고분자 막을 이용한 이온빔 배향 TN-LCD의 전기광학특성

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Electro-optical characteristics of TN-LCD on a Polyimide Surface Exposed to an Ion Beam

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Abstract : We studied liquid crystal (LC) alignment with ion beam (IB) on polyimide and electro-optical characteristics of twisted nematic (TN)-liquid crystal display (LCD) on the polyimide surface using obliquely ion beam exposure. A good uniform alignment of the nematic liquid crystal (NLC) alignment with the ion beam exposure on the polyimide surface was observed. In addition, it can be achieved the good EO properties, and residual DC property of the ion-beam-aligned TN-LCD on polyimide surface

Key Words : Polyimide film, Iom beam, LC alignment, pretilt angle, Residual DC, thermal stability

1. INTRODUCTION

Aligned liquid crystals (LCs) are widely used in flat panel display (FPD) technology. They are aligned by inducing anisotropyon the surface of a substrate. This surface is usually a polymer such as polyimide, coated on a glass substrate [1-2]. Rubbed polyimide surfaces have suitable characteristics such as uniform alignment and a high pretilt angle. However, the rubbing method has some drawbacks [3]. These include the debris left by the cloth during the rubbing process in an otherwise clean room environment; concern with electrostatic discharging and its influence on the electronic circuitry below the thin polyimide film. Thus, a non-contact alignment technique would be highly desirable for future generations of large, high-resolution LCDs.

A number of alternative alignment techniques have been reported, but none of these have so far been implemented in large-scale manufacturing. 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. However, this method has problems as reproducibility yet.

Also, the ion beam irradiated polyimide was also applied to the alignment of LC. Most of them mainly focused on basic cell parameters and fundamental mechanism [4].

In this research, we studied LC alignment effects and the electro-optical (EO) performances of the ion-beam-aligned TN-LCD with oblique ion beam exposure on the polyimide surface

2. EXPERIMENT

We used a polyimide surface as alignment layer. The polymers were uniformly coated on indium-tin-oxide (ITO) electrodes using the spin-coating method, and imidized at 220℃ for 1 h. The thickness of the PI film was set at 500Å. The polyimide layer was used by an Argon ion beam. The energy, integrated dose, and the angle of the plane of the substrate with respect to the ion beam were varied. After irradiation, two types of test samples were fabricated. One was arranged in an anti-parallel configuration, which was used for pretilt angle measurements. The other was the twisted nematic (TN) test sample, which was used for Electro-Optical measurement. After substrates coated the polyimide surface were bombarded by the ion beam, the two substrates were assembled together and filled with a nematic liquid crystal (NLC) (Tc = 72C , $\triangle\varepsilon$=8.2, MJ001929 from Merck Co.) for TN test samples.The thickness of the liquid crystal cells for TN test sample was 5 m. In addition, the thickness of the liquid crystal cells for pretilt test sample was 60 m.The pretilt angle of anti-parallel cell was measured by a crystal rotation method. LC alignment effects were observed using a polarized microscope. In addition Voltage-Transmittance and response time characteristics of ion-beam aligned TN-LCD were measured by LCMS-200 (Electro-Optical Measurement, from Sesim Photonics Technology) equipment. Also, the residual DC voltage properties of ion-beam-aligned TN-LCD were measured by a Capacitance-Voltage hysteresis method.

3. RESULT AND DISCUSSION

We show in Fig. 1 a good transmission of light as a function of applied voltage across twisted nematic liquid crystal cells made of polyimide layer, as alignment layers. A good voltage-transmittance(VT) characteristics of the ion-beam-aligned TN-LCD was achieved.

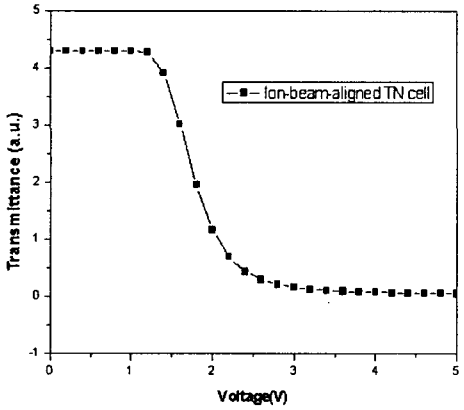

Figure 1. voltage-transmission(VT) characteristics of the ion-beam-aligned TN-LCD cells made of polyimide films

Figure 2 shows the response time characteristics of the ion-beam aligned twisted nematic liquid crystal cells made of polyimide films, as alignment layers. Considering transmittance of response time characteristics, fast response time of ion-beam-aligned TN-LCD using the polyimide surface was optically measured to be about 13 ms. In other words, the pretilt angle is very important because the tilt affects the LC alignment stability and Electro-Optical performances of LC operation modes using polyimide film.

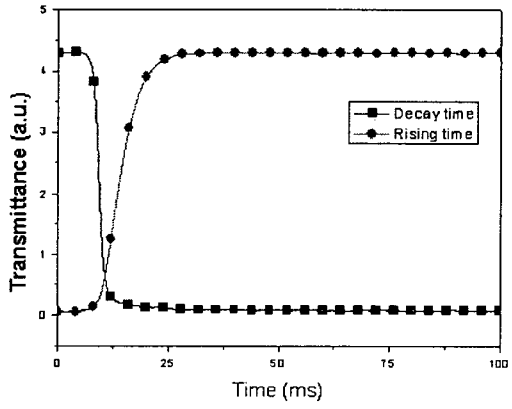

Figure 2. the response time characteristics of the ion-beam aligned TN-LCD cells made of polyimide films

Image sticking was also very important factor for the functioning of displays.This arises from residual charges that accumulate in a local region as the voltage is left on. When the voltage is removed, the image survives and gradually fades away with time as the charge is dissipated. We show in Fig. 3 the Capacitance-Voltage characteristics of the ion-beam-aligned twisted nematic liquid crystal cells made of polyimide films, as alignment layers. The residual charge characteristic of ion-beam-aligned TN has a little. However, the increased value of the residual charge was very small.

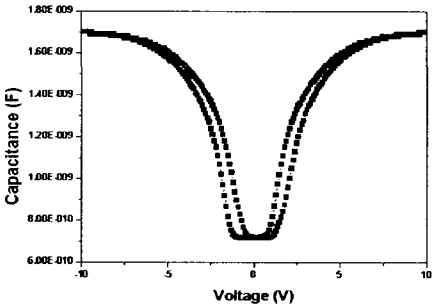

Figure 3. the Capacitance-Voltage characteristics of the ion-beam-aligned TN-LCDcells made of polyimide films

4. Conclusions

In conclusion, LC alignment effects and generation of pretilt angles with ion beam irradiation, the EO performances of the ion-beam aligned TN-LCD on the polyimide surface were studied. The good V-T curves in comparison with the polyimide were observed for the ion-beam-aligned TN-LCD with ion beam exposure on the polyimide surface. Also, the fast response time characteristics in the polyimide layer can be achieved for the ion-beam aligned TN-LCD using the polyimide surface. Finally, the residual DC voltage of the ion-beam-aligned TN-LCD on the polyimide surfaces was good

ACKNOWLEDDMENTS

This work was supported by National Research Laboratory program

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