Novel In-cell Retarder Materials for Transflective IPS-LCDs

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Keywords :In-cell retarder, Transflective, IPS

Abstract

We have developed new in-cell retarder materials that provide good transmittance and resolution with the goal of enhancing the properties of transflective IPS-LCDs. We explored various additive surfactants to optimize the applicability of the materials. Moreover, we selected photopolymerization initiators and liquid crystal diacrylate monomers as negative-type photo-patternable retarder materials, seeking to improve resolution and transmittance.

Introduction

Improved visibility and clarity are qualities in high demand for the liquid crystal displays (LCDs) found in cellular phones and digital cameras. Requested viewing characteristics include high contrast ratio, wide viewing angle, and readability outdoors. Improvements in readability and visibility outdoors can be achieved by using transflective In-plane switching (IPS) LCDs with in-cell retarders [1]. Transflective IPS-LCDs that incorporate retarders in the reflective portion of the color filter have already been introduced commercially [2] by Hitachi Displays, Ltd. Figure 1 shows the device structure of the transflective IPS-LCD incorporating the in-cell retarder described here. Since improving the properties of transflective IPS-LCD requires high transmittance and high resolution in-cell retarders, we examined potential new photopolymerization materials for their potential as use for in-cell retarders.

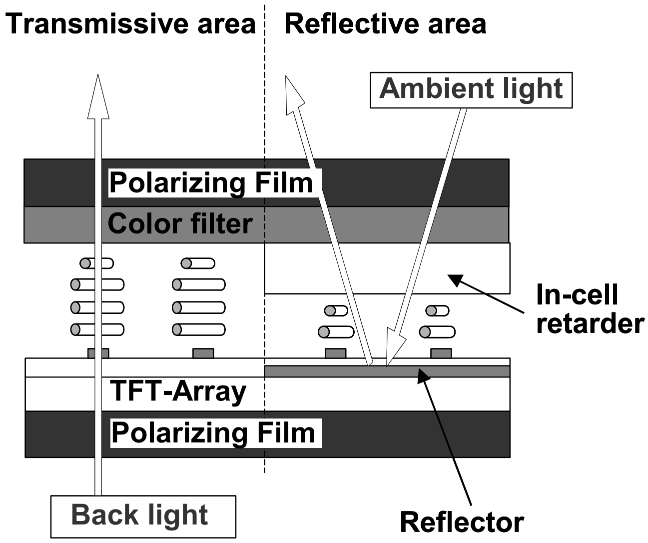


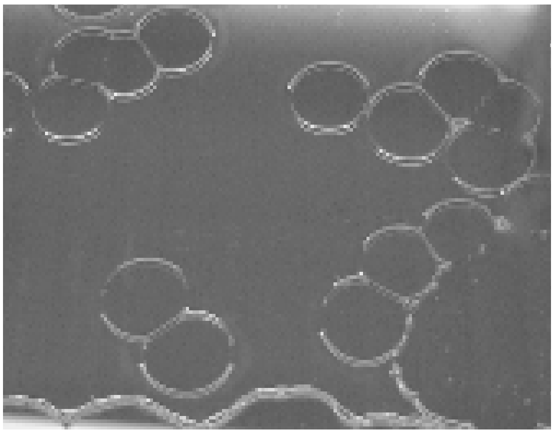
Figure 1 Device structure of the transflective IPS-LCD incorporating in-cell retarder.

Experimental

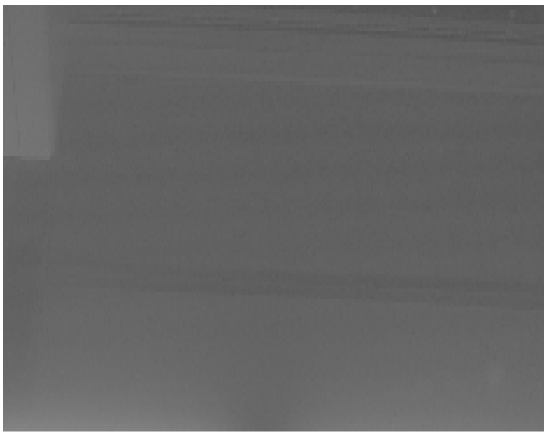
The wet character of the in-cell retarder was assessed under conditions in which the in-cell retarder material was applied to a substrate and dried on a hot plate. The quality of in-cell retarders was confirmed after coating the in-cell retarder material under conditions for dark states between crossed polarizers. We examined various photopolymerization initiators and liquid crystal diacrylate monomers, patterned by exposing with a photomask after coating and organic solvent development, for use as in-cell retarder materials. Shapes were confirmed after patterning in-cell retarders with a microscope, and light exposures were also optimized.

Results and Discussion

The additive agents were added to the material solutions to improve the wet character of the in-cell retarder material. Figure 2(a) shows the film conditions under which the film was spin-coated on the substrate. Without additive agents, the liquid crystal diacrylate monomer tends to precipitate and form defects on the dried film. Figure 2(b) shows that adding additive agents to the in-cell retarder material results in a sufficient wet character.



(a)

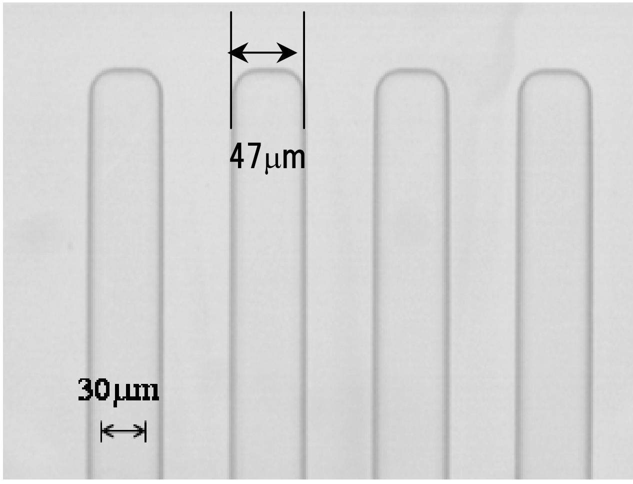


(b)

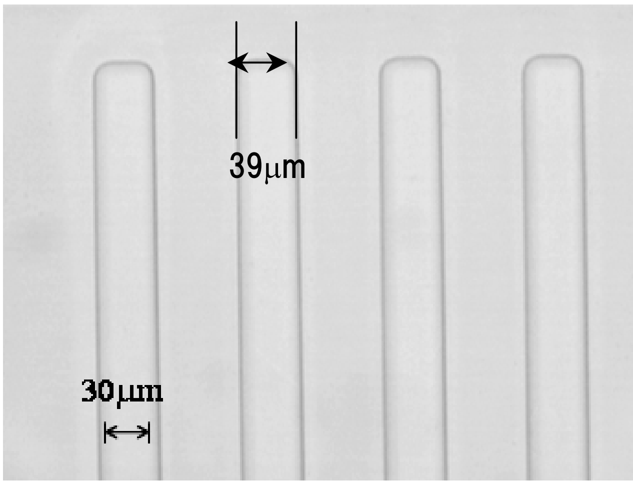
Figure 2 In-cell retarder materials applied to substrates without additive agents.

(a) Without additive agents (b) With additive agents.

Figure 3 shows the patterned shapes of the materials and a comparison of the differences between the photopolymerization initiators. The pattern resolutions obtained from initiator A and B were 47 μm and 39 μm, respectively. Materials with initiator B provided higher resolution.



(a)



(b)

Figure 3 Microscopic images of in-cell retarder materials.

(a) Photopolymerization initiator A

(b) Photopolymerization initiator B

Figure 4 shows a comparison of the optical transmittance spectra. We obtained higher transmittance with initiator B, particularly at 400 nm and 500 nm. This characteristic is ideal for enhancing the LCD reflective performance. We therefore consider that the initiator B improves the properties of the in-cell retarder.

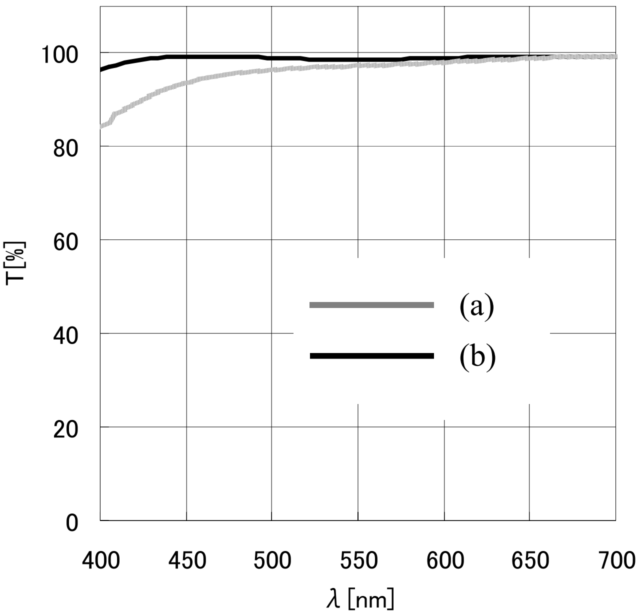


Figure 4 Optical transmittance spectra comparison of in-cell retarder materials

(a) Photopolymerization initiator A

(b) Photopolymerization initiator B

Summary

Provided is a new in-cell retarder material, with improved wet character, that enhances the properties of transflective IPS-LCDs, permitting fabrication of devices offering excellent transmittance and resolution characteristics.

References

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