The New Electrode Shape for Xe of High Density in AC PDP

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Abstract

One of the most serious problems in AC PDP is low luminous efficiency. One possible candidate for solving such a problem is using high Xe partial pressure. Increase of Xe percentages causes the driving voltage to rise, although brightness is increased. In this study, a new electrode structure is proposed to solve this problem. A test panel fabricated by using new electrode shows improvement of efficiency by 25% and reduction of sustain voltage by 20% compared with the conventional structure.

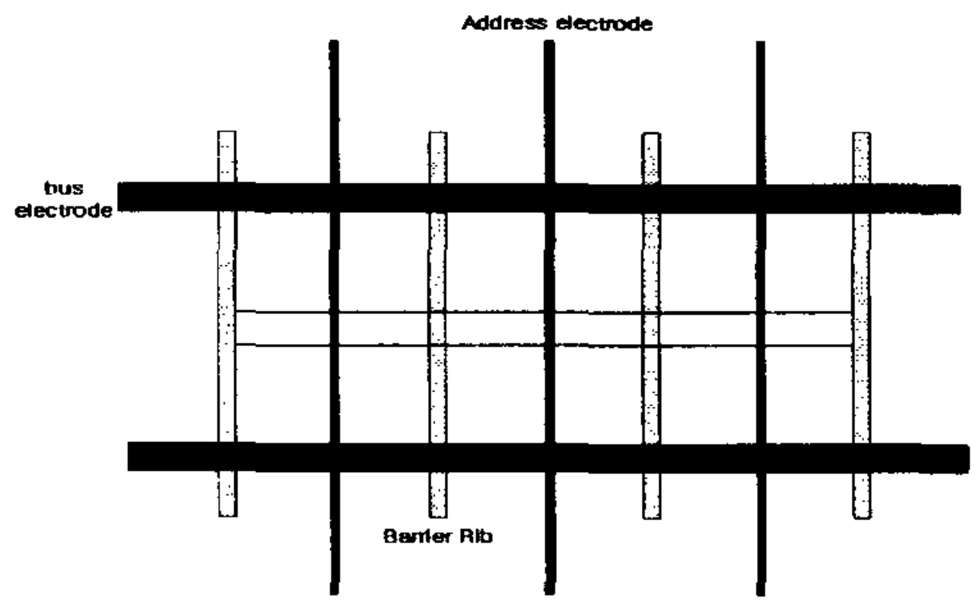
1. Introduction

The alternating current plasma display (AC PDP), which has been under the development for almost 30 year, has been improved remarkably in the past several years and is realized to open up a new and large display market. However, the full white efficiency in present PDP, typically about 1 lm/W, is rather low in comparison with CRT and limits the brightness. [1,2] Hence, efficiency improvement is a major objective in plasma display research. The luminous efficiency of PDP is given by following elemental efficiency: (1) the efficiency of the generation of vacuum ultraviolet (VUV) in plasma, (2) the efficiency of the transportation of VUV from the discharge volume to the phosphor surface in a discharge cell, (3) the efficiency of the transformation of VUV to visible light (phosphor efficiency), and (4) the efficiency of the utilization of the visible light. From these elemental efficiencies, the VUV production efficiency is expected to make the largest contribution to increase the luminous efficiency. [3-5]

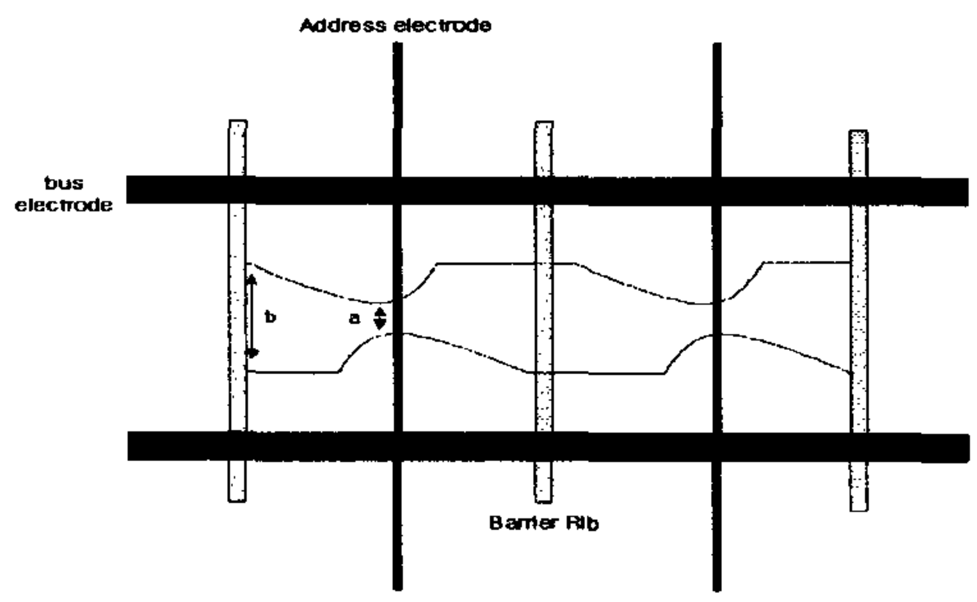
In this paper, in order to improve the luminous efficiency and luminance of AC PDP, high Xe percentage (10%) in working gas of Ne+Xe is used. Moreover, in order to reduce driving voltage, a new ITO electrode shape is proposed.

2. Fabrication of Test Samples

Table 1 shows the specification of test panel. Especially, ITO gaps of the suggested electrodes are changed to find an optimal shape. Fig. 2-1 (a) shows the conventional electrode that is adopted actually in AC PDP. Fig. 2-1 (b) shows the suggested electrode to realize high efficiency and low driving voltage. In this figure, the variable is the gap length, 'a' and 'b'. Fig. 2-2 shows the manufacturing process of front and rear panel in AC PDP. First of all, the front panel first goes through the patterning of ITO electrodes by the photolithography methods. And then, Bus electrodes, conductivity layer (Ag paste), are formed by the photolithography. Dielectric layers are made by screen-printed method on bus electrodes. Sealing glass layers are applied to the perimeter of the display area and pre-fired. This sealing glass will join the front and rear plates in the assembly of the panel and finally protective layer, MgO, is evaporated on the front panel. [6-8] The manufacturing process of the rear panel has a little difference from that of the front panel. A small hole is first made in a corner of the rear plate to connect to the vacuum system. Address electrodes (Ag paste) are first printed and next dielectric layers. The barrier ribs are formed by sandblast method and fluorescent material is printed among the ribs. After assembling the front and rear plates, the panel goes through the firing process as the frit glass of low-melting point seals the plates together. [9,10] Baking process under vacuum is provided to remove the contaminations adsorbed on the inner surface of the panel and to activate the protective layer. Finally, Penning mixture gas is admitted into the panel. The panel is then operated under the condition of somewhat higher voltage than firing voltage. [11-13] This aging operation cleans and activates the protective layer. This lowers the operating voltage and increases the uniformity on account of reducing the differences of the operating voltage over several regions of the panel. [14]



(a) Conventional electrode



(b) Suggested electrode

Fig 2-1. Schematic diagram of Conventional structure and Suggested structure

Table. 1 Specification of test panel

GAS	Ne(90%) + Xe(10%)		
		Conventional structure	Suggested Structure
Front Glass	ITO Gap	60um	a : 30 ~ 40um b : 50 ~ 80um
	ITO Width	310um	310um
	Dielectric Thickness	30um	30um
	MgO Thickness	5000Å	5000Å
	Bus Electrode width	100um	100um
Rear Glass	White-back Thickness	15um	15um
	Barrier Height	130um	130um
	Phosphor Thickness	30um	30um
	Address Electrode width	100um	100um

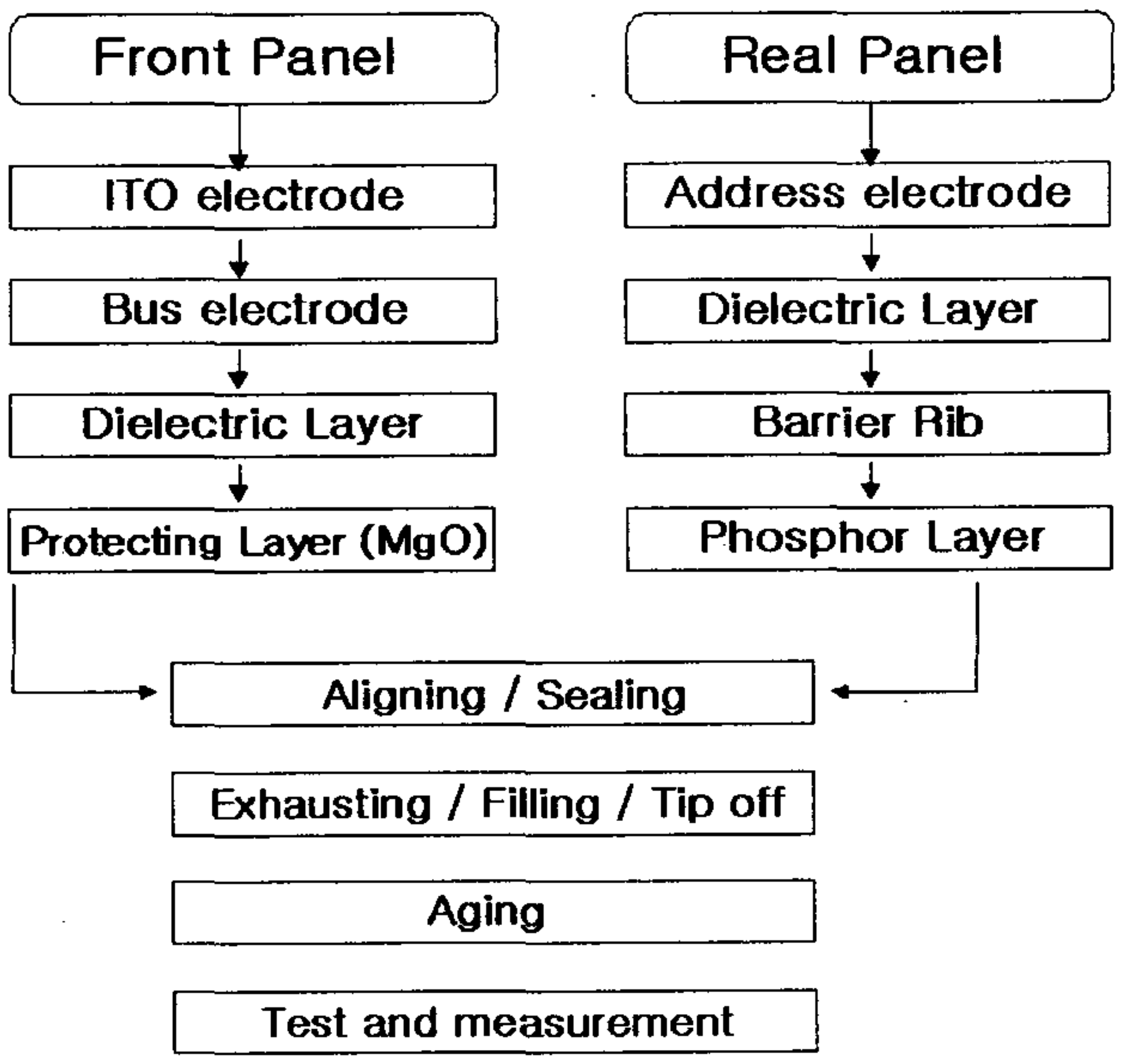


Fig 2-2. Flowchart of manufacturing process in AC PDP

3. Experimental Result and Discussion

3-1. Luminance

Table 2 and 3 show the static characteristics of the conventional electrode and suggested electrode. In this table, 'S 3060' means the gap 'a' is 30um and the gap 'b' is 60um. Fig 3-1 shows the relationships between luminance and the type of electrodes. In this figure, 'S 3070' shows the highest luminance. [15,16]

3-2. Luminous efficiency

Fig 3-2 shows the results of luminous efficiency for the conventional electrode and the suggested electrode. In this figure, 'S 3070' also shows the highest luminous efficiency. [17]

3-3. Dynamic margin

Fig 3-3 and Fig 3-4 show dynamic margin for the conventional and suggested electrodes, respectively. Fig 3-3 (a) and Fig 3-4 (a) show the relationships between the erasing (Vsetup) versus the displaying (Vsus). Fig 3-3 (b) and Fig 3-4 (b) show the relationships between the writing (Vadd) versus the displaying (Vsus). [18]

In Fig 3-3 (a) and Fig 3-4 (a), the part within a window shows the satisfactory operation area. Namely, this area is the region between the maximum voltage and the minimum voltage where addressing is performed correctly under the condition of actual driving. Therefore, the wider this area, the more stable. The suggested electrode (Fig 3-4(a)) is almost the same with the conventional electrode (Fig 3-3(a)).

Fig 3-3 (b) and Fig 3-4 (b) represent the relationships between the write voltage (Vadd) and the sustain voltage (Vsus). Similarly, the suggested electrode is almost the same with the conventional electrode.

Table 2. Static characteristics of the suggested electrode

	Vfmax	Vfmin	Vsmax	Vsmin
S 3050	197	176	133	126
S 3060	205	184	157	129
S 3070	225	215	159	146
S 4060	208	200	159	131
S 4070	218	216	156	146
S 4080	237	216	161	149

Table 3. Static characteristics of the conventional electrode

	Vfmax	Vfmin	Vsmax	Vsmin
Conventional Structure	250	216	181	159

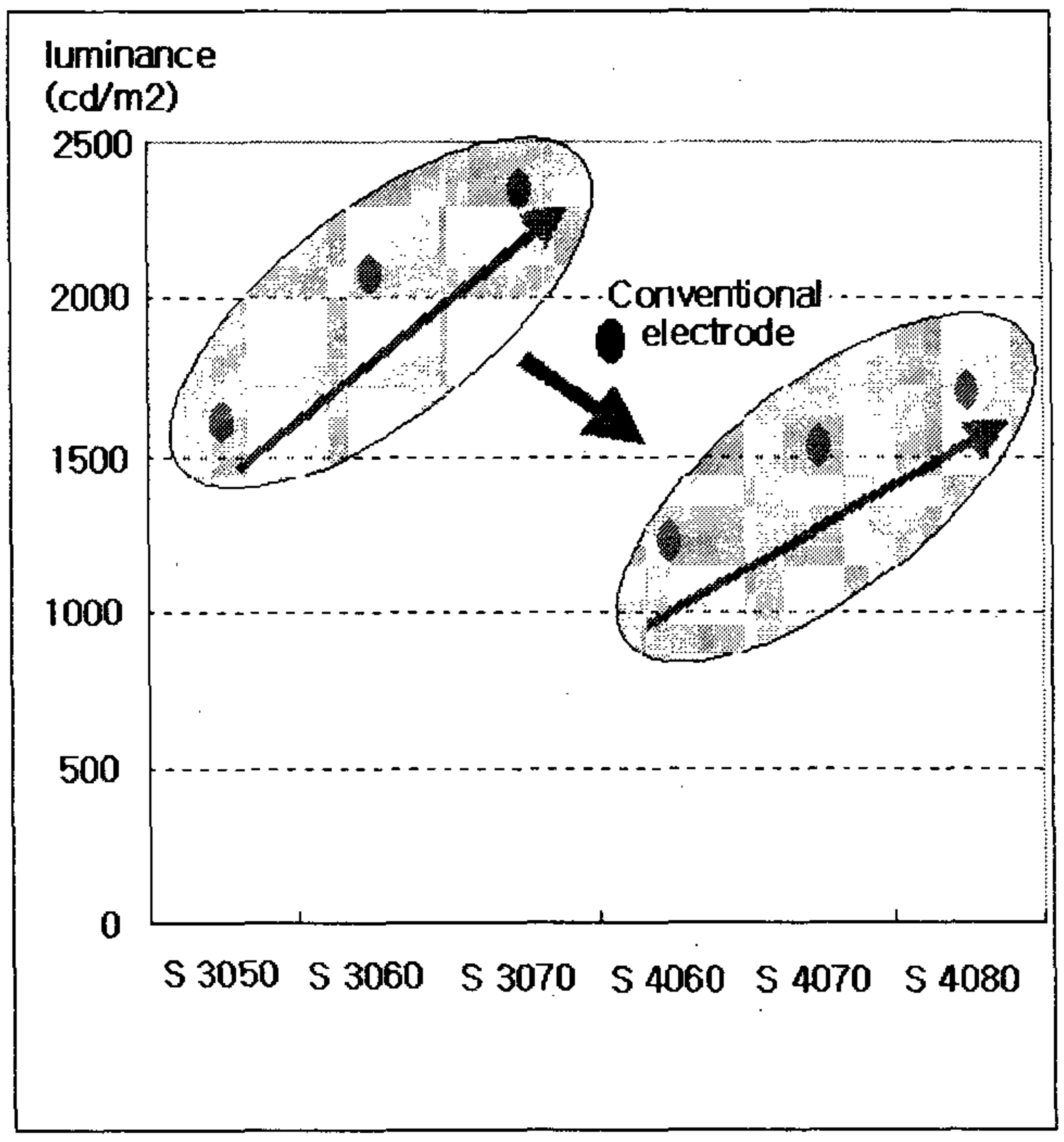


Fig3-1. Luminance change in the Conventional and the Suggested electrodes

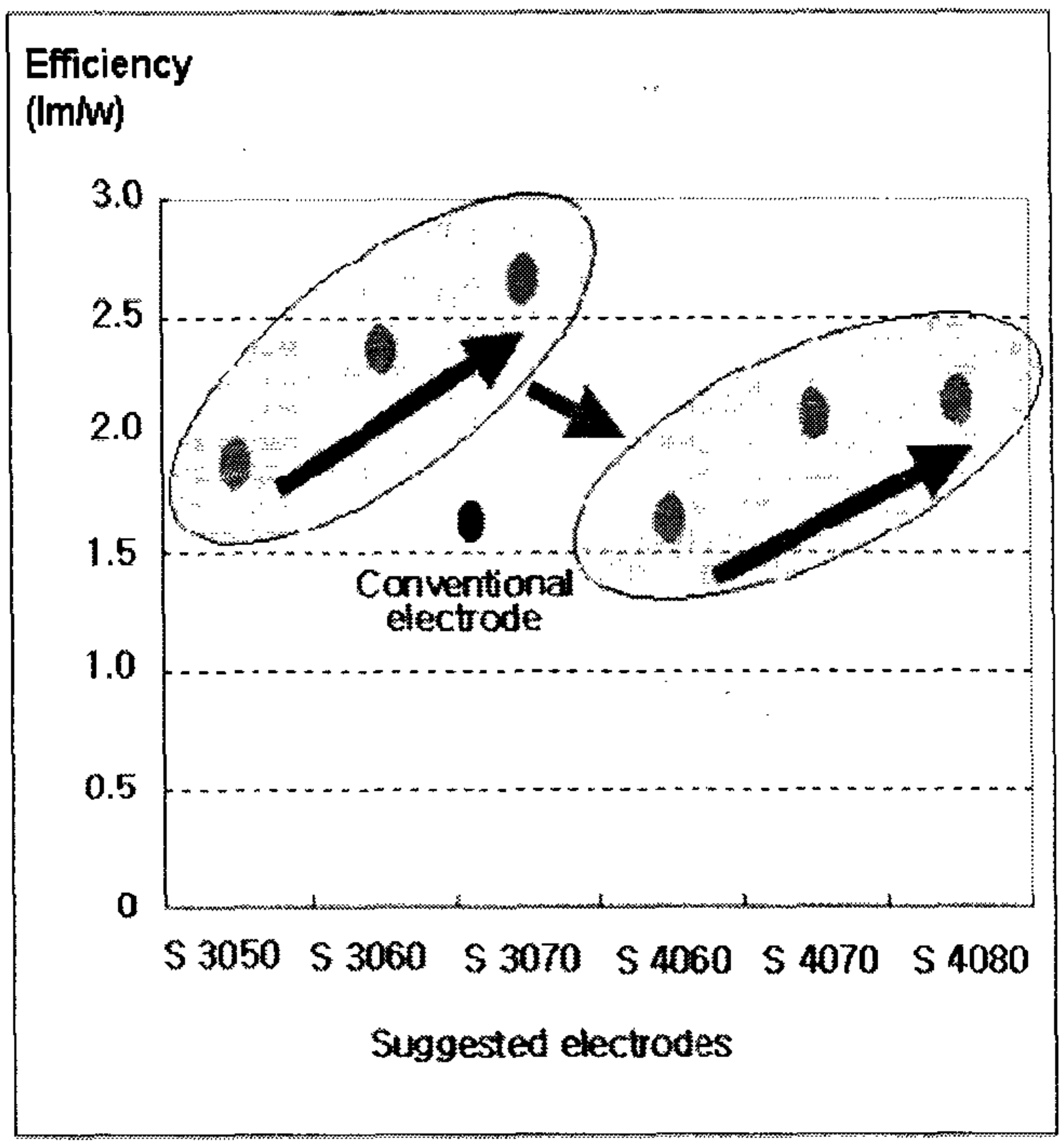
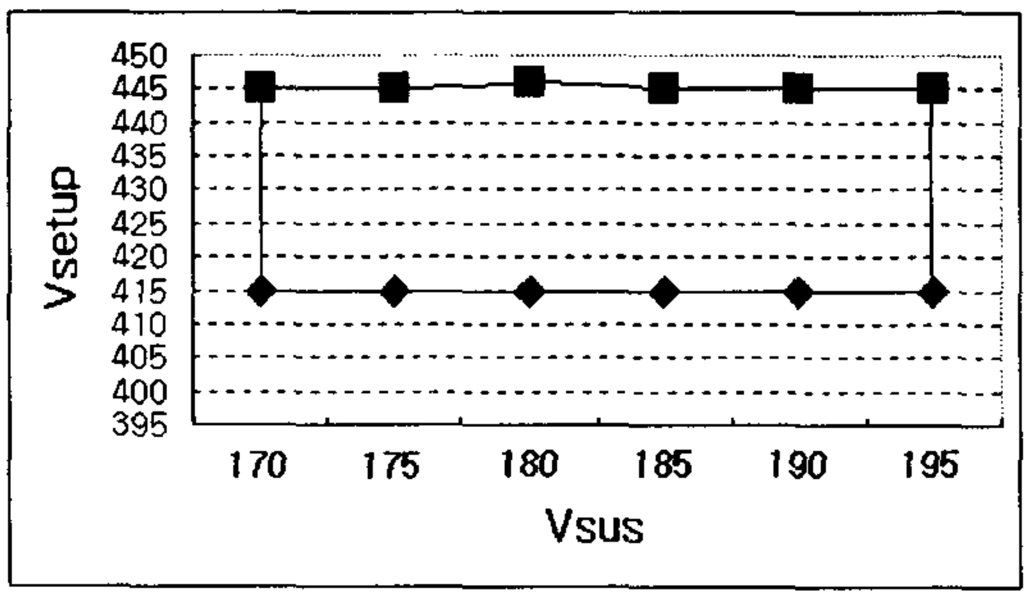
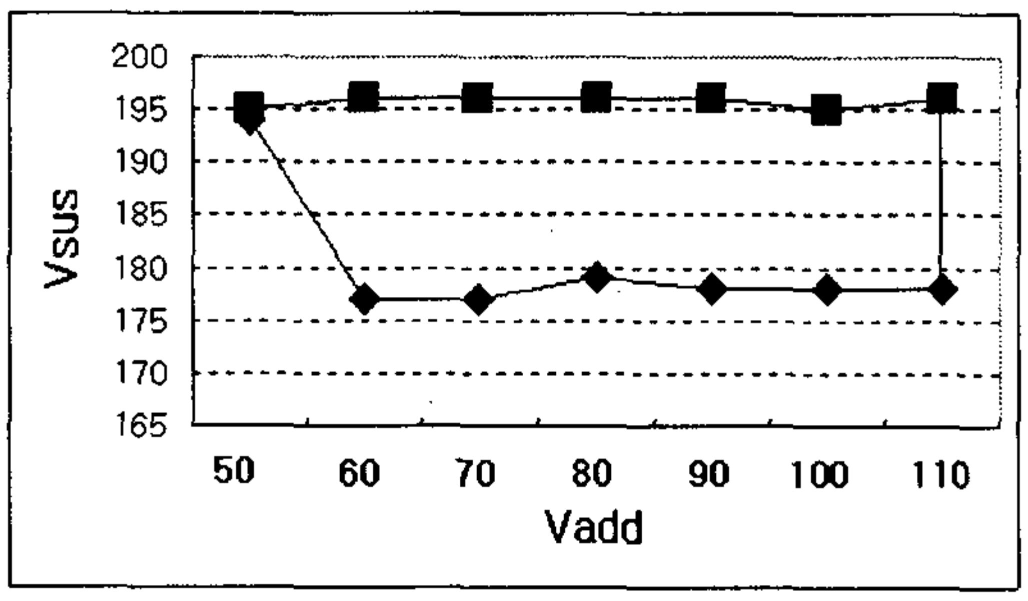


Fig 3-2. Luminous efficiency change in the Conventional and Suggested electrodes

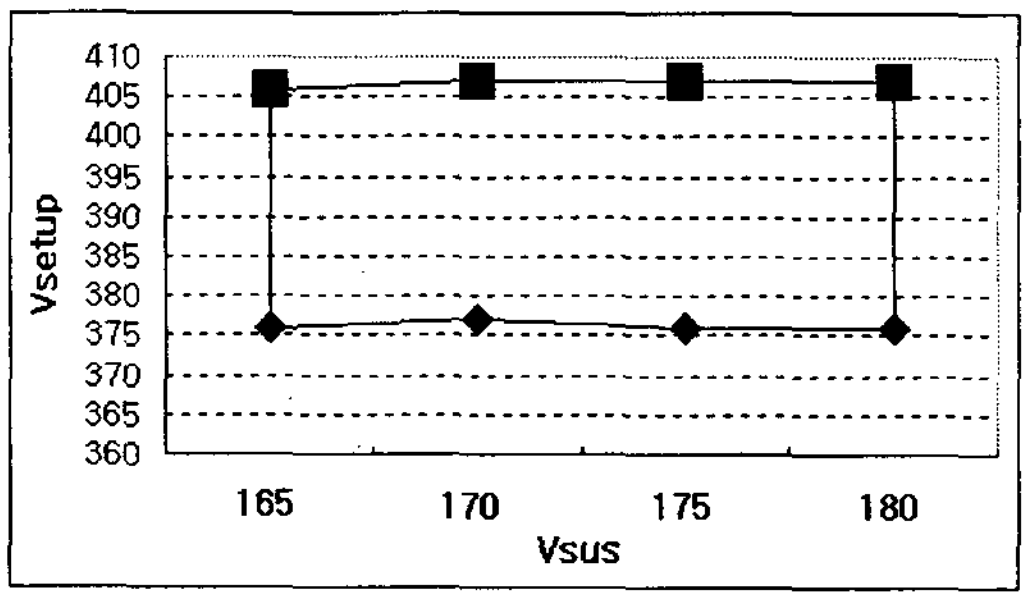


(a) Dynamic margin of Vsetup versus Vsus

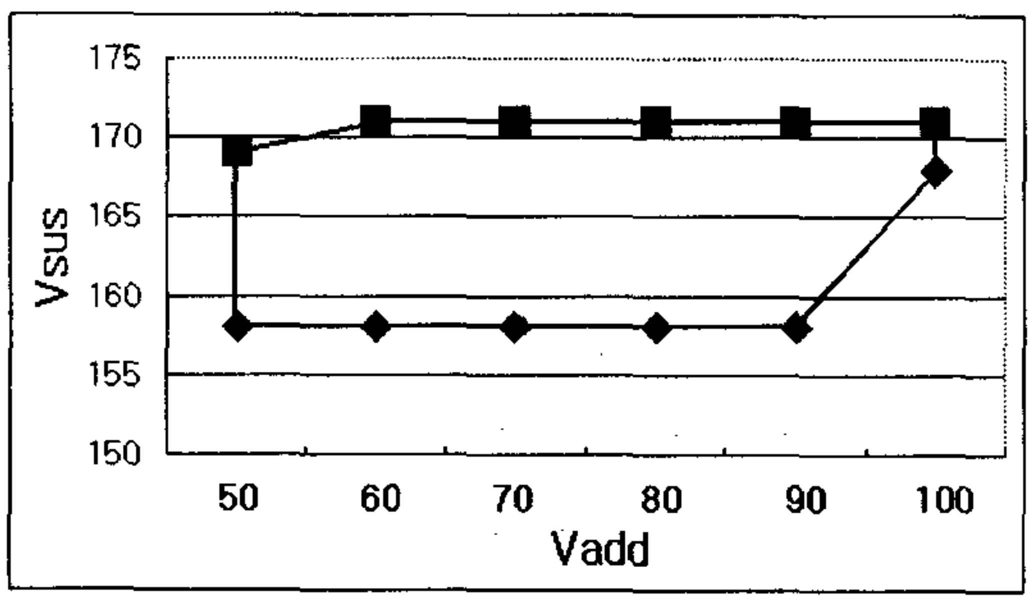


(b) Dynamic margin of Vsus versus Vadd

Fig 3-3. Dynamic margin of the conventional Structure



(a) Dynamic margin of Vsetup versus Vsus



(b) Dynamic margin of Vsus versus Vadd

Fig 3-4. Dynamic margin of the suggested Structure

4. Conclusion

In this paper, in order to improve luminous efficiency in AC PDP, a new discharge electrode structure is proposed and the characteristics of electro-optics, dynamic margin and contrast ratio are also investigated. The suggested 'S 3070' electrode shows higher luminous efficiency by 25% and lower sustain voltage by 25% than the conventional electrodes. Furthermore, the suggested electrode shape 'S 3070' shows almost the same dynamic characteristics with conventional one.

5. References

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