A New Firing Process Method by Using RTS System for Transparent Dielectric Layer of PDP

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Abstract

The conventional firing process method for the transparent dielectric layer in PDP Technology has disadvantages of low through put, high power consumption and large process area. We propose the rapid thermal scinterring (RTS) method as new process method to overcome these disadvantage characteristics. As the experimental result of this method, the optic transmittance(wavelength : 600nm) rate of transparent dielectric layer was more improved than conventional furnaces under the optimized gas supplying. Further, it was certified this method had the best conditions on the firing process of the PDP transparent dielectric layer.

Introduction

The transparent dielectric layer for PDP is made with low-melting point lead glasses. The optic transmittance rate of transparent dielectric layer about wavelength 600nm in PDP is required as high as possible through the firing process at 580℃. It takes 5~7hours to fire it by conventional furnaces. As conventional firing processes are done with heating air circulation methods, a lot of particles are easily attached, and then, after firing process, the layer surface and structure are contaminated. Finally, the optic transmittance rate is induced lowly. The most serious disadvantages of conventional furnaces are to require a huge equipment space and a high power consumption.

In order to overcome these disadvantages of conventional furnaces, we selected a clean method by the infrared absorption heating using halogen lamps. This RTS system was nearly same with the RTP system which used in semiconductor for rapid thermal processing technology [1][2][3].

Consequently, As we have reduced thermal rising time and thermal falling time, we have obtained the rapid firing process time. It has been confirmed the optic transmittance rate has heen affected by gas atmosphere in the firing process.

Experimental Process

The dielectric layer on a sodalime glass was coated by a screen printing method using the paste. Through a screen mesh(SUS #325), the high-softing point paste of NP-7972C(Noridake Co.) was printed on the sodalime glass(9 × 6cm, t=0.2cm) once, and next the NP-7973C(Noridake Co.) of same kind was printed on the NP-7972C material three times. The total height of coated dielectric layers will be approximately 55 ㎛. After coating, dielectric layer was just dried for 10 minutes at 80℃.

For the experiment, we split samples into two types for applying in RTS System and conventional furnace system, respectively. Targeted final firing temperature of total samples was set at 580℃.

Figure 1 shows the schematic diagram of RTS system. The upper chamber was set with halogen lamps. The temperature of sodalime glass measured by the thermocouple was inputted to the PID controller and the powers of halogen lamps were controlled by the PID controller. Quartz pins, quartz plate and ceramic plate

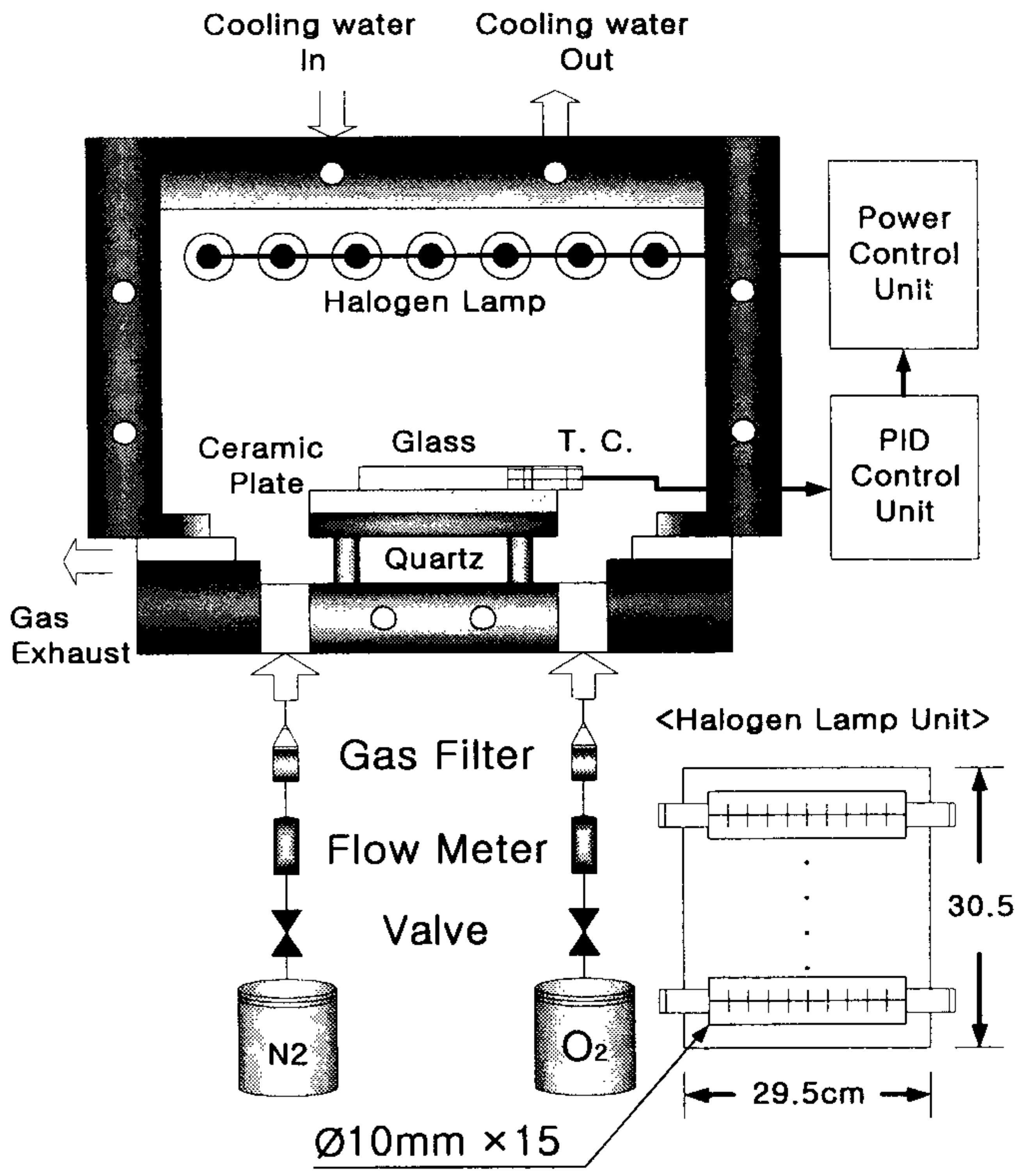

Figure 1. The schematic diagram of RTS system

were placed in the lower chamber. Because they had low heat conductivity, the cracks of sodalime glass due to the difference of thermal expansivity could be prevented. Dielectric samples in RTS system were also fired with two kinds of firing temperature profiles.

Figure 2 shows temperature profiles under various firing conditions. (a) is the temperature profile by RTS method for two hours, (b) is that by RTS method for 3 hours, and (c) is that by furnace for 6 hours, respectively.

In Figure 2 (a) and (b), firing process was done by the various mixture ratio of high-purity O_2 and N_2 gases. The mixture ratio about each sample is shown in Table 1, where are also written optic transmittance rates, firing temperture and firing meth

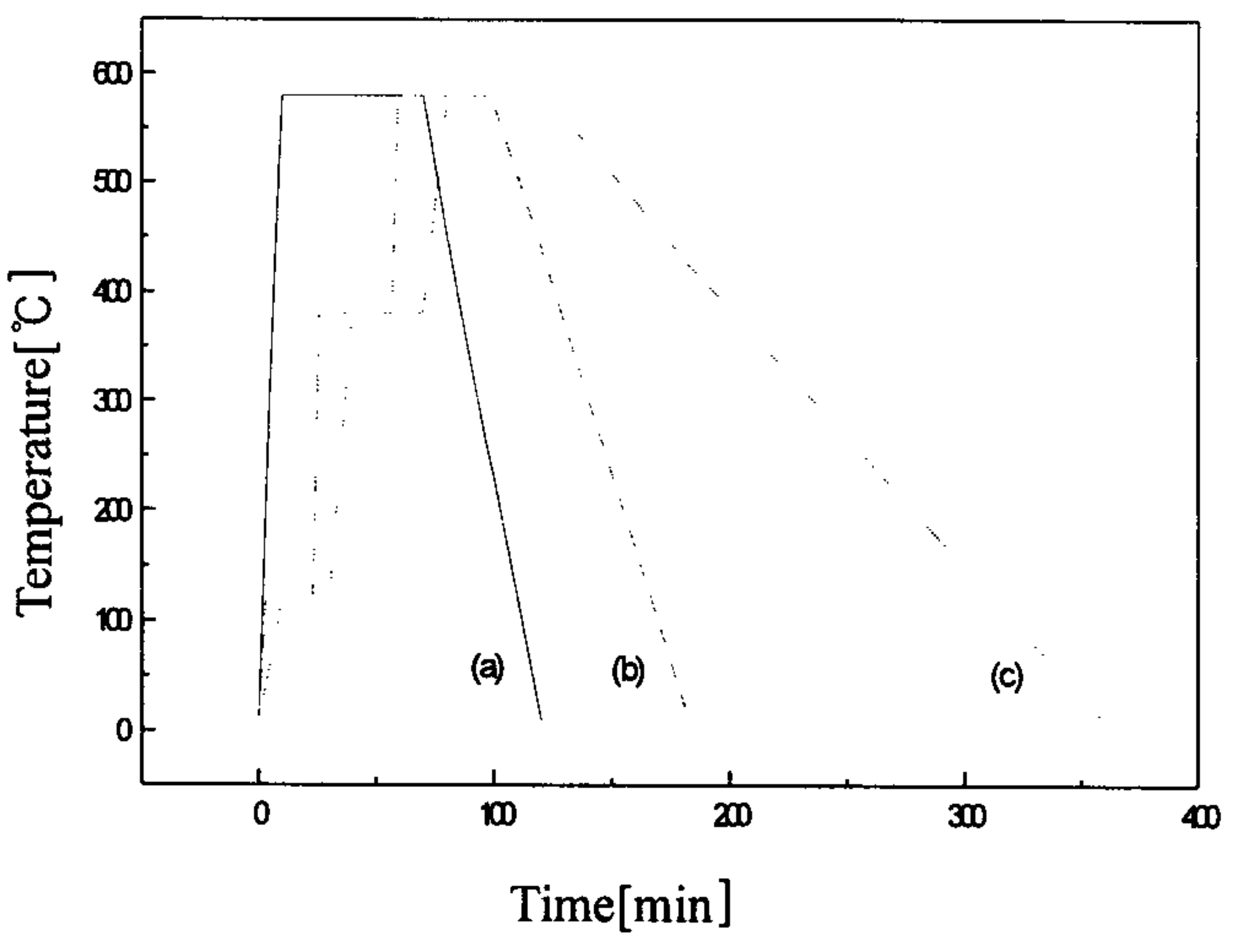

Figure 2. Temperature profiles of firing process.
(a) is by RTS method for 2 hours
(b) is by RTS method for 3 hours
(c) is by furnace method for 6 hours.

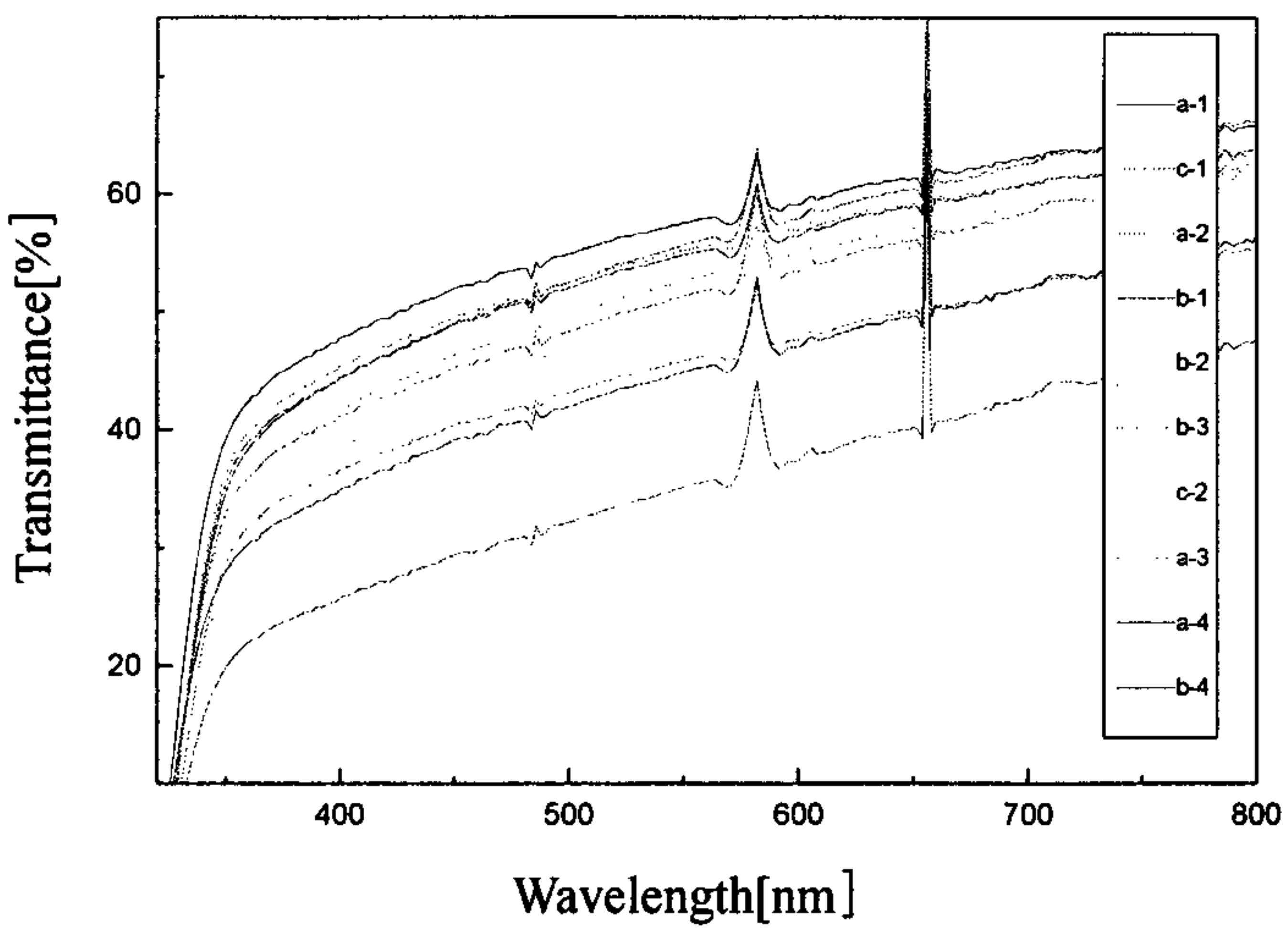

Figure 3. The comparison of optic transmittance rates between RTS system and furnace

-ods, respectively. The firing process by conventional furnace was done in air circumstance.

And then, transparent dielectric layers by conventional furnace were compared with those by RTS system in the aspect of optic transmittance rate.

Results and Discussion

After the firing process, all the samples' thicknesses were reduced to nearly 30 ㎛.

Figure 3 shows the comparison of optic transmittance rates under various experiment conditions. These were measured by a spectrophotometer(Hewlett Packard Co.). About wavelength 600nm, the top data line is a-1 and the bottom line is b-4 as we show in Figure 3 and Table 1. The optic transmittance rate of a-1 sample was presented to 59.1% under pure O_2 circumstance by RTS method. This value was a little high one as compared with furnace. This could be regarded (a) type samples as being annealed by the infrared absorption of RTS system. The b-4 value by pure N_2 circumstance presented the worst case with 37.4%. This reason could be regarded the glass surface as being damaged by the cooling effect of N_2 gas.

The (a) kind of samples by 2 hour-RTS method had more high optic transmittance rates than 3 hour-RTS method and 6 hour- furnace method. This could be regarded the firing process by RTS system as being possible to be processed by the infrared annealing effect, within a short time without cracking.

No	Optic Trans.	Firing Temp.	N_2	O_2	Firing method
a-1	59.1	580℃	0%	100%	RTS
c-1	57.9	580℃	In Air		Furnace
a-2	56.9	580℃	In Air		RTS
b-1	56.4	580℃	0%	100%	RTS
b-2	54.9	580℃	In Air		RTS
b-3	53.5	580℃	50%	50%	RTS
c-2	52.8	580℃	In Air		Furnace
a-3	47.6	580℃	50%	50%	RTS
a-4	47.0	580℃	100%	0%	RTS
b-4	37.4	580℃	100%	0%	RTS

*Temp.: Temperature, *Optic Trans.: Optic transmittance rate

Table 1. The comparison of firing conditions between RTS system and furnace

Conclusion

The new firing process method, RTS system for the transparent dielectric layer in PDP Technology was proposed. Through the high infrared emission of halogen lamps, we confirmed PDP glasses were easily heated by annealing effect. The optic transmittance rate of transparent dielectric layer by RTS system was improved under the optimized gas supplying. Besides, it is possible to be processed by the low power and in the short firing time, and to be reduced to small area for equipment space.

In the next time, we will try to improve the optic transmittance rate by advanced experimental methods and apply to the large glass samples of 20 inches and over.

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