Influence of Sustain Voltage on Wall Charge and Wall Voltage Characteristics in AC-PDPs

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Abstract

Influences of sustain voltage on wall charges and wall voltages are experimentally investigated in surface AC plasma display panels(AC-PDPs), in which electrode gap and width are 80 ㎛ and 270 ㎛, respectively. The filling gas is Ne-Xe gas mixture, and total pressures 300 Torr. Also it is found that the more amount of Xe mixing ratio makes the less wall charge and voltage for sustain voltage ranged from 140 V to 222 V. The response time has been delayed by adding a small amount of Xe to Ne in comparison with that without Xe. It is also found that the wall charge and voltage are reduced by adding a small amount of Xe to Ne in comparison with those without Xe.

Introduction

In Ac plasma display panel (AC-PDPs), wall voltages have important role in lowering the sustaining voltage due to wall charges accumulated on the dielectric surface. It is of great importance to experimentally measure the wall charges and various capacitances in AC-PDPs to determine the wall voltages according to the sustain voltage magnitude under various gas mixtures of Ne-Xe since they are dependent on the sustain voltage. Thus the quantitative experimental results on wall charges and wall voltages as well as capacitances versus sustain voltage magnitude for various gas mixtures of Ne-Xe are investigated in this research with the help of simple method[1] from current-voltage (I-V) discharge and charge-voltage (Q-V) characteristic curves, which is easier and more improved than there of Weber[2] and Tamida[3].

Experimental Configuration

Figure 1(a) shows the cross sectional view of AC-PDPs cell structure. A surface discharge AC-PDPs with three electrodes system is widely used, in which X and Y electrodes covered with dielectric layer are parallel to each other in front glass. A MgO protective layer is deposited on to the dielectric layer by the electron beam evaporation method with 0.5 ㎛ thickness. The sustaining discharge in AC-PDPs is occurred between these parallel sustaining electrodes of X and Y separated by 80 ㎛. Their electrode width are kept to be 270 ㎛ and cell pitch is fixed to be 1080 ㎛. On the rear glass the address electrode and barrier rib perpendicular to the two sustaining electrodes are located as shown in Figuare 1(a), in which Co is the capacitances of surface discharge space, Cp is the capacitances of intergap region including front glass medium parallel to the discharge region, and 2Cg is the capacitances of the dielectrics. In this experiment square voltage pulse with 40% duty ratio is applied between the two sustaining electrodes with driving frequency 100 kHz, while the address electrode has been floated to result in floating potential, i.e., half the sustaining voltage difference. The filling gas in AC-PDPs has been used Ne only and mixture of Ne-Xe(1%), Ne-Xe(4%) and Ne-Xe(7%). The filling gas pressure is fixed to be 300 Torr. The current and voltage waveforms between the two sustaining electrodes X and Y are measured by increasing the sustain voltage to investigate the influence of sustain voltage on the wall charges, capacitances, and wall voltages. Figure 1(b) shows the equivalent capacitances before and after the discharge. These equivalent capacitances before and after the discharge can be obtained from each slope of the Q-V characteristics curves.

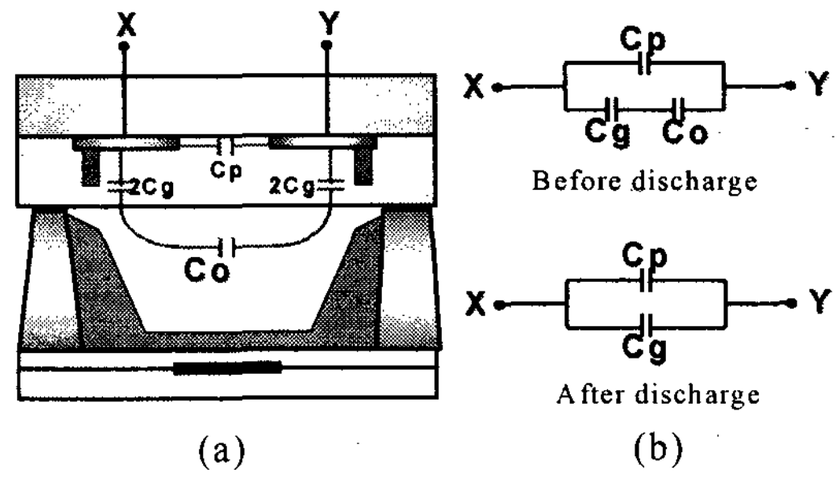

Fig. 1 (a) Crossectional sectional view of AC-PDPs Cell structure
(b) The equivalent circuit

Experimental Results and Discussions

Figure 2 shows the oscillograms of sustain voltage and current waveforms for Ne gas and various gas mixtures of Ne-Xe(1%, 4%, 7%) under 100 kHz driving frequency, in which the sustain voltage Vs = 180V is applied to the XY sustaining electrodes. It is noted for the sustain voltage Vs = 180V that the response time for the discharge current is shown to be the fastest for the Ne gas only. Meanwhile the response time for Ne-Xe gas mixtures are shown to be faster a little as the more Xe mixture ratio to Ne is included.

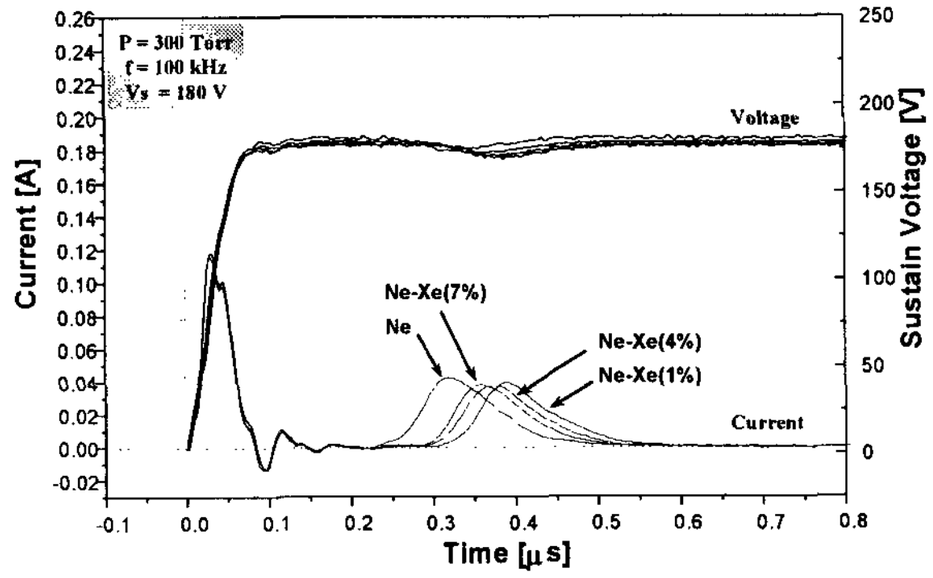

Fig. 2. Oscillograms of sustain voltage and current waveforms for Ne gas and various gas mixtures of Ne-Xe

Figure 3 shows the response time versus sustain voltage for Ne gas only and the various gas mixtures of Ne-Xe. It is noted that the response time gets to be fast from 956 ns to 108 ns as sustain voltage increases from 140 V to 222 V for Ne gas only. It is also found that the response time has been delayed by adding a small given amount of Xe to Ne in comparison with that without Xe.

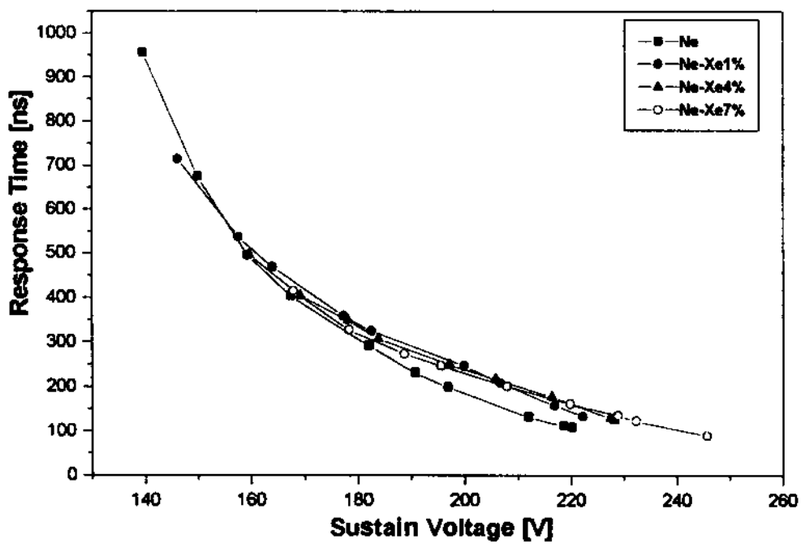

Fig.3. Response time versus sustain voltage

Figure 4 shows the maximum wall charges per unit cell accumulated on the dielectrics surface versus sustain voltage. It is noted that the wall charges are increased to be from 25 pC/cell to 54 pC/cell as sustain voltage increased from 140 V to 222 V for Ne gas only. It is also found that the wall charge has been reduced by adding a small amount of Xe to Ne in comparison with that without Xe. Also it is noted that the more amount of Xe mixture ratio (1%, 4%, 7%) makes the less wall charge, as shown in this Figure 5.

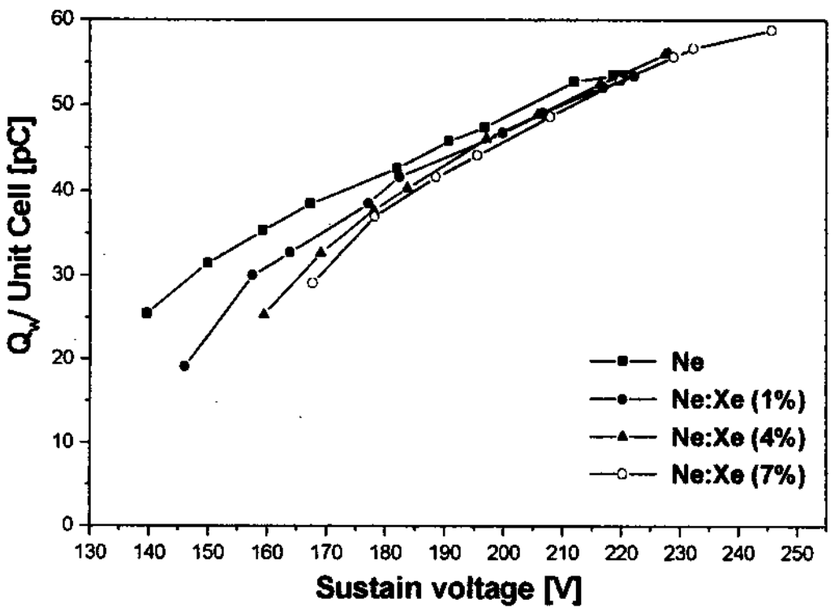

Fig. 4. Maximum wall charge per unit cell versus sustain voltage

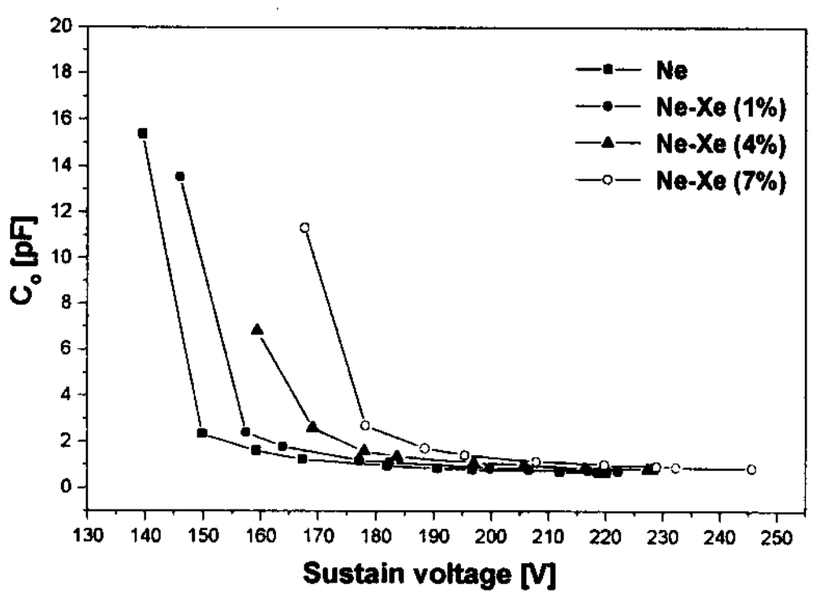

Fig.5. Capacitance Co versus sustain voltage

Figure 5 shows the capacitances Co per unit cell versus sustain voltage for Ne gas only and various gas mixtures of Ne-Xe. These capacitances can be determined from charge-voltage(Q-V) characteristics curve. The slopes of Q-V curve for before and after the surface discharge are experimentally determined to yield the capacitances of Co, Cp, and 2Cg per unit cell with the margin relation of Va - (Vs)max = Vw + 2Vg, where (Va) is the applied voltage for sustaining discharge, $(Vs)_{max}$ is the sustaining maximum voltage. The wall voltage Vw can be determined from Qw/Co, and 2Vg is the gap voltage of dielectrics described by Qw/Cg. It is noted that capacitances Co decreases from 15.3 pF/cell to 0.67 pF/cell for the Ne gas only as sustain voltage is increased from 140 V to 222 V. Also the larger capacitances Co are found for the more gas mixture ratio of Xe to Ne gas at given sustain voltage

Figure 6 shows the maximum wall voltages accumulated on the dielectric surface. It is noted that the wall voltages are increased to be from 1.7 V to 80 V as sustain voltage is increased from 140 V to 222 V for Ne gas only. Also it is found that the more mixture amount of Xe to Ne makes the less wall voltage, in which the mixture ratio of Xe to Ne are varied to be 1%, 4% and 7%.

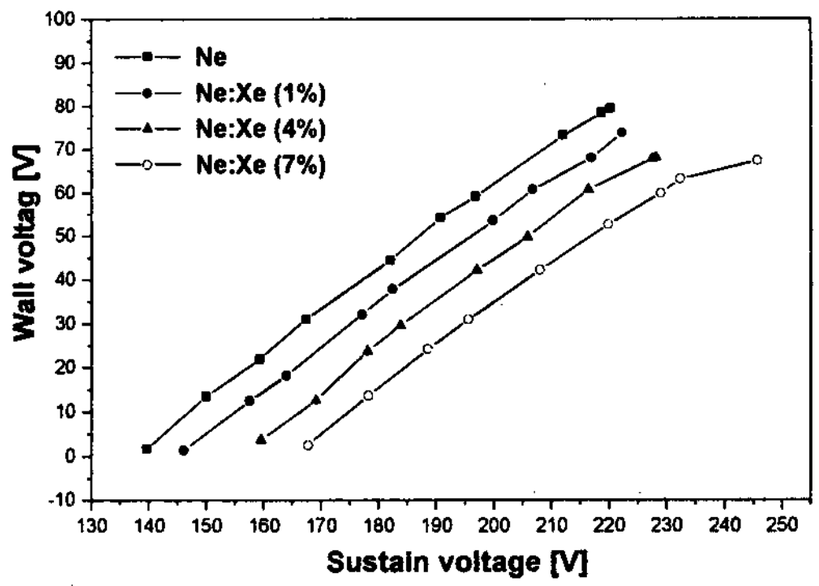

Fig. 6. Maximum wall voltage versus sustain voltage

Conclusion

Influences of sustain voltage on wall charges and wall voltage including capacitances are experimentally investigated in surface discharged AC plasma display panels. Adding a small amount of Xe from 1% to 7% to Ne also makes the capacitance Co large in comparison with that without Xe at given sustain voltage. It is found that the response time gets to be fast from 956 ns to 108 ns as sustain voltage increases from 140 V to 222 V for Ne gas only. It is found that the response time has been delayed by adding a small given amount of Xe to Ne in comparison with that without Xe. It is found that the wall charge and voltage have been reduced by adding a small amount of Xe to Ne in comparison with that without Xe. Also it is noted that the more amount of Xe mixture ratio makes the less wall charge and voltages for sustain voltage ranged from 140 V to 222 V.

References

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