IBS electrode structure for enhanced performance in ac PDP

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Abstract

In this paper, we propose IBS(ITO-BUS Separated) electrode structure. BUS electrode lines are placed apart from the ITO electrode lines, and they are electrically connected with vertical auxiliary electrodes. We varied the lengths of the vertical electrodes as 70, 120, 320um. The highest luminous efficiency and the largest IR emission peak were obtained for 70um length.

1. Introduction

Conventional electrode structure of front panel in AC co-planar type PDP consists of BUS and ITO electrodes as shown in Fig. 1. BUS electrodes are located on the ITO electrodes patterns on the front glass of PDPs [1,2]. AC voltage is applied for BUS electrodes, which is transmitted to the ITO electrodes beneath BUS electrodes, Plasma is ignited between the two ITO electrodes and the pixel turns on.

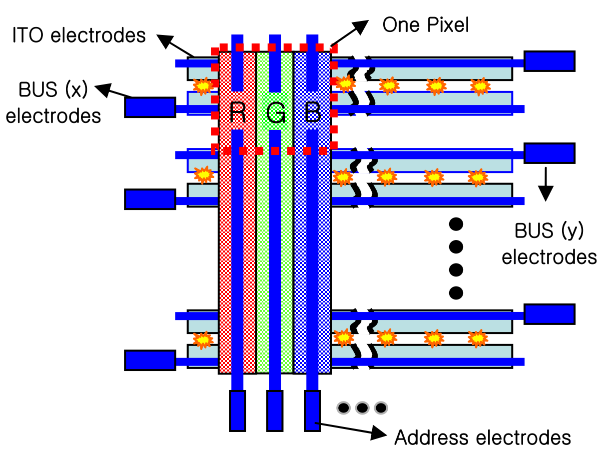

Fig. 1. Structure of BUS, ITO and Address electrode in Plasma display panel.

BUS electrode plays a role of an electrical pathway, which has to conduct the current provided through terminal electrodes along with the whole BUS line in as short a time as possible. Silver(Ag) is mostly used for base material for PDP BUS electrodes. ITO electrode has a role of igniting a plasma using a voltage difference delivered by x and y BUS electrodes. The width of ITO electrodes has to be large area to get high brightness [3]. Moreover, ITO electrodes have to be transparent as the lights generated in a pixel should be transmitted to our eyes passing through the front glass.

Fig. 2 is a schematic drawing of the proposed electrode structure, IBS(ITO-BUS separated) structure, in which BUS electrode lines are placed apart from the ITO electrode lines, and they are electrically connected with vertical auxiliary electrodes.

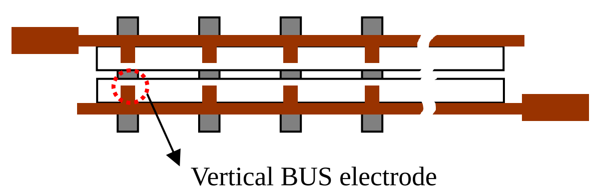

Fig. 2. Schematic drawing of the new electrode Pattern.

Assuming the conventional 42 inch SD panel structure, as shown in Fig. 3, the length of the electrical pathway between BUS electrode and ITO electrode is 150 ㎛ for the IBS structure, which is shorter than that of the conventional structure, 200 ㎛. This means that, in the sense of the electrical conduction between BUS and ITO electrodes, IBS electrode structure is more effective than the conventional one.

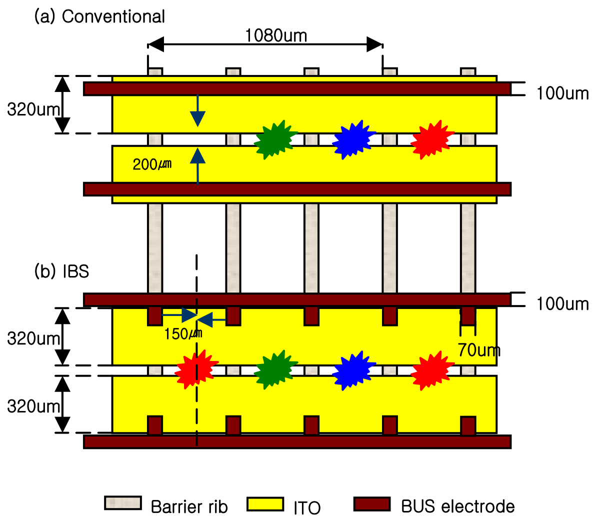

Fig. 3. Schematic drawing of the electrical pathway in (a) conventional and (b) IBS electrode patterns.

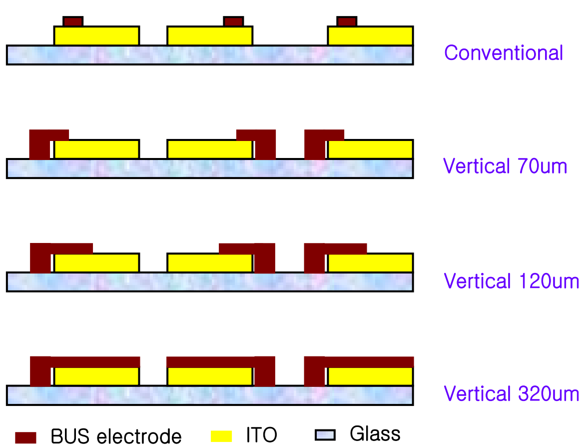

Fig. 4. Schematic drawing of conventional and IBS electrode structure with the vertical length of 70, 120, 320um respectively

In this research, we investigated the effect of the length of the vertical auxiliary electrode in the IBS structure on the discharge and luminance characteristics of the PDP panel.

2. Experimental

The 3-inch test panels have been manufactured with a cell size of 360 ㎛ by 1,080 ㎛ following the general specification of 42-inch SD(standard definition) PDP. ITO coated 2.8mm-thick PD200 glass substrates were used for the front substrates. ITO electrode patterns were manufactured by photolithography using DFR film. BUS electrode pattern was also manufactured by photolithography. Photo-sensitive Ag-based paste was printed, dried, exposed, developed and fired. Black stripe was formed by photolithography with photo-sensitive black colored paste. To decrease the experimental errors, conventional electrode pattern and IBS electrode pattern were placed together in a same panel. We varied the lengths of the vertical electrodes as 70, 120, 320 ㎛ as is shown in Fig. 2.

30 ㎛ thick-transparent dielectric layer was formed on the ITO and BUS electrode, and 6000Å-thick MgO layer was coated on it by electron beam evaporation method.

2.8mm-thick PD-200 glass substrates were used for the rear substrates also. Address electrode pattern was manufactured by the same method as BUS. Barrier ribs were manufactured by chemical etching method, and green phosphors were printed into the cell volumes. Front and rear substrates were assembled by sealing frits and inner cell spaces were filled with Ne-Xe 5%(400Torr) gas mixture after exhausted at 350℃.

Table 1 shows a summarized specification used for manufacturing the IBS structure panel in this paper.

TABLE 1. The specification of test panel

BUS width	Horizontal : 100 ㎛ Vertical :70 ㎛
ITO width	320 ㎛
ITO gap	80 ㎛
Dielectric thickness	30 ㎛
MgO thickness	7000Å
Barrier rib width	70 ㎛
Barrier rib height	130 ㎛
Phosphor thickness	20 ㎛
Gas pressure	400 torr

3. Results and discussion

Fig. 5 shows the voltage margin which was measured under 25kHz-25% continuous sustaining condition. It can be seen that the voltage margin is similar for all the electrode patterns.

Discharge power consumption was measured by the following relationship.

$$P_{disscharge} = P_{discharge\ on} - P_{discharge\ off}$$

As is shown in Fig. 6, the power consumption of the IBS electrode structure panel is higher than the conventional structure, and increases with the length of the vertical auxiliary electrode.

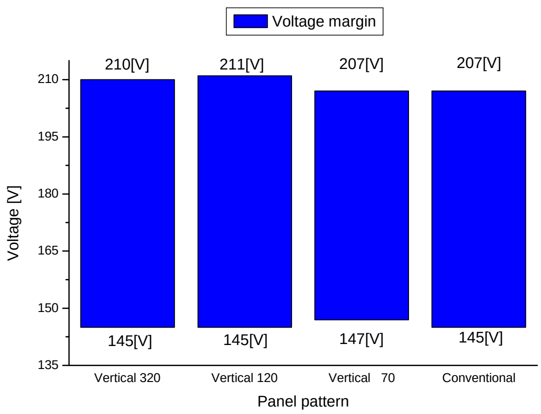

Fig. 5. Voltage margin characteristics for the conventional and IBS electrode structure panels.

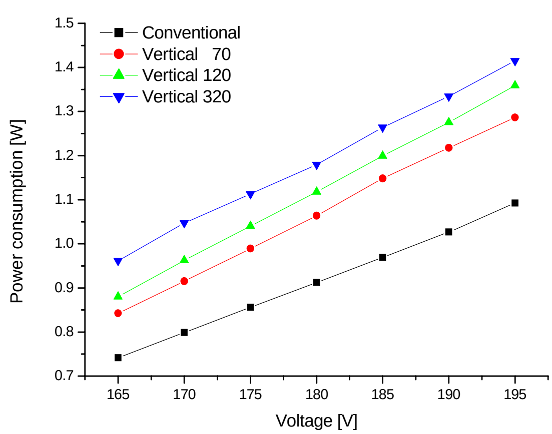

Fig. 6. Discharge power consumption for the conventional and IBS electrode structure panels.

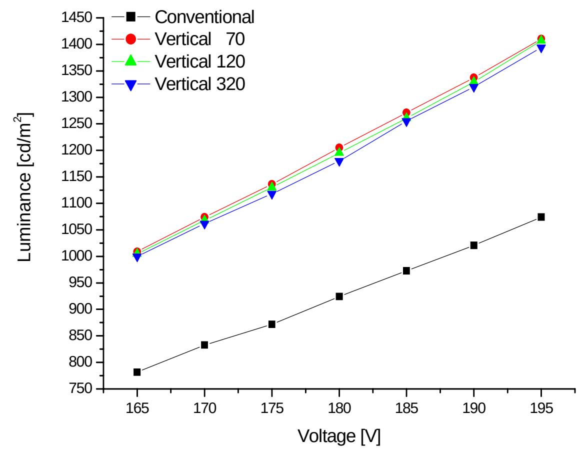

Fig. 7. Luminance characteristics for the conventional and IBS electrode structure panels.

Fig. 7 shows the luminance characteristics of the conventional and IBS electrode structure panels. As is shown in the figure, the luminance of the IBS electrode structure panel is higher than the conventional structure, and shows similar value regardless of different length of the vertical auxiliary electrode.

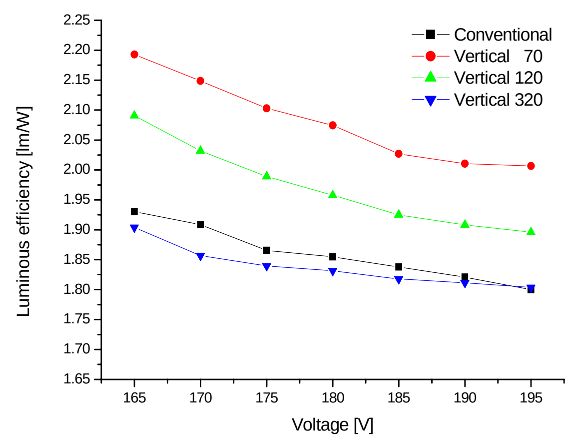

Fig. 8. Luminous efficiency for the conventional and IBS electrode structure panels.

Fig. 8 shows the luminous efficiency of the conventional and IBS electrode structure panels. As is shown in the figure, the luminous efficiency of the IBS electrode structure panel is higher than the conventional structure. Among them, IBS electrode structure panel which has a 70 ㎛ long vertical auxiliary electrode showed highest value.

This can be explained as follows. For the IBS electrode structure, the electrical power consumption increases as the length of the vertical auxiliary electrode increases. However, the luminance characteristics don't depend on the length of the vertical electrode. As a result, the IBS structure which has the shortest vertical electrode length shows highest luminous efficiency.

Fig. 9 shows the discharge current and IR emission waveforms for conventional and IBS electrode structure. The IBS structure panel shows higher IR emission and discharge current peaks compared to those of conventional structure. We assume that these characteristics are related to the enhanced luminous characteristics of the IBS electrode structure, and more works are being done for the analysis of the discharge characteristics of the IBS electrode panel.

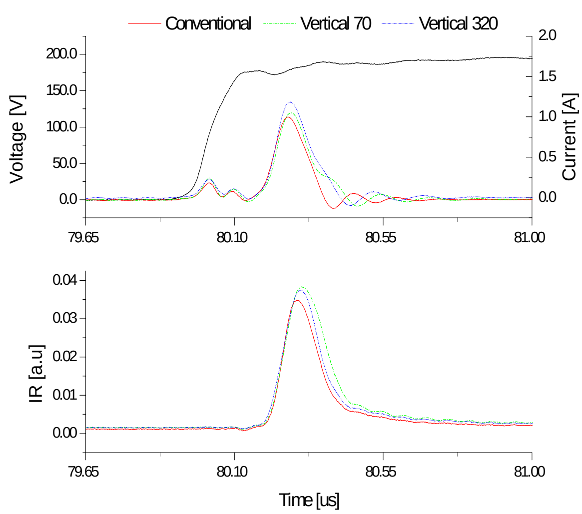

Fig. 9. Discharge currents and waveforms for the conventional and IBS electrode structure panels.

4. Summary

We varied the length of the vertical auxiliary electrode for the IBS structure as 70, 120, 320 ㎛. The electrical power consumption increased as the length of the vertical auxiliary electrode increased. However, the luminance characteristics didn't depend on the length of the vertical electrode. As a result, the IBS structure which has 70 ㎛ vertical electrode length showed highest luminous efficiency.

5. References

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