AC PDP의 변위전류 및 방전전류에 관한 연구

이우근*, 하석천, 이성현, 조정수, 박정후
부산대학교 전기공학과

A Study on the Displacement and Discharge Current Waveform in AC PDP

Woo-Geun Lee*, Seok-Cheon Ha, Sung-Hyun Lee, Jung-Soo Cho, Chung-Hoo Park
Department of Electrical Engineering, Pusan National University

Abstract - This paper deals with the relationships between discharge current wave form and the structure of AC PDP cells. The Paschen minimum can be found in the range of 200~300 torr under the condition of electrode width of 300㎛ and 100㎛ electrode gap. Furthermore, the charge current does not vary with the gas pressure, whereas the time delay in the discharge inception voltage decreased both peak and r.m.s discharge current increase with gas pressure and electrode width.

1. Introduction

The discharge electrodes of AC PDP covered with dielectric layer as like ozonizer. The discharge occur on the surface of dielectrics[1]. The AC PDP utilizes the radiation from the surface discharge. From the circuit point of view, the electrodes, dielectrics and discharge space can be modified as equivalent C-circuit as shown in Fig. 1.

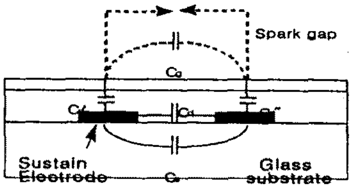


Fig. 1 Equivalent C-circuit of ac AC PDP

If a square wave AC voltage which is higher than discharge inception voltage is applied to the discharge electrodes of AC PDP, the discharge current can be detected as shown in Fig. 2. The discharge current wave form can be controlled by many parameters, such as the size of discharge cell, the pressure of working gas, electrode width and gap, and the thickness of dielectrics and so on. The applied voltage and discharge current waveform control is very important because these waveforms are concerned with brightness or luminance and power consumption of AC PDP[2][3]. In this paper, we have studied discharge characteristics and the relationship between some structure change of discharge cell and discharge current waveform of AC PDP.

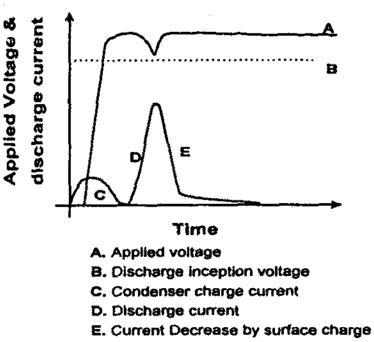


Fig. 2 The waveform of applied voltage and discharge current

2. Experimental Procedure

Fig. 3 shows a typical surface-discharge-type AC PDP. Sustain electrodes are arranged on the one glass substrate, and the other substrate serves as a cover glass which has the address electrodes, barrier rib and phosphor. The front glass was made with sodalime glass(70mm×90mm×3mm). The electrodes were prepared by screen printing(ATMA co. type AT-600H/E) using silver paste(Du pont, 7713 Ag conductor paste). The width of electrodes were varied from 150㎛ to 500㎛, and the gap between the electrodes were varied from 100㎛ to 500㎛. In these

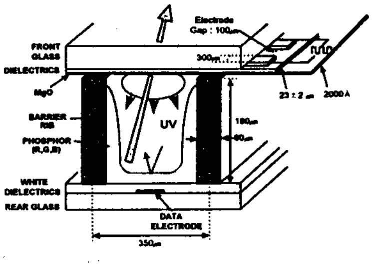


Fig. 3 A typical surface-discharge-type AC PDP

devices, the electrodes are covered with dielectric layer. Dielectric layer was printed with low melting point glass paste(Noritake co. NP-7972C and NP-7973C) and annealed at 590℃ for 120min. This was relatively easy to fabricate, but low melting point glasses contain lead which leads to high discharge voltage and low γ-coefficient[4].

In order to modify these properties dielectric layer is overcoated with a thin film of MgO which shows high γ-coefficient and reduce the inception voltage and high resistance to sputtering[5]. The thin film of MgO(2000Å~3000Å) was deposited on the dielectric materials by a magnetron reactive sputtering with Mg target.

The rear glass substrate provided with addressing electrodes is first coated with a white dielectric layer on the substrate and then a layer of barrier rib material(Noritake co. NP 7864, NP-7864A) was coated by screen printing method. Barrier rib patterns which is aligned with addressing electrodes was formed using photolithography method. The barrier ribs are sandblasted and annealed at 400℃. The barrier rib of 180㎛ height×80㎛ wide×350㎛ space was formed. The phosphor of Red, Green and Blue was printed between barrier ribs.

Discharge chamber is made with a cylinder of 200mm diameter and 80mm height. Quartz glass cover is at upper part of the chamber for observing the discharge of electrodes and discharge light. Pressure gauge(Setra co. Model 280) and digital display(GLA co. Md-100) were used to measure the working gas pressure. Power source-pulse generator for the square wave-can be controlled in the range of the frequency of 5~55㎑, voltage of ~300V and duty. In this study the sample is tested in the test chamber. The test chamber was exhausted up to ~10^{-6}Torr in order not to be affected by residual gas. Thereafter, the working gas-He-is filled to a given pressure. The characteristics of the sample were stablized by aging. The applied voltage is a variable but frequency was set to 30㎑.

3. Results and discussion

Fig.4 shows the relationship between discharge voltage and working gas pressure in PDP under the condition of electrode width of 300㎛, 100㎛ gap and constant voltage. The discharge voltage consists of discharge inception voltge V_f and discharge sustain voltage V_s. From Fig.4, it can be noticed that the Paschen minimum exist in the range of 200~300 torr at a given electrode structure.

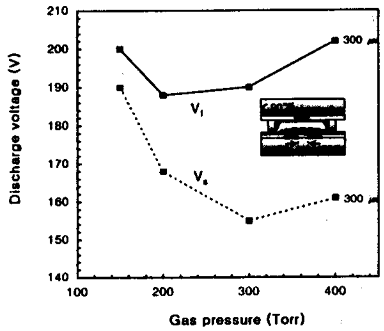
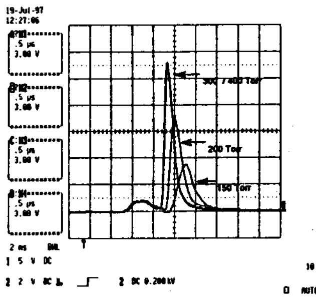


Fig. 4 Discharge voltage vs. gas pressure

Fig. 5 shows the discharge current waveform as a parameter of the working gas pressure. The condenser charge current does not vary with the gas pressure. However the time delay in the discharge inception voltage decreased with the working gas pressure.

Fig. 6 shows the relationships among gas pressure, peak discharge current and r.m.s discharge current. From Fig. 6, the current also increased with the gas pressure because of high collision ionization at high gas pressure.



Applied voltage : 195V   Electrode gap : 100㎛
Electrode width : 300㎛   Gas pressure : 150, 200, 300, 400 torr(He gas)

Fig. 5 Discharge current waveform as a parameter of gas pressure

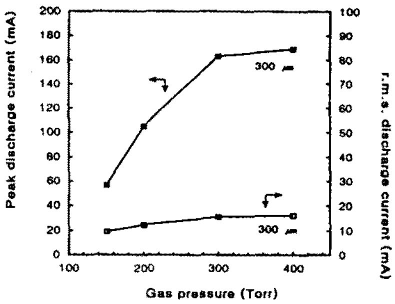


Fig. 6 Peak and r.m.s dischrage current as a parameter of gas pressure

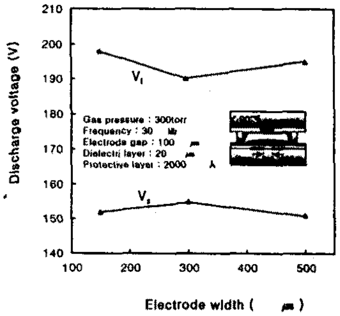
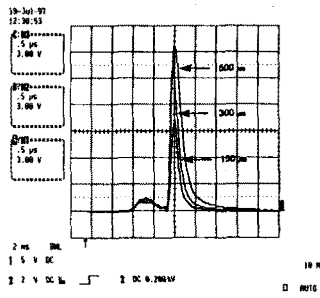


Fig. 7 Discharge voltage vs. electrode width

Fig. 7 V_f decreased with electrode width, whereas V_s increased up to 300μm. However V_f increased with the width, whereas V_s decreased above 300μm. In general, V_f and V_s do not varied significantly as the width increases. The range of V_f and V_s are 190~200V, and 150~155V respectively. The decrease in V_f may be due to the high ionization rate at high gas pressure. The increase in V_f at high pressure above 300 torr may be attributed to the higher diffusion rate of the discharge plasma to the side wall of the discharge cells than the increase in ionization rate.

Fig.8 shows the discharge current waveform as a parameter of electrode width in the range of 150~500 μm. The time delay in discharge inception voltage shows almost constant as the electrode width increases, because of the constant electrode gap, gas pressure and applied voltage. However, from Fig. 8 the peak and r.m.s discharge current is varied significantly as the electrode width increases.



Applied voltage : 195V
Electrode gap : 100μm
Electrode width : 150μm, 300μm, 500μm
Gas pressure : 300 torr (He gas)

Fig. 8 Discharge current waveform as a parameter of electrode width

4. Conclusion

[1] Paschen minimum exist in the range of 200~300 torr under the condition of electrode width of 300 μm, 100μm gap and constant voltage.

[2] The charge current does not vary with gas pressure. However, the time delay in the discharge inception voltage decreased with working gas pressure. The peak and r.m.s discharge current increase with gas pressure.

[3] The peak current and r.m.s discharge current are varied singnificantly as the electrode width increases

References

[1] Josef Rosenkranz, Stanislav Pekarek, and Martin Zacek, "Breakdown Voltage on the Surface Glow Discharge", IEEE Trans. Electron Devices.

[2] Tsutae Shindoda, " Improvement of Luminance and Lumious Efficiency of Surface-Discharge Color ac PDP", SID 91 DIGEST, pp.724-727

[3] Takeo Kamegaya, et al., " Basic Study on the Gas-Discharge Panel for Luminecent for Dispaly", Vol. ED-25, No. 9, 1978

[4] Toshinori Urade, et al., " A Protecting Layer for the Dielectrix in AC Plasma Panels", Vol. 23, No. 3, 1976

[5] Heiju Jchiike, et al., "Secondary Electron Emission Characteristics of Dielectric Materials in AC-Operated plasma Display Panels