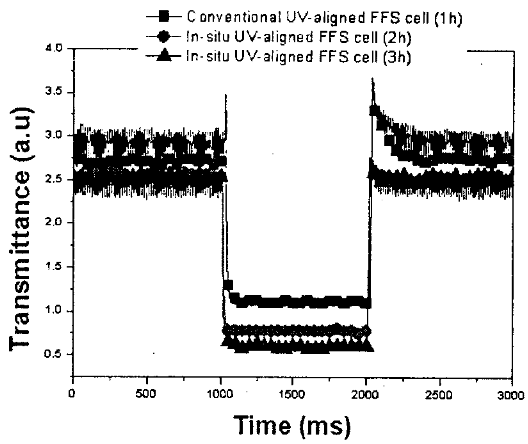

Fig. 3. Response time curve of three kinds of UV-aligned FFS-LCD on PI surfaces.

4. Conclusion

In conclusion, the EO characteristics of the UV-aligned FFS-LCD's with conventional photo-alignment and in-situ photo-alignment method using oblique non-polarized UV light on the PI surface were studied. More stable EO performance of UV-aligned FFS-LCD with in-situ photo-alignment method for 3h is obtained than that of the other UV-aligned FFS-LCD's. Consequently, to better EO performance of the UV-aligned FFS-LCD, we need study about optimizing condition in the in-situ photo-alignemnt method.

Reference

[1] S.-H. Lee, S.-L. Lee, and H.-Y. Kim, "Electro-optic characteristics and switching principle of a nematic liquid crystal cell controlled by fringe-field switching", Appl. Phys. Lett. Vol. 73, p. 2881, 1998.

[2] D.-S. Seo, K. Muroi and S. Kobayashi, "Generation of pretilt angle in nematic liquid crystal, 5CB, media aligned polyimide films prepared by spin-coating and LB techniques : effect of rubbing", Mol. Cryst. Liq. Cryst., Vol. 213, p. 223, 1992.

[3] D.-S. Seo, and J.-M. Han, "Generation of pretilt angle in NLCs and EO characteristics of a photo-aligned TN-LCD with oblique non-polarized UV light irradiation on a polyimide surface", Liq. Cryst. Vol. 26, No. 7, p. 959, 1999.