Studies about Visible Light Distribution in PDP Cells with 3-dimesional Optical Code

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Abstract

In order to improve the accuracy of simulated results, new UV source was designed. Previously the optical simulation was performed with the symmetric planar UV source. To design new UV source, UV distribution from the plasma fluid code was implanted to the 3-dimensional optical code to generate the visible light distribution. The results from planar UV source and new UV source were compared with the ICCD (Intensified CCD) image in real PDP cell and analyzed the variation of geometries and optical properties.

1. Introduction

In a plasma display panel (PDP), a cell structure is changed or designed in order to improve the luminance, luminous efficiency and addressing characteristics [1]. With the same size of panel, as the resolution increases, the cell pitch decreases. If the cell pitch decreases, it is very hard to achieve the high luminance and high efficiency. The detailed studies regarding to the front and rear panel geometries and optical properties of composed layers, such as dielectric layer, ITO (Indium-Tin-Oxide), reflective layer, black matrix and etc. were needed to be performed.

3-dimensional optical code [2] can be used to analyze the emission rays from the phosphors on the rear panel. The emitted rays can be reflected, transmitted or absorbed depending on the properties of confronted layers. The variation of geometries, such as height, shape and slope of the barrier rib, thickness of the front dielectric layer, position of the black matrix, and etc. can be simulated with the optical code. The studies about optical properties of composed layers, such as electrodes, dielectric layers, barrier rib, phosphor and etc., were needed to improve the luminance and luminous efficiency. Previously the optical characteristics in PDP cells were studied with the symmetric planar UV source [3]. But this study used the results from plasma fluid code [4]. The plasma fluid code that utilized the local field approximation and the drift-diffusion model was used for the numerical analysis.

2. Simulation conditions

Fig. 1. shows a reference PDP cell used in this simulation. The reference PDP cell and UV planar source were used in this simulation to compare with the new simulation.

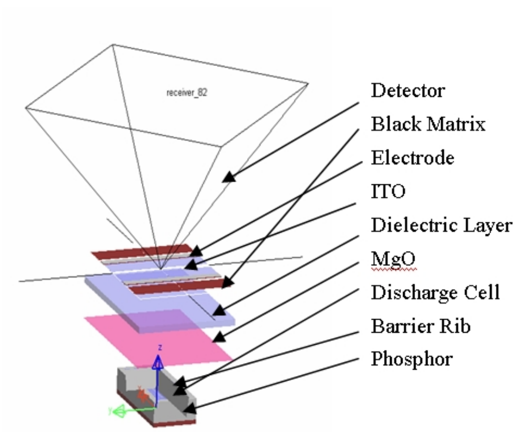

Fig. 1. Geometry of Simulated PDP cell.

The simulation parameters were as follows. The cell pitch is 0.678 x 0.300 mm, and it is same cell pitch of 42inch commercial HD PDP. Plasma Code simulated in Ne-Xe (90%-10%) mixture, 500 torr, 180 V-200 kHz sustain voltage.

Important geometries and optical properties are shown in Table 1. Optical properties of each layer was consist of reflectance(R), transmittance(T) and absobance(A).

TABLE 1. Geometry of Simulated PDP cell.

LAYER	Width (um)	T (%)	R (%)	A (%)
Barrier Rib	120	0	75	25
White Back	25	0	75	25
Bus Electrode	0.5	0	98	2
ITO	1.5	90	0	10
MgO	0.5	90	5	5
Front Dielectric layer	38	85	0	15

3. Results

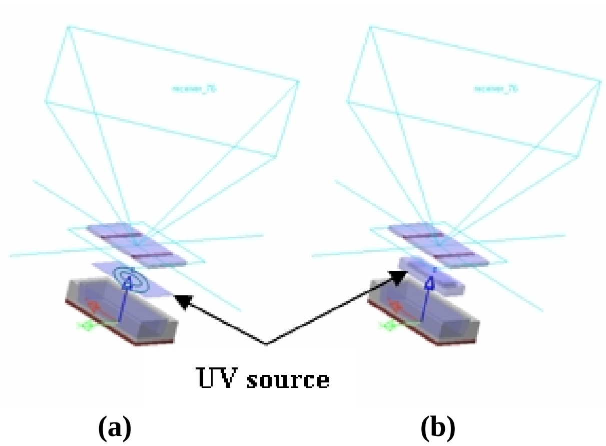

Fig. 2. (a) The planar UV source. (b) The new UV volume source.

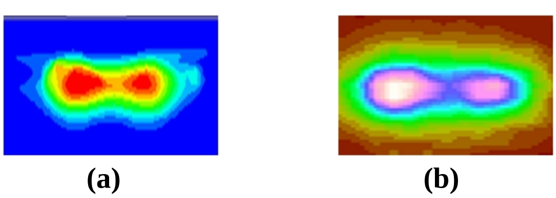

Fig. 3. (a) Special distribution of Xe-excitation simulated by the plasma fluid code. (b) Special distribution of the new UV source simulated by 3-dimensional optical code.

Fig. 2.(a) shows the symmetric planar UV source. It was used first than the new UV source. The planar UV source is consisted of the weight factor as distribution of ellipse. It was different from the UV distribution by practical electric discharge. So the UV distribution from discharge was calculated with the plasma fluid code. Fig. 3.(a) shows special distribution of Xe-excitation in plasma fluid code. The results was transformed to the Fig. 2.(b) by using 3-dimensional optical code, via three steps. Fig. 4. shows the design process. At the first step, the UV distribution simulated by the plasma fluid code was transformed to the contour. Then, the contour was approximated with the multi-cubes. At the last step, the multi-cubes was transformed to the 3-dimensional optical code. Fig. 3.(b) shows the results of the new UV source designed by using the plasma fluid code.

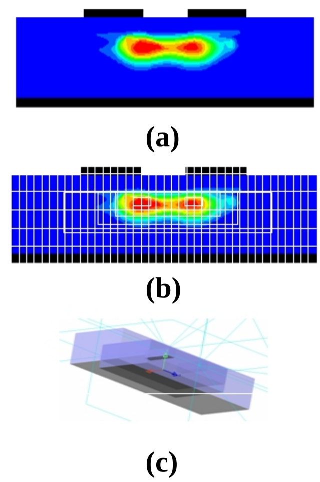

Fig. 4. Design process. (New UV source)

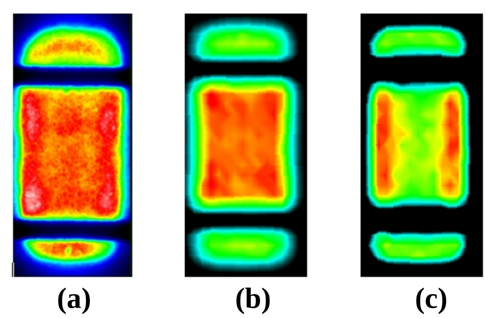

Fig. 5. (a) ICCD image of visible light distribution in a real PDP cell. (b) Visible light distribution simulated with the new UV volume source. (c) Visible light distribution simulated with the planar UV source.

Fig. 5. shows the results of the visible light distributions. The planar UV source and the new UV volume source were simulated in reference PDP cell which was proposed Figure 1. Fig. 5.(a) shows the ICCD image of visible light distribution. Fig. 4. (b),

(c) are the results of simulation. Compared to the results from planar UV source, Figure 4. (b) shows that the results from the new UV source could be improved the accuracy of light distribution. The new UV volume source was similar with the visible light distribution of ICCD image.

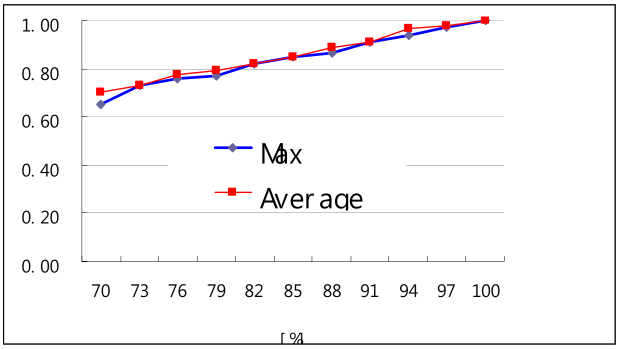

Fig. 6. Results for the different transmittance of dielectric layer.

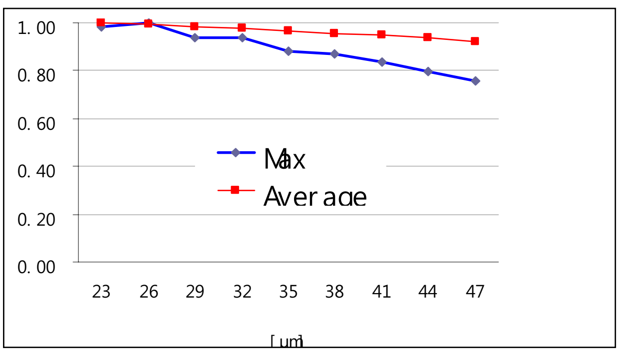

Fig. 7. Results for the different thickness of dielectric layer.

For example,to analyze the variation of geometries and optical properties, gathered illuminance results for the different transmittance and for the different thickness of dielectric layer by using new UV source. Fig. 6. shows the maximum and average results for the different transmittance of dielectric layer. Fig. 7. shows the maximum and average results for the different thickness of dielectric layer. These methodes can help to improve the luminance and efficiency when PDP cell is designed.

4. Impact

Currently we are working on the improvement of simulation accuracy by comparing with the visible light measurement of PDP cell. Improving the accuracy of simulation will be possible to design the new geometries and optical properties of PDP cell to improve the luminance and luminous efficiency.

5. References

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