

ITO solutions and resist inks for lift-off patterning of Transparent PDP electrodes

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1. Introduction

ITO sputtering with photo-etched patterning is used to create display electrodes on plasma display panels. But this type of patterning process consists of many steps, which requires additional costs of panel production. To solve this problem, we developed a lift-off ITO patterning process and ITO solutions and resist inks for the new process. The shorter process reduces the cost while providing low-resistance and high-transmission ITO films.

2. Characteristics of the Lift-off Process (Photo and Screen-print casting)

- 1) Quicker patterning is possible as the resist film removal and the ITO film formation are done simultaneously.
- 2) ITO film of lower resistance is obtained as the ITO solution does not contain resins.
- 3) The resist film does not dissolve in the ITO solution and repels it leaving sharp patterns.
- 4) The photo resist presents ideal work environments as it allows development in water. The easy control of the exposure and developing process also makes it easy to handle.
- 5) The resist ink for screen printing is thixotropic, which allows fine pattern printing.
- 6) ITO film accuracy
 - * Photo casting: Line width $5\mu\text{m}$
 - * Screen printing casting: Line width $140\mu\text{m}$

3. Characteristics of ITO Solutions and Resist Inks

Table 1 shows the characteristics of two ITO solutions. Table 2 shows the characteristics of lift-off photo resist ink and resist ink for screen printing.

Table 1 Characteristics of ITO solutions

Solution Type	TYPE-A	TYPE-B
Solid ITO content / wt%	10.0	5.8
Solvent	3-Methoxybuthyl-acetate	1-Propanol
Viscosity / mPa·s (at 25°C)	9.0~10.0	4.0~5.0
Specific gravity (at 25°C)	1.16~1.20	0.86~0.90

Table 2 Characteristics of resist inks

Resist Type	Nega- type Photoresist	Resist Ink for screen printing
Solid content / wt%	6.6	44.4
Solvent	Water, Butyl Cellosolve	Butyl carbitol acetate, Cyclohexanone
Viscosity / mPa·s (at 25°C)	90~100	160000~180000
Specific gravity (at 25°C)	1.00~1.10	1.05~1.10

4. Lift-off Process

Fig. 1 shows an ITO lift-off patterning process (photo casting) based on photolithography. Fig. 2 shows an ITO lift-off patterning process (screen print casting) based on screen printing. Either process may be according to the purpose and required patterning accuracy.

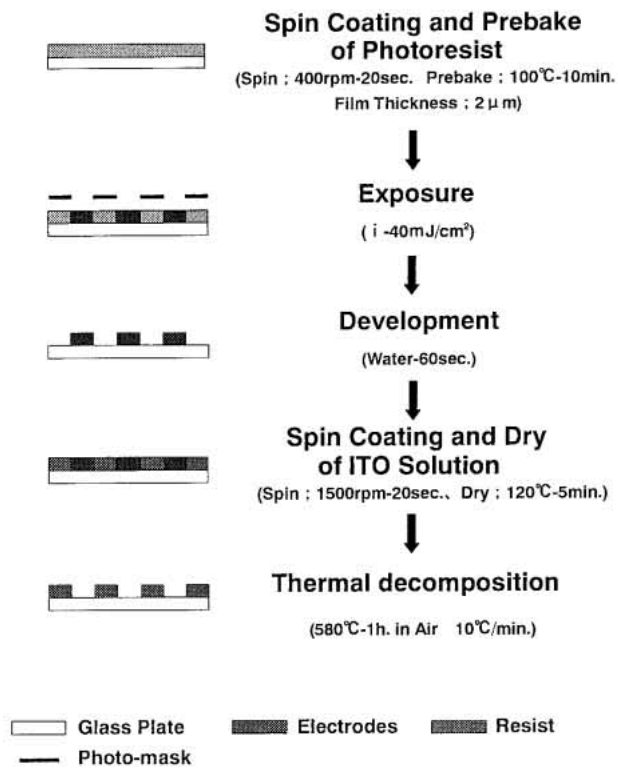


Fig. 1 Lift-off patterning process (photo casting method)

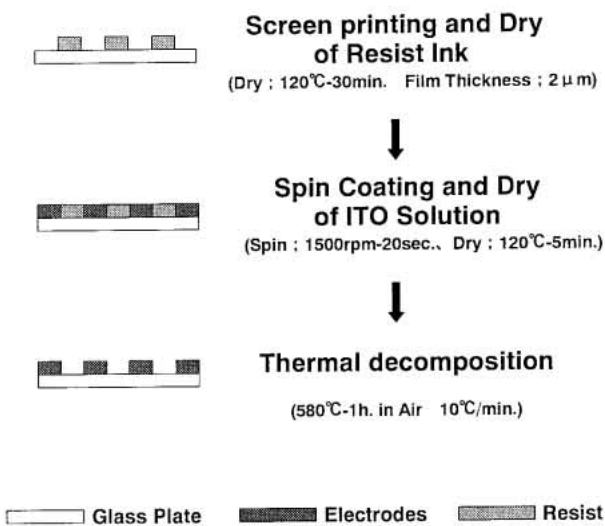


Fig. 2 Lift-off patterning process (screen print casting)

5. Lift-off ITO Patterns

Figs. 3 and 4 show microscopic images of ITO patterns by photo casting and those by screen printing, respectively.

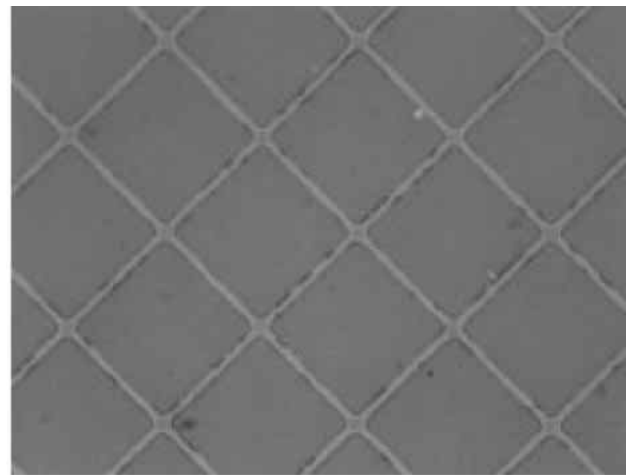


Fig. 3 ITO patterns by photo casting

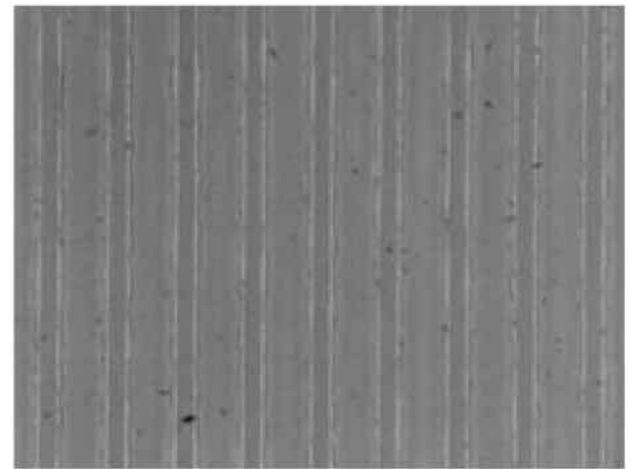


Table 3 Characteristics of ITO thin films

6. Characteristics of ITP Thin Films

Table 3 shows the characteristics of the ITO thin films.

Fig. 4 ITO patterns by screen printing

	TYPE-A	TYPE-B
Sheet resistivity / Ω/\square	430	355
Film thickness / nm	200	127
Specific resistivity / $\Omega \cdot \text{cm}$	8.52×10^{-3}	4.51×10^{-3}
Transmittance / % (at 550nm)	96.6	97.5
Haze / %	0	0.6
Pencil hardness	6H	6H