Influence of Redeposited Mg Particles on Electron Emission of MgO Surface and Related Discharge Characteristics in AC-PDP

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Abstract
In this paper, the influences of the redeposited Mg particles on the electron emission of the MgO surface and related discharge characteristics of an ac plasma display panel were examined using the cathodoluminescence and intensified charge-coupled device techniques. The experimental results showed that the electron emission at the redeposited region of the Mg particles on the MgO surface was intensified and concentrated, thereby resulting in improving the discharge characteristics, compared with those for non-redeposited region of the Mg particles .

1. Introduction
The surface states of the MgO layer are known to be an important parameter that affects the discharge characteristics in an ac-PDP. The MgO layer is used as a protective or electron emission layer in ac-PDP due to its strong resistance to ion sputtering and high secondary electron emission coefficient [1, 2]. Our previous experimental results showed that while the strong sustain discharge was repeatedly produced, Mg particles were sputtered from the MgO surface due to the bombardment of ions onto the MgO protecting layer, such that the Mg particles were predominantly redeposited on the MgO and phosphor layers of the cells in discharge region. Meanwhile, with no sustain discharge yet located near discharge region, Mg particles were transported from the adjacent cells where the MgO surface was sputtered and redeposited on the MgO surface. The redeposition of the sputtered Mg particles on another MgO surface of the non-discharge region adjacent to the discharge region can alter the reset or sustain discharge characteristics [3-6]. However, in the previous experiments, the electron emission of the MgO surface and the discharge characteristics related to the redeposition of Mg particles phenomenon was not investigated in detail. Accordingly, this study used CL measurements to investigate the changes in the MgO surface characteristics induced by redepostion of Mg particles on the MgO surface, and examined the resultant changes in the IR emission using the ICCD technique.

2. Experimental Setup
Figure 1 shows the optical-measurement systems and 42 in HD ac-PDP module with three electrodes used in the experiments, where X is the sustain electrode, Y is the scan electrode, and A is the address electrode. A commercial 42 in ac-PDP module with a working gas pressure of 420 torr was employed in this study, and its structure and dimensions were an XGA grade PDP with a box-type barrier rib. The gas mixtures used were Ne-He (35%)-Xe (11%). The MgO thin film was deposited on the dielectric layer of the ac-PDP by using ion-plating evaporation and the oxygen and hydrogen flow rates were kept at 220 and 60 sccm, respectively, during the deposition. Figure 2 shows the driving waveforms, including the reset, address, and sustain periods. The conventional driving waveform with a selective reset waveform was adopted. The frequency for the sustain period was 200 kHz. To produce the nonredeposited and redeposited regions of Mg particles on another MgO surface of the nondischarge region adjacent to the discharge region, the entire region of the 42 in panel was changed to a full-white background image immediately after displaying a square-type image (discharge region) at peak luminance for approximately 200 h [3-6].

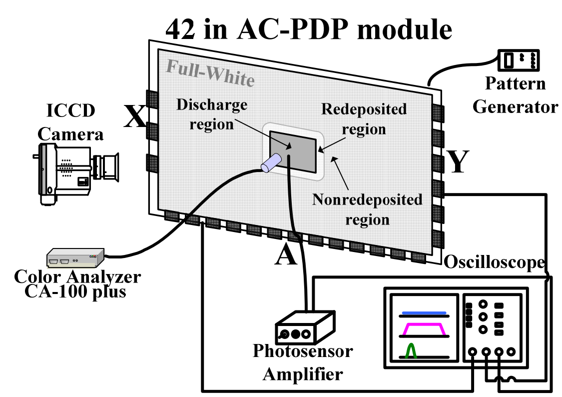


Figure 1. Schematic diagram of experimental setup employed in this study.

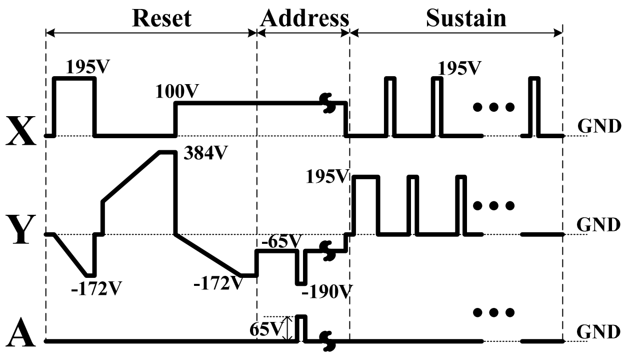
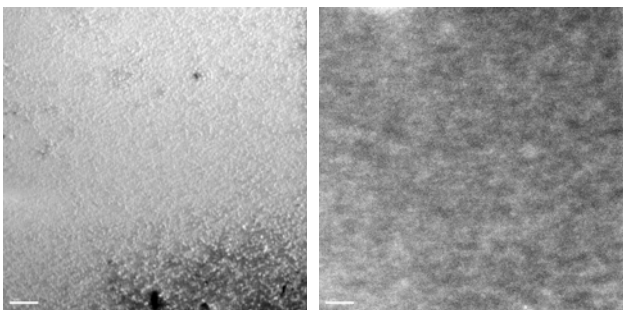
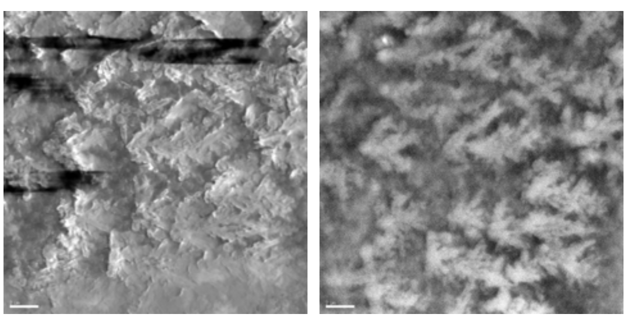


Figure 2. Schematic diagram of conventional driving waveform used in this study.



(a) (b)

Figure 3. (a) Plane SEM image and (b) panchromatic CL image on MgO surface measured from nonredeposited region of Mg particles on MgO surface (Ref.).

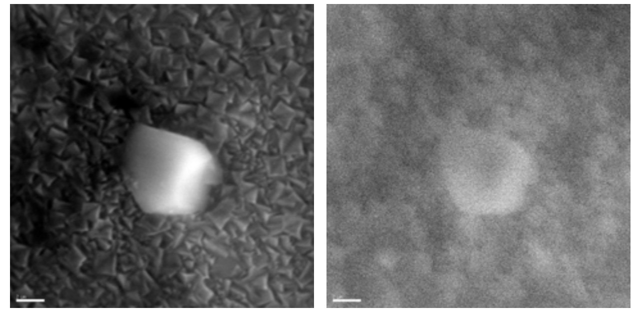


(a) (b)

Figure 4. (a) Plane SEM image and (b) panchromatic CL image on MgO surface measured from redeposited region of Mg particles on MgO surface.

3. Experimental Results and Discussion

Figure 3 shows the (a) plane SEM image and the (b) panchromatic CL intensity image on the MgO surface measured from the nonredeposited region (Ref.) of the Mg particles on the MgO



(a) (b)

Figure 5. (a) Plane SEM image and (b) panchromatic CL image on MgO surface measured from region of MgO single crystal powder (or crystal emissive layer (CEL)) on MgO surface.

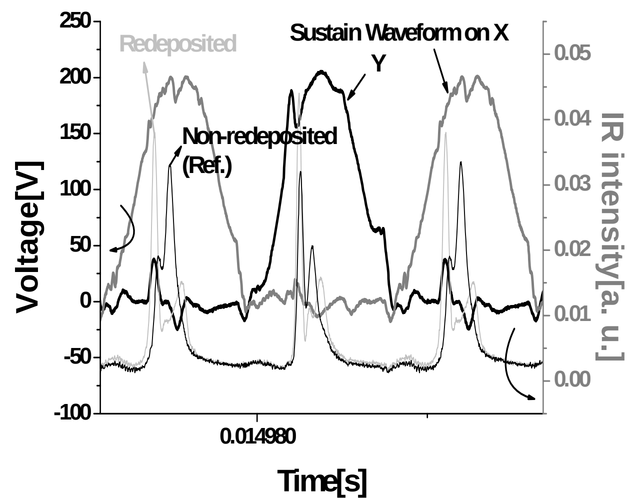
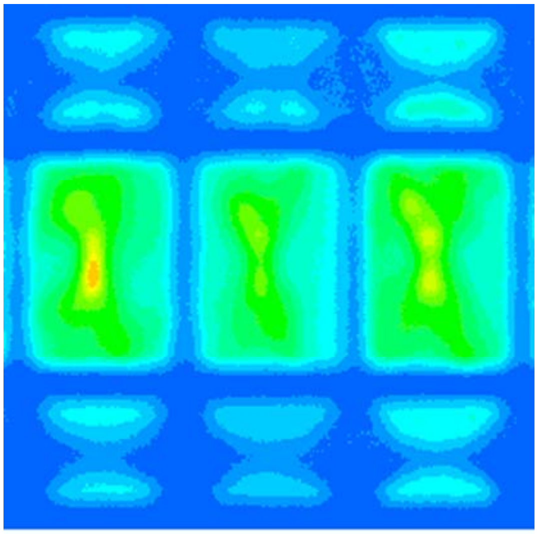


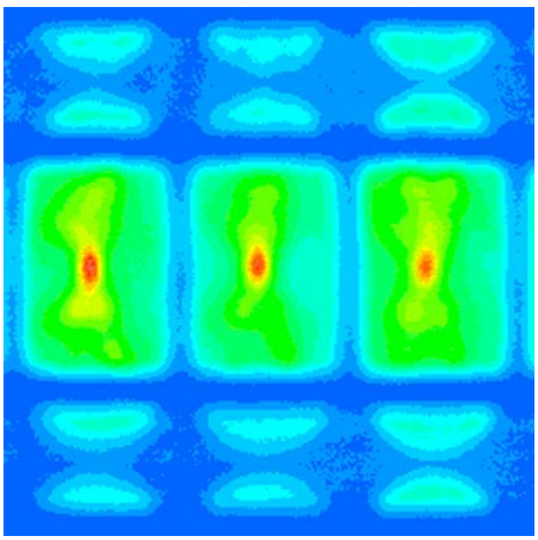
Figure 6. Comparison of IR (828 nm) emission intensities measured from nonredeposited (Ref.) and redeposited regions of Mg particles on MgO surface during sustain period under full-white background.

surface. In the CL intensity image of Fig. 3 (b), the dark image region means no detection of the electron emission. Meanwhile, the bright image region means detection of the electron emission. As shown in Fig. 3 (b), the electron emissions were evenly emitted from the whole MgO surface.

Figure 4 shows the (a) plane SEM image and the (b) panchromatic CL intensity image on the MgO surface measured from the redeposited region of the Mg particles on the MgO surface. As shown in Figs. 4 (a) and (b), the electron emissions in the CL intensity at the redeposited region of the Mg particles on the MgO surface was intensified and concentrated compared with that for nonredeposited region of the Mg particles.



(a)



(b)

Figure 7. Comparison of IR emission profiles by use of focus mode of ICCD measured from (a) nonredeposited (Ref.) and (b) redeposited regions of Mg particles on MgO surface during sustain period under full-white background.

Figure 5 shows the (a) plane SEM image and the (b) panchromatic CL intensity image on the MgO surface measured from the region of the MgO single crystal powder (or crystal emissive layer (CEL)) on the MgO surface. As shown in Figs. 5 (a) and (b), the electron emissions in the CL intensity at the region of the MgO single crystal powder on the MgO surface was also intensified and concentrated. The experimental results in Figs. 4 and 5 indicated that the MgO surface characteristics induced by redepostion of Mg particles on the MgO surface was similar to that of the deposition the MgO single crystal powder on the MgO surface [7, 8].

Figures 6 and 7 show the changes in the IR (828 nm) emission intensities and the IR emission profiles by use of the focus mode of the ICCD measured from the nonredeposited (Ref.) and the redeposited regions of the Mg particles on the MgO surface during the sustain period under the full-white background. As shown in Figs. 6 and 7, the IR emission peak for the redeposited regions of the Mg particles was observed to be shifted to the left and intensified compared with that for the nonredeposited regions of the Mg particles, indicating that the strong sustain discharge was efficiently initiated at a lower starting discharge voltage and intensified during the sustain period due to the increase in the electron emission characteristics of the MgO surface. The experimental results in Figs. 6 and 7 also indicated that the discharge characteristics induced by redepostion of Mg particles on the MgO surface was similar to that of the deposition the MgO single crystal powder on the MgO surface [7, 8]. Consequently, these experimental results confirm that the use of redepostion of Mg particles on the MgO surface can modify the MgO surface state as MgO single crystal powder on the MgO surface, thereby contributing to improving the discharge characteristics of the PDP-TV.

4. Conclusion

In this paper, the influences of the redeposited Mg particles on the electron emission of the MgO surface and related discharge characteristics of an ac plasma display panel were examined using the cathodoluminescence and intensified charge-coupled device techniques. The use of redepostion of Mg particles on the MgO surface can modify the MgO surface state as MgO single crystal powder on the MgO surface, thereby contributing to improving the discharge characteristics of the PDP-TV.

5. Acknowledgements

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