A Study of the Discharge Characteristics of PDP having Auxiliary Electrodes with High Xe% Working Gas

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Abstract

We propose new driving schemes, asymmetry and long gap mode, of PDP having auxiliary electrode between scan and common electrode. For the asymmetric modes, the auxiliary electrode located nearly center of the primary electrodes is connected to the scan or common electrode during all periods of reset, address and sustain. For the long gap mode, it is electrically disconnected or maintained at dc voltage of Vs/2 during sustain period except the first several sustain pulses. The proposed structure and driving method can provide higher luminous efficacy by minimizing consumption energy. The effectiveness of the new driving schemes has been investigated for various Xe partial pressure conditions.

1. Introduction

AC-PDP is becoming one of the major devices of large flat panel industry. It has outstanding display performances such as excellent moving picture image quality, good color expression power, high contrast and high peak luminance. In spite of the fact that luminous efficacy is greatly improved recently, it is still necessary to reduce power consumption. There have been many efforts to develop high-efficacy PDP by optimization of the cell structure and mixture ratio of working gas. Many researchers have conducted about various driving methods and electrode shapes to improve the luminous efficacy. [1~4] The achievement of very high luminous efficacy using auxiliary electrode has been reported recently. [5] However, it requires additional auxiliary pulse train between primary pulses, which makes it difficult to apply in high frequency sustain driving and induces additional cost increment. With this background, we propose simple, cost effective and high efficacy driving method suitable for PDP with auxiliary electrodes.

2. Panel Structure

Fig. 1 (a) is the reference structure used in this experiment. The gap between Y and Z electrode is 60 um. This gap where the discharge is ignited is called as the ignition gap in this paper. The ITO width of Y, Z electrodes is equally 270um. Fig.1 (b) is the suggested structure used in this experiment. This structure has 170um discharge gap between Y and Z electrode called the main electrodes. This electrode is designed to provide main discharge during sustain period. An auxiliary electrode having quite narrow width of 30um is located between the main electrodes. The roles of the auxiliary electrode are reducing the driving voltages and enhancing driving margin of long gap discharge. The ignition gap (Auxiliary-Z) is 60 um, which is the same as that of the reference structure.

Sub-pixel size used in the experiments is 676× 300μm which correspond to the 42-inch PDP with XGA resolution. The rear panel is same as conventional panel structure. The barrier ribs are patterned upon the stripe shape. The space of barrier ribs is filled with green phosphors. Table.1 is the detailed specification of the reference and the suggested structure. [6 ~ 8]

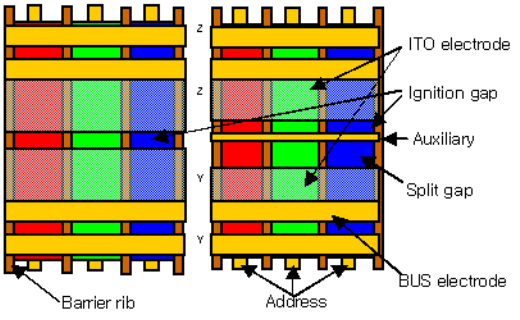

Fig. 1 the panel structure of a reference and the suggested structure having auxiliary electrodes

Table.1 The specification of a reference and a suggested structure.

working gas : Ne(base) + Xe 8, 12 and 15%			
Structure		reference	Suggested
Front	BUS electrode width	90um	90um
	ITO electrode width (Y / Z)	270/270um	230/200um
	Auxiliary electrode width (Y')		30um
	Y-auxiliary electrode gap		60um
	Main electrode gap	60um	170um
	Dielecrtics thickness	30um	30um
	MgO thickness	5000Å	5000Å
Rear	A(address) electrode width	100um	100um
	Barrier rib width/thickness	60/125um	60/125um
	phosphor thickness	30um	30um
	White-back thickness	20um	20um

3. Experimental Set-up

Fig. 2 shows the schematic diagram of test equipment used for driving and measurement. It is composed of signal generator, driving circuit, and oscilloscope.

The measurements of voltage waveform and current were carried out with a digital storage oscilloscope and a current probe. And the luminance of the samples is detected by the luminance colorimeter.(BM-7, Topcon Co.)

We measured the firing voltage, static margin, luminance, luminous efficacy and the current waveforms of the samples having auxiliary electrodes and compared with those of the reference cell.

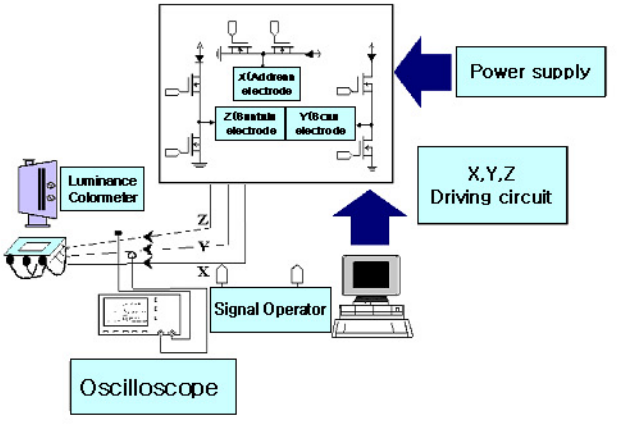

Fig. 2 shows the schematic diagram of test equipment

Fig 3 is the suggested driving schemes. Fig.3 (a) is gate driving signal for the asymmetric driving. In this mode of operation, the same shape of sustain pulses is applies to both Y and auxiliary electrodes. Y and auxiliary electrodes are electrically connected. And opposite sustain pulses are applied to the Z electrode. Two kinds of sustain pulses are operated at 10 kHz. Essentially, it is the same sustain driving with the conventional method.

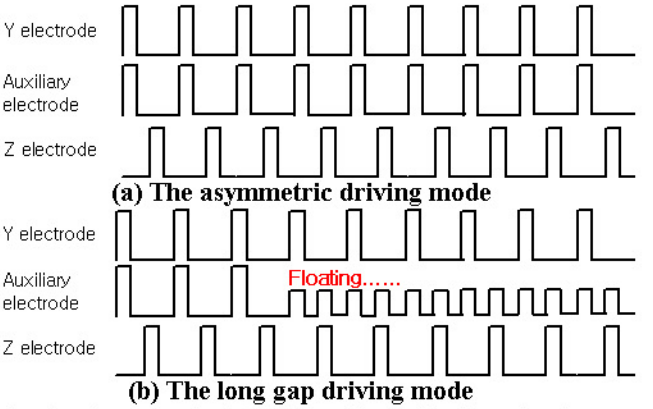

Fig. 3 The suggested driving scheme for the structure having auxiliary electrodes.

Fig. 3 (b) is for long gap mode. The center electrodes are electrically disconnected (or maintained at Vs/2) after the priming particles are well established by the several asymmetric driving pulses. Since the center electrode drives negligible current almost all discharge current is driven by two main electrodes. This mode resembles long gap discharge schemes. It has lower driving voltage than conventional long gap discharge and expected to consume lower energy than the asymmetric driving method.

4. Result and Discussions

4-1. Asymmetric Mode Driving

Fig. 4 shows the static margin characteristics. The structure having auxiliary electrode has almost the same firing and sustain voltage with a reference structure for 8% Xe panel. For Xe 12 and 15% panel, firing voltage and sustain voltage are a little higher than that of the reference structure, but the range of static margin is almost of the same with the reference structure. Though the structure having auxiliary electrodes has relatively the long length between two main electrodes, the increment of the firing and the sustain voltage is not so high, which suggest that the auxiliary electrode plays an important role for initiating discharge

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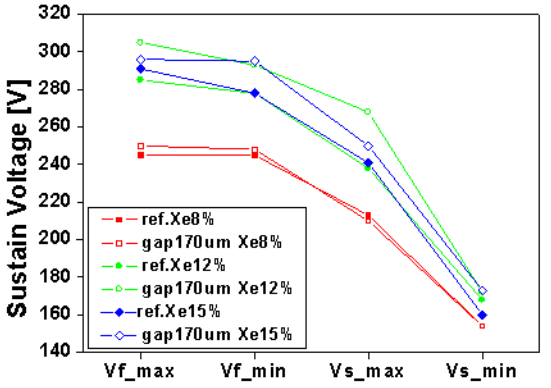

Fig. 4 The static margin characteristics

Fig.5 shows variations of luminance as a function of sustain voltages within a static margin. Luminance characteristics do not show clear tendency. For Xe 8% panels, the luminance of the structure having auxiliary electrodes is about 200 cd / m^2 higher than that of the reference structure at 230V. Under Xe 12%, it has about 150 cd / m^2 lower luminance at 260V. For the panel with Xe 15%, luminance difference is negligible. All these variations are within the experimental uncertainties.

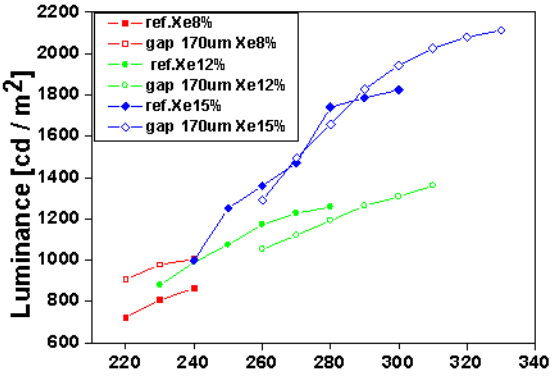

Fig. 5 The luminance characteristics

Fig. 6 shows power consumption characteristics at various sustain voltage and Xe percentage. The power consumption per one period of the suggested structure with Xe 8% shows lower value by 15.4 % than the reference structure at 230V. In 12, 15% Xe panels, power consumption is decreased by about 30%.

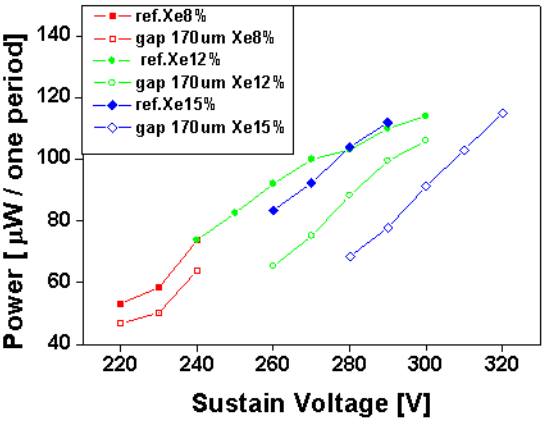

Fig. 6 The consumption Power

The luminous efficacy of the suggested structure is improved by about 50 % as shown in fig.7.

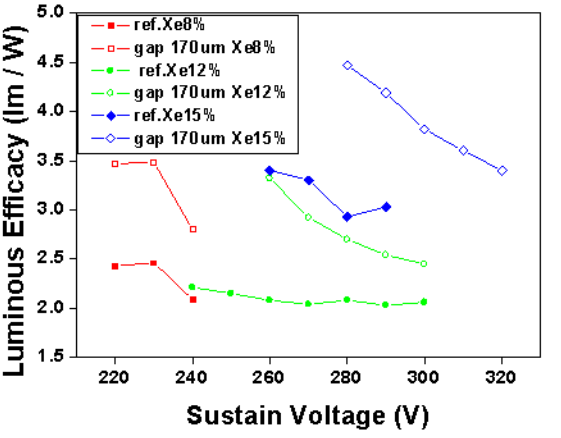

Fig. 7 The luminous efficacy

4.2 Long-gap mode driving

In this experiment, we have used 12% Xe panel. ADS driving scheme, almost same as commercially used one except for sustain period as shown in fig. 3, has been applied. The frequency of one sustain period is 100 kHz. The resulting efficacies of conventional, asymmetric mode and long gap mode are shown in Fig. 8. At 220V, when the suggested structure is driving with an asymmetric mode, the luminous efficacy improves 16% (0.29 lm/W). And when the suggested structure is driving with long gap mode, the luminous efficacy improves 26% (0.45 lm/W) as compared with the reference structure.

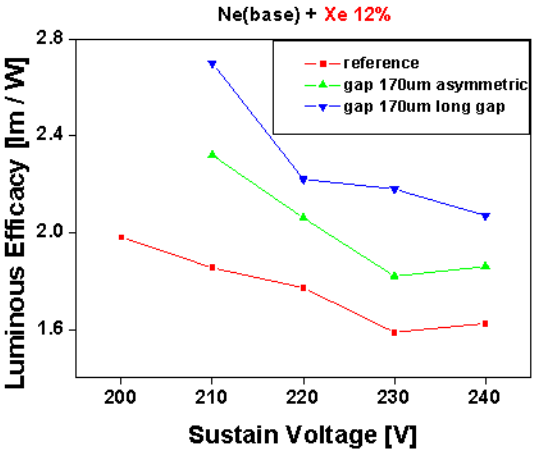

Fig. 8 The luminous efficacy of the structure having auxiliary electrode using suggested driving scheme

5. Summary

A new electrode structure and driving scheme is suggested in order to improve the luminous efficacy of AC PDP. For the suggested structure with simple consecutive sustain pulse driving, the luminance is almost the same as that of the reference structure and luminous efficacy is improved by about 50% compared with the reference structure.

When ADS driving is applied, efficacy is improved by16 % for the asymmetric mode and by 26 % for the long gap mode.

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