Effect of the photo-spacer and polymer wall on the mechanical stability of the polymer-stabilized ferroelectric liquid crystal system

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Abstract

Here we report the effect of photo-spacer and polymer wall on the mechanical stability of the polymer-stabilized ferroelectric liquid crystal (PSFLC) system. A better bending tolerance of the PSFLC cell was obtained when the polymer wall was formed parallel to the rubbing direction. In addition, the effect of the distance between photo-spacer columns as well as that of the distance between polymer wall columns on the mechanical stability of the liquid crystal was examined.

1. Introduction

Recently, flexible display has drawn much attention and various types of approaches are under going. Due to the portability and the battery problem of flexible display, memory property with no/ least power consumption to maintain the image is needed. Several mode of liquid crystal (LC) display with memory property, i.e. cholesteric, bistable twisted nematic and ferroelectric LC mode, has been attracted in this viewpoint of application. Among these LC modes, ferroelectric liquid crystal operates with least strength of electric field hence power consumption is also small. In addition, ferroelectric LC stabilized by some polymer network was found to have grayscale memory property and much effort to apply them on the flexible display has been done.

However, ferroelectric LC is too weak to the mechanical stress to use as flexible display mode. In this research, we used a substrate with columned photo-spacer and formed polymer wall in the cell by photo-induced phase separation method. Then, the mechanical stability dependence on the structural configuration of the cell was examined.

2. Results

The structural configuration of the cell is shown in figure 1. With the photo-spacer split substrate, polymer wall and polymer network is formed via two step polymerization using UV light source.

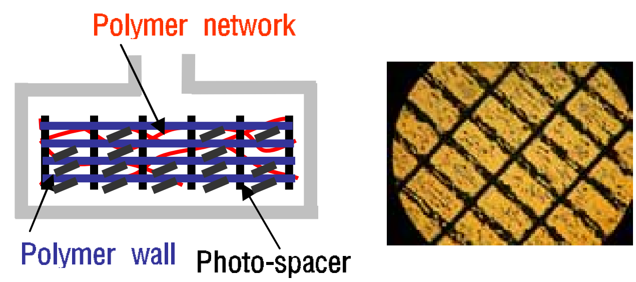

Figure 1. Schematic representation of the cell structure with photo-spacer and polymer wall.

The optical birefringence change of cells as a function of the radius of curvature at bent state is shown in figure 2. The cell with bead spacer or the one with polymer network shows much change of birefringence as the cell was more bent. However, the cell with photo-spacer shows little changes of birefringence. Especially, the cell with photo-spacer, polymer wall and polymer network shows least change of birefringence.

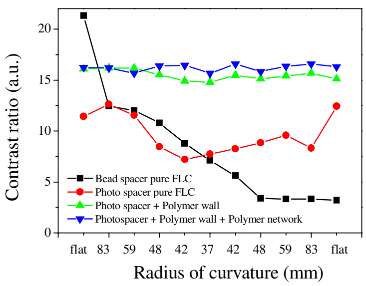

Figure 2. Birefringence of the cell with different supporting spacer as a function of the radius of curvature at bent state.

We examined the effect of the polymer wall direction on the mechanical stability as shown in figure 3. When the polymer wall was formed parallel to the rubbing direction, more enhanced bending tolerance was achieved. This result is found to be due to the different wall formation state of each cell. The cell with polymer wall parallel to the rubbing direction showed more enhanced phase separation behavior between the LC and monomer hence formed more extinct polymer wall.

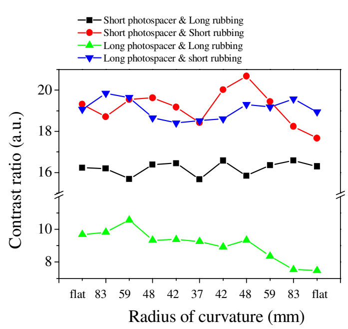

Figure 3. Birefringence of the cell with different direction of photo-spacer and polymer wall as a function of the radius of curvature at bent state.

Next, we examined the dependence of bending tolerance of the cell on the distance between the columned photo-spacers. As shown in figure 4, as the distance between the photo-spacer gets narrower, the bending tolerance of the cell was enhanced.

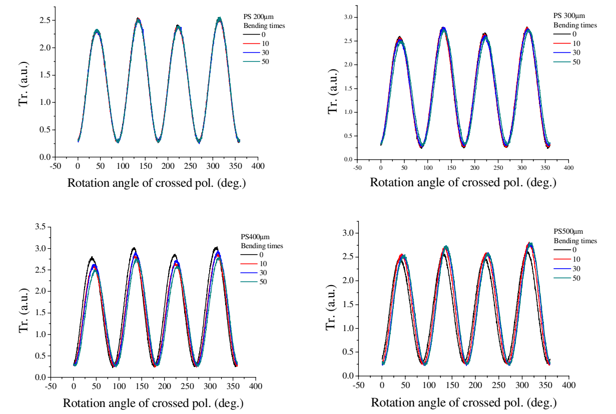

Figure 4. Birefringence of the cell with different distance of photo-spacer at bent state.

3. Conclusion

In this research, we showed an enhanced mechanical stability of the PSFLC using photo-spacer and polymer wall. Comparing with the previous report with polymer wall only system, it is more stable to the bending perturbation and also showed more enhanced orientation in the wall boundary area.

4. Acknowledgements

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5. References

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