EO Performances of the Ion Beam Aligned TN-LCD on a Carbon Nitride Thin Film Surface

Chang-Joon Park, Jeoung-Yeon Hwang, Hyung-Ku Kang, and Dae-Shik Seo

Department of Electrical & Electronic Engineering, College of Engineering, Yonsei University, 134 Shinchon-dong, Seodaemoon-ku, Seoul 120-749, Korea, 82-2-3147-1351, dsseo@yonsei.ac.kr

Han-Jin Ahn[1], Jong-Bok Kim[1], Kyung-Chan Kim[1], and Hong-Koo Baik[1]

[1]Department of metallurgical Engineering, College of Engineering, Yonsei University, 134 Shinchon-dong, Seodaemoon-ku, Seoul 120-749, Korea

Abstract

Carbon Nitride exhibits high electrical resistivity and thermal conductivity that are similar to the properties shown by diamond-like carbon (DLC) films. These diamond-like transport properties in Carbon Nitride come in a material consisting of sp^2-bonded carbon versus the sp^3-carbon of DLC. The diamond-like properties and nondiamond-like bonding make NDLC an attractive candidate for applications. Liquid crystal (LC) alignment capabilities with ion beam exposure on carbon nitride thin films and Electro-Optical (EO) performances of the ion-beam aligned twisted nematic liquid crystal display (TN-LCD) with oblique ion beam exposure on the Carbon Nitride thin film surface were studied. An excellent uniform alignment of the nematic liquid crystal (NLC) alignment with the ion beam exposure on the Carbon Nitride thin films was observed. In addition, the good EO properties of the ion-beam-aligned TN-LCD were achieved. Finally, we achieved the residual DC property of the ion-beam-aligned TN-LCD on the Carbon Nitride thin film.

1. Objectives and Background

Thin film transistor liquid crystal displays (TFT-LCDs) are widely used as information display devices such as monitors in notebooks, desktop and LCD-TV. A rubbing method has been widely used to align liquid crystal (LC) molecules on the polyimide (PI) surface. LCs are aligned due to the induced anisotropy on the substrate surface [1-5]. Rubbed polyimide surfaces have suitable characteristics such as uniform alignment and a high pretilt angle. However, the rubbing method has some drawbacks, such as the generation of electrostatic charges and the creation of contaminating particles [5]. Thus a non-contact alignment technique would strongly needed for future generations of large, high-resolution liquid-crystal display.

Most recently, the LC aligning capabilities achieved by ion beam (IB) exposure on the diamond-like carbon (DLC) thin film layer have been successfully studied by P. Chauhari et al [6]. A carbon nitride thin film exhibits high electrical resistivity and thermal conductivity similar to that of diamond-like carbon (DLC) thin films. Significantly, these diamond-like transport properties in Carbon Nitride come in a material consisting of sp^2-bonded carbon versus the sp^3-

carbon of DLC. The diamond-like properties and nondiamond-like bonding make Carbon Nitride an attractive candidate for applications such as high performance microelectronics [7]. Preparation of Carbon Nitride thin films can be carried out at low substrate temperature and with high deposition rates using PECVD [8].

In this study, we studied the Electro-Optical (EO) characteristics of the ion-beam-aligned twisted nematic (TN)-LCD with oblique ion beam exposure on four types of the Carbon Nitride thin film surface.

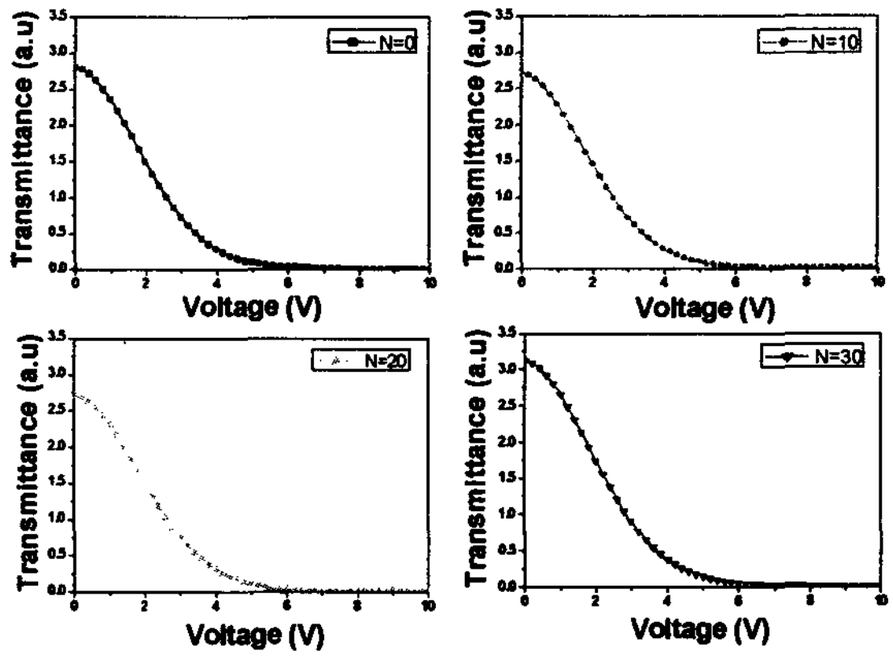

Figure 1. V-T curves of the ion-beam-aligned TN -LCDs with oblique ion beam exposure on the Carbon Nitride thin film surface

2. Results and Discussion

2.1 LC alignment

The LC pretilt angle varies with ion beam incident angle and irradiation time on Carbon Nitride thin films. The LC pretilt angle has the maximum value at 1min. about 10 degree, and the pretilt angle rapidly decreases with increasing ion beam irradiation time. We set a goal for applicable to TFT-LCD. Thus we determined Ion beam exposure time for 30sec. (6~7degree).

2.2 V-T Characteristics.

Figure 1 shows V-T curves of the ion-beam-aligned TN-LCDs with oblique ion beam exposure on the Carbon Nitride thin film surface. A good Voltage-Transmittance (V-T) curve can be achieved in the ion-beam-aligned in the ion-beam-aligned TN-LCD with ion beam exposure on the Carbon Nitride thin film surface which contains 30sccm nitrogen gas.

The transmittances of the ion-beam aligned TN-LCD on the Carbon Nitride thin films have a considerable difference according to composition quantity of nitrogen gas. Consequently, this system suggested that ideal composition quantity of nitrogen gas needed to achieve a good V-T characteristics of the ion-beam aligned TN-LCD was 30sccm.

2.3 Response Time Characteristics

Figure 2 shows the response time characteristics of the ion-beam-aligned TN-LCD with ion beam exposure on the Carbon Nitride thin film surface. The response time characteristics of the ion-beam aligned TN-LCD on the Carbon Nitride thin film surface improved by increasing composition quantities of nitrogen gas.

Therefore, fast response time characteristics for the ion-beam-aligned TN-LCD with ion beam exposure on the Carbon Nitride thin film was produced at 30sccm nitrogen gas. From these results, it is contended, herein, that the composition quantity of nitrogen gas needed to achieve a good V-T curve and good response time characteristics was 30sccm, as shown in Figs. 1

and Fig. 2.

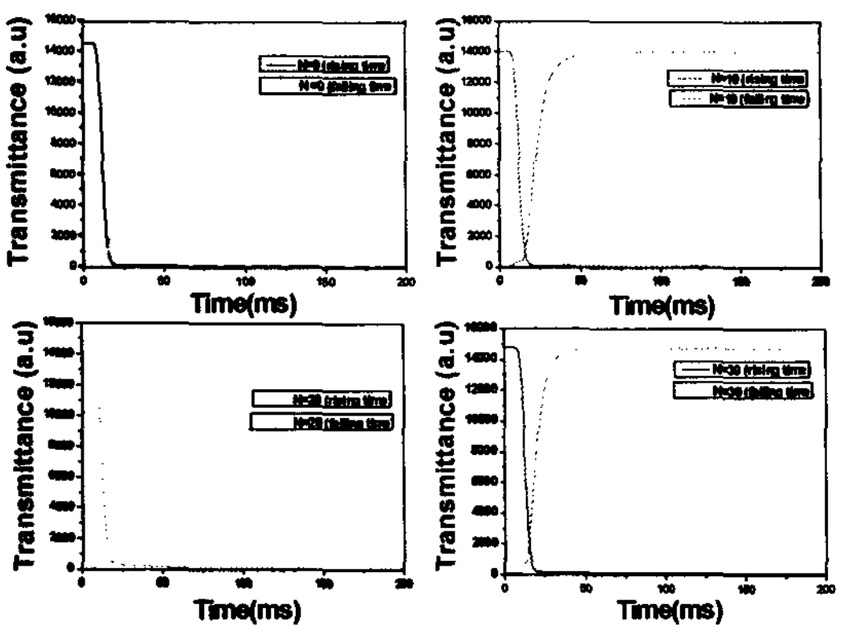

Figure 2. The response time characteristics of the ion-beam-aligned TN-LCD with ion beam exposure on the Carbon Nitride thin film surface

Table 1 shows the response times for ion-beam-aligned TN-LCD with various composition quantities of nitrogen gas on the Carbon Nitride thin film surface. The fast response time of ion-beam aligned TN-LCD with various composition quantities of nitrogen gas on the Carbon Nitride thin film surface for 30sccm, considering transmittance of response time characteristics, was optically measured to be about 19.23ms.

Table 1. The response times for ion-beam-aligned TN-LCD with various composition quantities of nitrogen gas on the Carbon Nitride thin film surface.

Alignment Layer (sccm)	**Response Time**		
	τ_r (ms)	τ_d (ms)	τ (ms)
N = 0 (DLC)	5.4	16.71	22.11
N = 10	5.3	17.68	22.98
N = 20	5.7	16.14	21.84
N = 30 (NDLC)	5.4	13.83	19.23

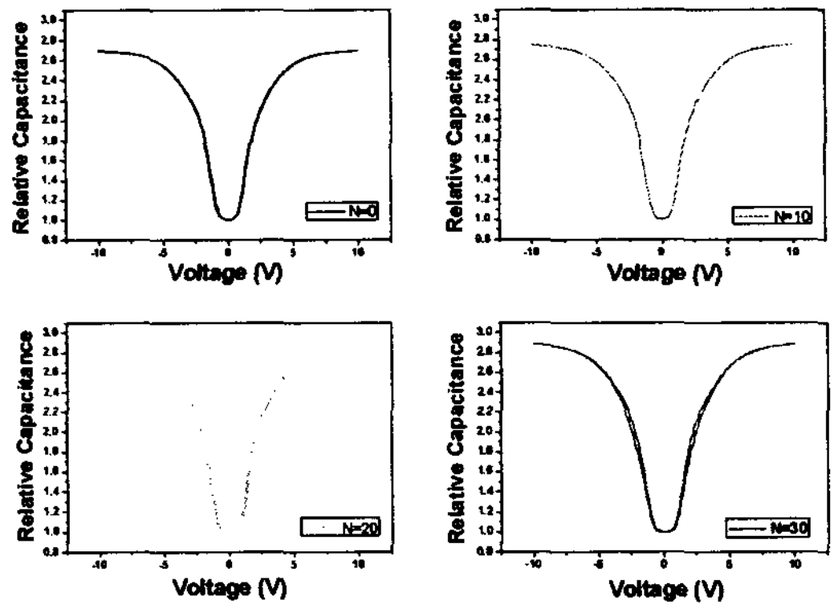

Figure 3. The Capacitance-Voltage characteristics of the ion-beam aligned TN-LCD with oblique ion beam exposure on the various composition nitrogen of Carbon Nitride thin film surface

Figure 3 shows the Capacitance-Voltage characteristics of the ion-beam-aligned TN-LCD with oblique ion beam exposure on the various composition nitrogen of Carbon Nitride thin film surface.

As the increasing nitrogen gas, the residual DC voltage of the ion-beam-aligned TN-LCD was increased as shown in Fig. 3. However, the residual DC property of the ion-beam aligned TN-LCD was very small. As a result, a good residual DC voltage characteristic was achieved.

Consequently, the EO characteristics and residual DC property of the ion-beam aligned TN-LCD with oblique ion beam exposure on the Carbon Nitride thin film surface are improved

more than those of the DLC thin film surface.

3. Impact

Carbon Nitride exhibits high electrical resistivity and thermal conductivity that are similar to the properties shown by diamond-like carbon (DLC) films. These diamond-like transport properties in Carbon Nitride come in a material consisting of sp^2-bonded carbon versus the sp^3-carbon of DLC. The diamond-like properties and nondiamond-like bonding make Carbon Nitride an attractive candidate for applications.

Furthermore, A Carbon Nitride thin film has better thermal stability than Diamond-Like Carbon (DLC) thin film.

Therefore we have used a Carbon Nitride thin film as New Liquid Crystal Alignment Layer. In addition, we achieved the good EO Characteristics and residual DC property of TN-LCD in comparison with PI and DLC thin film layer.

4. Acknowledgements

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5. References

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