

# 2 High transparent and conductive film

(Advanced Materials Research Group, New Technology Research Laboratory)

## Introduction

We have commercialized a variety of anti-static and EMI shielding film materials for a wide range of displays, relying on our proprietary super-fine particle synthesis, coating, and film fabrication techniques. Employing a special material and technology for film fabrication by screen printing, we have succeeded in developing a highly transparent and conductive film that has a sheet resistance of under  $\Omega/\square$  which is more than two orders of magnitude lower than conventional resistance, and a total light transmittance of over 70%.

## Features of the Highly Transparent and Conductive Film

1) This is a film with a micro structure that features both conductive and light transmittable areas (aperture). To the unaided eye, this film appears to be completely transparent (Figure 1).

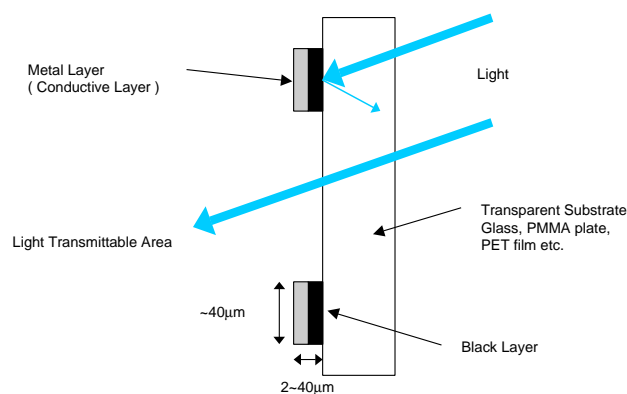


Fig.1 Schematic representation of cross sectional structure of High transparent and conductive film

2) This film is made by the screen-printing fine-lines of printing paste, including the use of plating-catalyst and electroless plating, to provide selective conductivity.

3) The minimum printable line width is limited to 60~80  $\mu\text{m}$  in conventional screen printing methods. Using a special printing material and technology, we have accomplished the fine line patterning that reduces the line width of the conductive area to 40  $\mu\text{m}$  or less. (Photo 1)



Photo 1 Microphotograph of High transparent and conductive film

4) There is another film fabrication technology, photo-etching of metal thin films, for manufacturing hetero-structure film. Our manufacturing method, however, does not require expensive equipment and requires fewer steps to produce the film.

5) Since the film structure design is flexible enough to provide the desired pattern, pitch and bias angle, the occurrence of moire fringes can be prevented. Our process allows users to change the areal ratio of the film aperture as desired and provides higher degrees of transparency than the conventional textile mesh made of a metallized surface. (Table 1)

Table 1 Design examples of High transparent and conductive films and their characteristics

No.	Pattern	Pitch ( $\mu\text{m}$ )	L/S ( $\mu\text{m}$ )	Substrate	Sheet Resistance ( $\Omega/\square$ )	Transmittance (%)
1	Square Mesh	300	30/270	PET film	0.15	70.3
2	Square Mesh	500	30/470	PET film	1.25	82.3
3	Square Mesh	500	40/460	PMMA plate	0.48	80.1
4	Square Mesh	400	35/365	Glass Plate	0.95	77.9
5	Hexagon Mesh	400	40/360	PET film	0.33	71.8

6) When the film is employed on the front side of a display, the viewing angle is not narrowed because the film is very thin (2~4  $\mu\text{m}$ ). (In the case of the textile mesh made of a metallized surface, the thickness is double the fiber diameter, so the mesh narrows the view angle and reduces visibility when seen from the side. Moreover the possibility that moire fringes will occur is high.)

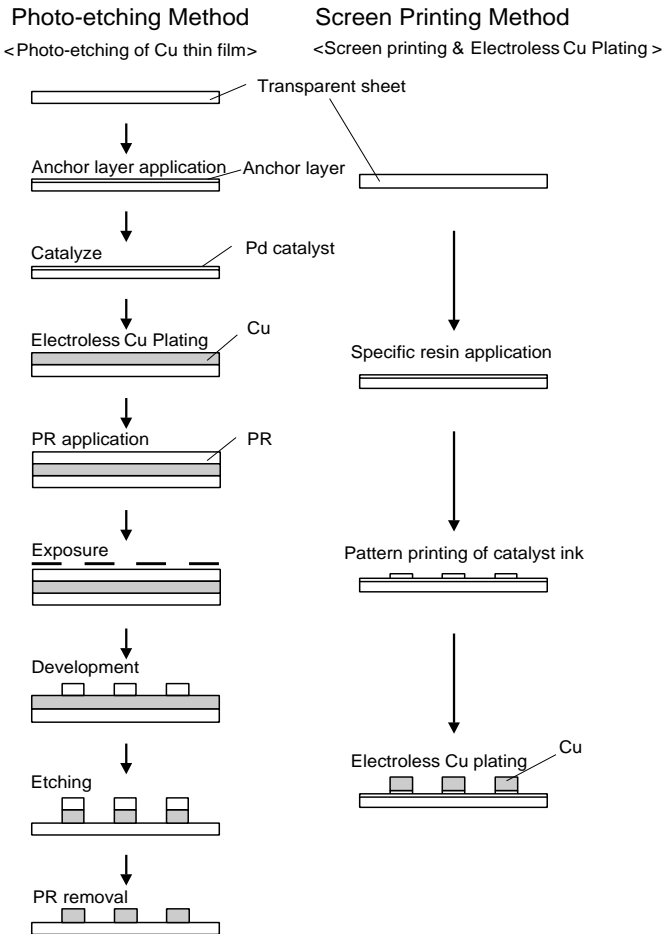


Fig.2 Fabrication process of High transparent and conductive film ( compared with photo-etching process )

- 7) Since the rear side of the conductive area is blackened, the reflection of outer light is suppressed.
- 8) The surface of the conductive area (metallic area) can also be blackened.

## Characteristics of the Highly Transparent and Conductive Film

- 1) Sheet resistance of between 0.1 and  $\Omega/\square$
- 2) Total light transmittance of 70% or higher (dependent on the film structure design)
- 3) EMI shielding performance of 35 dB or higher in the 1~1000 MHz frequency range (Figure 3)

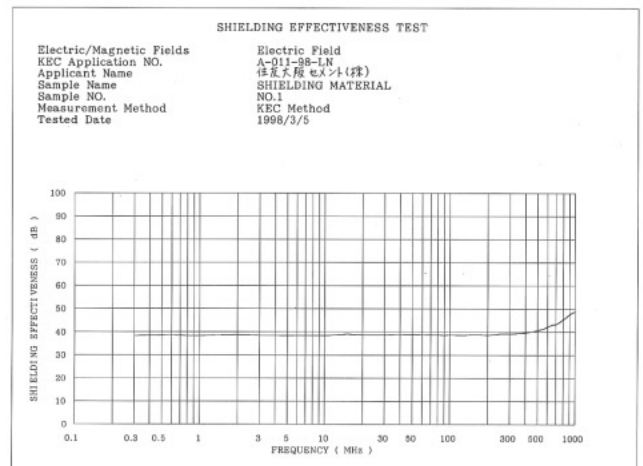


Fig.3 Electromagnetic shielding performance of High transparent and conductive film ( by KEC )

## Major Applications

- 1) EMI shielding film for use in various displays (particularly suitable for PDP and FED that emit strong leak electromagnetic waves in high frequency ranges)
- 2) Transparent electrode for a variety of electronic devices
- 3) Wiring for a wide range of electronic devices