# Influence of Image Sticking on Electro-Optical Characteristics in Alternating-Current Plasma Display Panels

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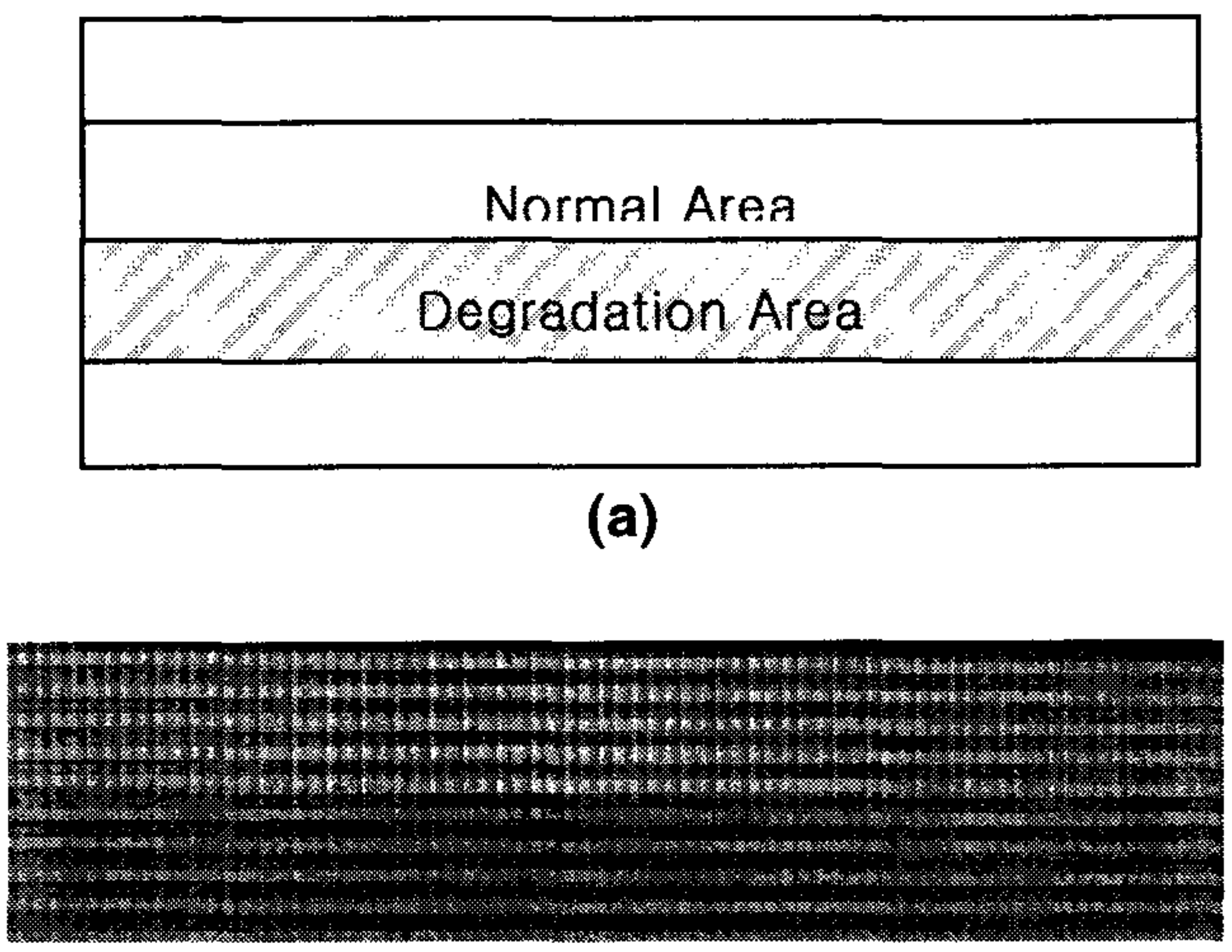
## ABSTRACT

We have investigated the electro-optical characteristics of image sticking in AC PDP. Although Image sticking is one of major factors to determine display quality in AC PDP, so far, it has not being reported why it is occurred and how we can prevent it. In this experiment, we have analyzed the effect of MgO protective layer and phosphor on the image sticking and we have measured the difference of firing voltage, brightness and discharge current between sticking image and normal image in AC PDP. As a result, Phosphor degradation is a more major factor than MgO protective layer and the firing voltage of gas discharge in sticking image is higher than that of normal discharge.

## INTRODUCTION

Alternating current plasma display panel (AC-PDP) is the most promising device for the large size display. But there are several problems which have to be solved in AC PDP, that is, low power efficiency, high price, image sticking and so on. Of these problems, Although Image sticking is one of major factors to determine display quality in AC PDP, so far, it has not being reported why it is occurred and how we can prevent it. In this experiment, we have investigated the electro-optical characteristics of image sticking and measured the secondary electron emission coefficient γ of degraded MgO protective layer and phosphor in AC PDP. The test panel for this experiment is a 3.5 inch, VGA class AC-PDP with a cell pitch of 1080 μm. The number of cells used in this experiment is 58 x RGB.

## Experiments and results




(a)

(b)

**Figure 1 Test panel in experiment and discharge image**

Figure 1-(a) shows a test panel in this experiment and figure 1-(b) shows discharge images of normal cells and degraded cells. All cells have 10 hours aging and of them, below 5-lines have more 24 hours aging for sufficient degradation of MgO protective layer and phosphor. The color deference between normal and degraded cells is very obvious and the degraded cells show more reddish-white spectrum.

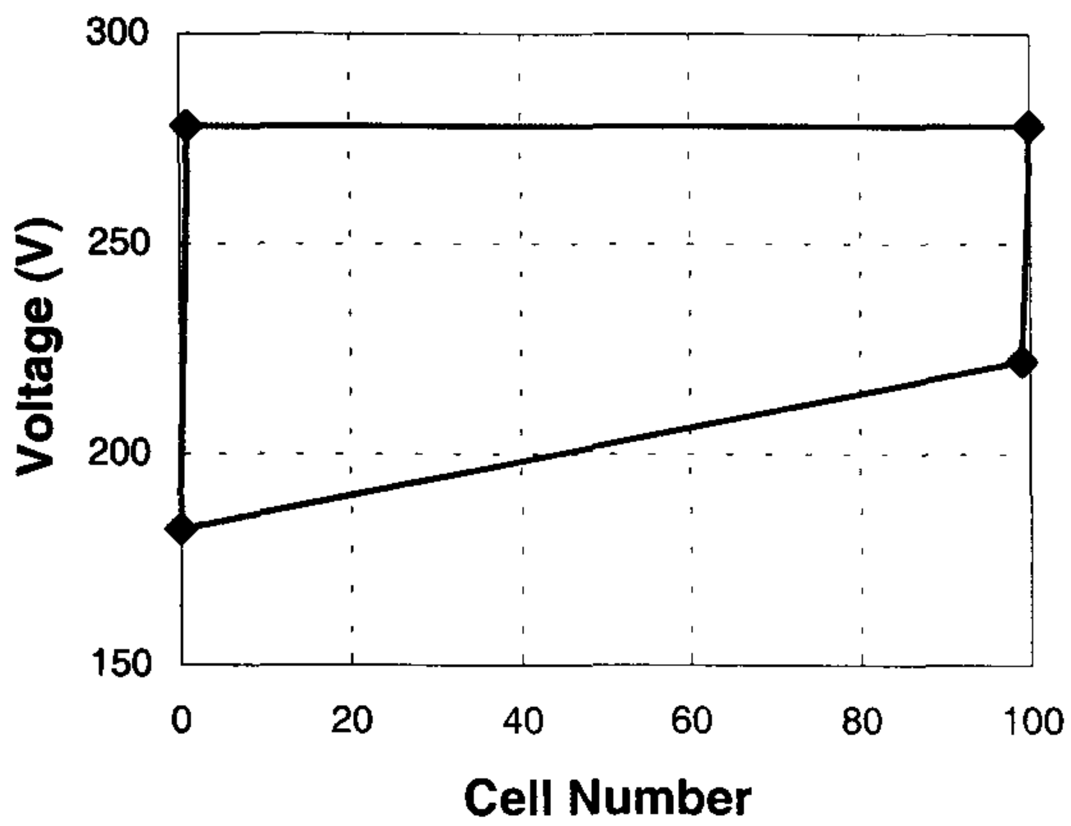



**Figure 2 Static margin of test panel before degradation**

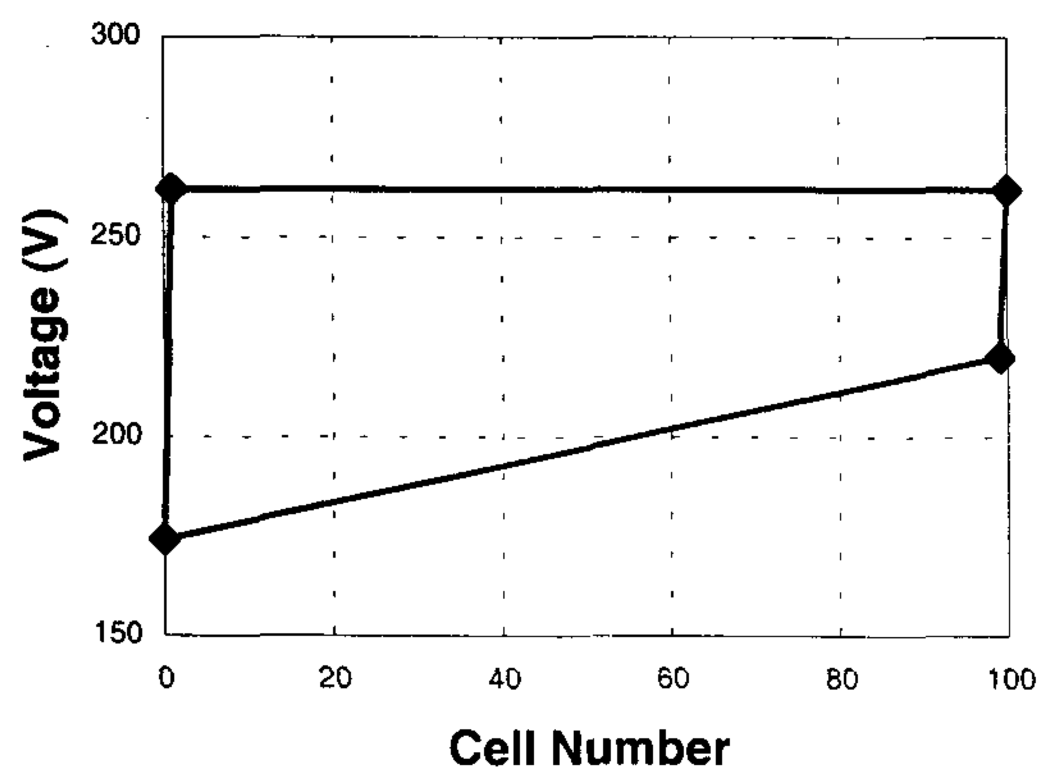



**Figure 3 Static margin of test panel after degradation**

Figure 2 and figure 3 shows the static margin of test panel before and after degradation, respectively. After degradation, firing voltage is lower up to 16V than that before and sustain voltage is also decreased about 2V, respectively. Since the firing voltage is more decreased than sustain voltage, thus static margin is seriously reduced after degradation.

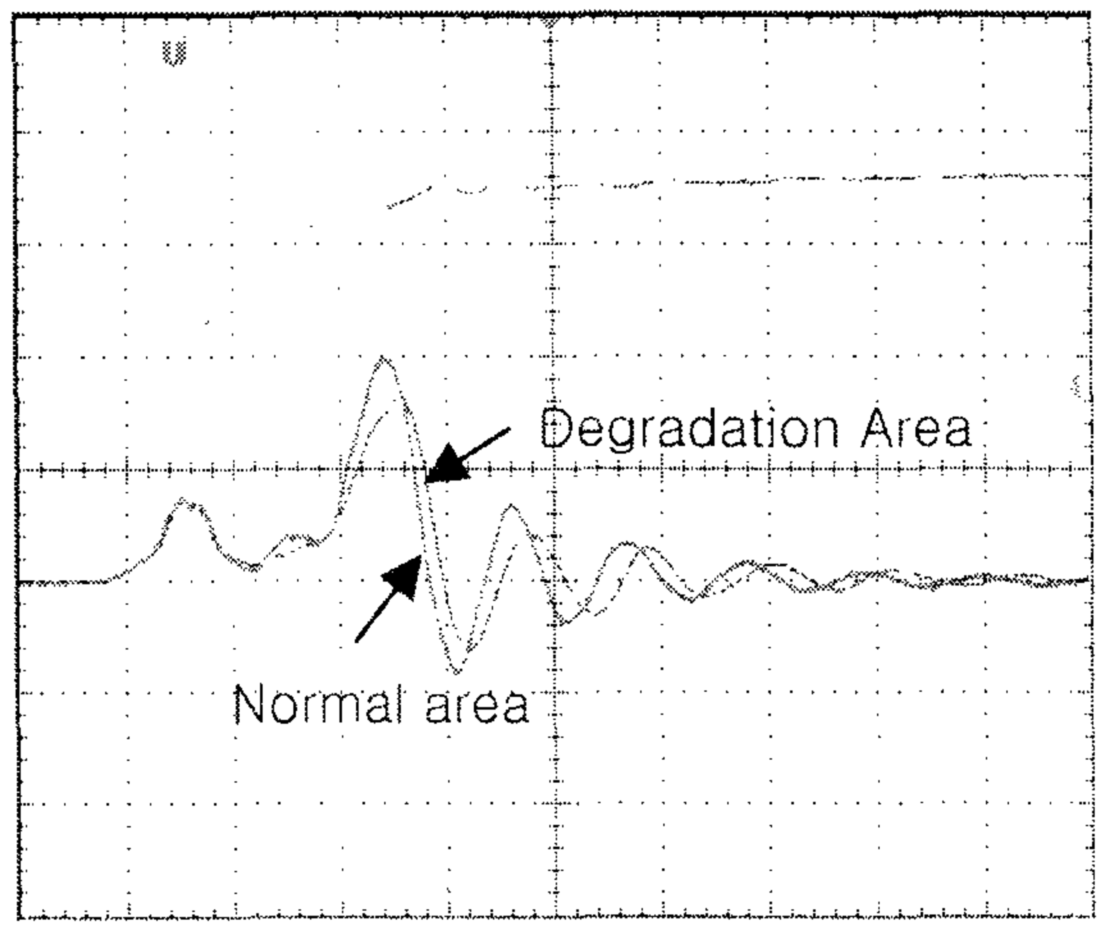



**Figure 4 Discharge currents before and after degradation**

Figure 4 shows the discharge currents before and after degradation. the peak of discharge current after degradation is decreased than before, while the width of current is increased.

| | MgO. Pho. | Reference | Phosphor | Pho. Refer | MgO | MgO Refer |
|---|---|---|---|---|---|---|
| Vfmin | 284 | 292 | 282 | 294 | 286 | 286 |
| Vfma | 284 | 292 | 282 | 294 | 286 | 286 |
| Vsma | 242 | 248 | 240 | 238 | 250 | 242 |
| Vsmin | 184 | 188 | 184 | 184 | 182 | 184 |

**Table 1 Firing voltages with cell conditions**

Shown in table 1 are firing voltages with cell conditions. In this table, the first and second columns are about cells that both MgO and phosphor are degraded and normal cells, respectively. And the other columns are, in turn, about cells that only phosphor was degraded, normal cell, cells that only MgO was degraded and normal cells, also respectively. And each row indicates in turn firing minimum voltage, firing maximum voltage, sustaining minimum and sustaining maximum voltage. For the trivial experimental problem, the data of first column can only be compared with data of second column, the third only with forth and the fifth only with sixth. In results, the third column, that is, only phosphor is degraded, has similar tendency with the first column with both MgO and phosphor are degraded, and In both case, the firing voltage is seriously reduced. But there is no difference of firing voltage between the fifth column only with degraded MgO and sixth column with normal cells. Therefore, these data mean the most major factor of image sticking is not the MgO degradation but the phosphor degradation and the MgO degradation is not direct factor of image sticking.

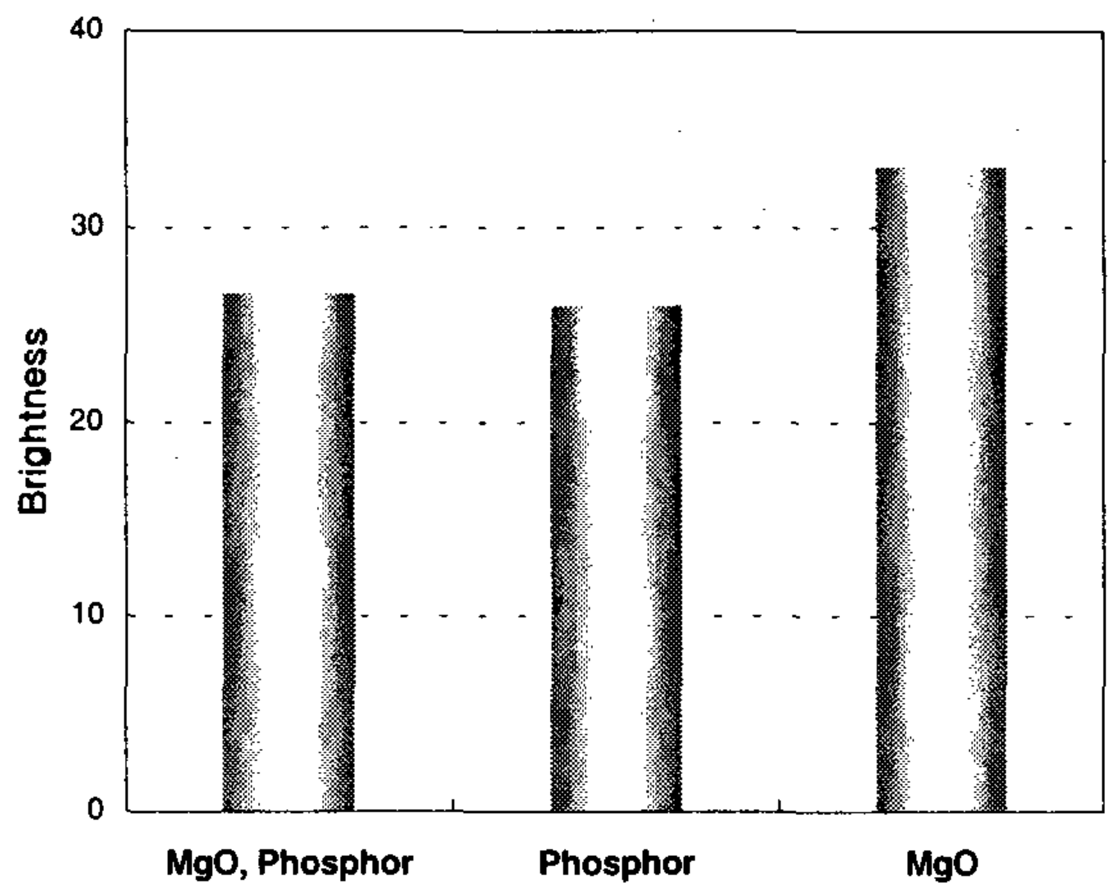



**Figure 5 Change of brightness with degradation material**

. Shown in figure 5 is changed of brightness with degradation material. Similarly above, Due to phosphor degradation, the brightness is seriously reduced and MgO has little effect on brightness. Figure 6 shows secondary electron emission coefficient γ according to the phosphor has degraded or not. Degradation phosphor has higher γ value than that of normal phosphor. Figure 7 shows secondary electron emission coefficient γ according to the MgO protective layer has degraded or not. Degradation MgO has slightly lower γ value than that of normal phosphor. However γ of phosphor has relatively higher value than γ of MgO layer. Therefore decrease of firing voltage and brightness are obviously dependent on phosphor degradation and the phosphor is the most major factor of image sticking.

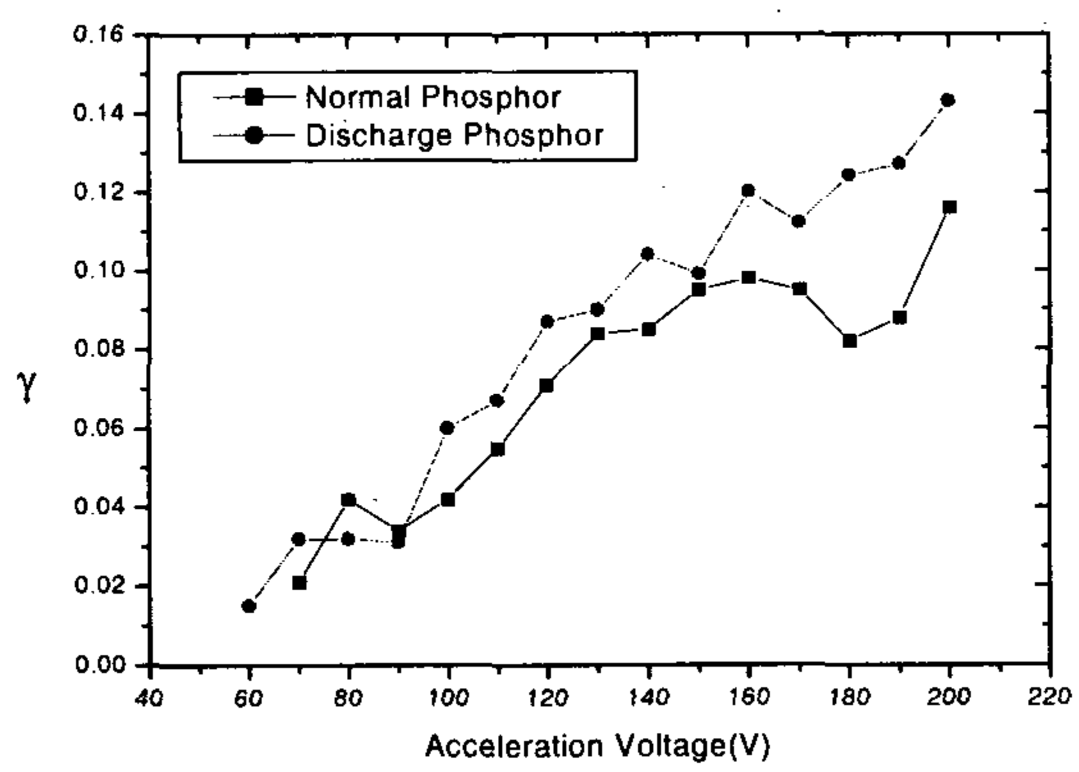



**Figure 6 Secondary electron emission coefficient γ according to the phosphor has degraded or not**

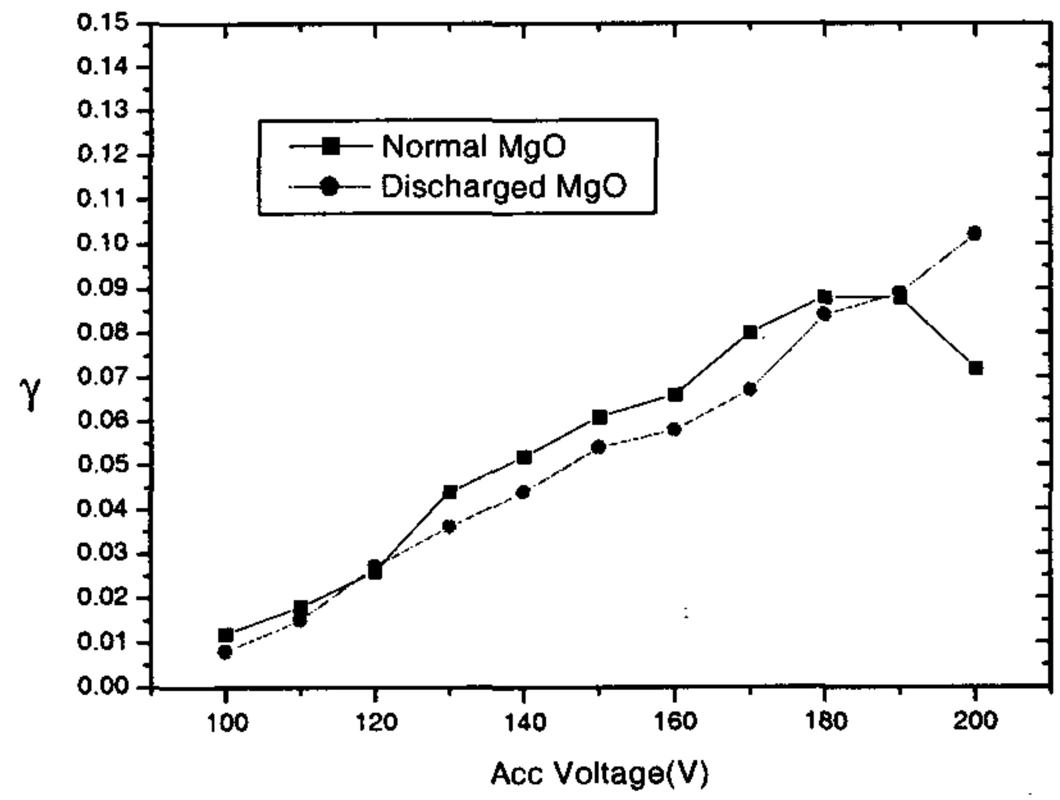



**Figure 7 Secondary electron emission coefficient γ according to the MgO protective layer has degraded or not**

## Conclusion

We have investigated the electro-optical characteristics of image sticking in AC PDP. Although Image sticking is one of major factors to determine display quality in AC PDP, so far, it has not being reported why it is occurred and how we can prevent it. In this experiment, we have analyzed the effect of MgO protective layer and phosphor on the image sticking and we have measured the difference of firing voltage, brightness and discharge current between sticking image and normal image in AC PDP. And we measured the secondary electron emission coefficient $\gamma$ of degraded MgO protective layer and phosphor in AC PDP. In the result, degradation MgO has slightly lower $\gamma$ value than that of normal phosphor. However $\gamma$ of phosphor has relatively higher value than $\gamma$ of MgO layer. Decrease of firing voltage and brightness are obviously dependent on phosphor degradation and the phosphor is the most major factor of image sticking.

## Acknowledgements

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