광확산제를 함유하는 PMMA 도광판의 제조와 특성 평가

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Preparation and Characterization of Light Guide Panel Based on PMMA with Light Scatterers

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1. Introduction

Conventional backlight unit (BLU) of liquid crystal displays (LCDs) is composed of various optical sheets such as light guide panel, diffusion sheet, prism sheet, and etc. These sheets are inevitable for uniformly distributing light over LCD system, but reduce the light transmission efficiency, making BLU the most energy consuming unit in the LCD module. Recently, much works on increasing the optical efficiency of BLU have been done. One of the approaches for it is to use a light guide panel containing small particles acting as light scatterers (LSs).

In this study, we prepared PMMA/LS composite sheets for light guide panel using a cell casting method and investigated the effect of the size and content of dispersed LS on the light scattering pattern. Experimental results are compared with those from a Monte Carlo simulation combined with Mie's scattering theory.

2. Experimental

2.1. Preparation of light guide panel

Two different types of light scatters are used in this study: TP (n = 1.41, diameter = 2.0, 4.5, 6.0μm) from GE Toshiba Silicon Co. and SBX series (n = 1.59, diameter = 6, 8, 12μm) from Sekisui Plastics Co. MMA were purified using Alumina column just before polymerization and initiators, AIBN and V-65, were recrystallized using methanol.

Light guide panel with LS was prepared by a cell casting method. First, mixture of MMA and LS was prepolymerized at 100°C for 15 min using AIBN and then V-65 was added to the mixture. After polymerized at 65°C for 30 min, the resultant syrup was injected in a glass cell and further polymerized in a water bath of 65°C for 4 hrs. The panels obtained were dried at 90°C for 24 hrs and then at 120°C for 2 hrs.

2.2. Characterization

The light scattering patterns of PMMA/LS composite sheets were measured using two

dimensional small angle light scattering apparatus with He-Ne laser of 632.8nm wavelength. The luminance, CIE chromaticity, and color temperature were also measured using luminance colorimeter (BM-7A, TOPCON Co).

3. Results and discussion

Figure 1 shows the variation of the scattering patterns of PMMA/TP120 composite sheets with the content of TP120 with the diameter of 2.0μm. When the content of TP120 is below 0.01 wt/ml%, the broadening of the light beam is not noticeable. However, as the content increases, the path of the incident light beam becomes very broad due to the light scattering by TP120. This indicates that the light scatterers incorporated into PMMA make the incident light very diffuse above a critical content.

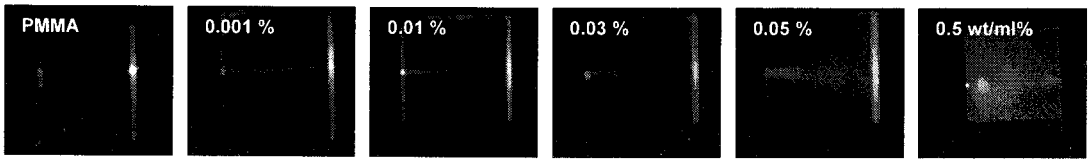

Figure 1. Light scattering patterns inside PMMA/TP120 composite sheets

Scattering efficiency of LS, which is calculated using Mie's scattering theory, is very dependent on the size of LS. For PMMA/TP composites, the most effective scattering efficiency is achieved with the diameter of about 6.5μm. Figure 2 shows luminance, CIE chromaticity, and color temperature of PMMA/TP2000B composite with the TP content of 0.005wt/ml%.

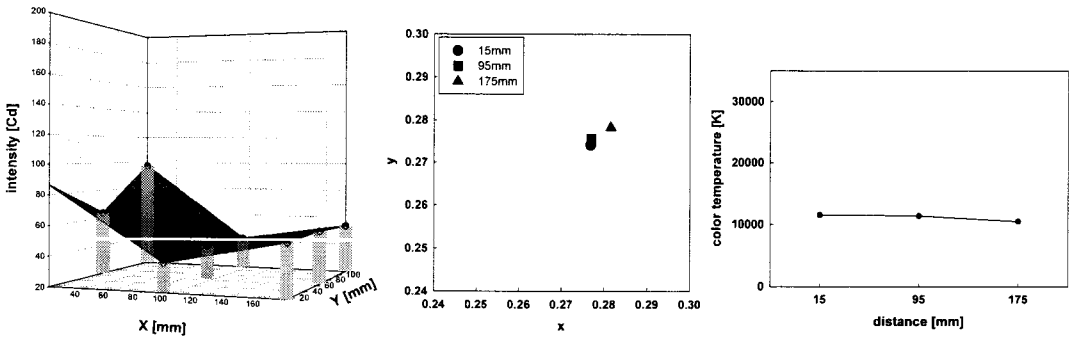

Figure 2. Luminance, CIE chromaticity, and color temperature of a PMMA/TP2000B composite

4. Acknowledgment

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5. References

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