The Influence of Xe Content on Wall Voltage Transfer Behavior

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Abstract

Various approaches were undertaken by major PDP makers in order to improve the luminous efficacy of the plasma discharge cells. There have been many reports that state that using a high Xe content PDP is one of the most promising key technologies available to improve the luminous efficacy. In the case of the higher Xe content panel, the higher address and sustain voltage were needed to drive the panel under the same reset condition. In this study, a variety of Xe content panels were investigated in order to examine wall voltage transfer behaviors. The transferred wall voltage status after addressing discharge at the same driving condition was analyzed by comparing Vt close curve of high and low Xe content panels. Through this analysis of Vt close curve difference, the driving waveform of a high Xe panel was quantitatively adjusted. Under the same address voltage condition, results showed that the amount of the transferred wall voltage and Vt close curve after addressing discharge was matched for the first sustain discharge. Taking these results into consideration, we conclude that the driving waveform for different Xe content panels could be designed for the desired addressing discharge condition and the wall voltage state of the cell could be quantitatively controlled and measured through these approaches.

1. Introduction

Improvement of luminance and luminous efficacy of PDP is one of the most important issues that need to be dealt with in order to compete with other large size flat panel displays, such as LCDs. Various approaches were undertaken by major PDP makers in order to improve the luminous efficacy of the plasma discharge cells. There have been many reports that state that using a high Xe content PDP[1] is one of the most promising key technologies available to improve the luminous efficacy. The different Xe content panels were investigated in order to examine wall voltage transfer behaviors in the driving stage. By using several 7.5 inch test panels which had the same XGA grade structure and different Xe gas content, the transferred wall voltage status after addressing discharge at the same driving condition was examined by measuring the Vt close curve in same driving condition. By analyzing the difference of the Vt close curve of high and low Xe content panels, we could calculate the new set down voltage (-Vy) and bias voltage of the common sustain (Vzb) of high Xe panel. Under the new driving conditions, the Vt close curve of high Xe panel after addressing discharge was matched to that of low Xe panel. Through this analysis of Vt close curve difference, the driving waveform of high Xe panel was quantitatively adjusted. Under the same address voltage condition, results showed that the amount of the transferred wall voltage and Vt close curve after addressing discharge was matched for the first sustain discharge. Taking these results into consideration, we conclude that the driving waveform for different Xe content panels could be quantitatively designed for same transferred wall charge state after the same addressing discharge condition. Moreover, it is possible to know the values of the voltage change of the driving waveform for the wall voltage state that we want to control quantitatively, which is also measurable.

2. Experimental

The experiments were done with 7.5” test panels, which have similar cell structure of large size XGA panels, were prepared by commercial grade protective and phosphor materials. The discharge gap between

ITO electrodes is fixed to 70 ㎛ in order to focus the effect of Xe content. The Xe content of the test panels was just varied from 10% to 20% because of the voltage limitation of measurement.

First, the static characteristics and Vt close curves of Xe 10% and 20% test panels were measured and the reference driving conditions were adjusted at 70V address voltage. Secondly, the Vt close curves in the driving stages were measured under the reference driving conditions. From the obtained information of the two Vt close curve, new driving conditions for the Xe 20% panel were calculated. Finally, we also measured the Vt close curve of the Xe 20% panel by applying modified driving waveforms.

3. Results and discussion

As mentioned above, the static characteristics of Xe 10% and 20% test panels were measured and shown in Table 1. The luminous efficacy of panels were measured at stable sustaining voltage (Vs), which is sustain minimum voltage plus 10V (Vsmin + 10V).

Table 1. Static Characteristics of Panels

Xe Content	Vs (V)	Luminance (Cd/cm^2)	Efficacy (Lm/W)
Xe 10%	168	219	1.51
Xe 20%	190	325	1.78

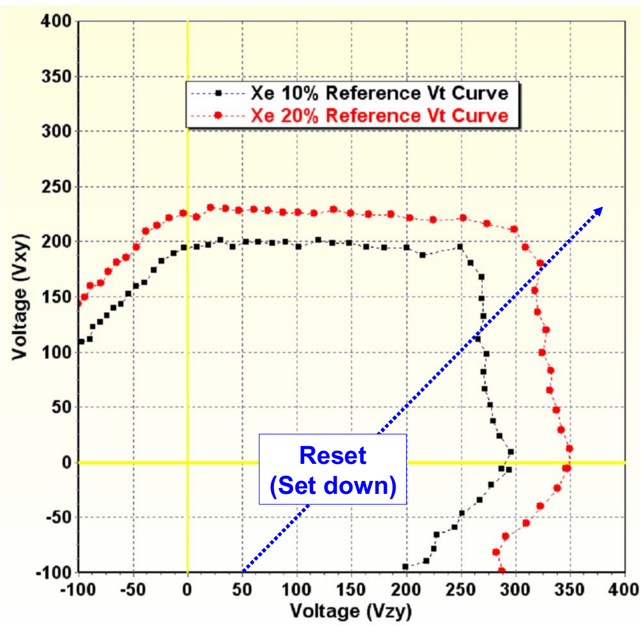

Fig 1. Vt close curve of Xe 10% and 20% Panels

The efficacy of the Xe 20% panel is improved by 15% regarding to the Xe 10% panel. In spite of this improvement of efficacy of the higher Xe panel, there are some problems, such as higher sustain and address voltages, which need to be overcomed for application.

Generally speaking, the higher sustain voltage of the high Xe content panel was well understood due to its higher threshold voltage of discharge as shown in Fig 1. Even though the Xe 20% panel has a higher threshold voltage, the panel could be stably driven and sustained at the given address voltage, if the wall charge state of the panel after the set down period (blue dotted vector line in Fig. 1) can be successfully moved to SDP (Simultaneous Discharge Point) of the Vt close curve.[2]

However, it is very difficult to define the SDP of the PDP panel experimentally because the shapes of Vt close curves were distorted when the position change after the wall voltage was transferred.[3]

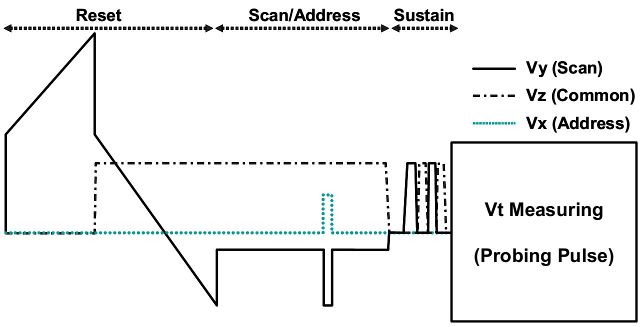

Fig 2. Waveform for Vt Measuring System

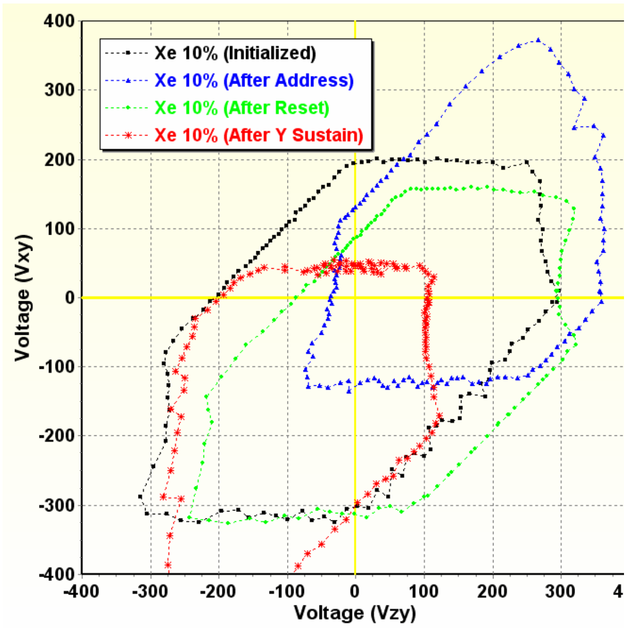

Fig 3. Change of Vt close curves in the driving stage of Xe 10% panel

In this study, we investigated the difference of Vt close curve of low and high Xe content panels to search the stable driving condition for higher Xe panels. In order to measure the Vt close curve in the panel driving stages, we designed the measuring waveform shown in Fig 2. The voltage levels of the reset period were decided and confirmed by real driving experiments of the test panels. The address voltage was fixed at 70V.

By using the Vt measuring system, the Vt close curves of Xe 10% panel in the driving stage could be measured and shown in Fig 3. We can see the changes of Vt close curve after reset, addressing, and 1st Y sustain discharge when comparing the initialized wall voltage state (black square dotted line in Fig 3). Due to the non-uniform distribution of the wall charge, the Vt curves were changed not only in the position but in the shape.[3]

The two different Vt close curves of Xe 10% and 20% panels after addressing discharge, having the same reference driving conditions, were shown in Fig 4. The results show that the surface discharge threshold voltage (Vzy) and the vertical discharge threshold voltage (Vxy) of Xe 20% panel are higher than that of Xe 10% panel. It means that the transferred wall charge is insufficient for the first sustain discharge when applying the sustain voltage (Vs, blue dotted vector line in Fig. 3) after addressing discharge in the case of Xe 20% panel. From these two Vt close curves, we can obtain the voltage difference in Vzy and Vxy, which are about 70V and 40V respectively.

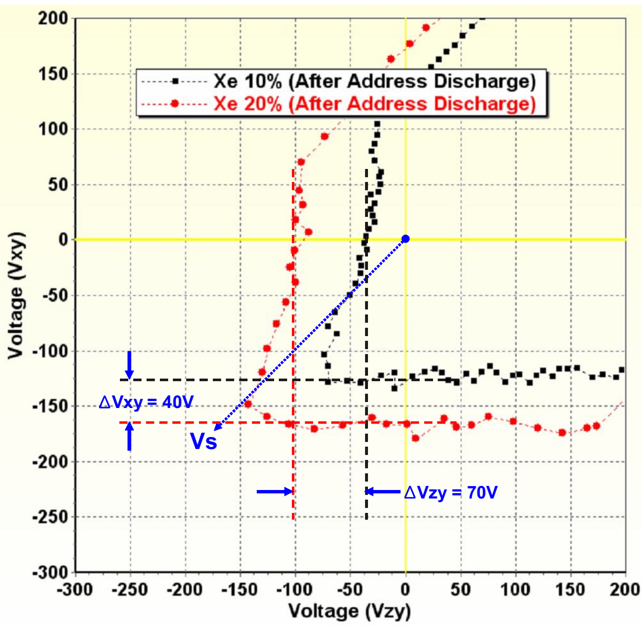

Fig 4. Vt close curves after addressing discharge in same driving condition

From these voltage differences (ΔVzy, ΔVxy), we can calculate the new voltage level of the set down voltage(–Vy) and bias voltage of the common sustain (Vzb) for the same threshold voltage level of Xe 10% panel after address discharge.

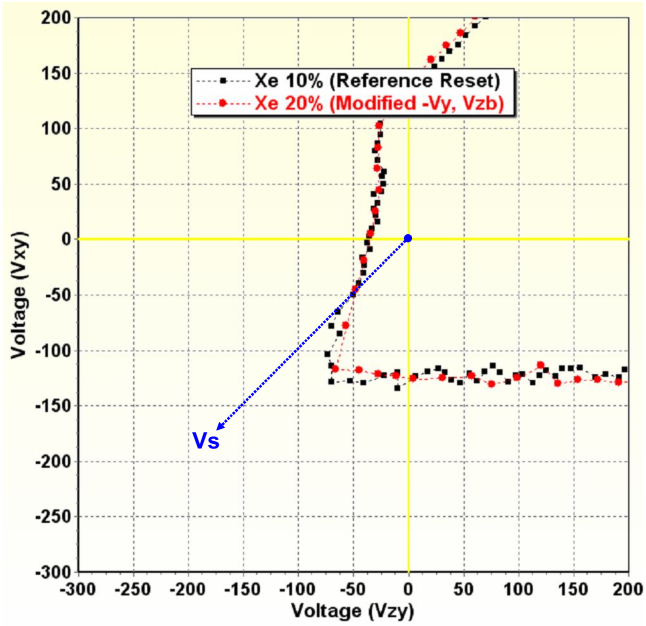

Fig 5. 2 Vt close curves after addressing discharge in each driving condition

The new set down voltage is changed to -180V from the -140V by 40V and the new bias voltage of the common sustain is also changed to 160V from 130V by 30V. By using the new driving waveforms, the Vt close curve of Xe 20% panel after the address discharge was shown in Fig. 4. The result shows that the new Vt close curve is almost matched to one of Xe 10% panel measured with the reference driving condition. It means that we could design the driving waveforms and drive the Xe 20% panel as well as Xe 10% panel by this analysis of Vt close curves in any driving stage.

4. Summary

By using the new Vt measuring system, the change of Vt close curves of Xe 10% panel could be measured at various driving stages in stable driving conditions. We also investigated the change of Vt close curve of high and low Xe content PDP test panels after addressing discharge in the same condition. Through the Vt close curve difference, we could understand the new voltage levels in driving waveforms for Xe 20% panel and measure the same Vt close curve with the new driving condition as a Xe 10% panel. Through this work, we could design the driving conditions of the high Xe content panel which were set with the same transferred wall voltage state as the low Xe panel. Taking these results into consideration, , we conclude that the driving waveform for the different Xe content panels could be designed for the desired addressing discharge condition and the wall voltage state of cell could be quantitatively controlled and measured through these approaches. This Vt analysis technique could be used for the other panel studies such as driving waveforms, structures and materials.

5. References

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