Address Electrode for PDP by Ink-Jet Method

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Abstract

Several methods are available for the fabrication of electrode pattern for the plasma display panel(PDP) including screen printing and photolithographic method.

Piezo type ink-jet printing method is considered to the method of choice for electrode patterning in manufacturing of PDP. Both silver ink and absorbent layer paste formulation were developed for ink-jet printing of electrode pattern. The ink-jet printing of silver electrode with preformed absorbent layer was especially suitable for the patterning of address electrode for high resolution PDP.

1. Introdution

Several methods are available for the fabrication of electrode pattern for the plasma display panel(PDP) including screen printing and photolithographic method

Currently photolithographic method is widely used for the formation of fine pattern of electrode for PDP. As the size of PDP increase over 60 inches and high resolution (XGA grade) is needed, however, piezo type ink-jet printing method is considered to the method of choice for electrode patterning in manufacturing of PDP. A silver ink for ink-jet printing consists of binder polymer, solvent, dispersant, nano-size Ag powder and additives. Each of the components used in the formulation has specific function and has effects on the resulting electrode pattern.

2. Experimental

2.1 Materials

Hydroxypropyl cellulose(Aldrich Chemical Co., MW 80,000) which is soluble in water was used as binder polymer for absorbent layer paste. 3-Methoxy-3-methyl butanol(3MMB) was used as solvent(T_b = 175℃) to dissolve HPC binder polymer. The Ag powder used was nano silver powder obtained from Nano-Bio Industries, Korea. The purity of the powder was 99.9% by weight and the average particle size(d_{50}) was 0.15～0.3 ㎛. Aqueous nano-size silver solution(100,000ppm) was also tested in the ink-jet printing .

Two different dispersants, BYK Chemie-180 and BYK Chemie-192 were used. The former was used to disperse Ag in the aqueous ink system and the latter in the organic solvent based ink.

3. Results and discussion

3.1 Absorbent Layer Paste

The components of absorbent layer paste were mixed with the aid of mechanical stirrer and three roll mill(Exact Co., Germany). The binder polymer(HPC) was dissolved in the 3MMB solvent. The mixture was stirred for 1hr with the mechanical stirrer and then milled for 2hr by using 3 roll mill. The absorbent layer paste with active solid content of about 25wt% showed optimum viscosity for screen printing on the rear panel of PDP. The evaluation of absorbent layer paste and process condition are shown in Table 1 and 2, respectively. The screen printing property of adsorbent layer with HPC content is shown fig.1

Table 1. Absorbent layer paste formulation

Sample No.	HPC(g)	3MMB(g)	coating property
ALP-1	14	20	×
ALP-2	10	20	×
ALP-3	6	20	△
ALP-4	5	20-	○

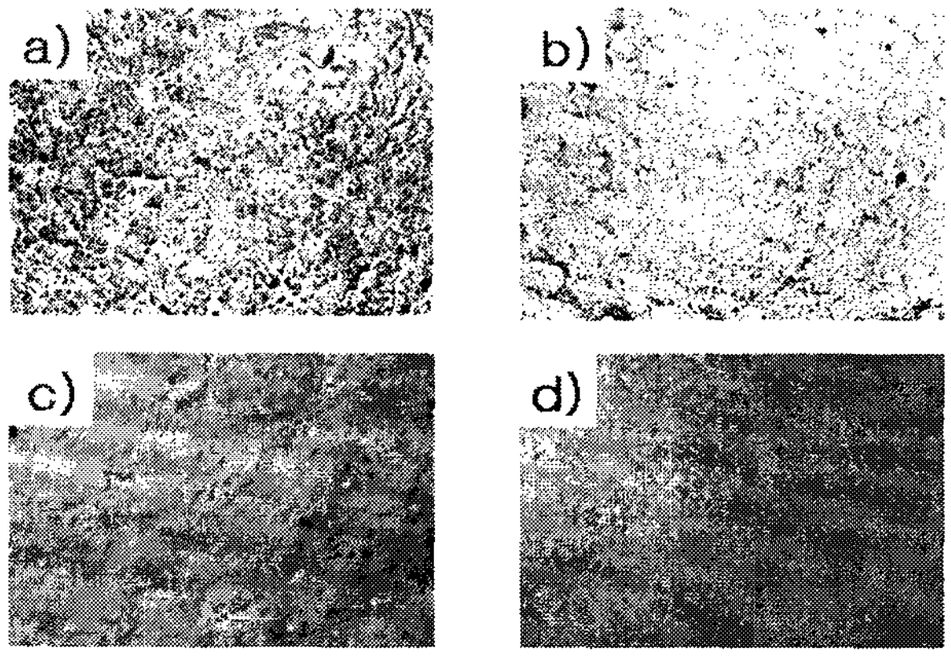


Fig. 1 Screen printing property of adsorbent layer with HPC content ; (a) 70%, (b) 50% (c) 30% and (d) 25%

Table 2. Absorbent layer process conditions

Process	Parameter	Optimum Condition
Screen printing	Viscosity(cps)	27,500 cps
Drying	Temp/Time	110℃/10min

3.2 Silver Ink

The vehicle for the preparation of silver ink had several components including suspending agent (polyallylamine), dispersant(BYK-180) and solvent(water). The nano-size Ag solution was mixed into this vehicle and the resulting mixture was dispersed with mechanical stirrer and ultrasonic apparatus. The procedure of silver ink is shown in Fig 2. The silver ink formulation was tested in the laboratory ink-jet printer. As shown in Table 3, EIJ-3 formulation gave best results. The Effect of dispersant is shown in Fig.3

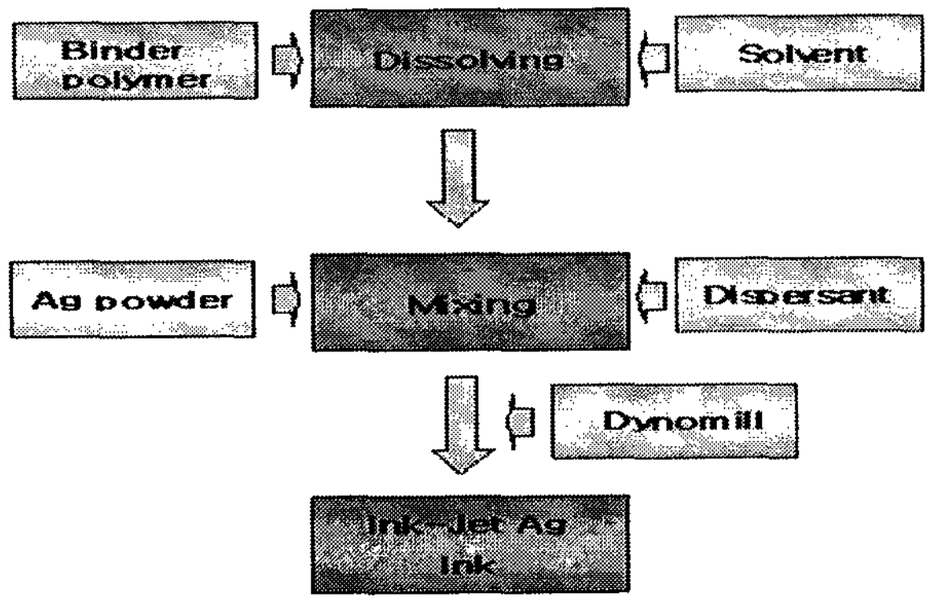
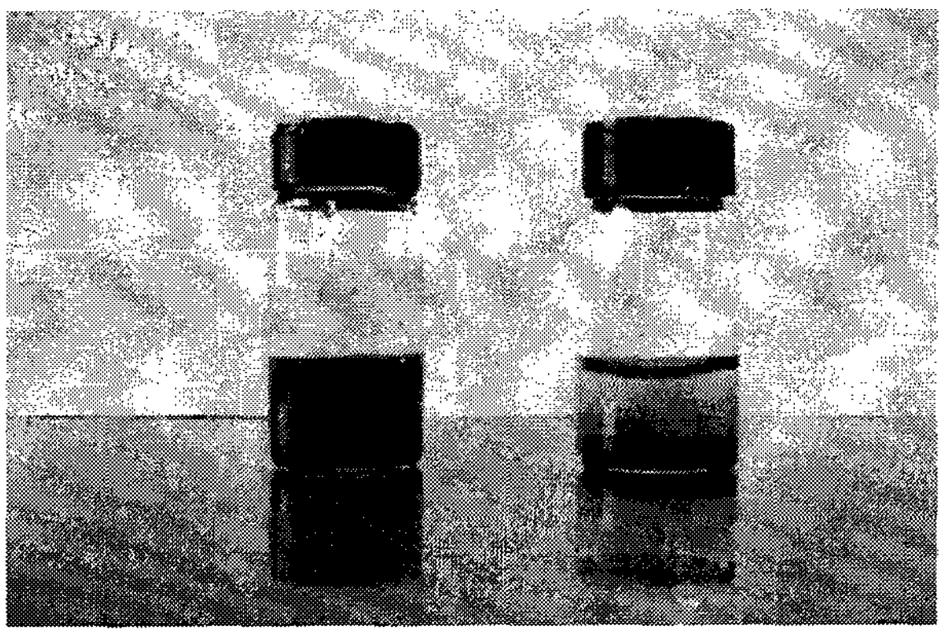


Fig .2 Fabrication of silver ink

Table 3. Silver ink system

	EIJ-1	EIJ-2	EIJ-3
Binder Polymer(g)	-	2.8	2.0
Solvent(g)	17.2	17.2	17.2
dispersant(g)	6.0	-	6.0
Ag powder(g)	8.0	8.0	8.0
Dispersion property	×	×	○
Ink-Jet printing	×	△	○



(a) (b)

Fig. 3 The Effect of dispersant (after 1hr) ((a) with dispersant, (b)without dispesant)

3.3 Ink-Jet Process with Absorbent Pretreatment

When silver ink system was tested in the piezo-type ink-jet printer, blur of Ag electrode pattern

was observed due to the flow of ink on the glass substrate. In order to improve the sharpness of silver electrode pattern, a pretreatment of glass substrate with absorbent layer paste was tried as shown in Fig. 4. Since the nano-size Ag ink is in aqueous medium, the preformed absorbent layer effectively blocked the blur of Ag electrode pattern. As shown in Fig 5. the Ag electrode fabricated with the pretreatment with absorbent layer gave sharp pattern of electrode compared to the untreated sample.

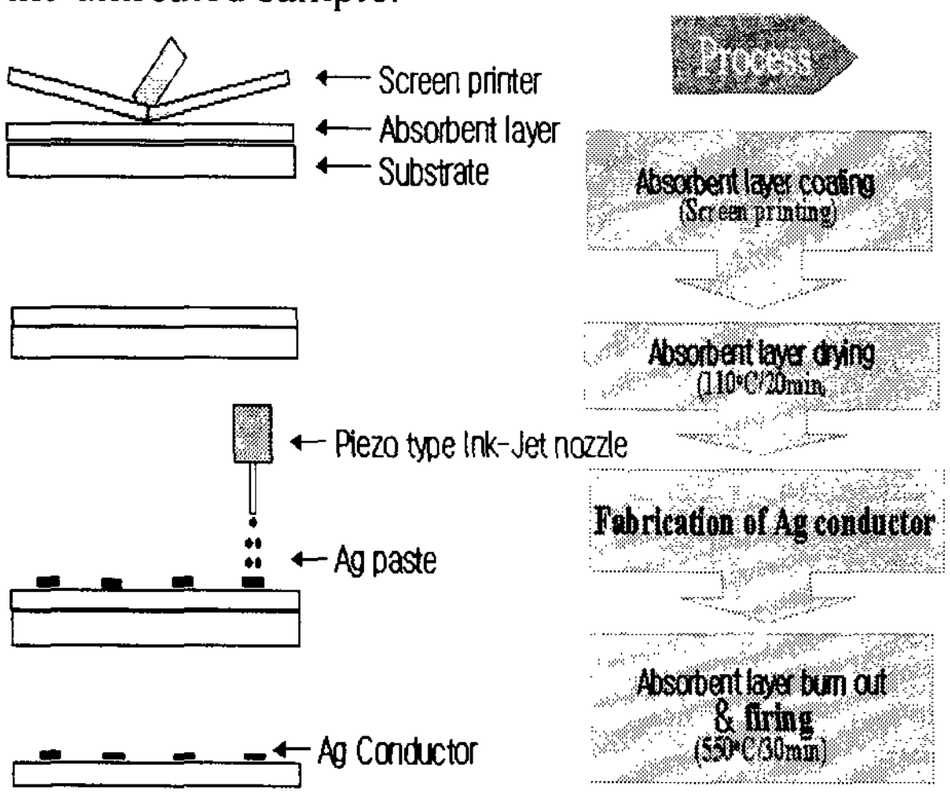
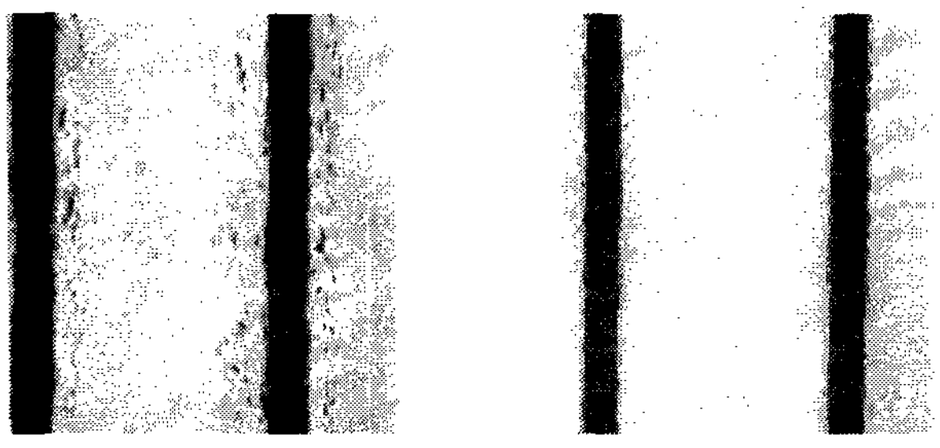


Fig.4 Ag Electrode by ink-jet print with pretreatment of absorbent layer



(A) **(B)**

Fig.5 Photographs of Ag electrode(×25) after sintering (A) without absorbent layer and (B) with absorbent layer

4.Conclusion

Both silver ink and absorbent layer paste formulation were developed for ink-jet printing of electrode pattern. The ink-jet printing of silver electrode with preformed absorbent layer was especially suitable for the patterning of address electrode for high resolution PDP.

5. Acknowledgements

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