ICCD Observation on Discharge Characteristics of 42-in. AC Plasma Display Panel Fabricated by Vacuum Sealing Method

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Abstract

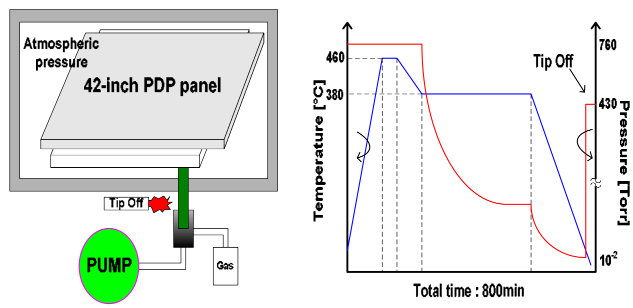
The vacuum sealing method is adopted to minimize the residual impurity gas by enhancing a base vacuum level, and the resultant changes in the reset, address, and sustain discharge characteristics, such as a firing voltage, IR emission, and ICCD image, were examined in comparison with the conventional sealing method in the 42-in. AC-PDP. In the PDP cells fabricated by the vacuum sealing method, the ICCD observation illustrates that the discharge is initiated and extinguished very fast and its IR emission intensity is high.

1. Introduction

It is well-known that if the base vacuum level before filling a discharge gas is higher, the reset, address and sustain discharge characteristics can be improved [1, 2, 3, 4, 5]. In a typical 42-in. conventional AC-PDP with a box-type barrier rib, the base vacuum level at a center region and a region located far away from the glass tip in 42-in. panel was obtained by 10^{-2} Torr.

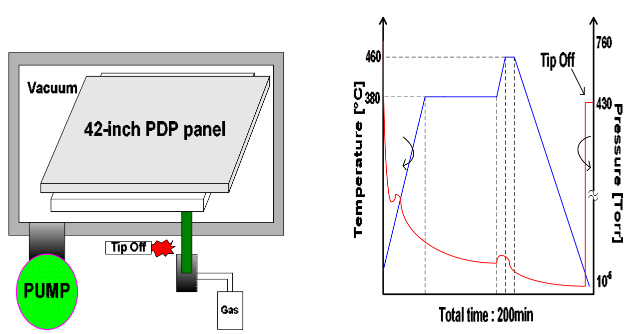
In this study, to improve a base vacuum level, the vacuum sealing method is adapted. In a vacuum sealing method, the front and rear glasses are sealed under a high vacuum chamber. The base vacuum level in a 42-in. panel with a box type barrier rib can be obtained by about 10^{-5} Torr by using the vacuum sealing method. The resultant changes in the reset, address, and sustain discharge characteristics, such as a firing voltage, IR emission, and ICCD image, were examined in comparison with the conventional sealing method in the 42-in. AC-PDP with a high Xe (11 %) content and a box-type barrier.

2. Experimental setup



(a) (b)

Fig. 1. (a) Schematic diagram of conventional sealing process, and (b) sealing temperature and corresponding pressure profile during convent-ional ional sealing process.



(a) (b)

Fig. 2. (a) Schematic diagram of vacuum sealing process, and (b) sealing temperature and corresponding pressure profile during vacuum sealing process.

Figs. 1 (a) and (b) show the (a) schematic diagram and (b) the sealing temperature and pressure of the 42-

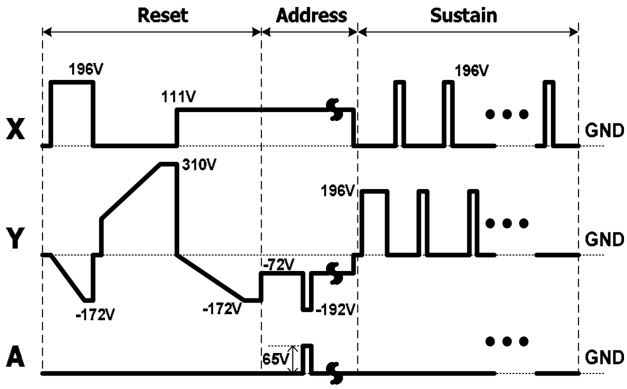


Fig. 3. Schematic diagram of conventional driving waveform used in this study.

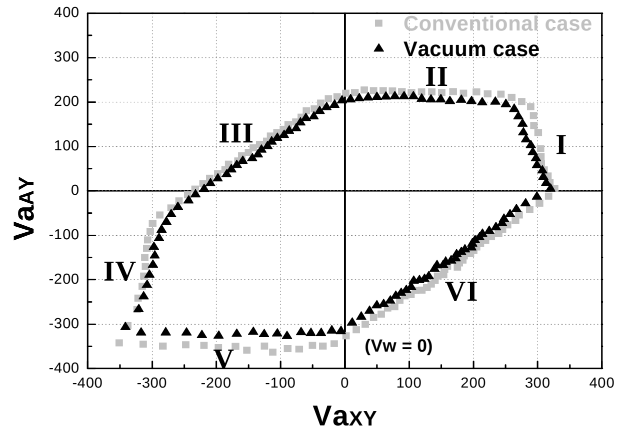


Fig. 4. Comparison of V_t close curves between 42-inch panels fabricated by conventional and vacuum methods without initial wall charges where Ⅰ: V_{tXY} (=Discharge start threshold cell voltage between X and Y), Ⅱ: V_{tAY} (=Discharge start threshold cell voltage between A and Y), Ⅲ: V_{tAX} (=Discharge start threshold cell voltage between A and X), Ⅳ: V_{tYX} (=Discharge start threshold cell voltage between Y and X), Ⅴ: V_{tYA} (=Discharge start threshold cell voltage between Y and A), and Ⅵ: V_{tXA} (=Discharge start threshold cell voltage between X and A).

in. test panel fabricated by the conventional sealing process. As shown in Fig. 1 (b), in the conventional sealing method, the front and rear glasses are sealed under an atmospheric pressure, such that the conventional sealing method has a low vacuum level of about 10^{-2} Torr. Figs. 2 (a) and (b) show the (a) schematic diagram and (b) the sealing temperature and pressure of the 42-in. test panel fabricated by the vacuum sealing process. As shown in Fig. 2 (b), in the vacuum sealing method, the front and rear glasses are sealed under a high vacuum, such that the vacuum sealing method has a high vacuum level of about 10^{-5} Torr. Fig. 3 shows the driving waveforms including the reset, address, sustain periods employed to compare the discharge characteristics of the 42-in. test panels fabricated by two different sealing methods.

3. Results and Discussion

Fig. 4 shows the changes in the V_t close-curves under no initial wall charges in the 42-in. test panels fabricated by two different sealing methods such as the conventional and vacuum sealing methods. As shown in Fig. 4, in the vacuum sealing case, the firing voltages in the sides, I(X-Y), II(A-Y), III(A-X), and IV(Y-X), that is, the firing voltages under the MgO cathode condition, were decreased remarkably, whereas the firing voltages in the sides, V(Y-A) and VI(X-A), that is, the firing voltages under the phosphor cathode condition, were also decreased remarkably. The variations in the firing voltages measured under the MgO or phosphor cathode conditions from the test panels are listed in Table 1.

Figs. 5, 6, and 7 show the changes in the IR (828 nm) emissions in the 42-in. panels fabricated by two different sealing methods such as the conventional and vacuum sealing methods when applying the conventional driving waveform during a reset, address, and sustain period. In the 42-in. panel fabricated by the vacuum sealing method, the IR peaks in the reset, address, and sustain periods were observed to be shifted to the left and intensified compared to the conventional sealing method at the same voltage. This result indicated that the reset, address, and sustain discharge were efficiently initiated at a lower starting discharge voltage during the reset, address, and sustain periods. Fig. 8 (a) shows the electrode structure with patterned ITO-type employed to

Table.1. Firing voltages measured from test panels fabricated by conventional and vacuum sealing methods.

Region		Firing voltage	
		Conventional Sealing method	Vacuum Sealing method
MgO Cathode	I	301V	279V
	II	223V	202V
	III	237V	216V
	IV	310V	299V
Phosphor Cathode	V	350V	322V
	VI	343V	317V

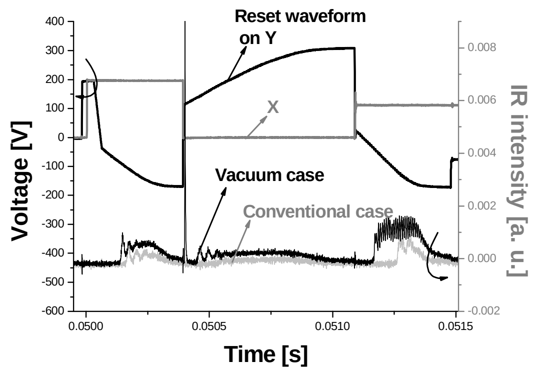


Fig. 5. Comparison of IR (828nm) emissions in 42-in. test panels fabricated by conventional and vacuum sealing methods during reset period.

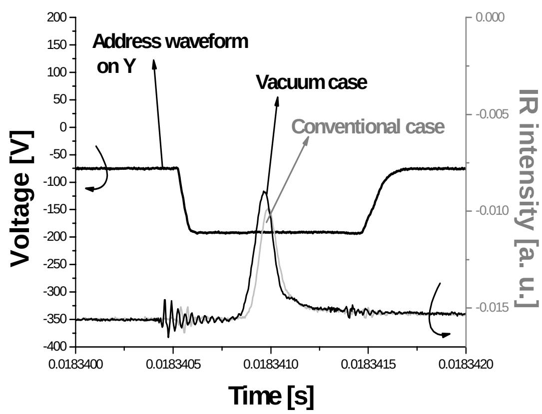


Fig. 6. Comparison of IR (828nm) emissions in 42-in. test panels fabricated by conventional and vacuum sealing methods during address period.

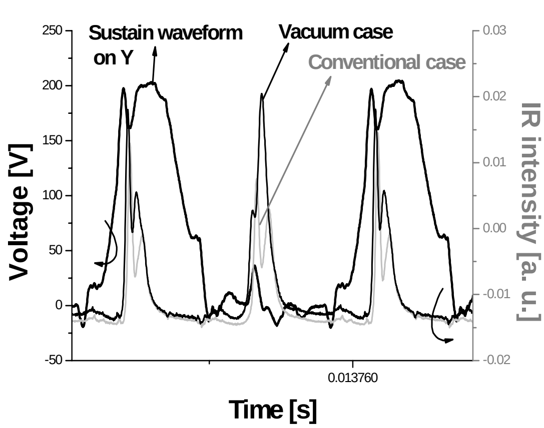


Fig. 7. Comparison of IR (828nm) emissions in 42-in. test panels fabricated by conventional and vacuum sealing methods during sustain period.

compare the discharge characteristics of the 42-in. test panels fabricated by two different sealing methods.

Figs. 8 (b) and (c) illustrate the IR emission images in the 42-in. panels fabricated by two different sealing methods such as the (b) conventional and (c) vacuum sealing methods using the focus mode of the image-intensified charge-coupled device (ICCD). It was observed that for the vacuum sealing method, the discharge was intensified during the sustain period compared to that of the conventional sealing method.

Figs. 9 (a) and (b) illustrate the temporal behavior of the IR emission images in the 42-in. panels fabricated by two different sealing methods such as the (a) conventional and (b) vacuum sealing methods using the gate mode of the ICCD. It was observed that the trigger discharge in the vacuum sealing method was initiated fast and intensified compared to that of the conventional sealing method during the sustain period.

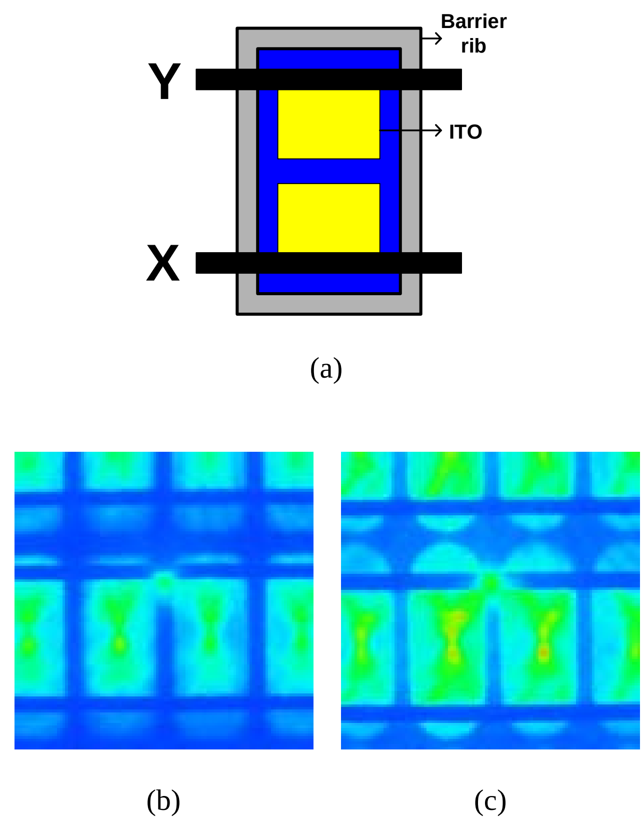
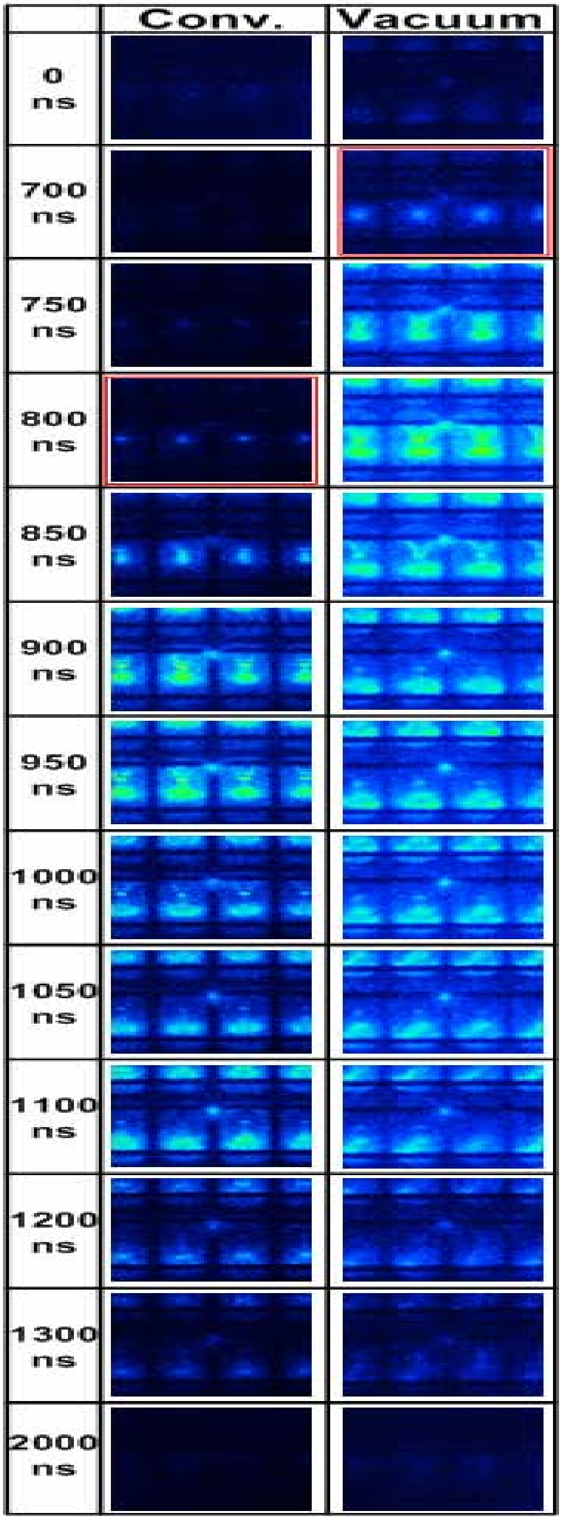


Fig. 8. (a) Schematic diagram of electrode structure with patterned ITO-type, and IR emission profiles during sustain discharge using focus mode of ICCD in 42-in. panels fabricated by (b) conventional and (c) vacuum sealing methods.



(a) (b)

Fig. 9. Comparison of temporal behavior of IR emission during sustain discharge using gate mode of ICCD in 42-in. panels fabricated by (a) conventional and (b) vacuum sealing methods.

In conclusion, the high base vacuum level in the 42-in. panel fabricated by the vacuum sealing method can enhance the discharge characteristics, such as a firing voltage, IR emission, and ICCD images, which are caused by a decrease in the residual impurity gases. It is expected that this experimental result can contribute to improving the discharge characteristics of the PDP-TV.

4. Summary

The changes in the reset, address, and sustain discharge characteristics, such as a firing voltage, IR emission, and ICCD image, in the vacuum sealing method, were examined in comparison with the conventional sealing method in the 42-in. AC-PDP. The high base vacuum level in the 42-in. panel fabricated by the vacuum sealing method can enhance the discharge characteristics, such as a firing voltage, IR emission, and ICCD image, which are caused by a decrease in the residual impurity gases. It is expected that this experimental result can contribute to improving the discharge characteristics of the PDP-TV.

5. References

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