Passive patterned polymer dispersed liquid crystal transparent display

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Transparent displays are favored as next-generation display devices with the characteristics of rendering images on the panel, and the observers can see the scenery from both sides at the same time[1]. It is widely used in various scenes, such as smart windows, head-up displays, near-eye displays, and advertising[2–3]. One class is passive transparent display, which requires a projection display to project an image onto a specific screen. Among them, electrically switchable PDLC is widely utilized as the projection screen or smart windows with scattering and transparent states due to its polarization independence, simple fabrication, and low cost for large-area displays.

In the past work, we propose a patterned PDLC transparent display using one-time UV exposure[4]. The device is fabricated by exposing the cell with a uniform UV light through a patterned mask, which selectively attenuates the UV light. The patterned UV light causes patterned polymer concentration of the PDLC, resulting in different voltage-transmittance responses of the device for different regions. Thus, three different states of total scattering, patterned transparent, and total transparent can be realized by applying proper driving voltages, respectively.

Figure 1(a) illustrates the fabrication process of a patterned PDLC transparent display. A 4 mm×4 mm mask with 82.5% UV attenuation is attached on the top substrate of the cell. The cell was cured by a uniform UV lamp for 30 min. Thus, a patterned UV exposure dosage distribution is obtained through the mask. Figure 1(b) illustrates the voltage-transmittance curves of the region A and region B. It is clearly shown that the cured PDLC in region A and region B have different electro-optical properties.

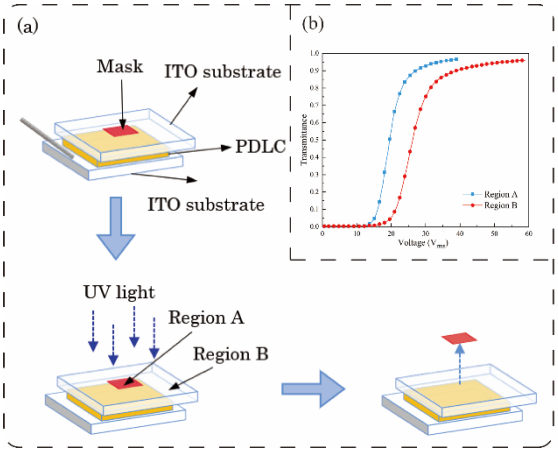

Fig. 1. (a) Fabrication process of the patterned PDLC transparent display. (b) Measured V-T curves of region A and region B of the device.

Figure 2(a) demonstrates that the patterned PDLC transparent display can be used in shutter mode as a smart window, especially for translucent partition walls, public information displays, advertising, etc. Figure 2(b) demonstrates the performance of the patterned transparent display in the projected display mode. By controlling the applied voltage, the proposed device can operate in the transparent state, total scattering mode and partial scattering mode as a specific screen for the projected image.

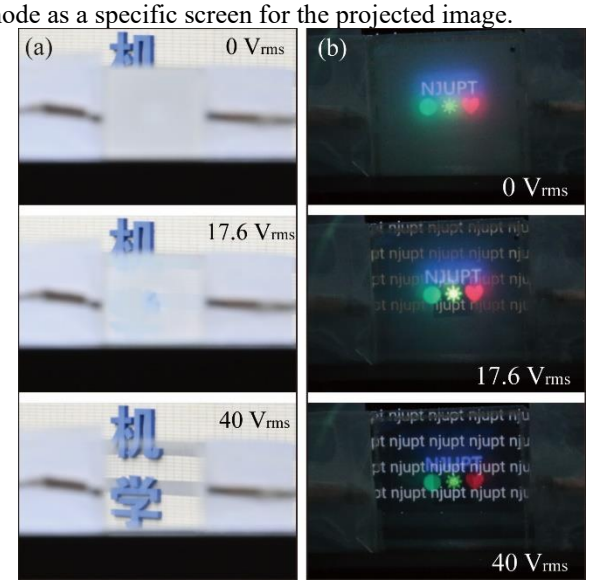

Fig. 2. (a) Fabrication process of the patterned PDLC transparent display. (b) Measured V-T curves of region A and region B of the device.

Furthermore, a flexible PDLC smart window with customized patterns can also be obtained by using PET-ITO substrates. The above proposed one-step UV exposure method is compatible with the manufactory process of flexible displays. It has the advantages of simple fabrication, low cost and high precision, which is conducive to its potential applications in the field of customized flexible smart windows.

References

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