8-2 A 15-in.-Diagonal Color Surface Discharge AC-Plasma Display Panel

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ABSTRACT

A 15-inch diagonal surface discharge color AC-PDP with three electrodes, i.e. two display electrodes and an address electrode, is fabricated. The display capacity is 320x200 pixels. Areal luminance is 24 cd/m2 (white). Ne+Ar+Xe gas is also investigated.

INTRODUCTION

AC-Plasma display is a high quality display which has several features of luminous type, wide viewing angle, high contrast, and high response time. Fujitsu succeeded in reducing cost due to development of high-voltage LSI and mass producing. The 9-18 inch monochrome (ne-orange) AC-PDPs have already been put into OA and FA markets and been spreading rapidly and color PDP is remained as a next problem to be solved. Also color plasma display is expected as a device realizing a large size wall hanging TV, and is made progress in research and development for the realization of these requirements.(1),(2),(3),(4)

Fujitsu has been developing surface discharge type color plasma display which has good features ,ie. memory function, high luminous efficiency, long and stable operation.

The authors fabricated a 8-inch diagonal three color panel , and made a 15-inch diagonal eight color panel on an experimental basis. In the 8-inch color PDP, 320x120 pixels with 0.6x0.8 mm pixel pich is realized. Red and green phosphors are arranged alternately vertical direction with 0.4 mm pich. In the 15-inch color panel, 320x200 pixels with 1.0 mm pixel pich is realized. Red, blue and green phosphors are arranged 0.5 mm pich. We also investigated Ne+Ar+Xe penning gas as a filling gas to improve luminance, luminous efficiency and operating life.

PANEL STRUCTURE

Figure 1 shows the panel structure of surface discharge PDP. The group of the pair of sustaining electrodes

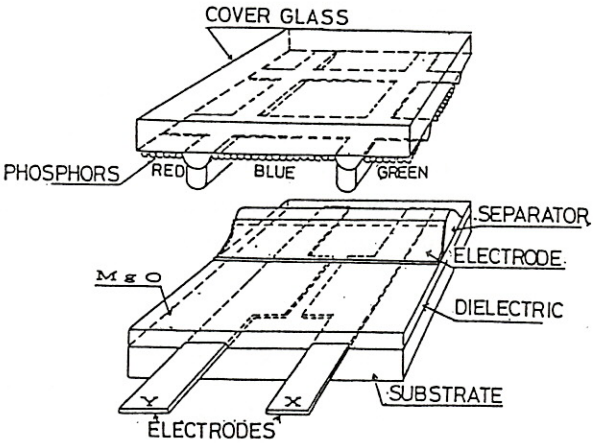
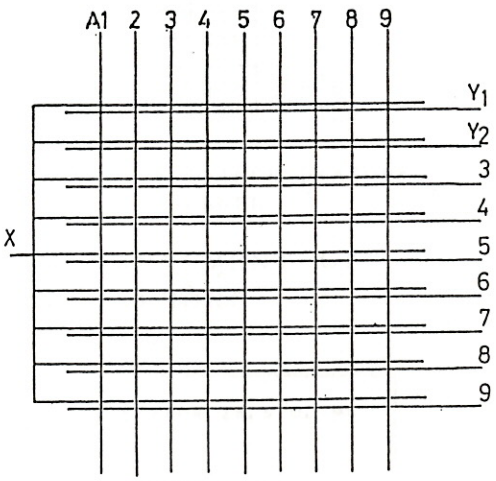


Fig. 1 PANEL STRUCTURE



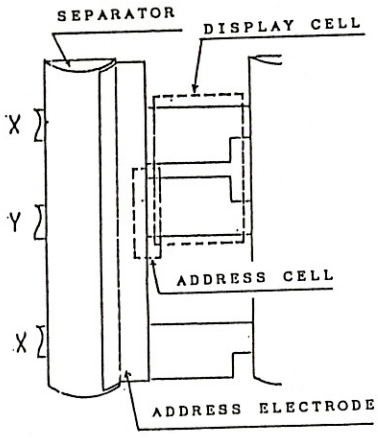
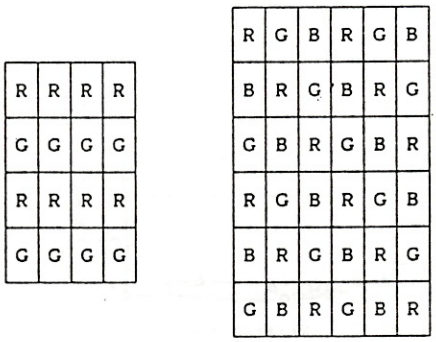


Fig. 2 CONNECTION OF ELECTRODE AND TOP VIEW

(X,Y) which are parallel to each other is constructed on a glass substrate. These sustaining electrodes are covered by the dielectric layer. On the dielectric layer the rib is constructed to be perpendicular to sustaining electrodes. These ribs are useful to cut the coupling of adjacent display cells. On the one side of the rib address electrode is constructed. These electrodes and dielectric layer are covered by MgO protecting layer. Phosphor is formed on the cover glass. Between phosphors corresponding to pixels the rib is formed to prevent the optical crosstalk due to leak of ultra-violet come from discharge. They are constructed by thick film printing. Material of phosphor is $(Y.Gd)BO_3$:Eu for red, $BaMgAl_{14}O_{23}$:Eu for blue, and Zn_2SiO_4:Mn for green. Gap between the substrate for electrodes and that for phosphor is about 100 um. In this space Ne+Ar+Xe penning gas is filled. Figure 2 shows top view of the substrate for electrode. We defined the cross region of X sustaining electrode and writing electrode as an address cell and defined the facing region of X and Y sustaining electrodes as a display cell. And also figure 2 indicates principle of the connection of electrode. X display electrode can be unified and address electrode and Y display electrode are connected each. The fabricated PDP is composed of 320 cells by column and 240 cells by row. Phosphors are arranged vertically with alternation of red and green. Thus the number of display pixels is 320 by column and 120 by row. The size of display cell is 0.6 mm horizontally and 0.8 mm vertically. The 15-inch PDP has 640 cells by column and 400 cells by row. Two types of composition of display pixel are investigated. Figure 3 shows arrangement of phosphor for the 8-inch and the 15-inch panels each other.

INVESTIGATION OF FILLING GAS

To improve luminous efficiency, brightness, and life, Ne+Xe+Ar mixture gas is investigated. In the case of He+Xe penning gas although the luminous efficiency is improved as rise of the Xe mixture concentration the driving voltage becomes higher as rise of Xe mixture concentration so that one faces the driving problem. The authors consider to improve the luminous efficiency while suppressing the rise of firing voltage as low as possible. Thus we investigated to improve luminous efficiency based on Ne+Xe penning gas. As well known Ne+Xe penning gas is adopted for usual PDPs and emits neon-orange color, however, the driving voltage is about 30 volts lower than He +Xe penning gas. Therefore we examined to introduce the third gas (Ar gas) to Ne+Xe penning gas to eliminate visible light. Figure 4 shows the relation between chromaticity of green color and Ne concentration on the Ne + Ar + Xe(0.3%) system. This indicates that when Ar gas is introduced more than 20 %, visible light from Ne is eliminated. Figure 5 shows the



a) 8 INCH DIAGONAL PANEL b) 15 INCH DIAGONAL PANEL

Fig. 3 ARRANGEMENT OF PHOSPHORS

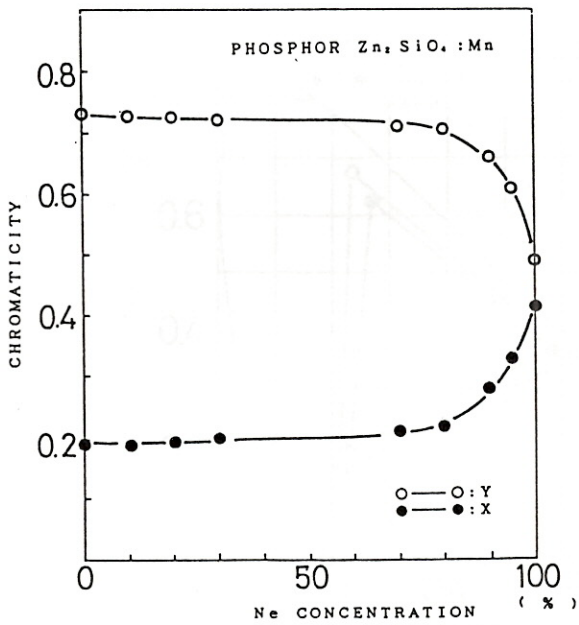


Fig. 4 RELATION BETWEEN CHROMATICITY AND Ne CONCENTRATION

dependencies of efficiency of green, luminance, firing voltage, and minimum sustaining voltage on Ne concentration. Luminance, firing voltage, and sustaining voltage decrease with decreasing Ar concentration. Luminous efficiency has maximum value at the 20% Ar concentration. In the case of Ne+Ar+Xe penning gas we confirmed about twice up in the efficiency compared to the case of He+Xe penning gas and we obtained 0.4 lm/W with white color. And also we observed that life is related to filling gas. Figure 6 indicates the comparison of life for the case of Ne+Ar+Xe penning gas to that for the case of He+Xe penning gas. The life time of the Ne+Ar+Xe penning gas is about ten times longer than that of He+Xe penning gas.

CHARACTERISTICS

The surface discharge color PDP is the display system using luminance of phosphor as mentioned above. Luminous color is changed by using different phosphor and chromaticity of each phosphor is very good as indicated in figure 7. However if the color panel has the open cell structure like as usual AC-PDP, non-lit cell emits slightly due to ultra-violet come from adjacent lit cell. This deteriorates display quality. To eliminate the cross talk, we constructed the rib between adjacent phosphor and obtained the chromaticity as shown in figure 7. Table 1 shows the characteristics of the 8-inch and the 15-inch panel. Fig.8 shows sample display of 15 inch color plasma display panel.

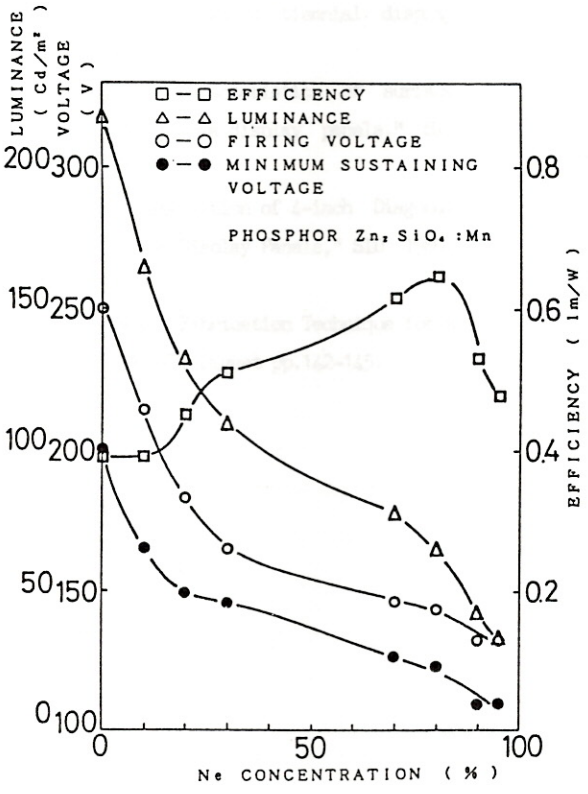


Fig. 5 RELATION BETWEEN EFFICIENCY AND Ne CONCENTRATION

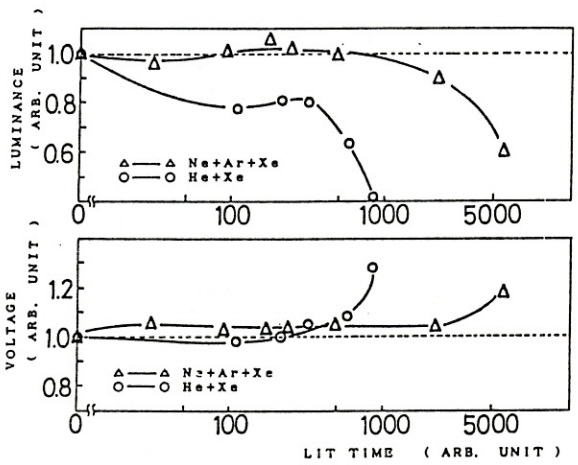


Fig. 6 RELATION BETWEEN LIFE AND FILLING GAS

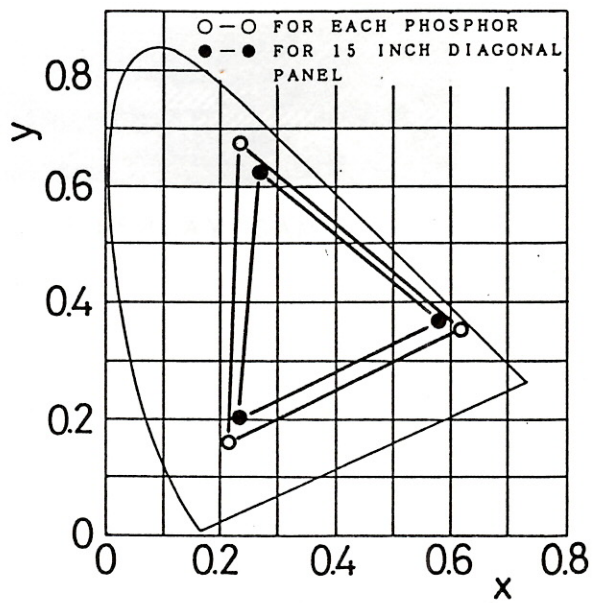


Fig. 7 CHROMATICITY

CONCLUSION

We fabricated 8-inch panel which has 320x240 cells (320x120 display pixels) and 15-inch experimental panel which has 640 x 400 cells (320 x 200 display pixels) by the surface discharge PDP with three electrodes which includes the electrode used for display only and address electrode. Display colors are three colors of red, green, and yellow for 8-inch panel and are 8 colors mixed with three primary colors of red ,green , and blue for 15-inch panel. The cell pitch is 0.5 mm. (the display pixel pitch is 1.0 mm.) Although this size makes sufficient resolution for larger display, the realization of higher resolution is necessary for OA terminal use. In future it is necessary to make higher resolution by improving the fabrication technique of phosphor and rib, also it is necessary to grow larger capacity and to obtain higher luminance.

REFERENCES

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TABLE1 CHRACTERISTICS OF PANELS

DISPLAY SIZE		8INCH DIAGONAL	15INCH DIAGONAL
NUMBER OF PIXELS (ROW AND COLUMN)		240×320 (120×320 DISPLAY PIXELS)	400×640 (200×320 DISPLAY PIXELS)
PITCH (VERTICAL AND HORIZONTAL)	CELL	0.4×0.6mm	0.5×0.5mm
	DISPLAY PIXEL	0.8×0.6mm	1.0×1.0mm
DISPLAY COLORS		APPLICATION OF RED AND GREEN 3 COLORS DISPLAY (RED・GREEN ・YELLOW)	APPLICATION OF RED , GREEN AND BLUE 8 COLORS DISPLAY
AREA BRIGHTNESS		42Cd/m² (YELLOW)	24Cd/m² (White)
PEAK BRIGHTNESS		77Cd/m² (RED) 170Cd/m² (GREEN)	41Cd/m² (RED) 19Cd/m² (BLUE) 91Cd/m² (GREEN)
SUSTAIN VOLTAGE		140V	140V

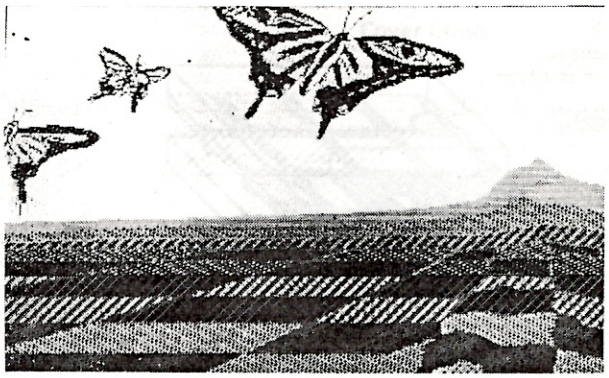

Fig. 8 DISPLAY SAMPLE