NDLC박막에 이온빔배향법을 사용한 In Plane Switching(IPS) cell의 전기광학특성

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Electro-Optical Performances of In plane Switching(IPS) Cell on the Inorganic Thin Film by Ion Beam(IB) Method

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Abstract : We studied the nematic liquid crystal (NLC) alignment capability by the IB(Ion bean) alignment method on a NDLC(Nitrogen Diamond Like Carbon) as a-C:H thin film, and investigated electro-optical performances of the IBaligned IPS(In plane switching)cell with NDLC surface. A good LC alignment by IB exposure on a NDLC surface was achieved. Monodomain alignment of the IB aligned IPS cell can be observed. The goodelectro-optical (EO) characteristics of the IB aligned IPS cell was observed with oblique IBexposure on the NDLC as a-C:H thin film for 1min.

Key Words : NDLC, ion beam, response time, LC alignment, pretilt angle

1. INTRODUCTION

Liquid crystal displays (LCDs) are widely used as information display devices such as monitors in notebooks, desktops,and LCD TV. A rubbing method has been widely used to align liquid crystal (LC) molecules on the polyimide (PI) surface. [1-3]. 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 [4,5]. Thus we strongly recommend a non-contact alignment technique for future generations of large, high-resolution LCD.

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. Also, our research group already studied IB alignment method using DLC thin film.

In this article, we report on LC alignment and pretilt angle generation with IB exposure on the surface of NDLC(nitrogen diamond like carbon) as a-C:H:N thin-film deposited by rf magnetron sputtering, and EO characteristics of the ion beam aligned IPS cell with oblique IB exposure on the NDLC as a alignment layer.

2. EXPERIMENT

The a-C:H:N (NDLC) thin films were prepared by RF magnetron co-sputtering equipped with a 5 N-purity Carbon target.The glass substrates were first cleaned with standard cleaning procedures (TCE acetone methanol) and then rinsed in deionized water. Cleaned substrates were loaded in the central region of the substrate holder located about 50mm away from the targets. The sputtering chamber was initially evacuated by a turbo molecular pump to the base pressure of about 7.5_10_4 Pa. For the NDLC films deposition, the working pressure was maintained at about 0.67 Pa with Ar-ambient gas. Prior to the film deposition, pre-sputtering was performed for 10 min to remove any contamination on the target surface. The thickness of the NDLC thin film layer was about 20nm.

The IB system is shown in Fig. 1. The IB power was used 1200eV.

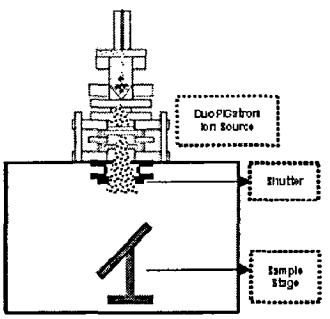

Fig. 1. Ion beam exposure system

The gap of the Ion beam aligned LC cell was 60㎛, and the cell thickness of the Ion beam aligned IPS cell was about 4㎛. The LC cell was filled with a nematic liquid crystal (NLC) (Tc = 72C , Δε=8.2, from Merck Co.). To determine LC alignment condition, a polarization

microscope was used and pretilt angle was measured crystal rotation method at room temperature. Voltage-Transmittance (V-T) and response time characteristics of the UV aligned TN-LCD were measured by a LCD-700 (LCD Evaluation System, from Otsuka Electronics Co.) equipment.

3. RESULT AND DISCUSSION

The LC pretilt angle observed with IB exposure on the NDLC thin film as a function of N_2 gas percent are shown in Fig. 2. It is shown that the LC pretilt angle generated was about 3 in the all-incident angle on the NDLC thin film when N_2 gas was 2 and 4 sccm. However, LC pretilt angle generated show decrease with increasing N_2 gas percent. So, NDLC thin film with low pretilt angle was used in the IPS cell.

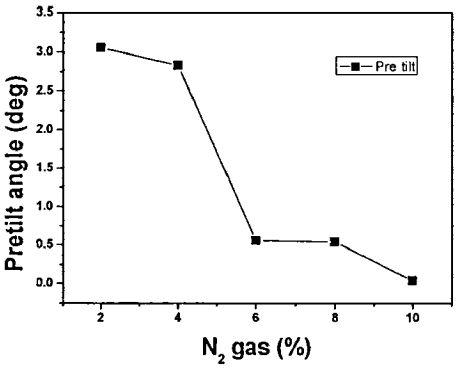

Fig. 2. Generation of pretilt angles in NLC with IB exposure on NDLC thin film surfaces for 1 min as a function of N_2 gas percent.

Figure 3 shows a good transmission of light as a function of applied voltage across IPS cells made of NDLC thin film as alignment layers. A stable V-T curve of IB aligned IPS cell on the NDLC thin film was measured.

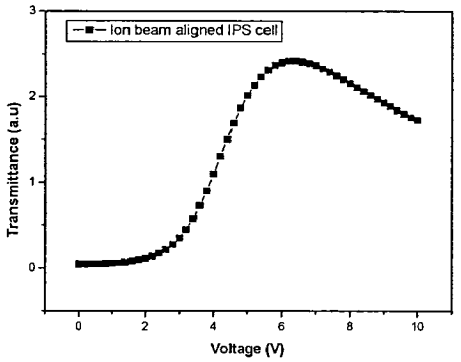

Fig. 3. Voltage-transmittance characteristics of the IB aligned IPS cell on NDLC thin film

Figure 4 shows the response time characteristics of the IB aligned IPS cells made of NDLC thin films, as alignment layers. A stable curve for IB aligned IPS cell on the NDLCthin films is shown.

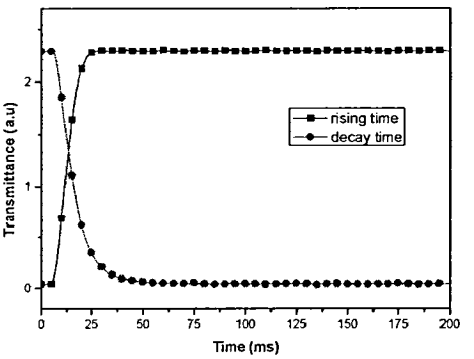

Fig. 4. Response time (RT) characteristics of the IB aligned IPS cell on NDLC thin film

4. Conclusions

In conclusion, we studied about LC alignment effect and the controllability of pretilt angle in a new alignment layer of the NDLC thin film deposited by rf magnetron sputtering, and investigated electro-optical performances of the IB aligned IPS cell with the IB exposure on NDLC thin film surface. We achieved a good alignment characteristic using IB alignment method on the NDLC thin film when N2 gas is from 2sccm to 10sccm at the sputtering. Also, we obtained high pretilt angle on the NDLC, and then NLC alignment capabilities show decrease with increasing N2 gas percent. Finally, the EO characteristics of the IB aligned IPS cell using IB alignment method on the NDLC as a alignment layer.

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REFERENCES

[1] J. M. Geary, J. W. Goodby,. A. R. Kmetz, and J. S., J. Patel,. Appl. Phys., 62, p. 4100 (1987).

[2] D.-S. Seo, K. Muroi, and S. Kobayashi, Mol. Cryst. Liq. Cryst., 213, 223 (1992).

[3] D.-S. Seo, S. Kobayashi, and M. Nishikawa, Appl. Phys. Lett., 61, P. 2392 (1992).

[4] K. Kobayashi and Y. Limura, SPIE 2175, p.123 (1994).

[5] M. Nishikawa, B. Taheri, and J. L. West, SID'98, p.131 (1998)