Transport of space charge between sub-pixels in AC-plasma cell discharge

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Abstract

In this experiment, we have investigated that the transported space charge between sub-pixels in AC-plasma cell discharge. The test pulse 30 V, 5 ㎲ was applied to the address electrodes of neighbor cells of discharge occurred cells. And we have measured the transported space charge between sub-pixels in accordance with the various last sustain pulse widths t(time gap between the rising edges of sustain and test pulses) of 0.2 to 3 ㎲. It was observed that the peak value of transported space charge has been shown to be 21.5pC at 1.0 ㎲. And the IR peak value have been occured after 0.51 ㎲ with respect to sustain voltage.

1. Introduction

1-1. Objectives and Background

The main problems of AC-PDP are luminosity, efficiency and cost. To improve electrical characteristics and luminosity of AC-PDP, the study of electro-optical discharge phenomenon is very important. There are 4 main driving periods in AC-PDP. They are the reset, address (writing), sustain and erasing period between them sustain period take the responsibility for luminosity and efficiency [1][2].

The space charge during a plasma cell discharge plays a very important role in AC-Plasma display panel. When discharge was occurred in a cell, space charge is rapidly increased. However, a plasma discharge cell was not perfectly an enclosed structure. So, a little amount of space charge could be transported to the neighbor cells through the gap between front panel and barrier ribs. The transported space charge has a possibility to makes a crosstalk of mis-discharge in a neighbor cell. We have investigated the transported space charge between sub-pixels in AC-plasma discharge cell. For the measurement of the transported electrons, the detecting pulse method[3] has been used in this experiment.

1-2. Experimental Configurations

The transition of space charge between sub-pixels during sustain discharge has been experimentally tested in an AC-Plasma display panel(PDP) with a versatile driving simulator(VDS) system, in which arbitrary driving waveforms and sequences can be used [3]. 4 inch test panel with VGA class has been used in this experiment. A MgO protective layer is deposited over the dielectric layer by an electron-beam evaporation method with 0.5 ㎛ thickness. The electrode width and cell pitch are kept at 300 and 1080 ㎛. The reset discharge in AC-PDP occurs between the parallel sustaining electrodes of X and Y, which are separated by 90 ㎛. On the rear glass, the address electrodes of 70 ㎛ in width and barrier rib of 130 ㎛ in height are located perpendicular to the two sustaining X-Y electrodes. The filling gas is a mixture of Ne(96%) and Xe(4%), and the total pressure is maintained at 350 Torr. And the electro-optical signal

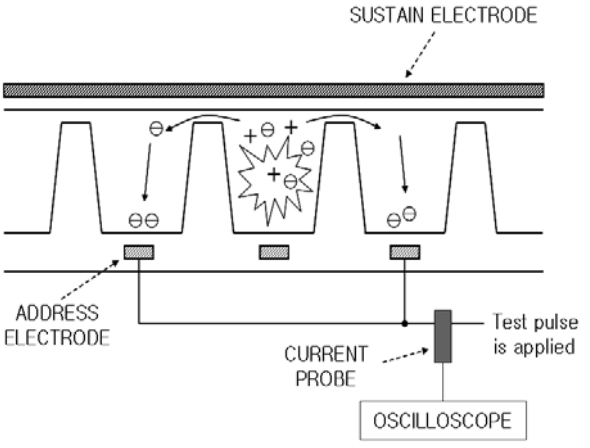

Figure 1. Transport of space charge between sub-pixels

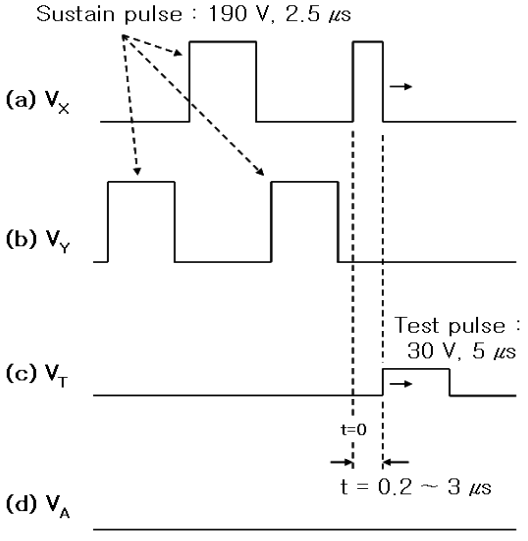

Figure 2.
(a) Sustain voltage (applied to X electrode).
(b) Scan voltage (applied to Y electrode).
(c) Test pulse voltage (applied to address electrode of neighbor pixels of discharge pixels)
(d) Address voltage of discharge sub-pixels

during the discharge has been detected by IR (Infrared) detector, whose detecting wavelength ranges are from 820 to 830 nm. The number of cells used is 133×RGB.

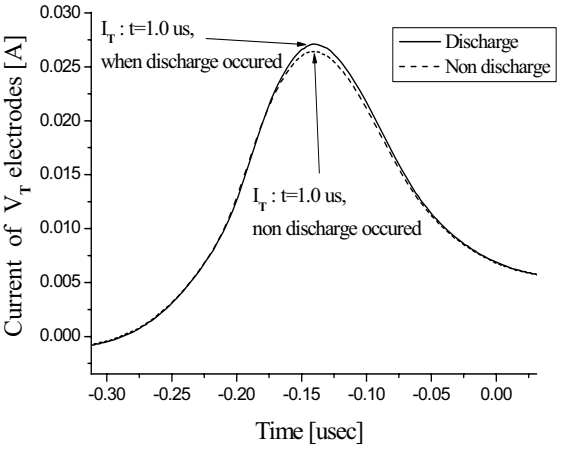

Figure 3. Difference of currents by transported space charge at t = 1.0 μs.

Figure 1 shows the transport of space charge between sub-pixels and the simplified schematic of current sensing along with applied test pulse. As shown in the figure 1, when discharge occurred in a cell, a very small amount of space charge is transported to the neighbor sub-pixels through the gap between front panel and barrier ribs. Transported space charge can be detected by applied test pulse to address electrodes of neighbor cells.

Figure 2 shows the simplified schematic of waveforms applied to sustain, scan and address electrodes in a period of sustain discharge time. The sustain pulse of 190 V, 2.5 μs was used in this experiment. Each sustain pulses of X and Y electrodes make discharge alternatively. And the last sustain pulse of the X electrode has various pulse widths(t) of 0.2 to 3 μs for the temporal effect of space charge. Then, subsequent test pulse was also followed after the last sustain pulse.

2. Results

Figure 3 shows the currents at test pulse with(line) and without(dotted line) discharge with sustain pulse width t of 1.0 μs. The test pulse current at neighborhood address sub-pixel with discharge is denoted by line in figure 3. The dotted line is the address current of neighbor sub-pixel when discharge was not occurred in sub-pixels. It is noted that the

difference of currents is apparently observed. The difference of peak current values is about 0.6 mA.

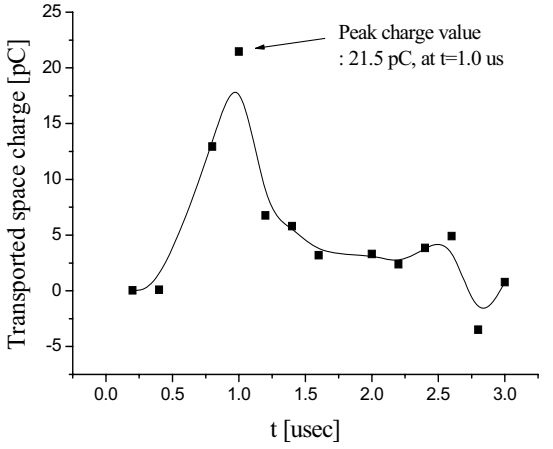

Figure 4. Transported space charge between sub-pixels versus the last sustain pulse width of 0.2 to 3 μs.

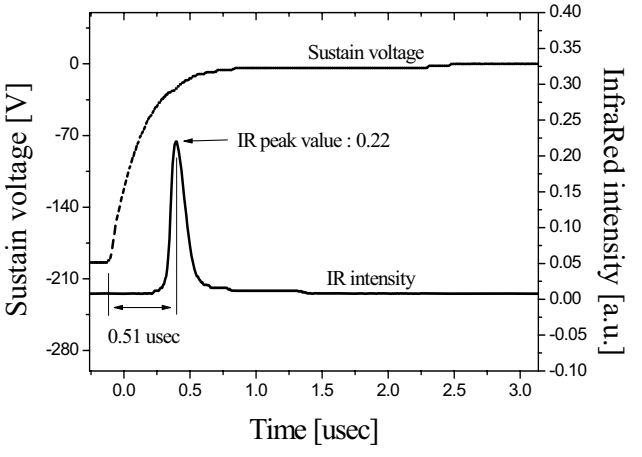

Figure 5. IR emission when sustain discharge is occurred.

Figure 4 shows the transported space charge, which has been obtained by integrating the difference of the current in the figure 3 by time, between sub-pixels in accordance with the various last sustain pulse width t(time gap between the rising edges of sustain and test pulses) of 0.2 to 3 μs. It was observed that transported space charge increased in a time of 0.2 to 1.0 μs. And the peak value has been shown to be 21.5pC at 1.0 μs. In the last sustain pulse width of 1.0 to 3.0, it was shown that transported space charge was been decreased, generally.

Figure 5 shows IR emission when sustain discharge is occurred. IR peak value have been occurred at 0.51 μs from the rising edge of sustain pulse. At the point of this time, not only IR emission but also space charge in a discharge cell has peak value. The maximum charge transport of space charge has been occurred at last sustain pulse width of 1.0 μs from rising edge of sustain pulse as shown in the figure 4.

3. Conclusion

The transported space charge between sub-pixels in AC-plasma discharge cell has been investigated in this experiment. Test pulse of 30 V, 5 μs was applied to the address electrodes of neighbor cells of the cells occurred discharge for detecting the difference of currents by transported space charge. The results show The maximum charge transport of space charge has been occurred at last sustain pulse width of 1.0 μs from rising edge of sustain pulse as shown in the figure 4 in this experiment.

4. Acknowledgements

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5. References

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