Influence of Sustain Pulse-Width on the Electro-Luminous Efficiency in AC-PDPs

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Abstract

Influence of sustain pulse-width on electro-luminous efficiency is experimentally investigated for surface discharge of AC-PDP. It is found that the firing voltage is decreased as the pulse-width is increased from 2 μs to 8 μs with sweeping frequency range of 10 kHz to 50 kHz. It has been found that the optimal sustain pulse-width is in the range of 3 ~ 4 μs under driving frequency range of 30 kHz and 50 kHz, based on observations of memory coefficient, wall charge, and wall voltage as well as luminous efficiency.

Introduction

In AC plasma display panels (AC-PDPs), sustain pulse-width play an important role in improvement on the operating margin and luminous efficiency. It is therefore of great importance to investigate the influence of sustain pulse-width on the electrical characteristics and luminous efficiency in AC-PDP to determine the optimal sustain pulse-width. Thus, the operating margin and the luminous efficiency as well as wall charges and wall voltages are measured in terms of the sustain pulse-width in the range of 2 μs to 8 μs. The wall charges and wall voltages have been measured by simple method resulted from the measurements of all capacitances in AC-PDP[1][2].

Experimental Configuration

Figure 1 shows the cross-sectional view of AC-PDP cell structure. In surface discharge AC-PDP with three electrodes system the X and Y electrodes that are covered with dielectric layers of 30 μm in thickness are parallel to each other in front glass. A MgO protective layer is deposited on the dielectric layer by the electron beam evaporation method with 0.5 μm in thickness. The cell pitch is fixed to be 1080 μm and the width and gap of the electrode are respectively kept to be 260 μm and 100 μm. On the rear glass the address electrodes of 100 μm in width and barrier rib of 120 μm in height are located. The number of discharge cells for three paired XY-line is 834. In this experiment a square driving voltage pulse with rising time of 300 ns is applied, while the address electrode has been floated. The filling gas is a mixture of Ne(96%) and Xe(4%), and total pressure is kept to be at 400 Torr.

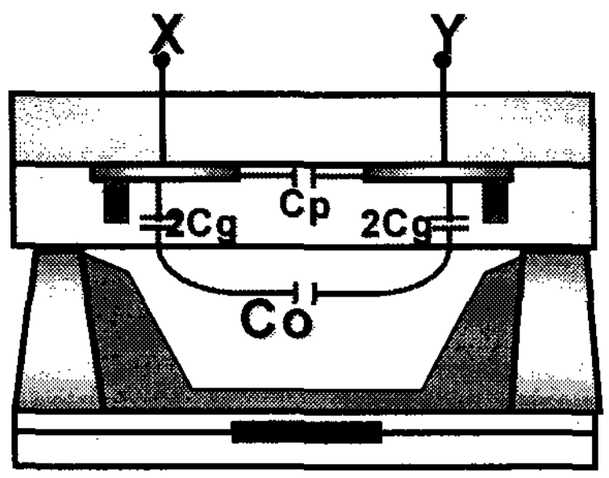


Fig. 1. Cross-sectional view of AC-PDP cell

Experimental Results and Discussions

Figure 2 shows the variations of firing voltage for various sustain pulse-width ranged from 2 μs to 8 μs. It is noted that the firing voltage decrease as the sustain pulse-width increases from 2 μs to 8 μs. These characteristics are same as all frequency regime between 10 kHz and 50 kHz. These characteristics may originate from the reason that the seed electrons gain more energy for gas breakdown and then the ionization rate becomes to be high as the sustain pulse-width increases.

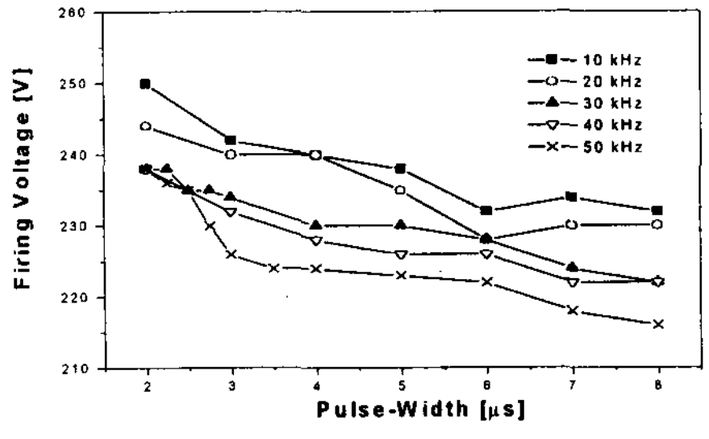


Fig. 2. Variations of firing voltage versus sustain pulse-width

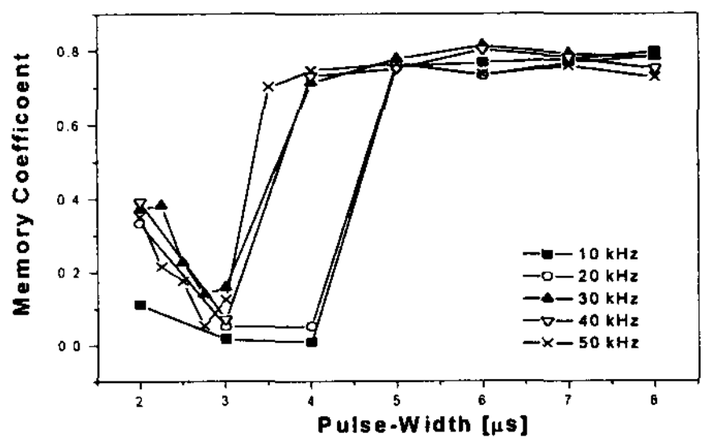


Fig. 3. Memory coefficient versus sustain pulse-width

Figure 3 shows the memory coefficient versus sustain pulse-width. It is noted that the memory coefficient is significantly increased from 0.16 to 0.71, as the sustain pulse-width is increased from 3 μs to 4 μs and beyond which it maintains constant value 0.8 up to sustain pulse-width 8 μs for driving frequency 30 kHz. These characteristics are originated from the amount of wall charge accumulated on dielectric surface. These characteristics shows the existence of optimal sustain pulse-width for the given driving frequency, with which priming particles in gas-filled discharge space make the enough margin for stable operation.

Figure 4 shows the wall charges per unit cell versus sustain pulse-width. It is noted that the wall charges increase from 21.5 pC/cell to 36.2 pC/cell as the sustain pulse-width is increased from 2 μs to 6 μs and beyond which the wall charge is slightly decreased for 30 kHz driving frequency. These increase in the wall charge are attributed to the longer pulse-width, which results in more amount of wall charges accumulated on the dielectric surface,

but the excessively long sustain pulse-width has no more effect on wall charge accumulation.

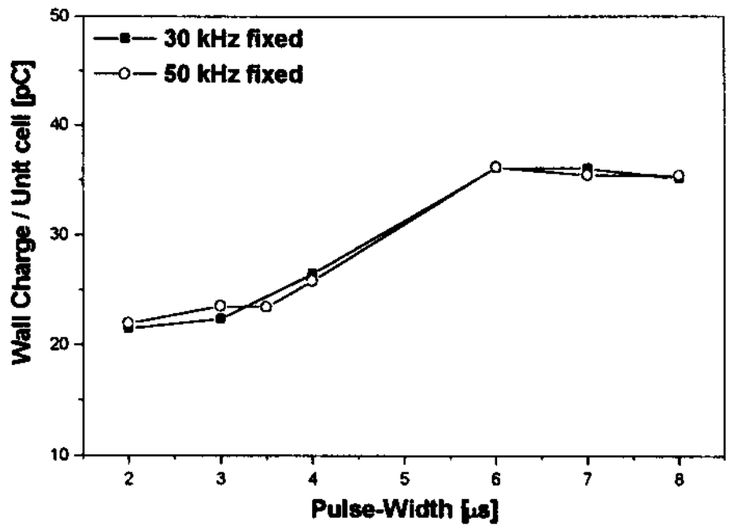


Fig. 4. Wall charges per unit cell versus sustain pulse-width

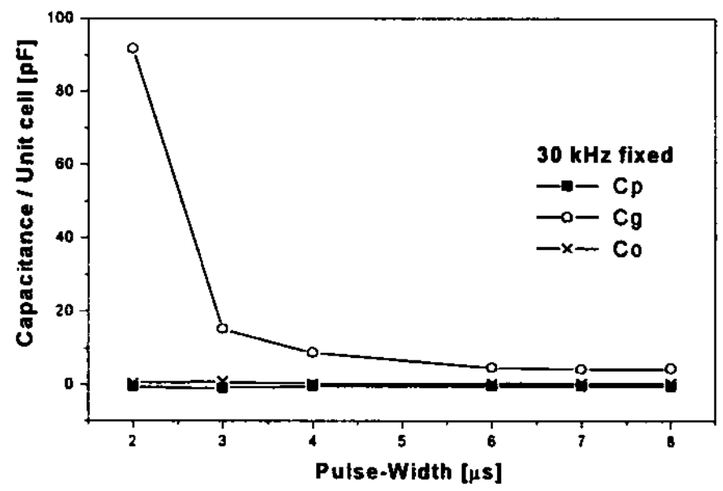


Fig. 5. Capacitances Co, Cp and Cg versus sustain pulse-width

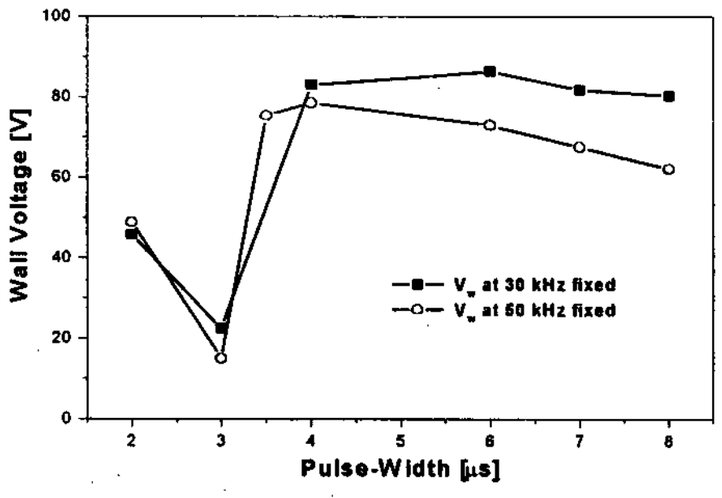
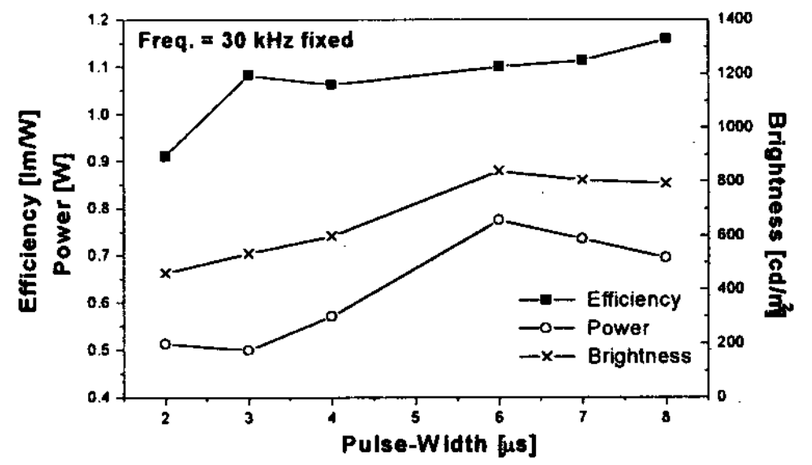


Fig. 6. Wall voltages versus sustain pulse-width

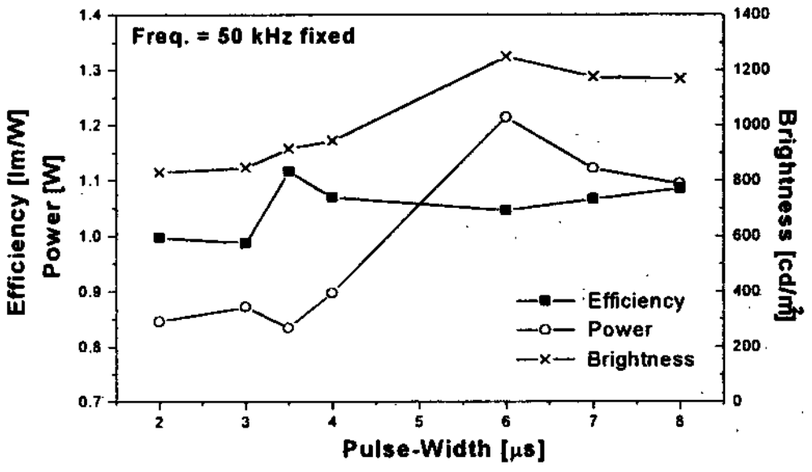
Figure 5 shows capacitances Co, Cp, and Cg per unit cell versus sustain pulse-width. These capacitances can be determined by Q-V analysis method along with the margin relation[1][2]. It is found that the capacitance Cp between the gap electrodes in the dielectrics has a negative capacitance characteristics, which is caused by wall charge accumulated on the dielectric surface in previous pulse.

Figure 6 shows the wall voltages induced by accumulated wall charges between the gas-filled space, which is experimentally determined by dividing the wall charge Qw accumulated on the dielectric surface by capacitance of discharge space Co. The wall voltage is significantly increased in the sustain pulse-width region of 3 μs and 4 μs. These characteristics are caused by both the wall charge quantities accumulated on the dielectric surface, as shown in fig. 4, and the memory coefficient characteristics as shown in Fig. 3.

Figure 7 shows power, brightness and the luminous efficiency versus sustain pulse-width ranged from 2 μs to 8 μs for two fixed frequency of 30 kHz (a) and 50 kHz (b), respectively. As the sustain pulse-width is increased up to 6 μs, the power consumption of discharge and the brightness are increased. It is also noted that the luminous efficiency shows the slight increment for all sustain pulse-width region. It is noted that the maximum luminous efficiency for 30 kHz and 50 kHz are 1.16 lm/W and 1.12 lm/W respectively, since the power consumption for 30 kHz is much less than that for 50 kHz.



(a) Freq. = 30 kHz



(b) Freq. = 50 kHz

Fig. 7. Efficiency, power, and brightness versus sustain pulse-width

Conclusion

Influences of sustain pulse-width on the electrical characteristics and luminous efficiency have been experimentally investigated to determine the optimal sustain pulse-width in the surface discharge AC-PDP. The firing voltage decreases as the sustain pulse-width increases. The memory coefficient is significantly increase as the sustain pulse-width is increased from 3 μs to 4 μs and beyond which it maintains constant value. The wall charges increase as the sustain pulse-width is increased from 2 μs to 6 μs. The wall voltage is significantly increased in the sustain pulse-width of 3 μs and 4 μs. If the pulse-width is in optimal value, then the margin is enlarged because of wall charge increment. It has been concluded that the optimal sustain pulse-width is in the range of 3～4 μs under driving frequency range of 30 kHz and 50 kHz, based on observations of memory coefficient, wall charge, and wall voltage as well as luminous efficiency.

References

[1] E. H. Choi, et al., Proceedings of IDW '98, p.535 (1998).
[2] E. H. Choi, et al., Jpn. J. Appl. Phys. 38, pp6073 (1999)