P-176L: *Late-News Poster:* Improvement of Luminous Characteristics of AC-PDP with Long Discharge Path Using Ridged Front Dielectric Layer

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Abstract

The luminous characteristics of the LDP (Long Discharge Path: 500 μm)-PDP with a ridged front dielectric layer were investigated, where the ridged front dielectric layer means that the dielectric layer between the sustain electrodes was etched out completely using the Sand-blasting process. In the LDP-PDP of which the main discharge is produced along the address electrode, the higher luminance was obtained due to the improved visible transmittance in the ridged front dielectric layer, thereby contributing to improving the luminous efficiency of a LDP-PDP with a ridged front dielectric layer. As a result, it was observed that the luminance of the LDP-PDP with a ridged front dielectric layer increased about 16~17 %, when compared to that of the LDP-PDP cell with a conventional dielectric layer, whereas the corresponding luminous efficiency was improved about 12~14 % due to the slight increase in the discharge current.

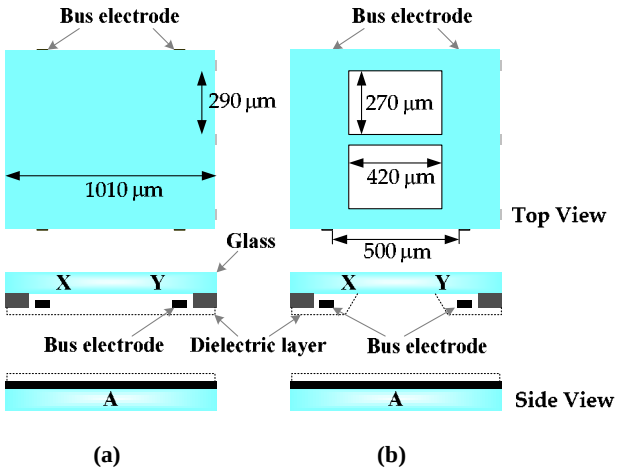

Fig. 1. Schematics diagram of top view and side view of LDP-PDP cell structure with conventional (a) and ridged (b) front dielectric layer

1. Introduction

Many researches have been made to improve the luminous efficiency of an AC-PDP, but the realization of a high efficient AC-PDP is still a key issue so as to be superior to the quality of LCD-TVs. In this sense, the high efficient discharge mode of the AC-PDP with a long discharge path (400 μm) was proposed in detail [1, 2, 3]. In the LDP-PDP with no ridged dielectric layer, the intensive luminance was obtained between the two sustain electrodes, because the main discharge was produced along the address electrode [3]. Accordingly, if the dielectric layer between the two sustain electrodes is completely removed in the LDP-PDP, it is expected that the higher luminance can be obtained due to the improved transmittance in the visible region, thereby contributing to improving the luminous efficiency of a LDP-PDP. In this paper, the effects of the ridged front dielectric layer on the luminous characteristics of a LDP-PDP are examined under the 5 % Xe con tent at some driving conditions. In particular, the changes in the luminance caused by the visible transmittance characteristics in

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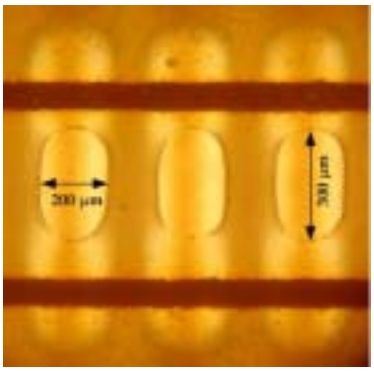
the LDP-PDP with a ridged front dielectric layer are investigated intensively.

2. Experiment

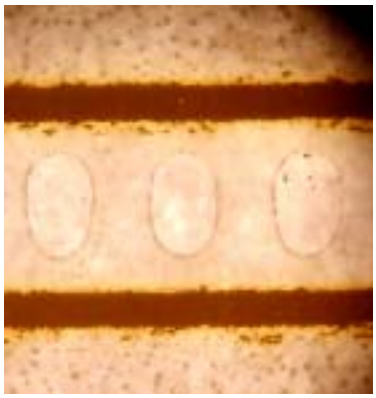
Fig. 1 (a) and 1 (b) show the schematic diagrams of the LDP-PDP cell structure with (a) conventional and (b) ridged front dielectric layer, respectively. To simultaneously investigate the discharge characteristics of the LDP panel with a conventional and a ridged front dielectric layer, the 6-inch test panel with two cell structures was used based on the green phosphor. The thicknesses of the front dielectric layers of the two structures were the same of about 30 μm. The ridged dielectric layer was made using the Sand-blasting process. The discharge gap between the two sustain electrodes, X and Y was 500 μm, and the width of the silver sustain electrode (X or Y) with no ITO was 100 μm. The width of the address electrode (Z) was 80 μm. The ridged area of a dielectric layer was designed to be a box shape of which the dimension was 420×270 μm for avoiding a crosstalk when the discharge is produced. However, the after Sand-blasting and baking process, the ridged area was formed an elliptical shape with the dimension of 300×200 μm, respectively, as shown Fig. 2 (a). When the visible transmittance of the front panel with the ridged dielectric layer (Fig. 2 (b)) under the non-discharge condition was measured simply by using the backlight source, the improved transmittance of the ridged front dielectric layer was obtained, and its increase rate in the luminance was about 8~9 %. The height of the closed type barrier rib was 125 μm. The gas pressure was at 450 Torr and the gas mixtures were a Ne-Xe (5 %). Fig.3 shows the voltage waveforms Vx, Vy, and Vz, applied to the sustain electrodes, X, and Y, and address electrode, Z, respectively at a frequency of 50 kHz. The width of the sustain pulse ($t_{WS} = t_{WX} = t_{WY}$) was 8 μs. The address pulse had a width of 1μs and its position was coincided with a rising point of the sustain pulse.

3. Result and Discussion

Fig. 4 (a) and 4 (b) show the pictures of the LDP-PDP cell structure with (a) conventional and (b) ridged front dielectric layer during the discharge, respectively. In the conventional sustain gap (<100 μm) structure, a ridged front dielectric layer mainly plays a role in intensifying the electric field between the two sustain electrodes. The resultant driving voltage under the high Xe % content can be lower than that of an AC-PDP with conventional front dielectric layer, thus resulting in obtaining a high luminous efficiency [4, 5]. On the other hand, the ridged front dielectric



(a)



(b)

Fig. 2. Picture of ridged LDP-PDP cell (a) and its front glass when discharge is not produced (on the Light Box)

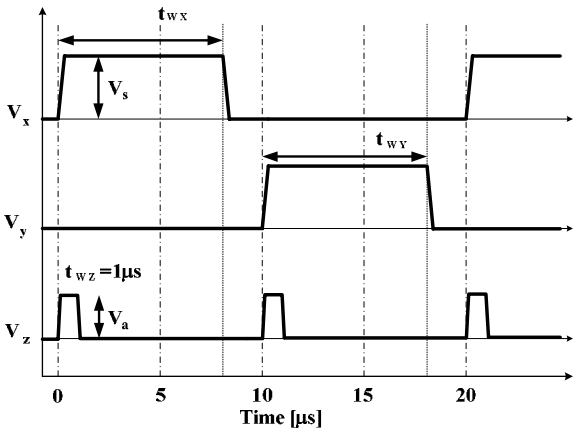
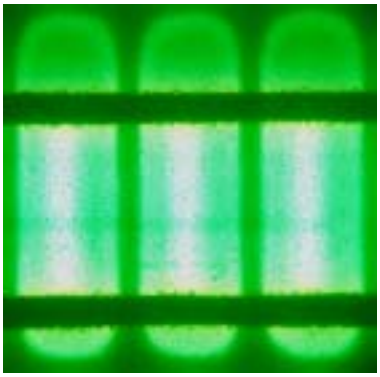


Fig. 3. Sustain voltage waveforms applied to three electrodes during sustain-period

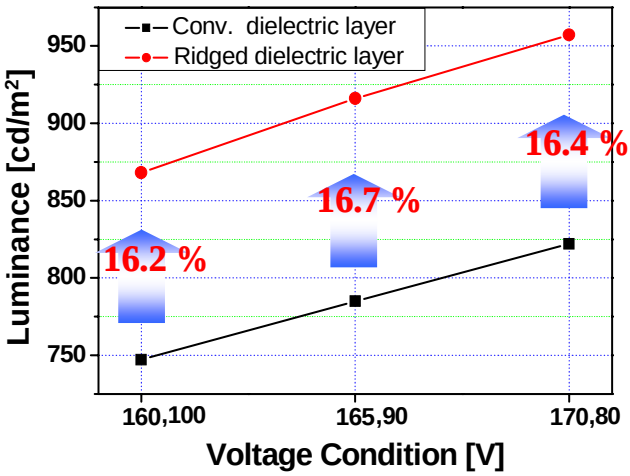


(a)

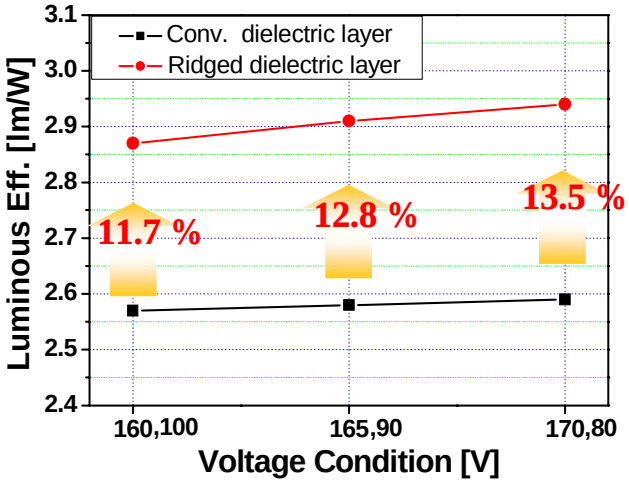
(b)

Fig. 4. Pictures of LDP-PDP cell structure with conventional (a) and ridged (b) dielectric layer when discharge is produced.

layer of the LDP-PDP mainly plays a role in enhancing the visible transmittance of a front panel. Thus, the higher luminance can achieved simply by removing the dielectric layer between the two sustain electrode, because the main discharge long path along the address electrode produces the brightest light of the LDP-PDP cell. Finally, higher luminous efficiency can be achieved, as shown in Fig. 4 (b). This means that in the LDP-PDP cell structure, the luminous efficiency can be improved due to the improvement of the visible transmittance of a front panel. Figs. 5 (a) and (b) show the changes in the (a) luminance and the (b) luminous efficiency of the conventional and ridged LDP-PDP as a function of sustain voltage. The luminance of the ridged dielectric case increased about 16~17 % when compared to that of the conventional case. This increase rate in the luminance (about 16~17 %) during the discharge was much higher than that (about 8~9 %) under no discharge condition. As shown in the LPD-PDP of Fig. 4 (a), the discharge is focused along the address electrode between the two sustain electrodes, so that the intensive light can be obtained in the ridged dielectric area, as shown in Fig. 4 (b). However, the discharge current also increased slightly, and the resultant luminous efficiency was improved about 12~14 %. It was observed that the IR intensity was almost the same between the LDP-PDP cells with ridged and a conventional front dielectric layer, as shown in Fig. 6, meaning that the improvement of the luminous efficiency in the LDP-PDP with a ridged dielectric layer was mainly due to the better visible transmittance. Fig. 7 shows the sustainable regions of the LDP-PDP cell structures with a conventional and a ridged front dielectric layer, respectively.



(a)



(b)

Fig. 5. Changes in luminance (a) and luminous efficiency (b) of conventional and ridged LDP-PDP with different voltage conditions

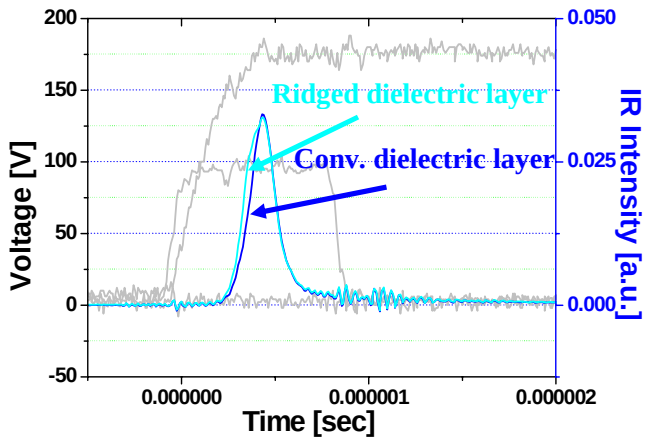


Fig. 6. IR intensity of LDP-PDP cell with ridged and conventional front dielectric layer

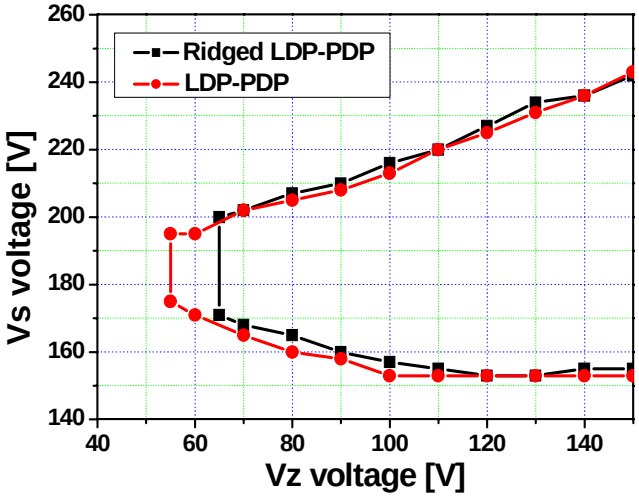


Fig. 7. Sustainable region of LDP-PDP with conventional and ridged front dielectric layer

In the ridged LDP-PDP structure, the sustainable region shrinks a little in a view of an address voltage. It is thought that the capacitance of the ridged dielectric layer is slightly reduced and the some of the wall charges accumulating at the surface of the ridged area may not contribute to the trigger discharge prior to the main discharge of the LDP discharge.

4. Conclusion

The luminous characteristics of the LDP-PDP (500 μm) with a ridged front dielectric layer were investigated. Since the main discharge of the LDP-PDP is produced along the address electrode, the higher luminance was obtained due to the improved visible transmittance in the ridged front dielectric layer without much sacrifices of the power consumption. Thereby, this point contributes to improving the luminous efficiency of a LDP-PDP with a ridged front dielectric layer. As a result, it was observed that the luminance of the LDP-PDP with a ridged front dielectric layer increased about 16~17 %, when compared to that of the LDP-PDP cell with a conventional dielectric layer, whereas the corresponding luminous efficiency was improved about 12~14 % due to the slight increase in the discharge current.

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