Suppression of MgO hydration using Self-Assembled Monolayers

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Abstract

We suggest the use of a self-assembled ultra thin organic film that can suppress the hydration of MgO protective layer in AC-PDP. We analyzed the degree of hydration of MgO layer in AC-PDP by XPS when exposed to air after vacuum deposition which proved the effectiveness of the hydration prevention. We also made PDP test panels to demonstrate the improvement in the luminance and luminous efficiency when the hydration of MgO surface is suppressed by the use of self-assembled ultra thin organic film.

1. Introduction

MgO is one of the best suitable, protective material for the dielectrics in AC-PDP because it has a high secondary electron emission coefficient and low sputtering yields. The hydration and carbonization of MgO surface after vacuum deposition has been studied extensively because it directly affects the discharge voltage and other important AC-PDP characteristics such as the luminance and luminous efficiency.

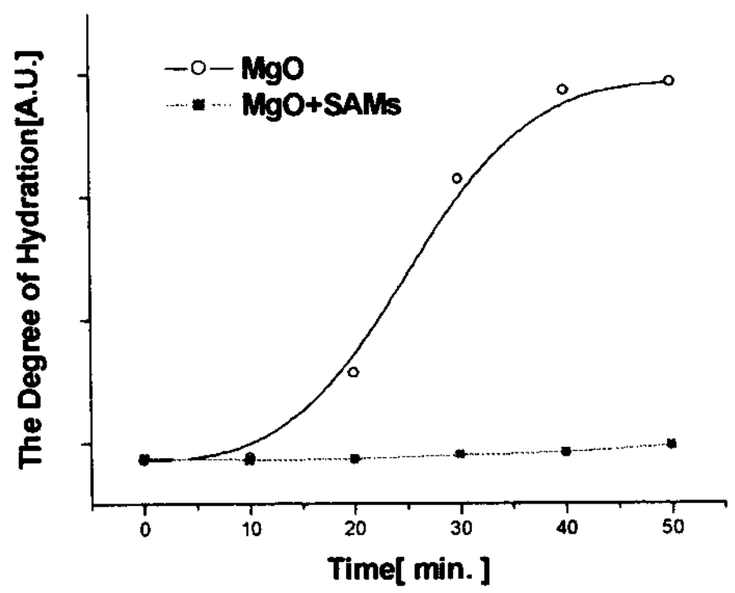
In this study, we applied an ultra thin organic, self-assembled monolayer onto MgO surface after vacuum deposition and examined the effectiveness of this for the suppression of hydration and carbonization of MgO surface and improvement of discharge characteristics of PDP.

2. Experiments

We used the Octyltrimethoxysilane ($CH_3(CH_2)_7Si(OCH_3)_3$) as the protective material for MgO surface which is known to form an ultra thin monolayer by chemisorptions and self-organization. It has the methyl group (CH_3) which can give the hydrophobic property once the monolayer is formed. We formed the monolayer in a vacuum chamber at the substrate temperature of 100℃ using Ar as the carrier gas.

To study the effectiveness of prevention of the MgO surface from hydration and carbonization when exposed to air, we changed the exposure time to air after vacuum deposition of MgO and studied its surface by XPS (X-ray Photoelectron Spectroscopy) with its results shown in Fig.1. It shows that the application of SAMs(Self-Assembled Monolayers) can suppress the hydration and carbonization of MgO surface.

(a)



(b)

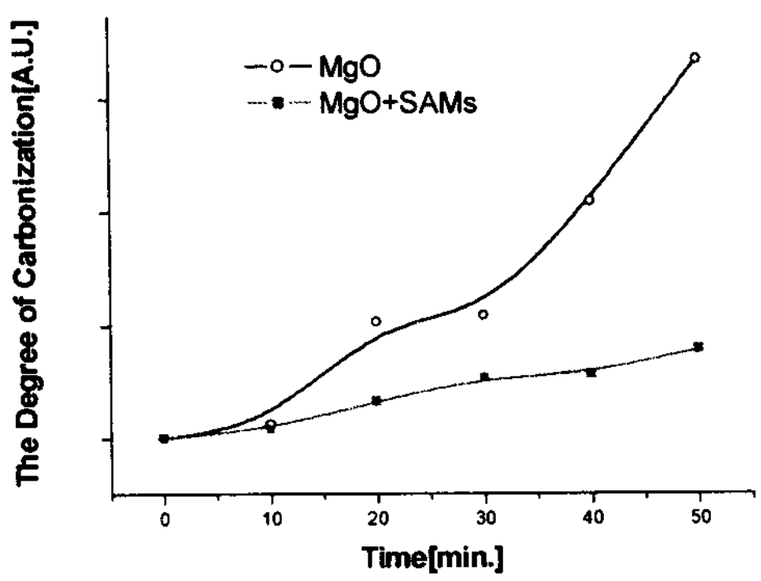


Figure 1 (a) The degree of hydration and (b) the degree of carbonization as a function of exposure time in air.

Based on these results, we proceeded to confirm the

effectiveness of the application of SAMs in real PDPs. Figure 2 shows the design of the front panel. One half of the display area was covered by SAMs and the discharge characteristics of SAMs-covered and non-covered parts were compared. The display area is 2" in diagonal and the discharge gas is 5% Ne-Xe mixture at the pressure of 400torr.

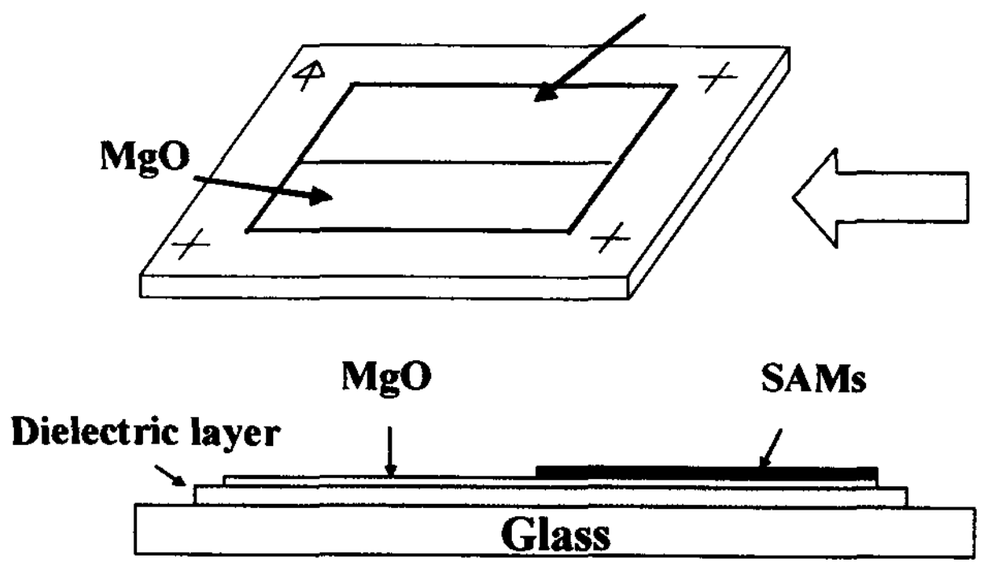


Figure 2 Schematic of front plate.

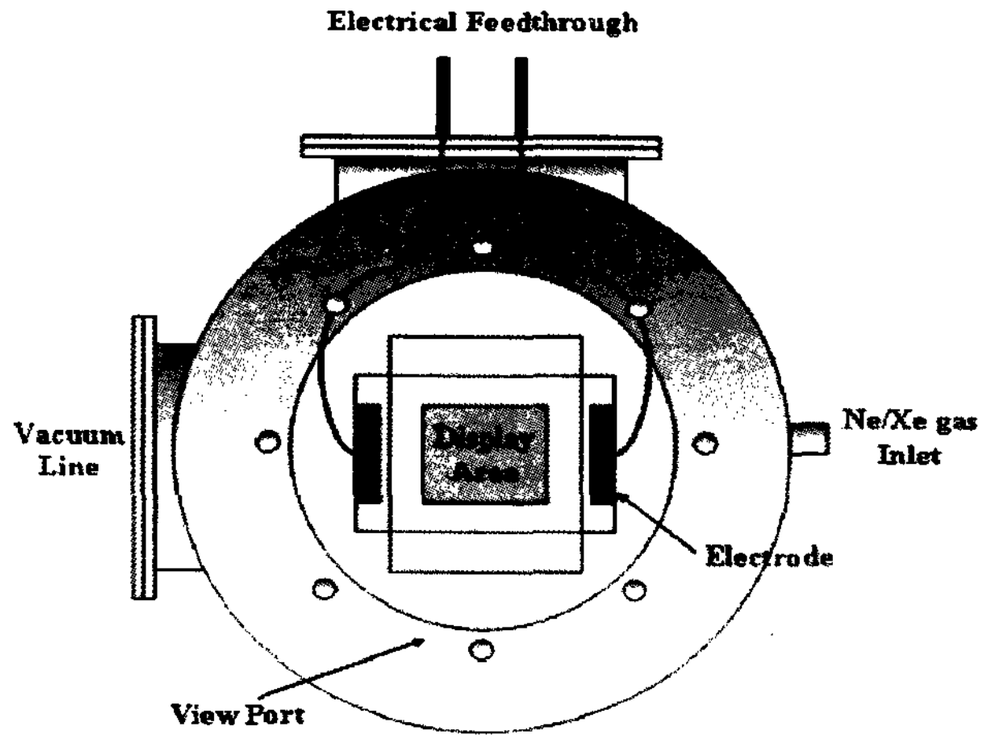


Figure 3 Schematic of discharge chamber.

First we examined the luminance, luminous efficiency and operating voltage without sealing and putting the assembled front and rear plate into a measuring vacuum chamber such as shown in Fig.3.

3. Results and discussion

As time passed, the overall firing and sustain minimum voltages decreased due to the self cleaning effect of MgO surface by discharge as shown in Fig.4. It also shows that the firing and sustain minimum voltages of the part protected by SAMs shows slightly lower than those of unprotected part.

Fig.5. shows the luminance and luminous efficiency of both parts. The part covered by SAMs shows much higher, well sustained luminance and luminous efficiency than those of uncovered part.

Next, we compared the discharge characteristics of whole test panels with and without SAMs. Fig.6. shows the panel with SAMs exhibits much lower sustain minimum voltage. Fig.7. and 8 show the panel with SAMs exhibits much higher, well maintained luminance and luminous efficiency than the one without SAMs which may results from the discharge gas contamination by the H_2O, CO_2 coming out from $Mg(OH)_2$ and $MgCO_3$.

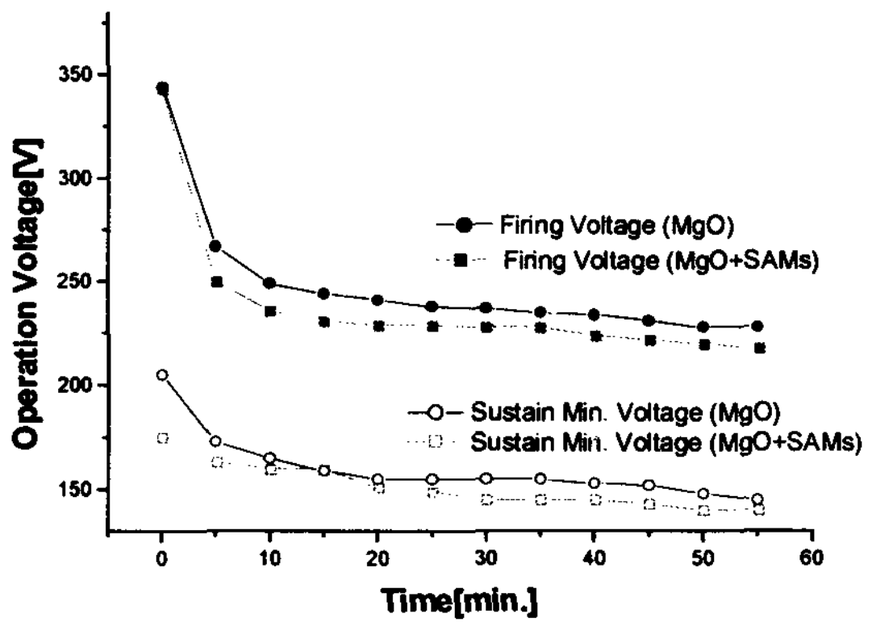


Figure 4 The operation voltage of Test-Panel as a function of discharge time.

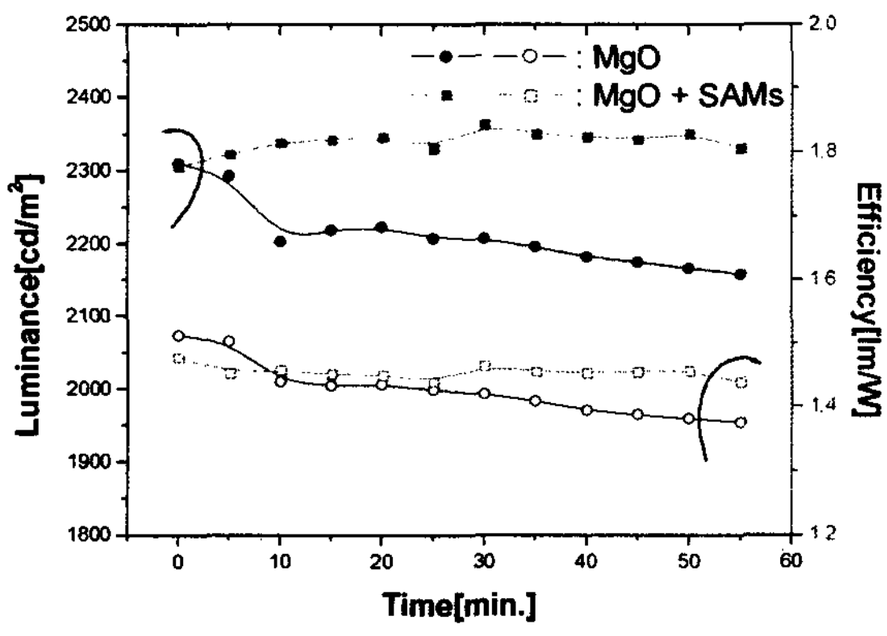


Figure 5 The luminance and luminous efficiency as a function of discharge time.

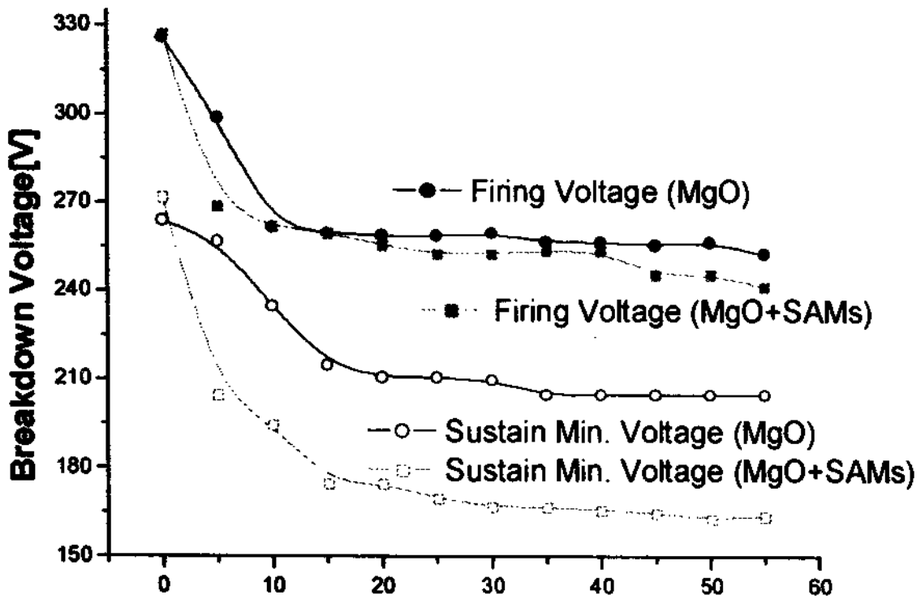


Figure 6 The operation voltage of whole panel as a function of discharge time.

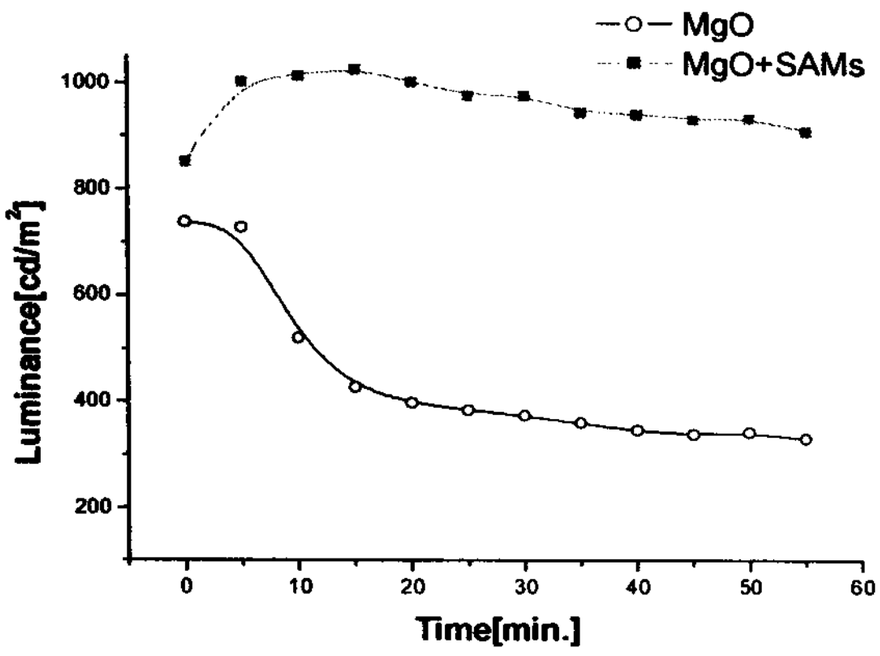


Figure 7 The luminance as a function of discharge time.

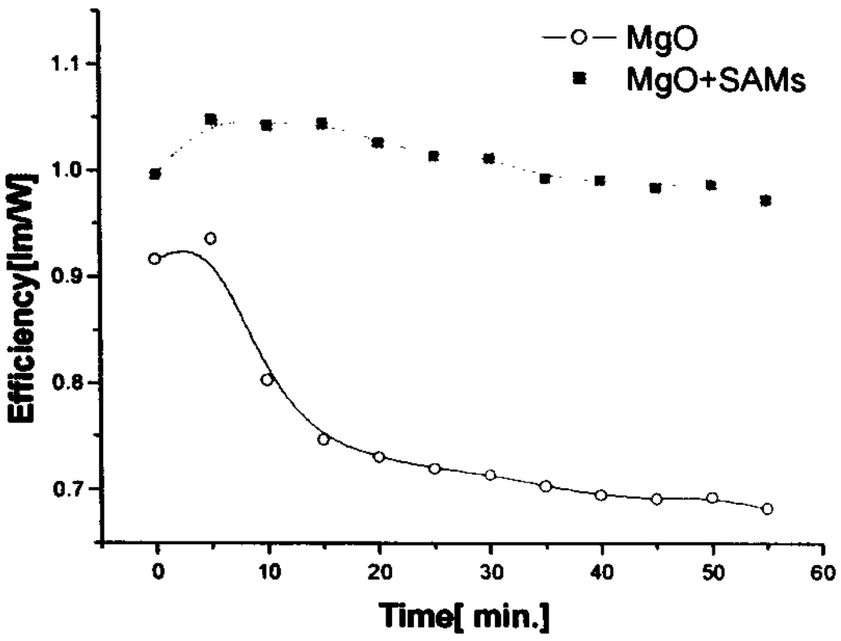


Figure 8 The luminous efficiency as a function of discharge time.

4. Conclusion

In this study, we suggested an application of SAMs(Self-Assembled Monolayers) to protect MgO surface from hydration and carbonization. XPS study shows that SAMs can suppress MgO surface hydration and carbonization. When SAMs was applied to test PDP, the panel with SAMs showed much improved discaharge characteristics such as lower discharge voltage, higher luminance and luminous efficiency.

5. References

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