The Influence of Phosphor Thickness on Electrical and Optical Characteristics of AC PDP

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Abstract

This paper deals with the effect of the thickness of R,G and B phosphor on the electrical and optical characteristics in the reflective type AC PDP. By analyzing various parameters, such as addressing voltage, surface discharge voltage, luminance and luminous efficiency, the optimum value of the phosphor thickness is 50 ㎛ under the condition of 150 ㎛ barrier rib height.

Introduction

The commercial production of PDPs for large area wall-hanging televisions has recently started. However, sufficient luminance and luminous efficiency is still needed. One of the factors affecting on the luminance and efficiency of AC PDP may be the phosphor layer thickness. Since a phosphor itself is a kind of dielectrics, the thicker the phosphor thickness the smaller the discharge space. Therefore, its thickness may affect on the cell discharge characteristics, such as the charge diffusion, the luminous efficiency and the luminance in AC PDP. The charging on phosphor may also affect on the discharge characteristics of AC PDP. In this paper, the effect of the thickness of phosphor layer on the electrical and optical properties in the reflective type AC PDP is investigated.

Panel structure and driving

Fig. 1 shows a panel structure of a surface-discharge-type ac-PDP.[1] Actually primary color phosphors (Red, Green and Blue) are formed in each groove. But we coated only one phosphor per one panel to reduce the influence of the other phosphors. The thickness of this phosphor is varied.

In this study, the ADS (Address-Display-Separation) driving method is adopted.[2] The voltage waveform applied to the three electrodes is shown in Fig. 2.

Table 1 shows experimental conditions.

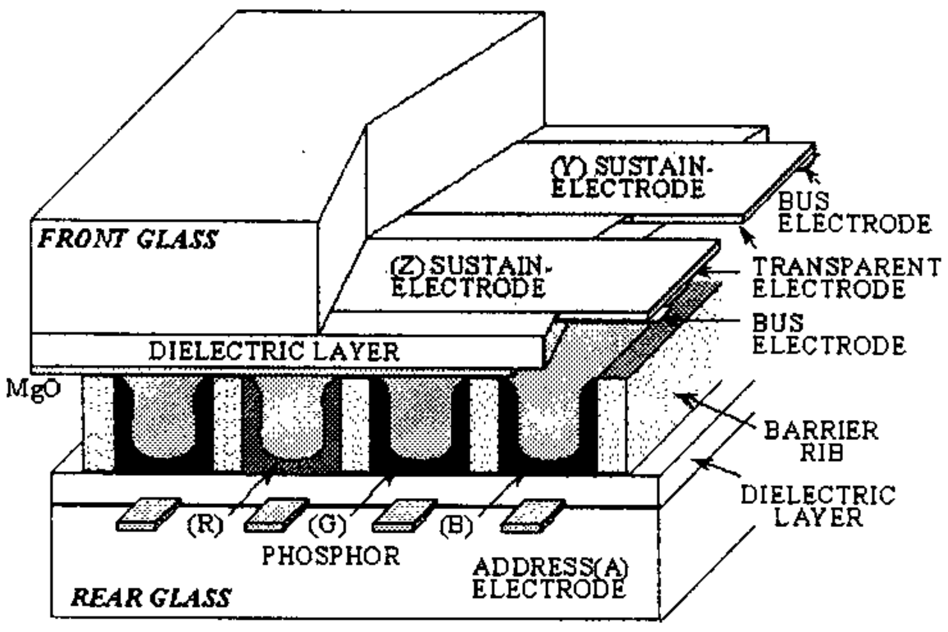

Fig. 1 Panel structure of surface-discharge type ac PDP

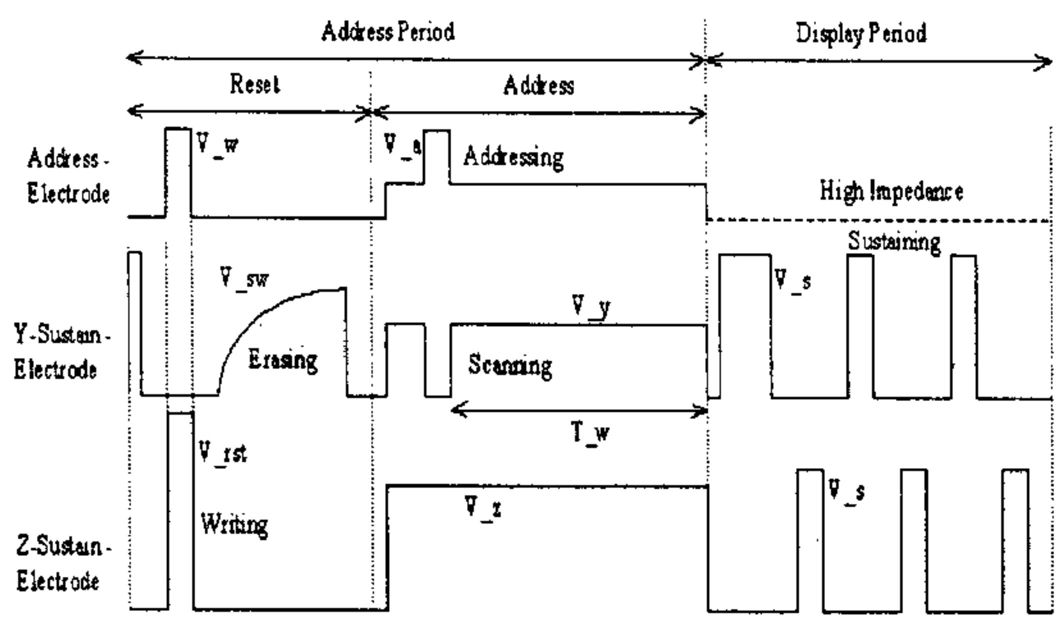

Fig. 2 Applied driving waveform of ADS method

Table 1 Specifications and Performance of the panel

Number of cells		20 × 5
Cell pitch		0.36 ㎜ × 1.08 ㎜
Phosphor	R	$(Y,Gd,Eu)BO_3$
	G	$BaAl_{12}O_{19}:Mn$
	B	$(Ba,Eu)MgAl_{10}O_{17}$
Gas composition		He – Xe(2%) 500Torr
Bus electrode	Width	100 ㎛
Transparent electrode(ITO)	Width	300 ㎛
	Gap	100 ㎛
Barrier Rib	Height	150 ㎛
	Width	80 ㎛
Address- pulse	Width	4 ㎲
Sustain- pulse	Width	5 ㎲
	Freq.	67kHz
	Voltage	210V
Sustain- duty ratio		0.67

Results and discussion

Fig. 3 shows the results of the luminance of phosphors versus the phosphor thickness under the condition of applied voltage 210V and 67kHz. The luminance increased up to 70 ㎛ of the thickness and then it decreased. These results show that the maximum luminance is obtained at the thickness of about 70 ㎛. Above 70 ㎛, the luminance is decreased[3].

Fig. 4 shows the luminous efficiency as a parameter of the phosphor thickness. The luminous efficiency is increased up to 70 ㎛ as like the luminance results. As the phosphor layer thickness increases, the discharge current is decreased as shown in Fig. 5. The efficiency is saturated after the peak value.

Fig. 5 shows the typical steady state current waveform. The discharge current shows that a spark discharge lag becomes longer and a peak current becomes lower as the thickness increases. This result may come from the reduced discharge space.

The charge of the first sustaining current per cell is shown in Fig. 6 as a parameter of the thickness of phosphors. This result shows that the charge decrease with increase in the phosphors thickness.

Fig. 7 shows the variation of addressing voltage with the thickness of phosphors. This result shows that the addressing voltage is different for a kind of phosphors. The addressing voltage increases with the phosphor thickness. It is seen that the addressing voltage sharply increases above 50 ㎛. When the thickness is above 80 ㎛, the addressing voltage was higher than 350V.

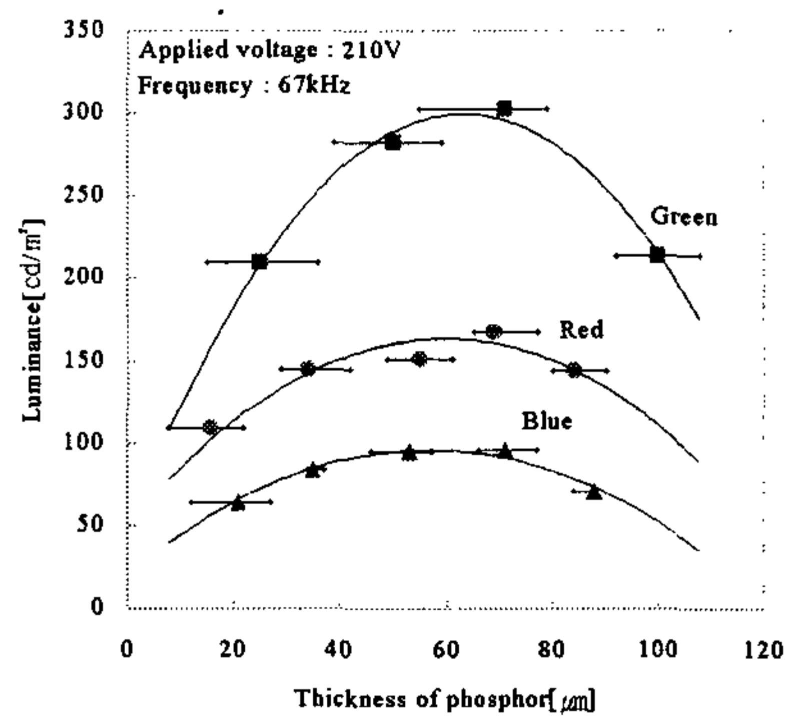

Fig.3 Luminance as a parameter of phosphor thickness

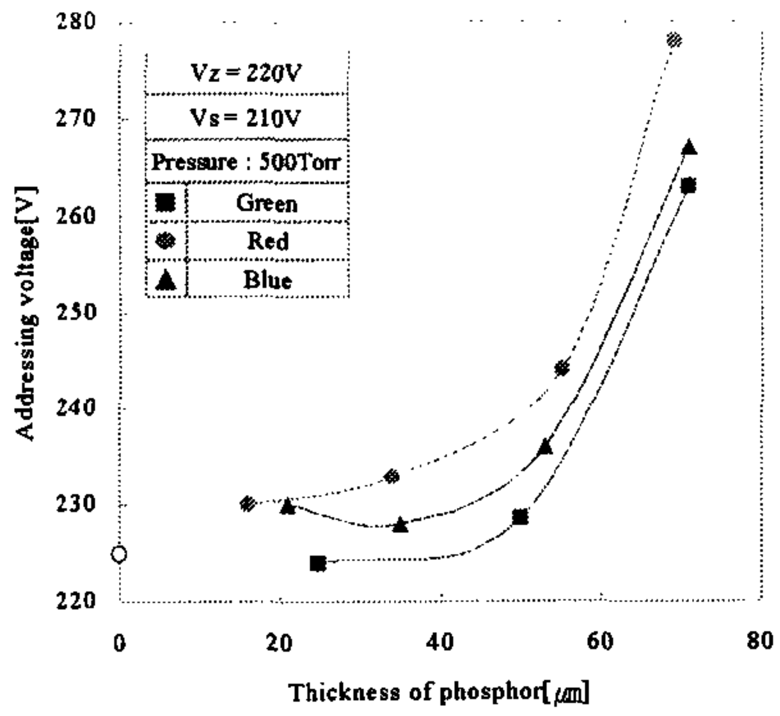

Fig. 7 Addressing voltage as a parameter of phosphor thickness

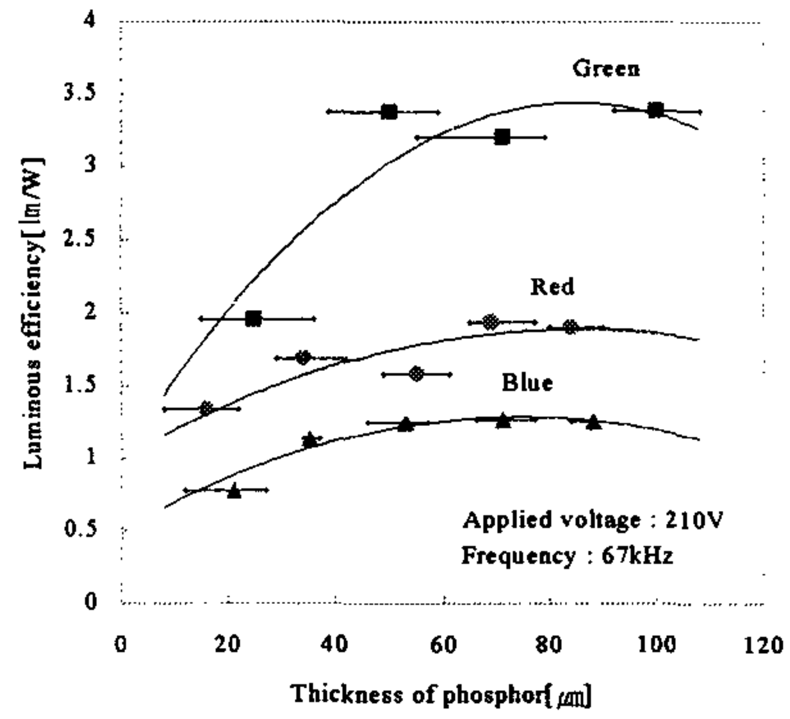

Fig.4 Luminous efficiency as a parameter of phosphor thickness

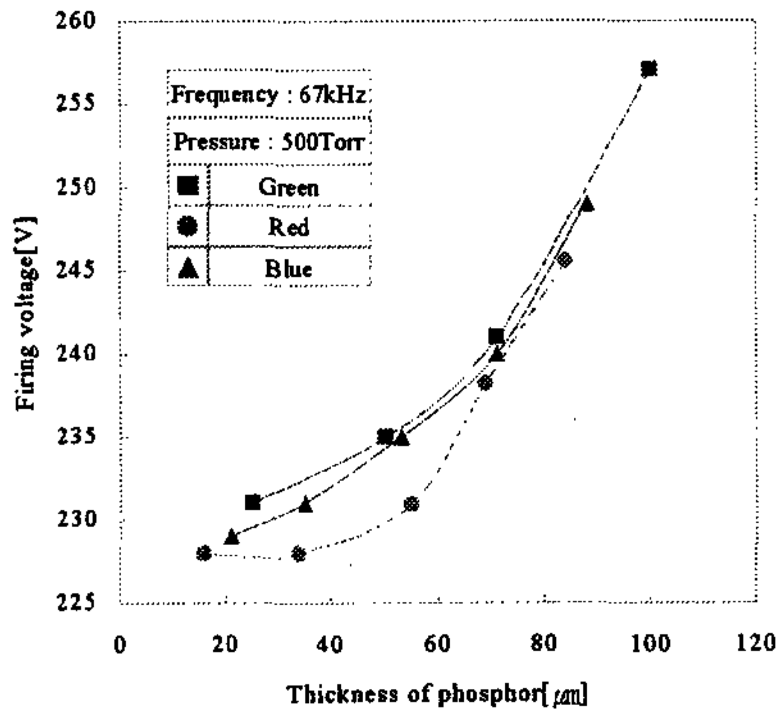

Fig. 8 Firing voltage as a parameter of phosphor thickness

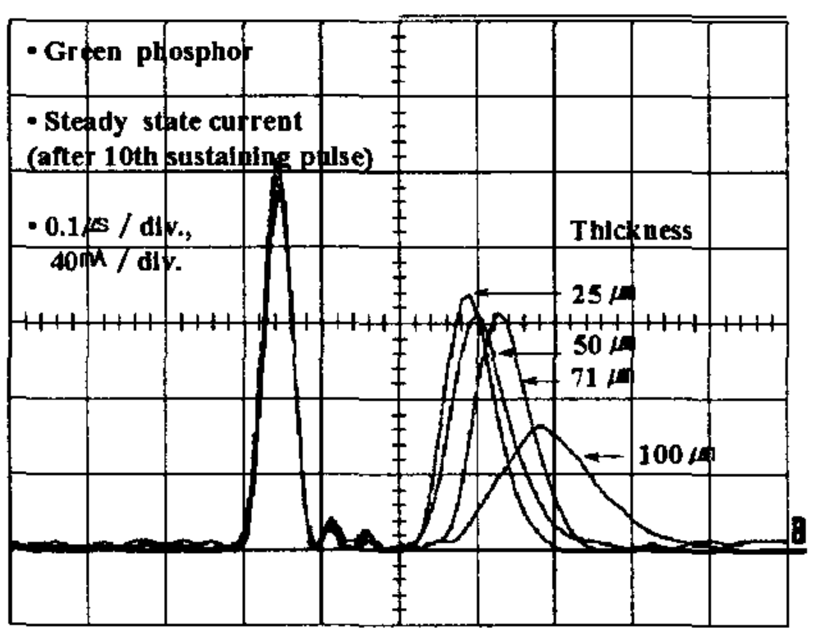

Fig. 5 Steady state current waveform of green phosphor

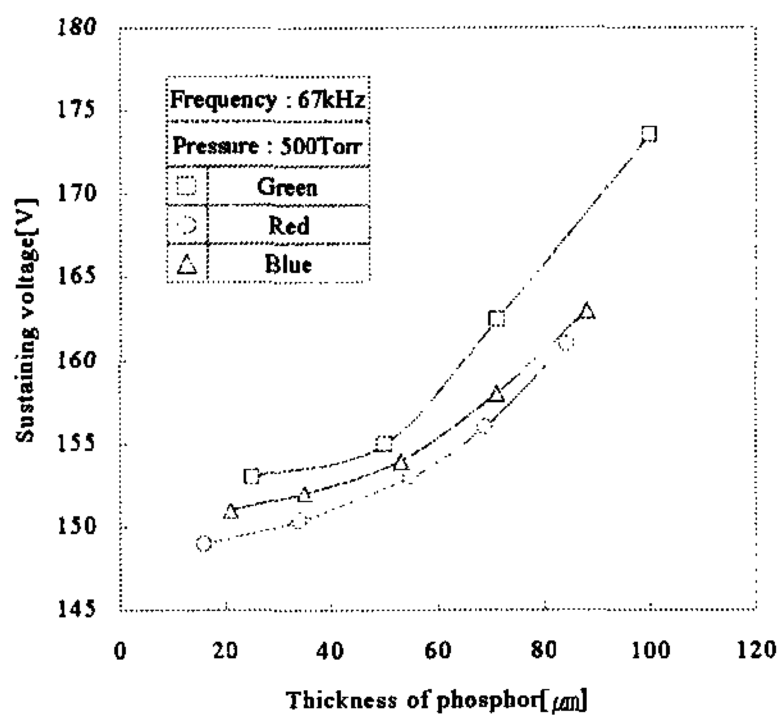

Fig. 9 Sustaining voltage as a parameter of phosphor thickness

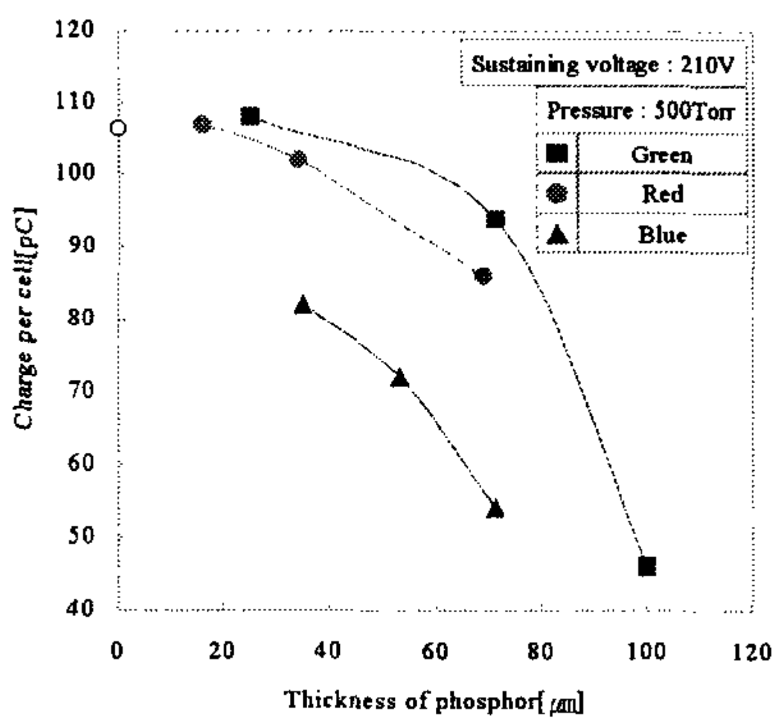

Fig. 6 Relationships between the charge of the first sustaining current and the thickness of phosphors

Fig. 8 and Fig. 9 show the firing voltage and the sustaining voltage between Y and Z electrode as a parameter of the phosphor thickness, respectively. It is seen that the firing and the sustaining voltage increase with the phosphor thickness.

Conclusions

1) The maximum of the luminance and the luminous efficiency is obtained at the phosphor thickness of 70 μm.
2) The spark discharge lag increases and the peak current decreases with increase in the thickness. The blue phosphor shows the longest discharge lag.
3) The addressing voltage sharply increased above 50 μm.
4) The optimum thickness of phosphors is about 50 μm in view point of luminance, efficiency, addressing voltage and discharge lag.

References

[1] N. T. Nguyen, et al., *IDW '96*, p.295-298, 1996
[2] Tsutae Shinoda, *ASIA Display 98*, p1065-1070
[3] H. Uchiike, et al., *SID 90 DIGEST*, p481-484