Ultra-large and thin light guide plates fabricated using UV imprinting process

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Abstract

As the demand of larger and thinner flat panel display increasing, conventional methods such as injection molding and hot embossing to fabricate light guide plates (LGPs) become difficult and unsuitable. This study reports a low-cost and high-throughput method to fabricate large-size (320 mm × 240 mm, 15” in diagonal) LGPs by using UV-based imprinting process. As shown in Fig. 1, the apparatus based on the mechanisms of gas-assisted pressing and UV-curing consists of a upper chamber equipped with a gap-retained holder, a seal film, a lower chamber, and a UV-LED lamp.

As shown in Fig. 2, the dos patterns of LGP have been successfully transferred from the stamper to the whole 320 mm × 240 mm PMMA substrate with negligible air bubble defects by UV-based imprinting process with gas-assisted pressing capacity. The result demonstrates the capacity of this proposed process for the fabrication of large-size LGP with thin thickness down to 0.8 mm. In order to verify the optical property of the fabricated LGP, a laboratory-constructed back light module is employed. Fig. 3(a) shows the photography of lights emanating from the fabricated 320 mm × 240 mm × 0.8 mm LGP when the edge LEDs are on. This indicates that the fabricated LGP using proposed process has high potential for use in a conventional LCD monitor. Fig. 3(b) shows the measured corresponding light intensity distribution over the whole LGP. Although the light intensity distribution is not uniform, it is acceptable. The reason why the light intensity distribution is not uniform is the design of micro-dot patterns. In fact, the distribution of micro-dot patterns on stamper is designed for the LGP used in edge-light backlight module with cold cathode fluorescent lamps (CCFLs). In this study, however, the light source of laboratory-constructed back light module employed to inspect and verify the optical property of fabricated LGP used white LEDs instead of CCFLs because the required size of CCFLs were not available, meaning the optical property (light intensity distribution) may be different. The uniformity of light intensity distribution could be

upgraded by designing the distribution of micro-dot patterns on stamper for using in the back light module with white LEDs light source.

This study has demonstrated the fabrication of large-size and thin LGPs by using UV-based imprinting process, and the possibility of UV-based imprinting process for fabricating other large thin optical elements.

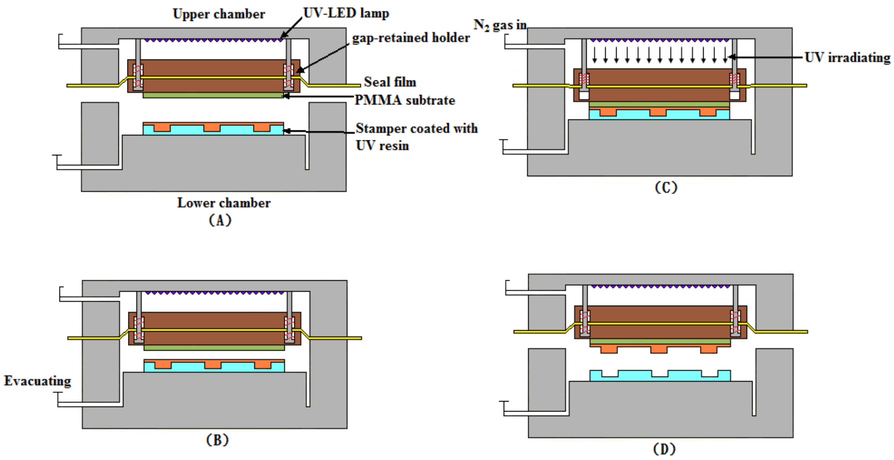
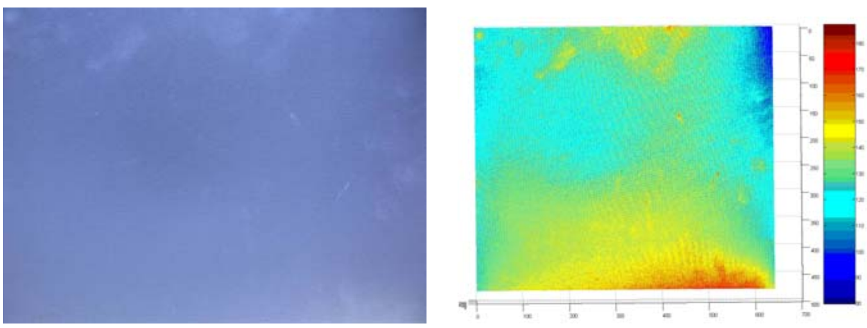


Fig. 1. Schematic diagram showing the apparatus and process of the UV-based imprinting process with gas-assisted pressing mechanism.

Fig. 2. The fabricated large-size (320mm × 240mm × 0.8 mm) PMMA light guide plate with dots patterns.



(a) (b)

Fig. 3. (a) The camera image of lights emanating from the fabricated 320 mm × 240 mm × 0.8 mm LGP when the edge LEDs are on. (b) The corresponding measured

light intensity distribution.