High luminous efficiency AC PDP with the auxiliary electrode

Jae Hyun Lee, Sang Dae Park, Bhum Jae Shin, Kyung Cheol Choi
Department of Electronics Engineering, Sejong University, Kwangjin-gu, Seoul,143-747, Korea
Tel : +82-2-3408-3904 , E-mail :kyungcc@sejong.ac.kr

Abstract

The real test panel with the 200μm discharge gap in a coplanar AC plasma display panel was investigated. The auxiliary electrode was placed between two sustain electrodes and used for providing wall charges and prime particle during sustain period. The luminous efficiency had the maximum value when the voltage of the auxiliary pulses was 20 ~ 100[V]. The luminous efficiency of coplanar long-gap discharge with auxiliary electrode was 2.6 times as much as that of the conventional structure.

1. Introduction

Plasma Display is one of the most promising technologies for large flat panel display. The AC plasma display panel (PDP) with coplanar electrodes was the leading technology among PDPs. Most important problem is that an AC PDP consumes a lot of power because the luminous efficiency is relatively low. Many researches on the improvement of luminous efficiency such as a new design of electrode structures and driving technique, and an optimization of discharge gas chemistry have been carried out [1,2]. Some papers proposed the high luminous efficiency PDP model by using numerical simulations [3,4]. Generally, AC PDPs utilize vacuum ultra violet (VUV) rays emitted from the negative glow region. The coplanar structure has been adopted for an AC PDP as mentioned before. The discharge gap of the coplanar electrode is about 80μm. The negative glow is occurred on the 80μm – spacing coplanar electrode. This kind of conventional structure has relatively low luminous efficiency because the electric field intensity of the coplanar electrode is strong enough [5]. The very well known way to increase the luminous efficiency is to make the discharge gap longer [6,7,8]. In this work, we investigated discharge characteristics of the AC PDP with coplanar long-gap of 200μm. The sustain electrode with the coplanar gap of 200μm has the auxiliary electrode located at the center of sustain electrode pair.

2. Experiment

Figure 1 shows the schematic drawing of the coplanar plate of the test panel used in this work. The sustain electrode with the gap of 200μm was made on the coplanar plate. Each sustain electrode pair has the auxiliary electrode located at the center of them. The width of the sustain electrode was 200μm and the width of the auxiliary electrode was 100μm. A transparent dielectric layer was coated with a 32μm thickness by using screen print and a 5000Å- thick MgO thin film was deposited by using electron-beam method. The green phosphor plate was adopted to investigate the luminance characteristics. The discharge gas was Ne + Xe (4%) and operating pressure was 450torr.

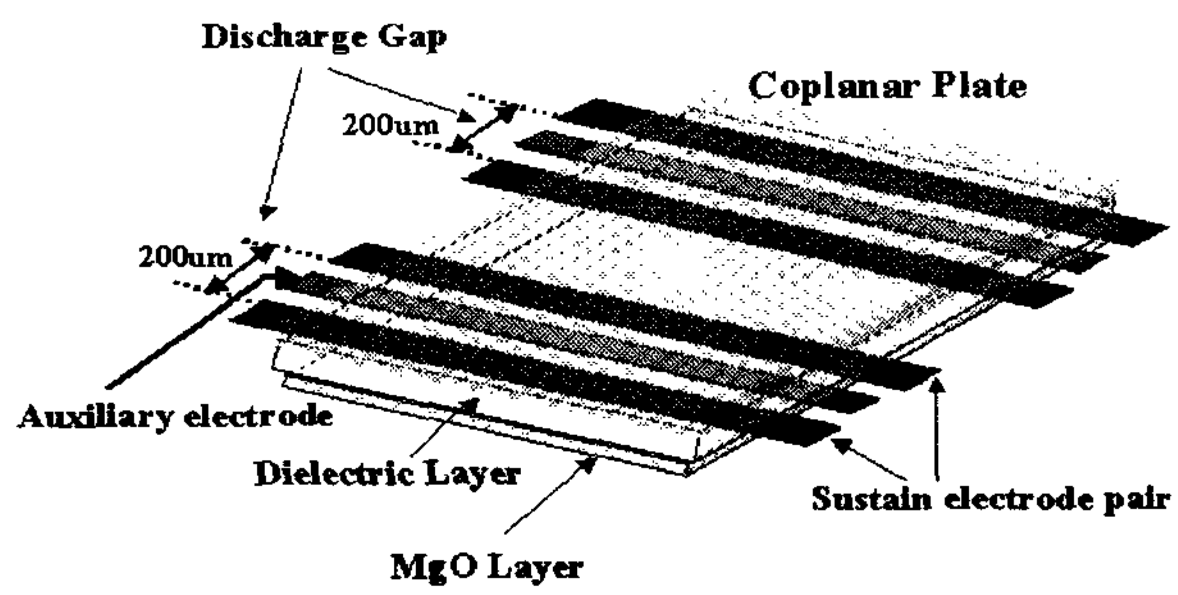


Fig.1 Schematic drawing of the coplanar plate of a 3-inch test plasma display panel

Figure 2 shows the waveforms applied to the sustain and the auxiliary electrode. The width of sustain pulse was 4μs and its frequency was 50kHz. The frequency of the pulse applied to the auxiliary electrode was 100kHz and its pulse width was 2μs.

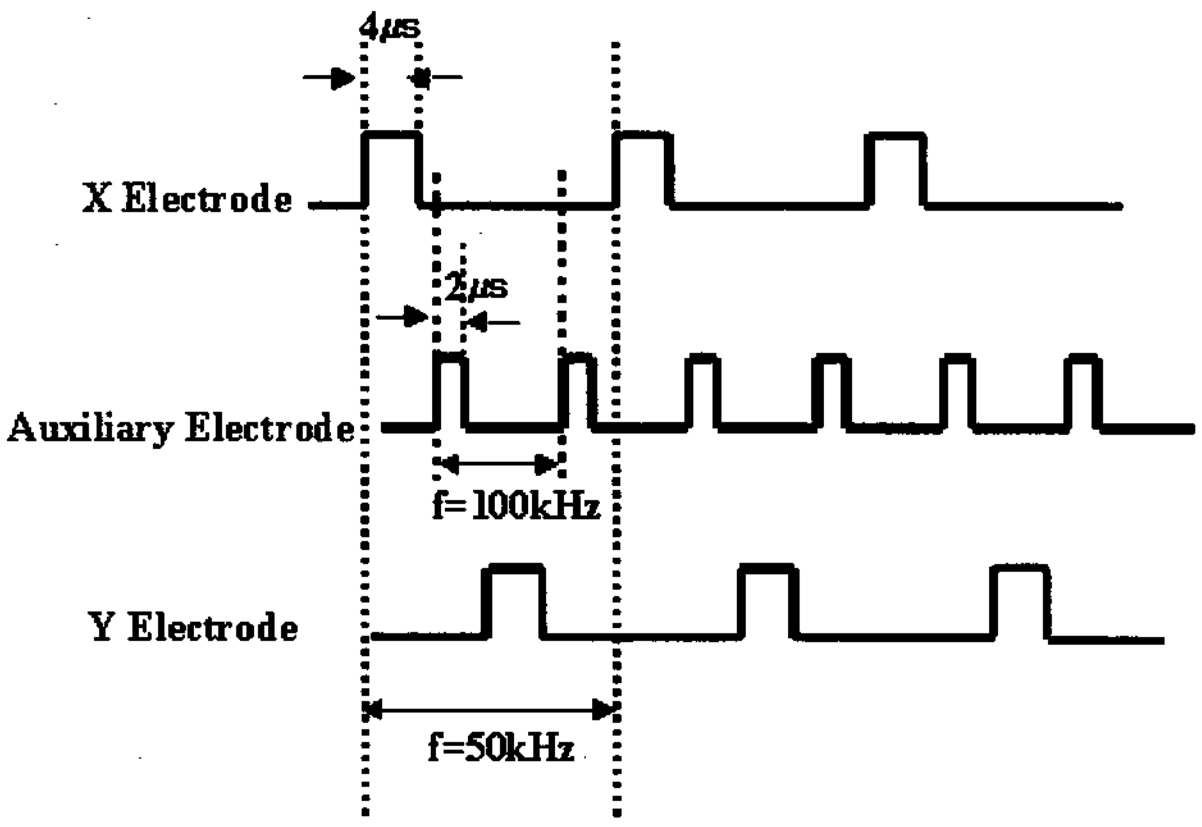
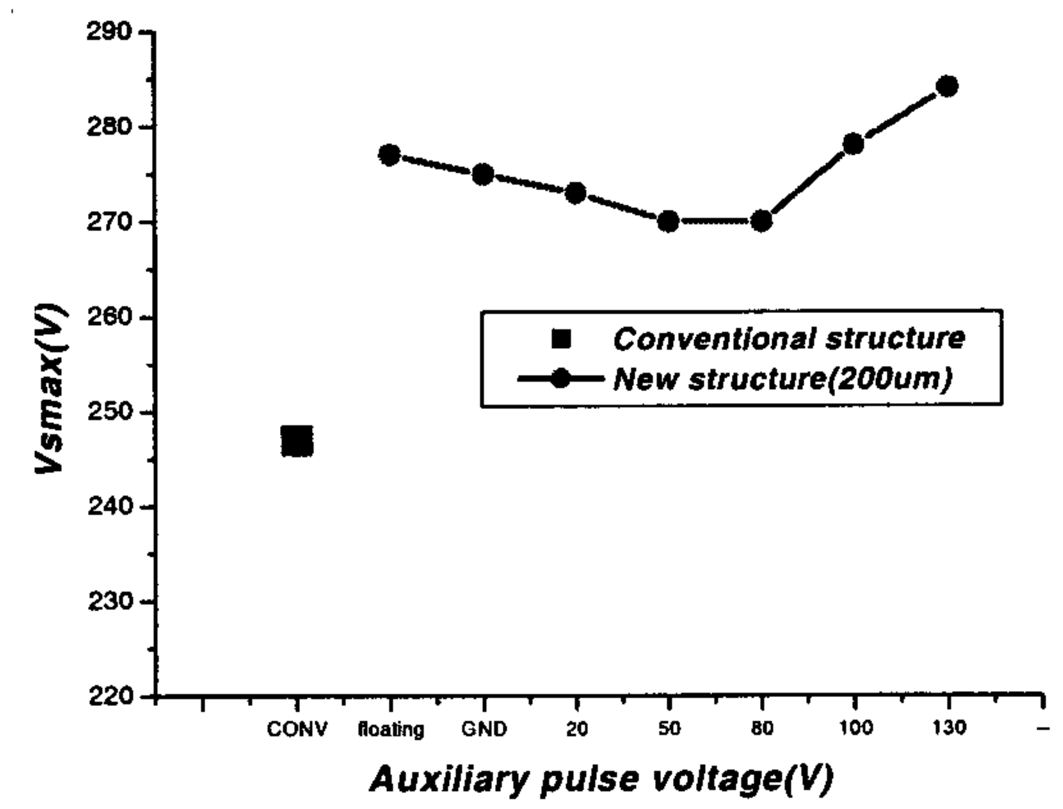


Fig.2 Pulse waveforms applied to the sustain and the auxiliary electrode

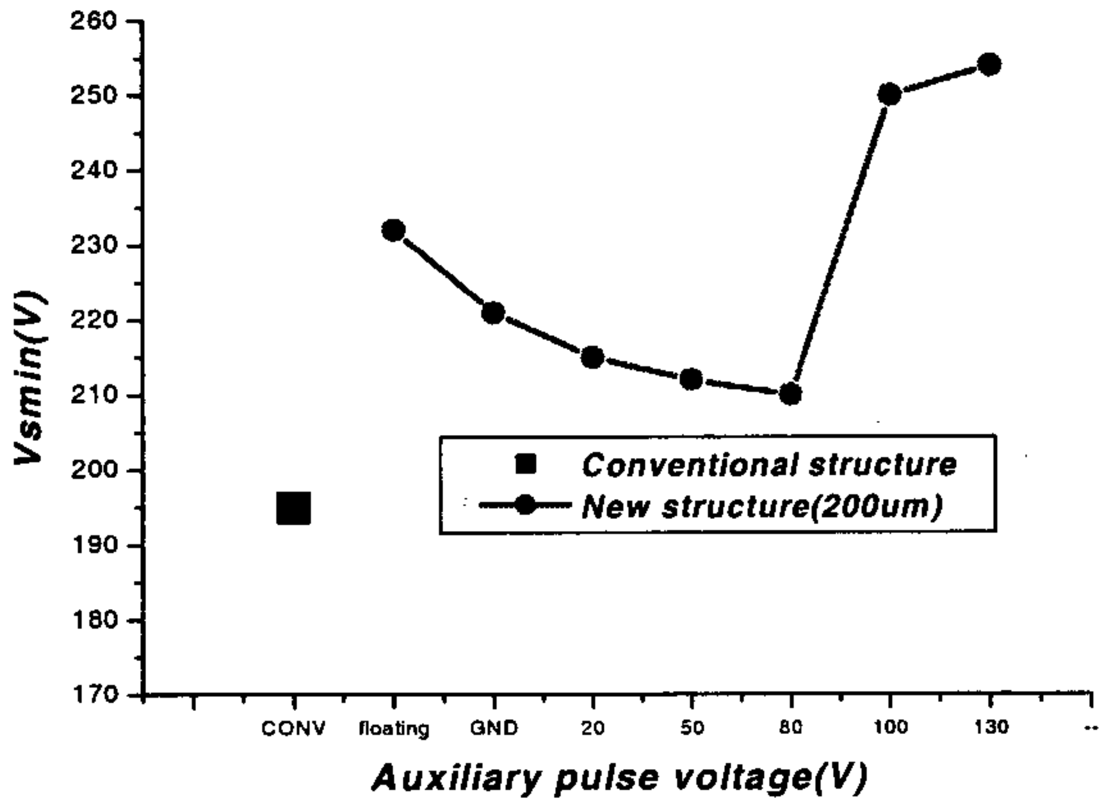
3. Results and Discussion

Figure 3 shows the maximum and the minimum sustain voltage as a function of the auxiliary pulse voltage. The maximum and the minimum sustain voltage of the coplanar 200μm - discharge gap are higher than those of the conventional structure. The auxiliary electrode located at the center of sustain electrode pair was adopted to reduce operating voltage. The maximum sustain voltage decreased as the voltage of the pulse applied to the auxiliary electrode increased until 80V. The maximum sustain voltage started to increase when the voltage of the pulse was from 80V to 130V. The curve of the minimum sustain voltage was similar to that of the maximum sustain voltage.

Figure 4 shows the luminance as a function of the voltage of the pulse applied to the auxiliary electrode. The luminance was measured when the sustain voltage was 255 [V]. When the voltage of



(a)



(b)

Fig.3 (a) Maximum sustain voltage and (b) Minimum sustain voltage as a function of the voltage of the pulse applied to the auxiliary electrode

the pulse applied to the auxiliary electrode increased, the luminance increased slightly until 50[V]. The luminance was changed abruptly when the voltage of the auxiliary pulse was 80V. The same phenomena have been observed when the discharge current was investigated. Figure 5 shows the discharge current as a function of the voltage of the pulse applied to the auxiliary electrode.

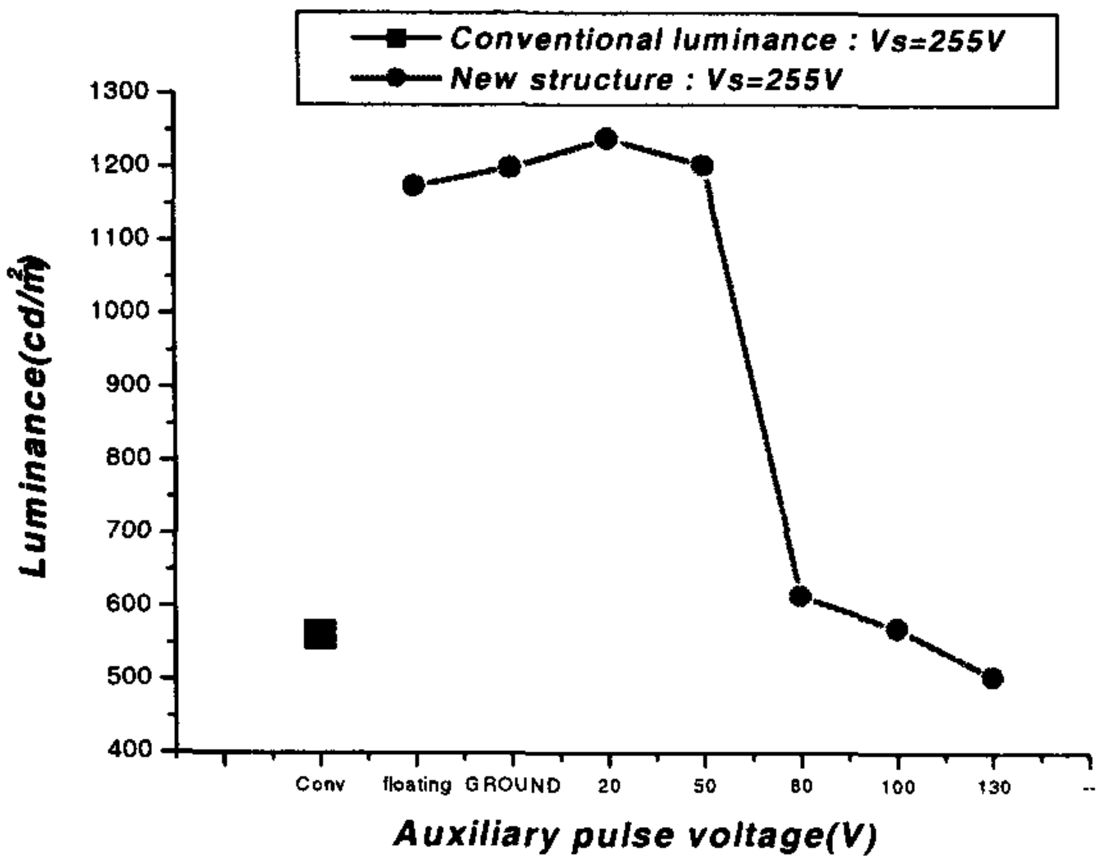


Fig.4 Luminance as a function of the voltage of the pulse applied to the auxiliary electrode

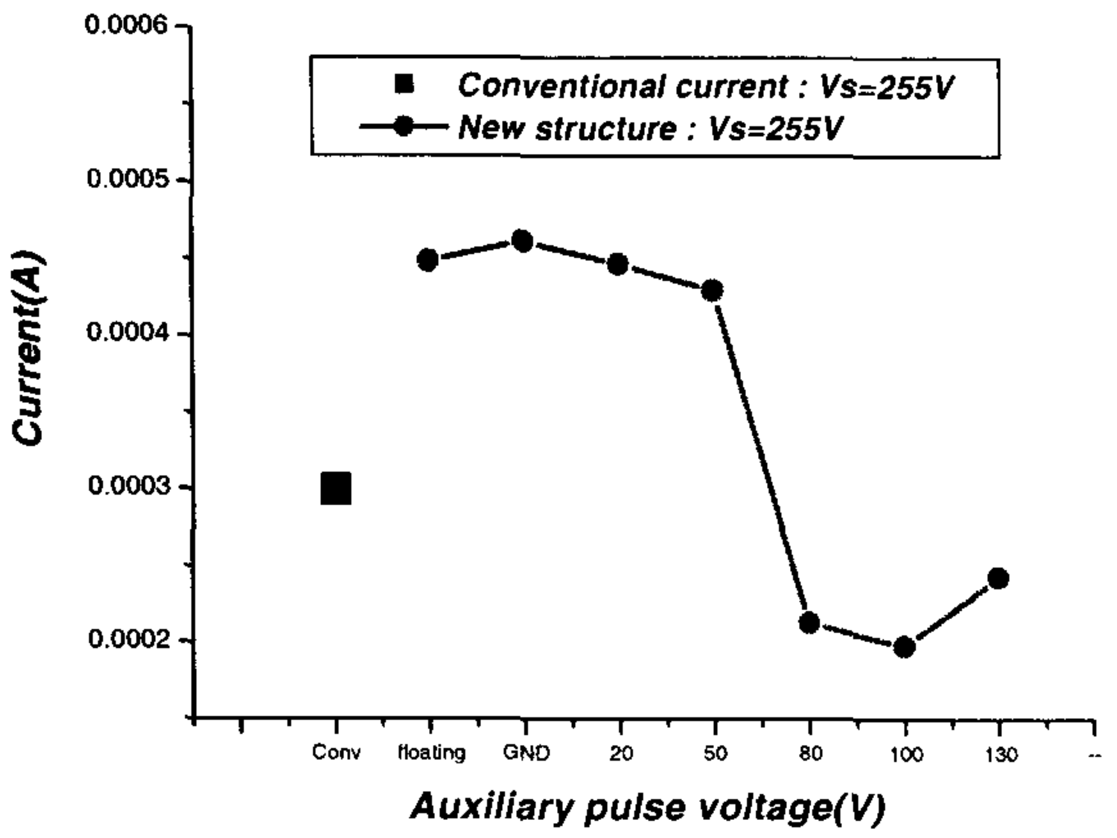


Fig.5 Discharge current as a function of the voltage of the pulse applied to the auxiliary electrode

Figure 6 shows the luminous efficiency as a function of the voltage of the pulse applied to the auxiliary electrode. The luminous efficiency rised to a maximum around 20 ~ 100[V] and then fell. When the auxiliary pulse voltage was 130V, the luminous efficiency started to decrease.

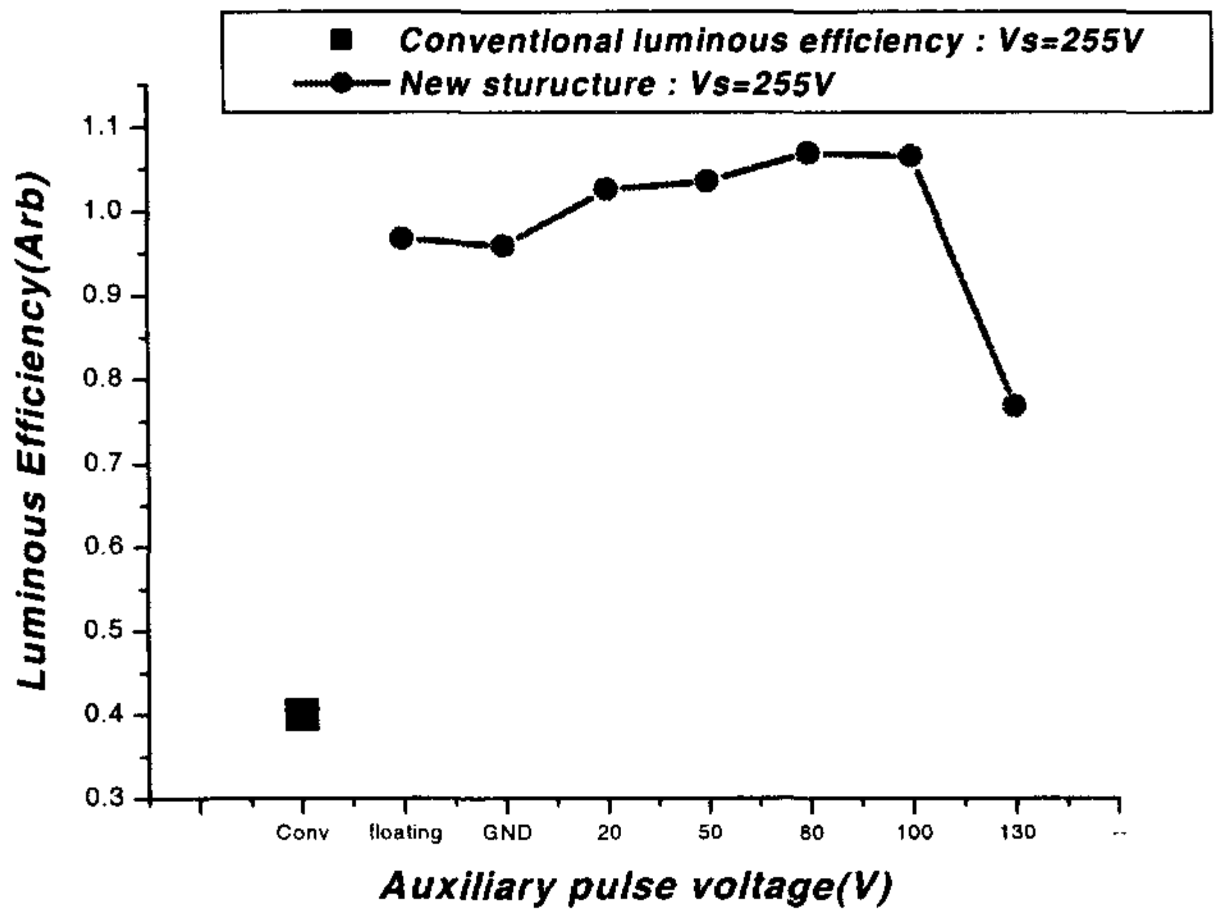


Fig.6 Luminous efficiency as a function of the voltage of the pulse applied to the auxiliary electrode

4. Conclusion

The new structure and driving scheme for a high luminous efficiency AC PDP was proposed in this work. The discharge characteristics of the real 3-inch test panel with VGA resolution was investigated. The real 3-inch test panel has an auxiliary electrode located at the center of the sustain electrode pair. The luminous efficiency had the maximum value when the voltage of the auxiliary pulse was 20 ~ 100[V]. The luminous efficiency of coplanar long-gap discharge with auxiliary electrode improved by 160% in comparison with that of the conventional structure.

5. References

[1] K. Amemiya, N. Saegusa, and M. Uchidoi, "A 50-in Diagonal Plasma Display Panel with High Luminous Efficiency and High Display Quality", SID'02, pp1060-1063,2002.
[2] T. Minami, M. Ishii, K. Igarashi, T. Shiga, and S. Mikoshiba, "Low Voltage Drive of High Xe-Content, High-Efficiency PDPs", EURO'2002, pp65-68, 2002.

[3] H. S. Chae, J. K. Lee. "Striation phenomenon in the plasma display panel", Appl. Phys, VOLUMN 8, NUMBER 3 pp1070-1080(2001).
[4] S. S. Yang, S W. Shin, H. C. Kim, and J. K. Lee, " New PDP cell designs for high luminous efficiency and radiation transport model in PDP", IMID'02, pp 590 – 593, 2002.
[5] N. Kosugi, K. Tachibana, M. Seki, and T. Sakai, "Evaluation of micro positive columns in DC-PDPs by laser spectroscopic microscopy", IDW' 99, pp687-690, 1999.
[6] J. Ouyang, T. Callegari, N. Lebarq, B. Caillier, and J.P. Boeuf, "Plasma Display Panel Cell Optimization", EURO' 2002, pp53-56, 2002.
[7] J.D. Schemerhorn, E. Anderson, D. Levison, and C. Hammon, J. S. Kim, "A controlled Lateral Volume Discharge for High Luminous Efficiency AC-PDP", SID'00, pp106-109, 2000.
[8] J. H. Lee, B. J. Kim, S. M. Hong, K. C. Choi, "Discharge characteristics of the AC PDP with Coplanar long-gap Electrodes", SID'03, 2003.