

Application of the New Panel Structure for High Luminous Efficiency in AC-PDPs

Jae Sung Kim, *Member*, Chung Huan Jeon, Eun Cheol Lee, *Member*, Young Joon Ahn, *Member*, Seok Dong Kang, *Member*, Sung Yong Ahn, Young Kyo Shin, *Member*, Jae Hwa Ryu, *Member* and Jerry D. Schemerhorn

Abstract

A new PDP cell structure called CSP (Charge Storage Pad) improves the luminous efficiency by 1.6 times and prevents cross talk between adjacent cells. The CSP, which is a conducting material, is inserted between the dielectric layer and the MgO film in the front plate. This CSP produces a longer time-averaged discharge path to get a high luminous efficiency and confines the discharge to prevent cross talk.

Keywords : PDP(plasma display panel), CSP(charge storage pad), luminous efficiency, cross talk, discharge

1. Introduction

The color ac plasma display panel (AC-PDP) is one of the most promising technologies for large-area flat panel displays, realizing more than 40 inches diagonal wall hanging TV. There have been various intensive efforts for improving the brightness and luminous efficiency to compete with current CRT displays [1]. However, the low luminous efficiency is still one of the major problems of the present PDP.

The luminous efficiency of the PDPs are influenced by the following four processes [2]. These are VUV emission from the discharge, VUV transport to the phosphor, visible light conversion on phosphor, and visible light output process through the front plate.

We noticed that there is a need to improve the VUV emission from the discharge for a dramatic improvement of luminous efficiency. We studied the relationship between the electrode gap length and the efficiency of panel. This shows that the bigger electrode gap length, the higher efficiency in PDP [3]. However, it is impractical because of the higher driving voltage at the large electrode gap length. To solve this problem, we developed a new panel structure causing a longer average discharge length without increasing the driving voltage

In this paper, we will discuss the characteristics of the surface discharge type AC-PDP with a new panel structure called CSP (Charge Storage Pad).

2. Experimental

Fig. 1 shows the new panel structure with CSPs. The structure of the panel is almost the same as the conventional three-electrode surface discharge type PDP. The sustain electrodes are formed on the front plate in parallel. The dielectric layer and the MgO film are formed on the sustain electrode. In addition, the CSPs are inserted between the dielectric layer and the MgO film. The back plate has the same structure as conventional panels. The address electrodes which are orthogonal to the sustain electrode, barrier rib and phosphor are formed on the back plate.

The CSP was made from a transparent conducting material such as ITO and it was formed before the MgO

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J. S. Kim, C. H. Jeon, E. C. Lee, Y. J. Ahn, S. D. Kang, S. Y. Ahn, Y. K. Shin and J. H. Ryu are with the Digital PDP Division, LG Electronics Inc., 191-1, Kongdan-dong, Kumi-city, Kyungsangbuk-do 730-030, Korea. **E-mail** : kimjs2@lge.co.kr **Tel** : +54 460-7383 **Fax** : +54 460-7323

Jerry D. Schmerhorn is with the Electro Plasma Inc.

coating. The shape of CSP was a square and it was disconnected to the external circuit, leaving it to float.

The size of the test panel was 7.5" diagonal and the cell pitch is 1.26mm. The luminous efficiency was measured using only sustain pulses. The sustain pulse was square wave with frequency of 10 kHz.

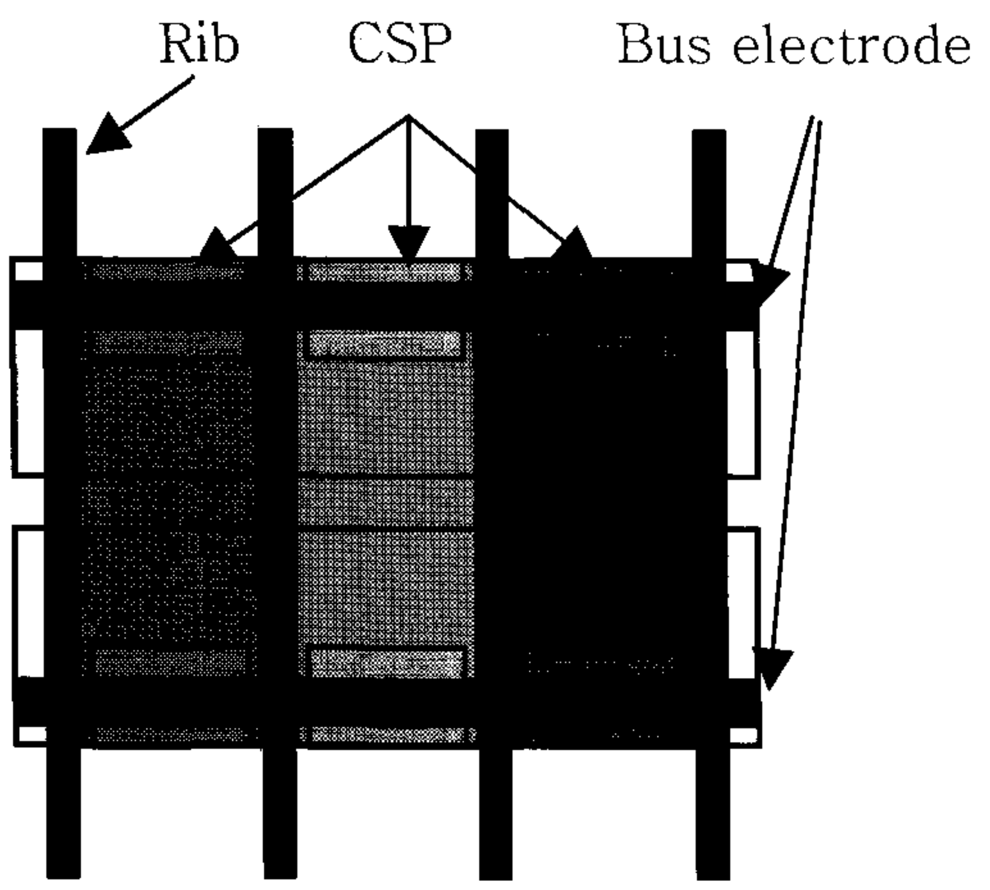


Fig. 1. Schematic of a discharge cell with CSPs

3. Results and Discussion

Luminance and luminous efficiency have previously been reported to increase because of large sustain electrode width [4], but in this case the power consumption is large and thus cross talk between the cells occurs.

The new structure shows an even higher luminous efficiency without the excessive power consumption and cross-talk even though the width of sustain electrode is large.

3.1 Luminous efficiency

The operation of the standard surface discharge type AC-PDP is explained as follows. The discharge is initiated at the gap of sustain electrode and progresses outward in time along the electrode. The accumulated wall charge on the dielectric layer reduces the electric potential of the electrode and finally stops the discharge [5].

The discharge current is influenced by the width of the electrode. At a large electrode width, the discharge current is large and luminance is high. Usually, the sustain electrode consists of the transparent electrode and metal bus electrode. The discharge current flows from the electrode gap to the bus electrode but the bus electrode blocks the light output even though it consumes the power.

On the other hand, the CSP can adjust the relationship between the luminance and discharge current more effectively. The CSP is located under the bus area and is bigger than the bus, so the discharge current flows from the electrode gap to the CSP. The discharge is initiated at the gap of sustain electrode and spread out along the sustain electrode and stops at the edge of CSP because the CSP has a lower potential than the sustain electrode, as shown in Figure 4 and it is a conductive material. The CSP does not block light output because it is transparent, yet maintains a discharge for a longer time until the CSP is charged.

Fig. 2 shows the discharge current shape during a constant pulse. The CSP changes the discharge current shape to get a peak at the later time and at a longer discharge path that is more efficient. This means that a discharge occurs with a long discharge path for longer time than the actual average gap length. In long discharge path, more excited particles, which contribute to VUV emission, can be produced and results in high luminance [3].

Table 1 shows the performances of CSP structure panel and conventional panel. Inserting the CSP between the dielectric layer and the MgO film enables the high luminance and high luminous efficiency with a large electrode width.

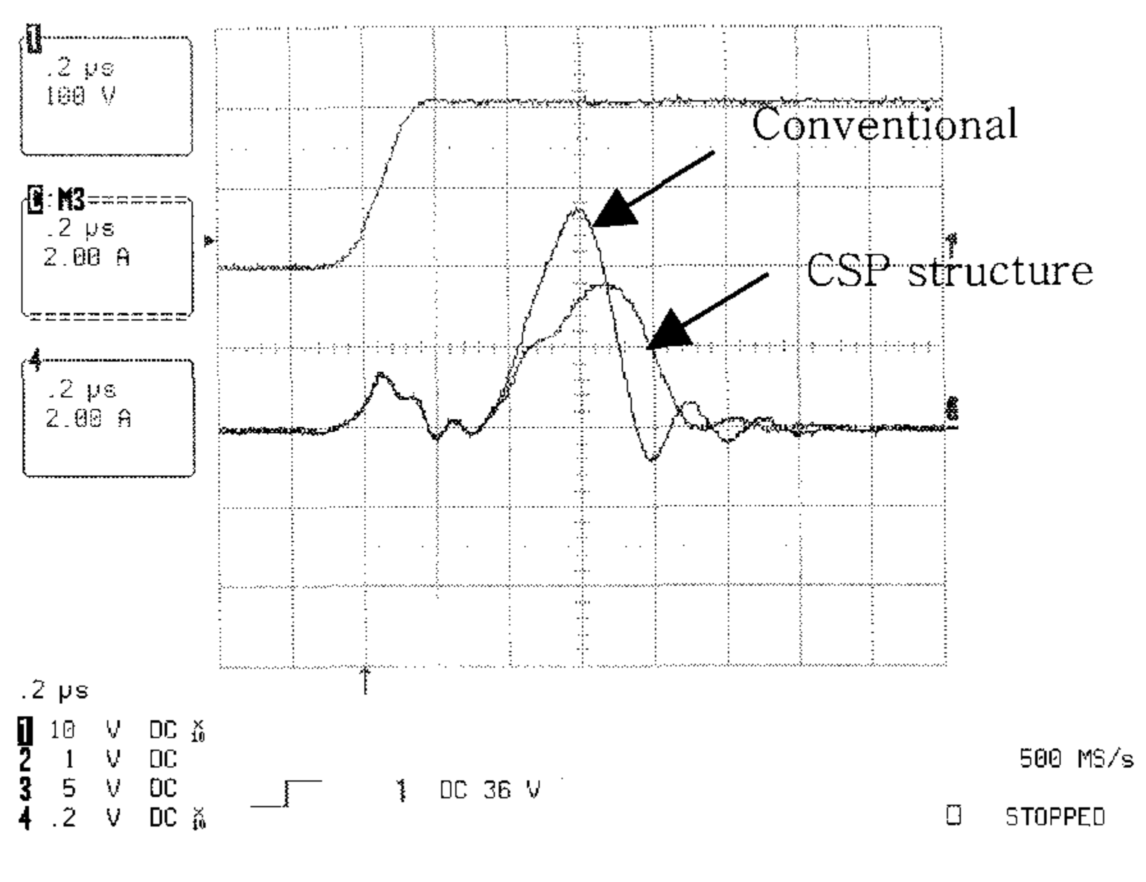


Fig. 2. The discharge current waveform measured during sustain period.

TABLE 1. Performance of the new structure panel

	CSP structure	Conventional
Luminance [cd/m^2]	374	232
Power consumption [W]	4.3	4.1
Luminous efficiency [lm/W]	1.6	1.0

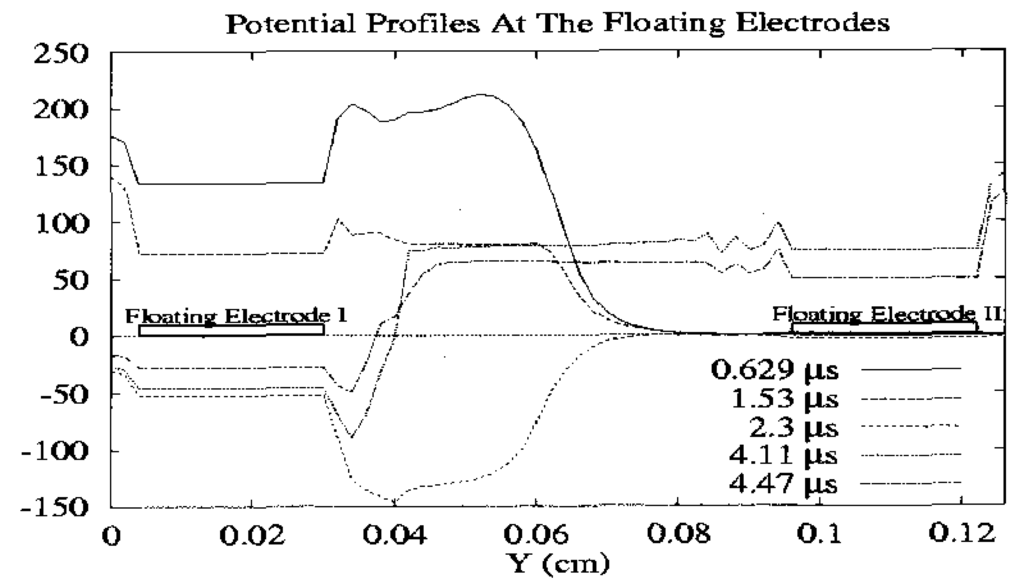
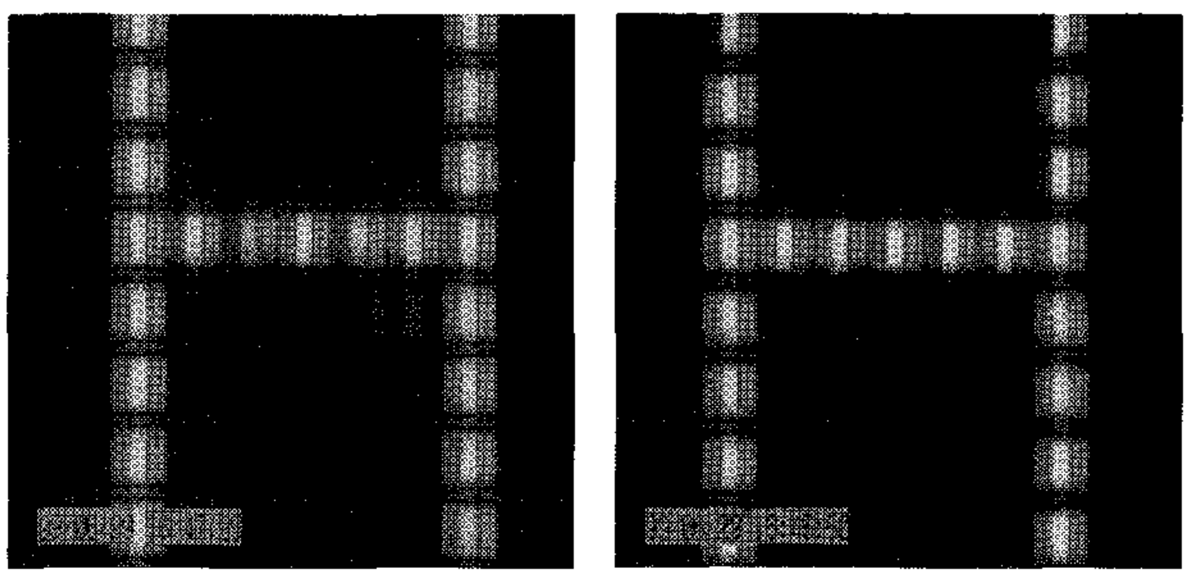


Fig. 4. Simulation result of the electric potential line in the new structure

3.2 Cross-talk between adjacent sustain electrodes

As shown in Fig. 3, the new structure with CSP did not show any cross talk, while the conventional structure showed significant cross talk between adjacent sustain electrodes, in case of a wide sustain electrode width.

This phenomenon can be explained as follows. Fig. 4 shows the simulation result of the electric potential line. The floating CSP has lower electric potential than sustain electrode so the discharge is confined between the CSPs. This reduced electric potential prevents any discharge and eliminates cross talk.



(a) (b)

Fig. 3. Cross talk without CSP and with CSP (a) Without CSP (b) With CSP

4. Conclusion

A new PDP cell structure called CSP (Charge Storage Pad) is suggested to improve the luminous efficiency and prevent cross talk between adjacent cells. The CSP produces a longer time averaged discharge path to obtain a high luminous efficiency and confines the discharge to prevent cross talk.

Using this cell structure, the luminous efficiency is improved by 1.6 times and the cross talk between adjacent cells is prevented.

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