The effects of high Xe contents on the improvement of luminous efficacy of AC PDP with Segmented electrode in Delta color arrayed Rectangular subpixels(SDR)

Tae Jun Kim, Dong Cheol Jeong, Woo Joon Chung, Ki Woong Whang
School of Electrical & Computer Engineering, Seoul National University,
San56-1 Shinlim-dong Kwanak-gu, Seoul, Korea

E-mail : tjkim@pllab.snu.ac.kr, Phone : +82-2-880-7253

Abstract

In this paper, we investigate the characteristics of luminous efficacy as a function of Xe partial pressure in AC PDP. SDR structure has shown much larger increment of luminous efficacy compared with the conventional one especially below 10% Xe contents. The luminous efficacy around 4.0 lm/W is achieved with Ne-Xe10%, 400Torr in Monochrome green phosphor test panel under 10kHz continuous sustaining frequency.

1. Introduction

AC PDPs need to improve many of their display characteristics especially the luminous efficacy. Many attempts have been made to increase the luminous efficacy such as the optimization of gas mixture

Recently, the high Xe content discharge gas is frequently adopted for its features of increasing luminous efficiency considerably.[1] It was reported that the luminous efficacy is increased with increasing the sustaining voltage with high Xe and high pressure.[2]

To apply high Xe contents in conventional AC PDPs, the most serious drawback that has to be solved is high breakdown voltage levels. If we can decrease the breakdown voltage without any loss in luminous efficacy, it would be the best solution to get high luminous efficacy with high Xe contents. However, it is intrinsically very difficult to decrease breakdown voltage level with high Xe contents because its heavy mass lowers electron temperature. Therefore we can take another route to increase the luminous efficacy with high Xe contents. It is to find optimal structure that exhibits the highest luminous efficacy at the moderate Xe contents, which does not raise breakdown voltage significantly. We need the breakdown voltage of the structure not to be sensitive to the increasing Xe contents. The more luminous efficacy increment per unit additional Xe content is the better.

In search of the optimal structure for high Xe environment, we applied high Xe contents to SDR(Segmented electrode in Delta color arrayed Rectangular subpixels) structure that showed 30% higher efficiency than the conventional structure did.[3] We have compared the luminous efficacy improvement of SDR structure for increasing Xe contents with that of the conventional one. We report here the luminous efficacy characteristics of SDR structure as a function of Xe contents, which has shown much larger efficacy increment than that of the conventional one.

2. Experimental Setup

The conventional structure is the most popular reflective type with 3-electrode surface discharge structure. The SDR structure used here is shown in Fig. 1.[3] The SDR structured AC PDP consists of rectangular barrier rib arrayed in delta shape and segmented sustain electrode for each subpixels. There is no sustain electrode over vertical barrier ribs and bus electrode is exactly aligned over horizontal barrier ribs.

The test panels are driven with continuous sustaining pulses of 25% duty, 10 or 50kHz square wave. Xe content is varied between 4% and 16%. Total gas pressure is changed from 400 to 600torr.

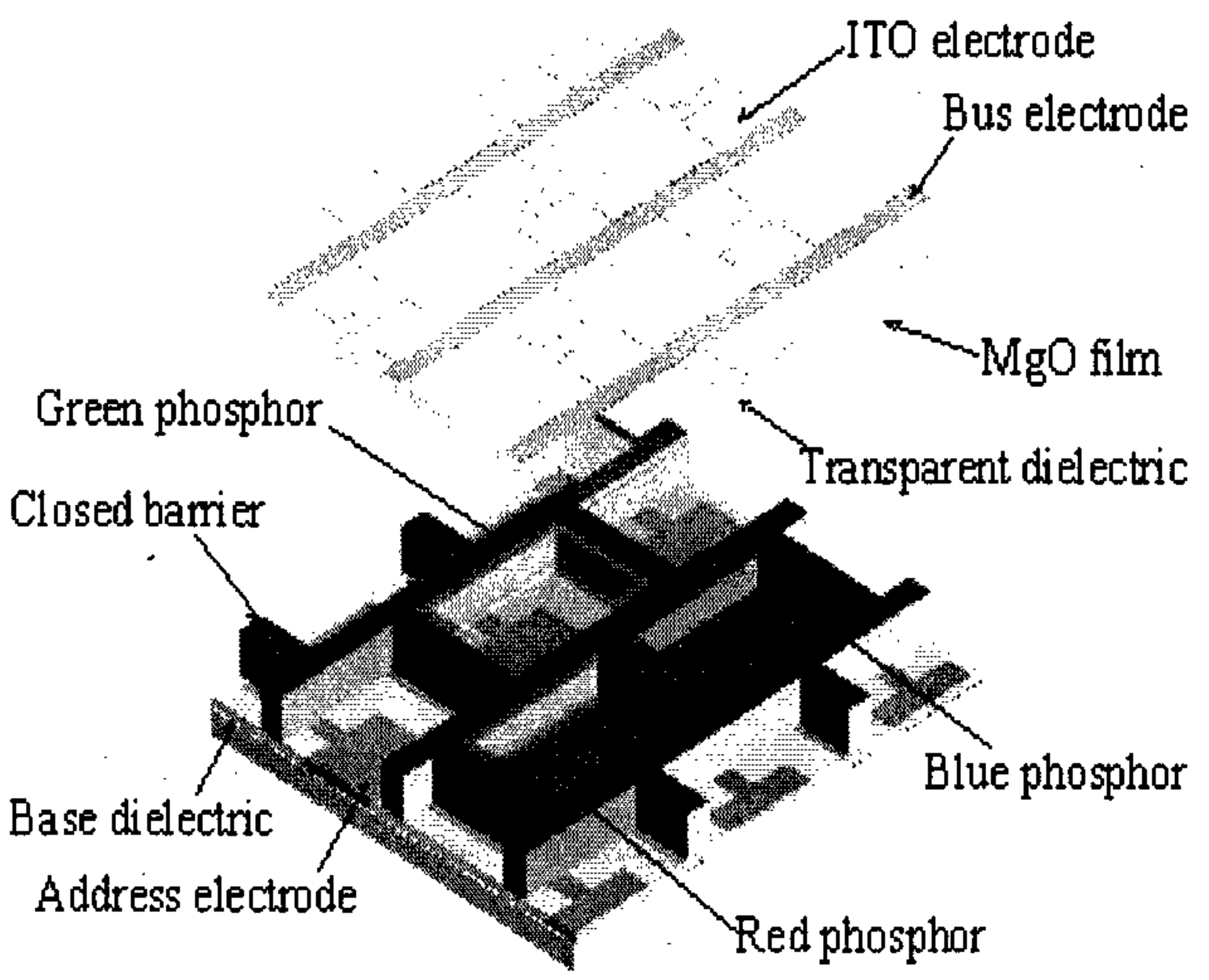


Fig. 1 SDR(Segmented electrode in Delta color arrayed Rectangular subpixels) structure

3. Results

The luminous efficacy which is measured at the middle of sustain voltage margin as a function of Xe contents 4, 8, 12% and total gas pressure 400, 500, 600Torr at 50kHz continuous sustaining in SDR structure is shown in Fig. 2. The luminous efficacy increment was more sensitive to total gas pressure than to Xe partial pressure. The efficacy increment for gas pressure of 100Torr is comparable to the amount when Xe contents increase about 2%.

It is well known that the breakdown voltage and the sustain voltage margin increase as the Xe contents and gas pressure increase. In Fig. 3, the voltage margin of conventional and SDR structure is shown. The sustain and firing voltages increased about 5 and 8V in SDR respectively, which results in 3V wider sustain voltage margin per 1% additional Xe. The middle of sustain voltage margin is increased 7V/1%Xe. That means that if we add 10% more Xe to gas mixture, we have about 70V higher middle sustain voltage.

Luminous efficacy at the middle of sustain voltage margin at 400Torr as a function of Xe concentrations under 10kHz continuous sustaining are depicted in Fig. 4. SDR structure shows higher luminous efficacy improvement than that of the conventional structure. Both structures showed a slight saturation in luminous efficacy over 10% Xe contents. The SDR structure shows much higher efficacy improvement especially below 10% Xe contents.

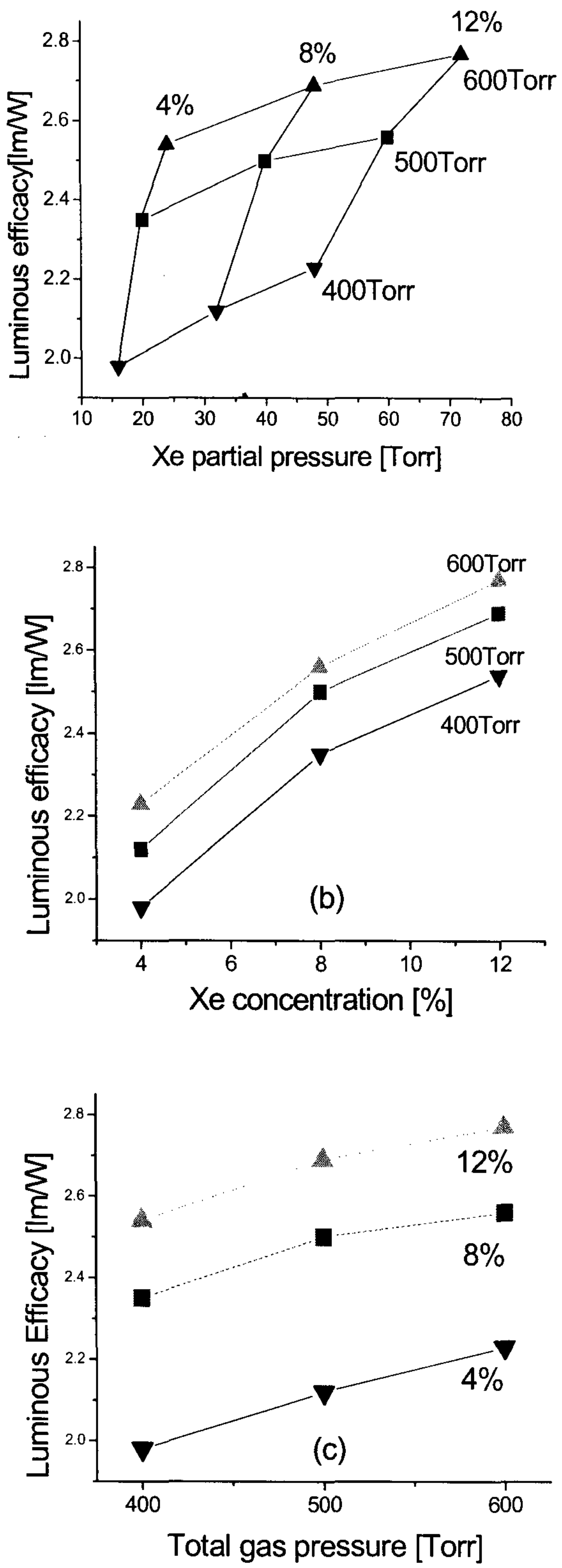
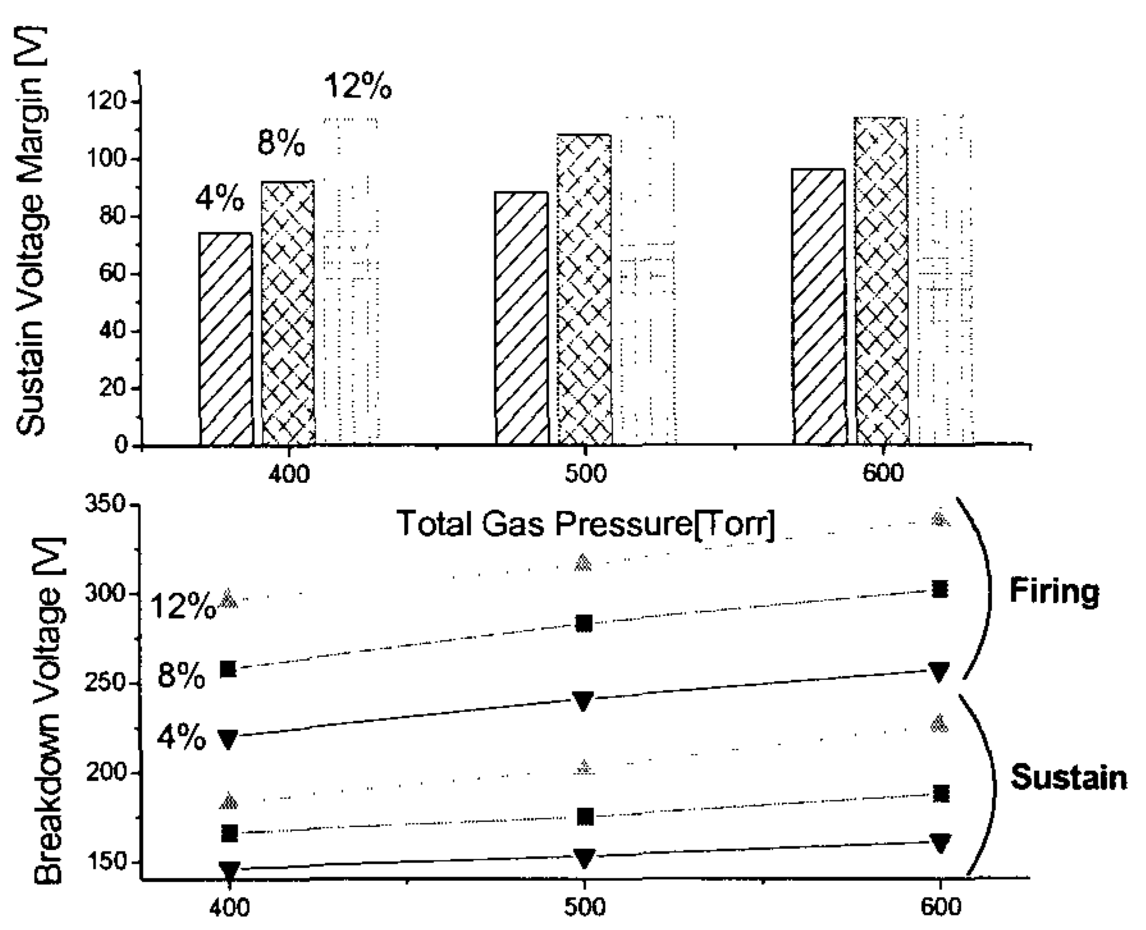
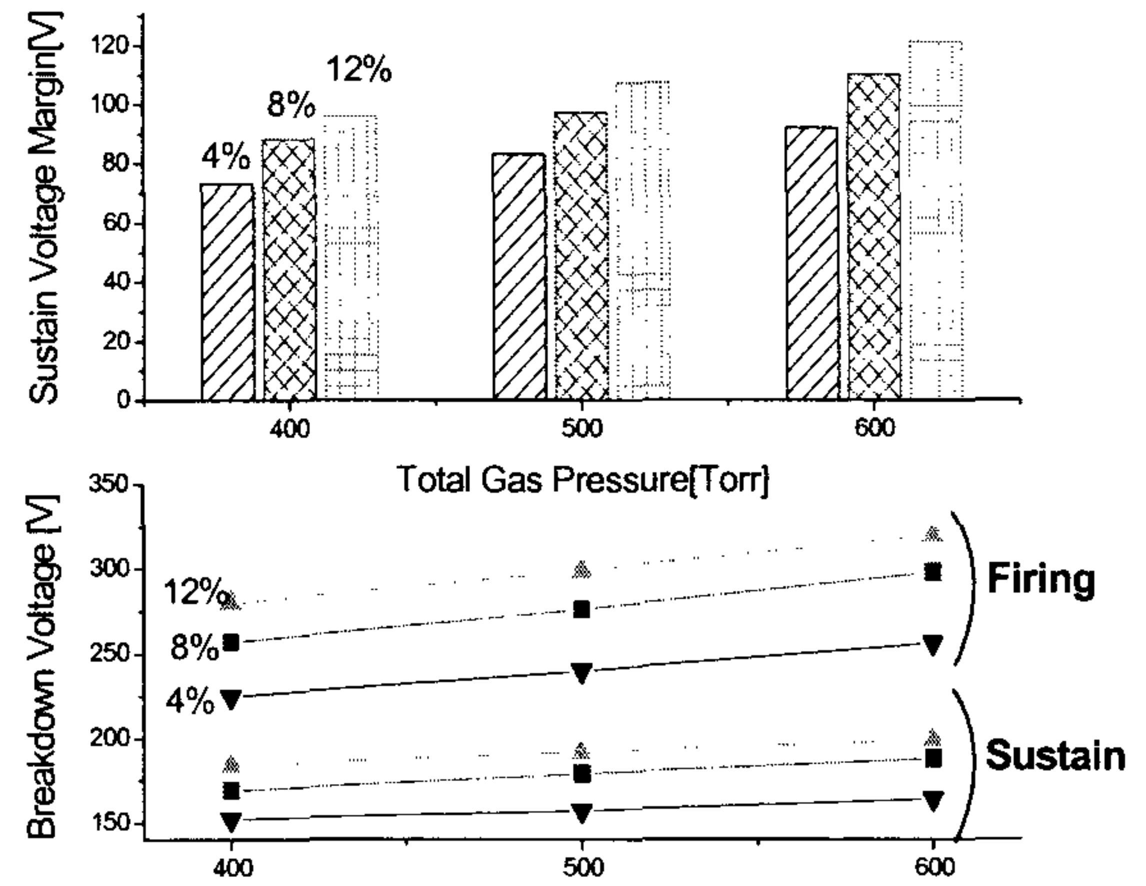


Fig. 2 Luminous efficacy development trends in SDR structure as a function of (a) Xe partial pressure(Torr), (b) Xe concentration(%), (c)total gas pressure(Torr)



(a)



(b)

Fig. 3 Sustain voltage margin as a function of Xe contents and total gas pressure in (a) Conventional (b) SDR structure

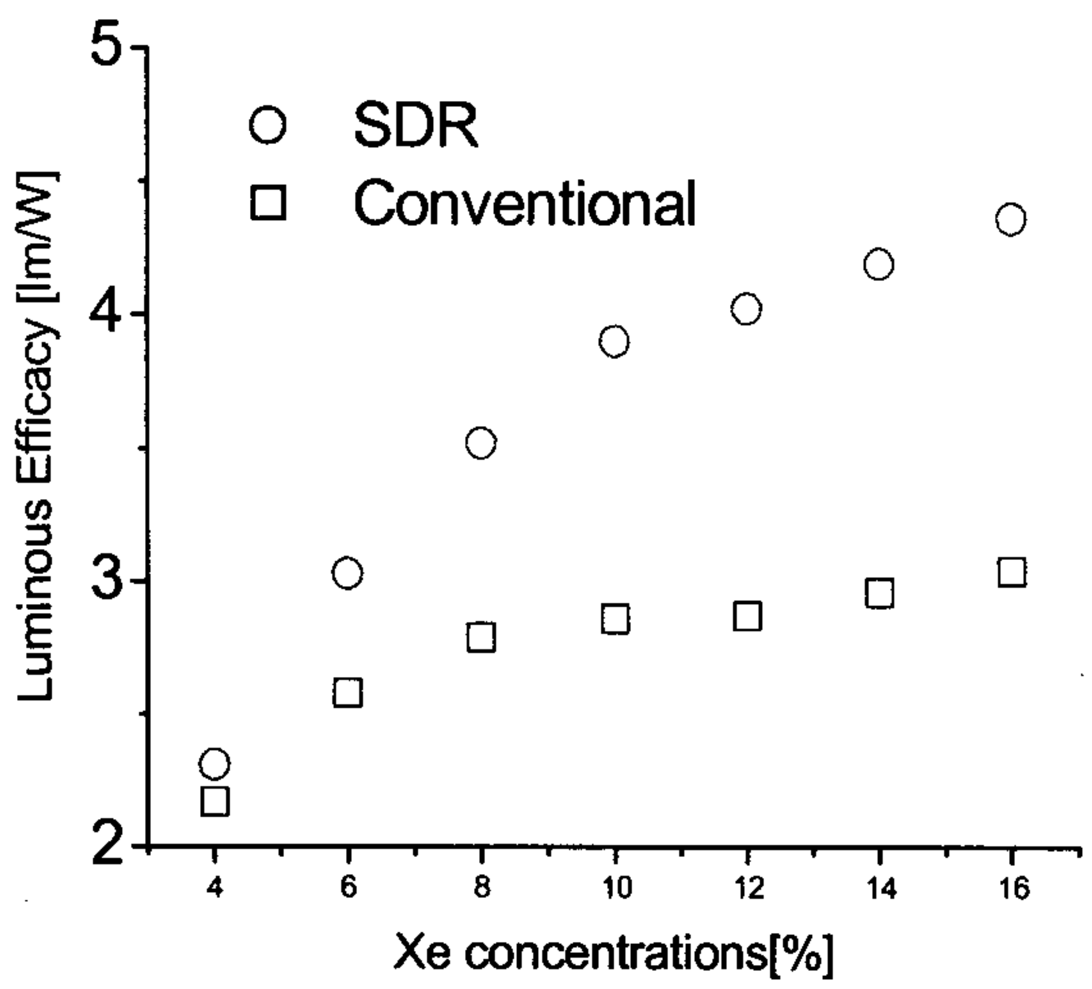


Fig. 4 Luminous efficacy as a function of Xe concentrations

4. Summary

The experimental results show an interesting difference in the luminous efficacy increment between the conventional and SDR structures as the Xe contents increase. The luminous efficacy around 4.0 lm/W is achieved at Xe 10% 400Torr. An attempt to understand this phenomenon is undergoing and may be helpful to design high luminous efficacy AC PDP cell structure.

5. References

[1] G. Oversluizen, S. de Zwart, T. Dekker, and M.F.Gillies, "The route towards a high efficacy PDP", SID'02 pp848-851, 2002

[2] G. Oversluizen, S. de Zwart, S. van Heusden and T. Dekker, "Dependence of PDP efficacy on the gas pressure", IDW'00, pp631-634, 2000

[3] C. K. Yoon, J.H.Yang, W.J.Cheong, K. C. Choi and K.W.Whang, "High luminance and efficacy AC-PDP with segmented electrode in delta color arrayed rectangular subpixels", IDW'00, pp.627-630, 2000