Investigation into the stability of ion beam treated inorganic alignment layer

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Abstract

Inorganic alignment layer (IAL) was deposited on an indium-tin-oxide (ITO) by using reactive sputtering deposition method. After deposited, IAL was irradiated by Ar^+ ion beam (IB) for liquid crystal (LC) alignment. IAL treated by various conditions such as IB energy, IB incident angle, and IB irradiation time had excellent alignment property and electro-optical property the same as that of PI. We investigated into the stability of ion beam treated IAL after a lapse of long time. However IAL irradiated IB did not occur degradation of electro-optical property. The results implied that IAL irradiated IB was adopted as LC alignment layer instead of rubbed polyimide.

1. Objectives and Background

Liquid crystal displays (LCDs) are widely used for information display devices and the technique of liquid crystal (LC) alignment is an important issue in the fabrication of LCDs. In the many techniques proposed for LC alignment, the mechanical rubbing method is the most widely used due to a very simple method for obtaining uniform alignment of LC and its high productivity. However the many researchers have been found the new alignment method and new alignment material in spite of the many advantages of rubbing method because the method does present a number of problems, including the generation of dust and static electricity and polyimide also requires a heat treatment process (up to 200 °C), limiting the choice of substrates and materials.

In recent years, several alignment methods have been proposed as potential replacements of the rubbing method such as oblique evaporation [1], a polyimide Langmuir-Blodgett (LB) film method [2], and photoalignment [3]. The photoalignment method is particularly promising as a next generation method. But photoalignment is thought to provide only weak anchoring strength and low stability.

In this paper, we use to inorganic material such as hydrogenated amorphous silicon oxide (a-SiOx:H) and ion beam irradiation treatment as well as measure degradation of electro-optical property, including V-T, Response time, and VHR.

2. Results and discussion

Figure 1 and Table 1 show the stability of electro-optical property (V-T and Response time) of IB irradiated a-SiOx:H film. Sample is fabricated by reactive magnetron sputtering method and treated by kaufman ion source. The thickness of a-SiOx:H film (10 nm) is measured by ellipsometry and energy, incident angle, and irradiation time of ion beam is 200eV, 45°, and 1min, respectively. Although a-SiOx:H is aged until 100 days, voltage-transmittance and response time values of a-SiOx:H are almost same as initial value.

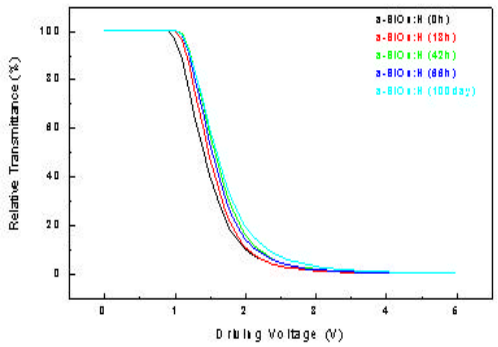

Figure 1. The change of Voltage-Transmittance (V-T) curve in a-SiOx:H after aging test.

	V-T (V)		Response time (ms)		
	V_{10}	V_{90}	Rising	Decay	total
0 h	2.109	1.173	3.333	6.408	9.741
18 h	2.045	1.163	3.547	7.029	10.576
42 h	2.188	1.226	3.475	6.815	10.290
66 h	2.148	1.204	3.303	6.015	9.318
100 day	2.315	1.223	3.560	7.831	11.391

Table 1. The V-T and Response time in a-SiOx:H after aging test.

Fig. 2 shows the stability of voltage holding ratio (VHR) in a-SiOx:H. VHR value of a-SiOx:H film is about 98% and degradation of VHR does not nearly occur. Therefore ion beam treated a-SiOx:H is replaced by rubbed polyimide.

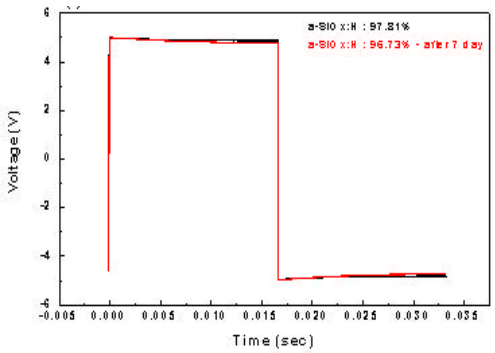

Figure 3. The change of VHR curve in a-SiOx:H after aging test.

3. Conclusion

In summary, hydrogenated amorphous silicon oxide has excellent electro-optical property (V-T, Response time, and VHR) as well as high stability of electro-optical property.

4. Reference

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