Effect of Full-White Aging Discharge on Recovery of Boundary Image Sticking in AC-PDP

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ABSTRACT

When displaying the square-type image with peak luminance for a long time in 42-in. PDP-TV, the permanent image sticking and boundary image sticking appeared. This image sticking phenomenon is deeply related to the Mg species sputtered from the MgO surface of the discharge cell due to the iterant strong sustain discharge. In particular, the boundary image sticking is due to the re-deposition of the Mg species on both the MgO and phosphor layers in the non-discharge region adjacent to the discharge region. To reduce the boundary image sticking, the effects of full-white aging discharge on the boundary image sticking were observed. The full-white aging experiment showed that the MgO morphology in the boundary region was changed due to the 100 hours full-white aging discharge, which was almost similar to that in the non-discharge region. Furthermore, the changes in the discharge and luminance characteristics in the boundary image sticking region were observed after the 100 hours full-white aging discharge. As a result, it is observed that the full-white aging discharge can contribute to reducing the boundary image sticking considerably.

Ⅰ. INTRODUCTION

For the realization of high quality PDP, the image sticking problem has been one of the issues to be solved urgently. The image sticking is known to be induced in the PDP cells where the strong sustain discharges have been produced repeatedly during a sustain-period [1, 2, 3, 4]. Moreover, the image sticking is known to be induced even in the non-discharge cells adjacent to the discharge cells, which is called a halo-type boundary image sticking. Our previous experimental result shows that the main culprit for inducing the permanent image sticking is deeply related to the Mg species sputtered from the MgO surface of the discharge cell due to the severe ion bombardment during a sustain discharge [4]. The deposition of the sputtered Mg species on the phosphor layer in the discharge cells, or the re-deposition of the sputtered Mg species on another MgO surface of the non-discharge cells adjacent to the discharge cells, can alter the reset or sustain discharge characteristics, thus causing an image sticking or boundary image sticking [4]. This paper focuses on examining the effect of full-white aging discharge on the recovery of boundary image sticking. In this paper, the luminance, IR (828 nm) emission, and Vt close-curve of the non-discharge region adjacent to the discharge region were observed in comparison with the non-discharge region far away from the discharge region, under the two different image patterns, such as the dark and full white backgrounds, after displaying the full-white aging for about 100 hours in 42-in. PDP-TV.

Ⅱ. FULL-WHITE AGING DISCHARGE FOR BOUNDARY IMAGE STICKING CELL

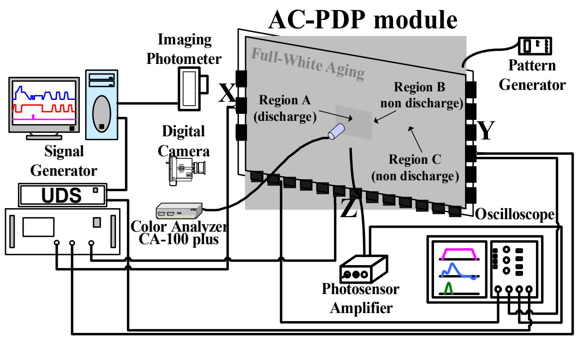
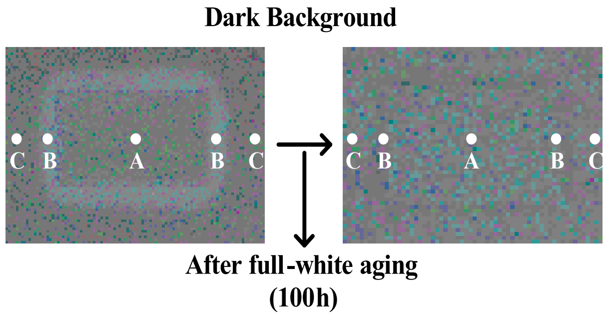


Fig. 1. Schematic diagram of experimental setup employed in this research.

Fig. 1 shows the commercial 42-in. ac-PDP module with a box-type barrier rib and the optical-measurement systems employed in this experiment. The color analyzer (CA-100 plus), Imaging photometer (Prometric PM Series), pattern generator, signal generator, and the photo-sensor amplifier (Hamamatsu, C6386) were used to measure the luminance, IR emission, and Vt close-curve, respectively. To reduce the boundary image sticking, the entire region of the 42-inch panel was changed to the dark and full white background images immediately after the full-white aging discharge is produced continually for about 100 hours. The frequency for the sustain-period was 200 kHz, and the sustain voltage was 205V. The driving method with a selective reset waveform was adopted. The gas chemistry in the experiment was Ne-Xe (15 %)-He (35 %).

Fig. 2 shows the luminance difference among the three regions, A, B, and C observed under the dark background image after the full-white aging discharge for about 100 hours. Before the full-white aging discharge, as shown in



(a)

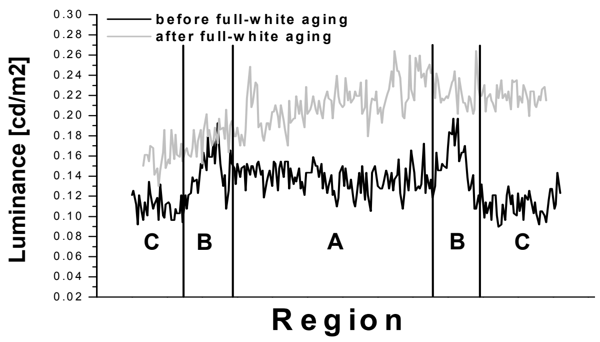


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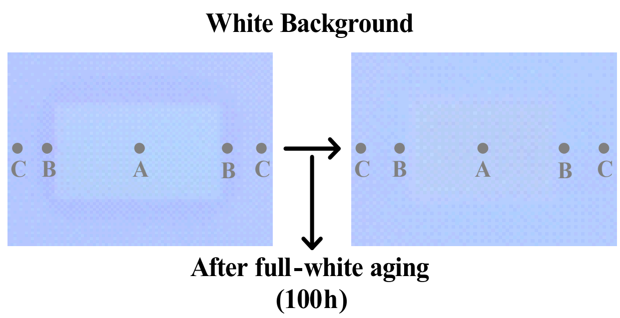
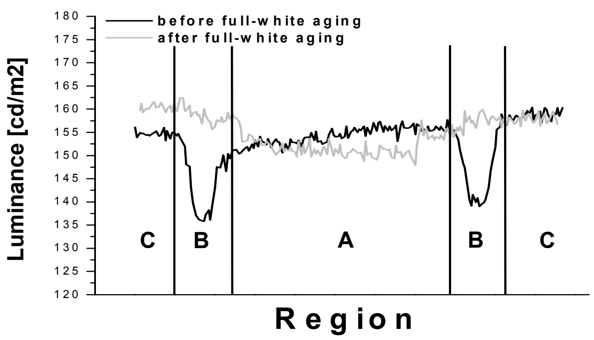
Fig. 2. (a) Image sticking pattern under dark background captured from test panel, (b) luminance difference among regions, A, B, and C before and after full-white aging discharge.



(a)



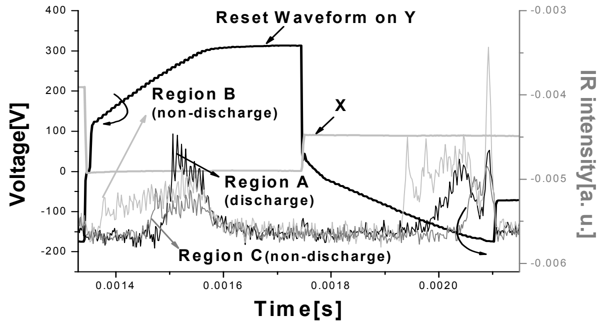
(b)

Fig. 3. (a) Image sticking pattern under full-white background captured from test panel, (b) luminance difference among regions, A, B, and C before and after full-white aging discharge.

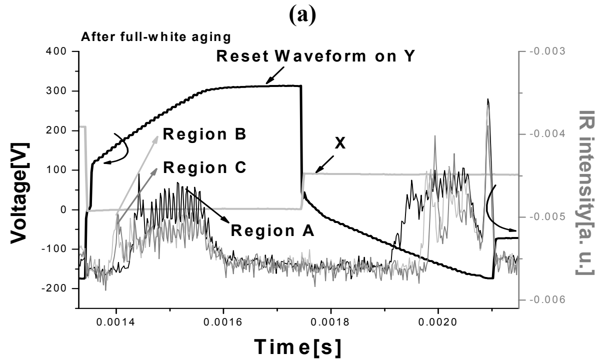
Fig. 2 (b), the image sticking was observed in the regions A and B. The luminance of the discharge region A, *i.e.*, image sticking cells, was observed to be higher than that of the non-discharge region C. In particular, the non-discharge region adjacent to the discharge region, *i.e.*, boundary region (B), showed the highest luminance under the dark background. However, after the full-white aging discharge, the image pattern and luminance of the regions B and C were observed to be almost the same. Fig. 3 shows that the luminance difference among the regions, A, B, and C observed under the full-white background image after the full-white aging discharge for about 100 hours. After the full-white aging discharge, the image pattern and luminance of the regions B and C were also observed to be the same under the full-white background, as shown in Fig. 3 (b).

Ⅲ. EXPERIMENTAL RESULTS

Fig. 4 shows the changes in the IR (828 nm) emissions measured from the regions A, B and C during the reset period under the dark background produced only by the weak reset discharge. Before the full-white aging discharge, as shown in Fig. 4 (a), the IR peak in the regions B was observed to be shifted to the left in comparison with that in region C, indicating that the weak reset discharge was initiated efficiently at a lower starting discharge voltage during a reset period. However, after the full-white aging discharge, the ignition time and intensity of the IR (828 nm) emission waveforms were observed to have no difference between the regions B and C, as shown in Fig. 4 (b). Fig. 5 shows the changes in the IR (828 nm) emissions measured from the regions A, B and C during the sustain period, which show the same tendency as that of the reset discharge under the dark background. After the full-white aging discharge, the ignition time and intensity of the IR (828 nm) emission waveforms were also observed to have no difference between the regions B and C, as shown in Fig. 5 (b). In order to investigate which was the main factor for the recovery of the difference in the luminance and IR characteristics between the regions B and C after 100 hours full-white aging discharge, the Vt close-curve was measured in the three regions, A, B, and C, respectively. Before the full-white aging discharge, as shown in Fig. 6 (a), the firing voltage in the Y-A (phosphor cathode condition) and Y-X (MgO cathode condition) discharges in region B were decreased slightly by about 5-10 V and by 10-15 V in comparison with that in region C, respectively. The reduction of the firing voltage in the surface and plate gap discharges is presumably due to the deposition of Mg species onto the MgO and phosphor layers, which is caused by the sputtering of the MgO induced by the iterant strong sustain discharge in region A [4]. After the full-white aging discharge, as shown in Fig. 6 (b), the firing voltage under the phosphor and MgO cathode condition in the regions B and C are almost the same. Consequently, this result clearly shows that the full-white aging discharge contributes to the recovery of the boundary image sticking cells. The scanning electron

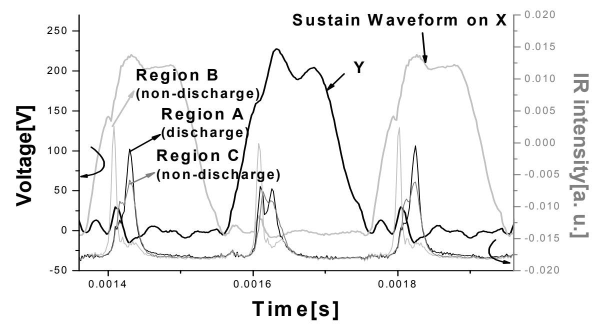


(a)

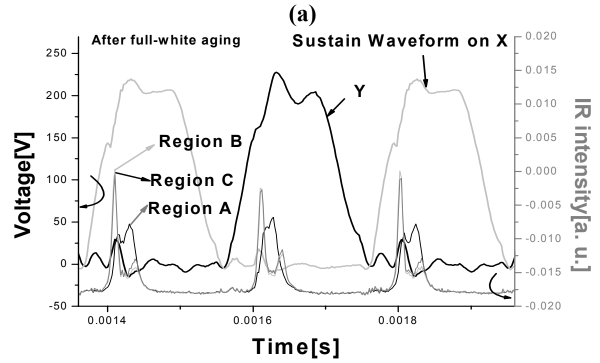


(b)

Fig. 4. Comparisons of IR (828 nm) emissions measured from regions A, B, and C during reset-period under dark background, (a) before full-white aging and (b) after full-white aging discharge.

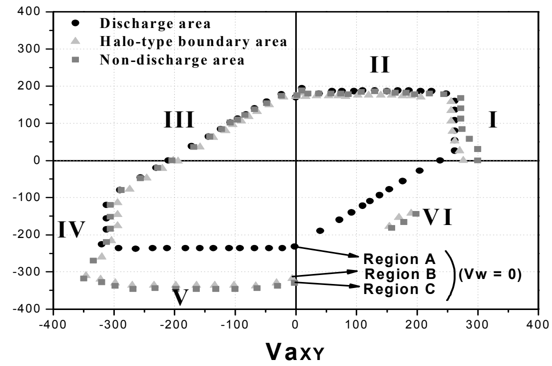


(a)

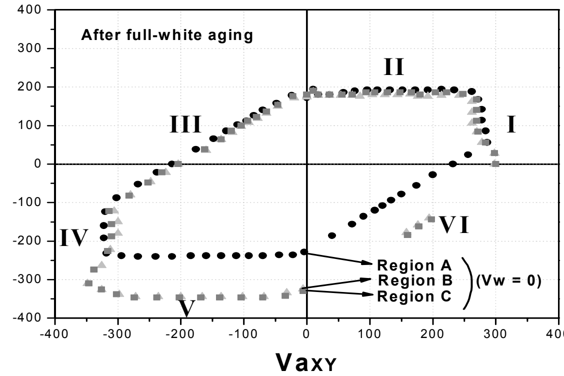


(b)

Fig. 5. Comparisons of IR (828 nm) emissions measured from regions A, B, and C during sustain period under full-white background, (a) before full-white aging and (b) after full-white aging discharge.



(a)



(b)

Fig. 6. Comparison of Vt close-curves measured from regions A, B, and C without initial wall charges, (a) before full-white aging and (b) after full-white aging discharge.

microscope (SEM) and time of flight secondary ion mass spectrometry (TOF-SIMS) were measured to inspect the surface morphology and analyze the deposited Mg species, respectively, after the 100 hours full-white aging discharge. Fig. 7 shows the SEM images captured from the regions A, B, and C. Before the full-white aging discharge, as shown in Fig. 7 (a), the morphology in region B is almost similar to that of the cell in the discharge region (region A). The morphology of the MgO surface should not change if the cell is not discharged. Nonetheless, the change in the morphology of the MgO surface in the non-discharge cell (region B) was observed. However, after the full-white aging discharge, the morphology in region B becomes almost similar to that of the cell in region C, which means that the 100 hours full-white aging discharge contributes to recovering the boundary image sticking. Fig. 8 shows the comparison of the Mg-profiles on the red phosphor layer for regions A, B, and C by using the TOF-SIMS analysis. In Fig. 8, the Mg-profile means the intensity of the Mg sputtered from the red phosphor layer with operating time when the Ar ions struck the surface of the red phosphor layer. Before the full-white aging discharge, as shown in Fig. 8 (a), the Mg intensity in regions A and B was shifted upward, compared to that in region C, indicating that the Mg species was re-deposited onto the phosphor layer.

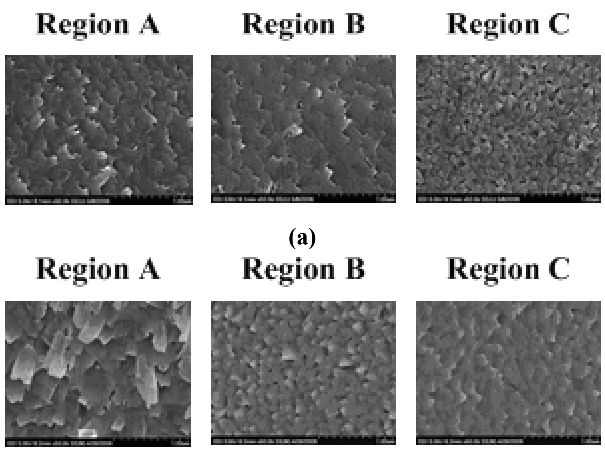


Fig. 7. Comparison of MgO surface SEM images measured from regions A, B, and C, (a) before full-white aging and (b) after full-white aging discharge.

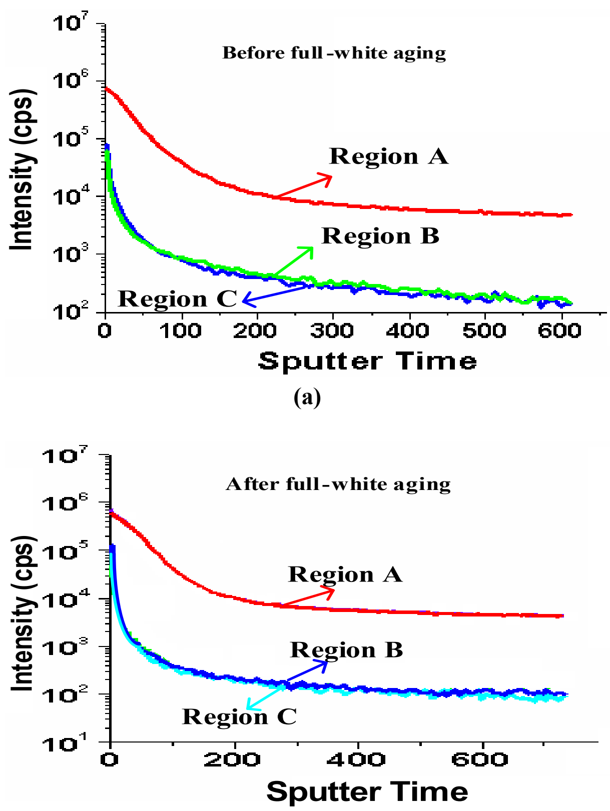


Fig. 8. Comparison of Mg-profiles of red phosphor layer for regions A, B, and C measured using TOF-SIMS analysis, (a) before full-white aging and (b) after full-white aging discharge.

Although the sputtered Mg species were predominantly re-deposited in the discharge region A, there was also a slight re-deposition in the non-discharge region B adjacent to the discharge region A. However, after the full-white aging discharge, the Mg intensity in region B is almost

Table 1 CIE(1931) chromaticity coordinates and color temperatures measured from region A, B, and C before and after full-white aging.

			region A	region B	region C
Before full-white aging	Chromaticity coordinates	x	0.2644	0.2578	0.2621
		y	0.2780	0.2519	0.2595
	Color Temperature, T[K]		13214	22500	17334
After full-white aging	Chromaticity coordinates	x	0.2687	0.2603	0.2611
		y	0.2784	0.2620	0.2601
	Color Temperature, T[K]		12500	17334	17667

similar to that of the cell in region C, which means that the 100 hours full-white aging discharge contributes to recovering the boundary image sticking. Table 1 shows the CIE chromaticity coordinates and related color temperatures measured from the regions A, B, and C. Before the full-white aging discharge, as shown in Table 1, the chromaticity coordinates and color temperatures, X and Y, were changed for both the image sticking cells (region A) and boundary image sticking cells (region B). However, after the full-white aging discharge, the chromaticity coordinate and color temperature in region B are almost similar to that of the cell in region C.

Ⅳ. CONCLUSIONS

When displaying the square-type image with peak luminance for about long times in 42-in. PDP-TV, the boundary image sticking appeared. Thus, the image sticking needs to be solved urgently for the realization of a high image quality in AC-PDP. The image sticking is known to be induced even in the non-discharge cells adjacent to the discharge cells, which is called a boundary image sticking. To reduce the boundary image sticking, we observed the effect of full-white aging discharge. As a result of monitoring the differences in the IR emission, luminance, Vt close-curve, SEM, and TOF-SIMS analysis between before and after full-white aging discharges, it is observed that the full-white aging can reduce the boundary image sticking considerably. It is expected that this experimental result can contribute completely to eliminating the boundary image sticking of the PDP-TV.

Ⅴ. REFERENCES

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