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**KOLON Dry Film Resist**

**KP-2100 Series**

**Technical Data Sheet**

**KOLON**

**[www.ikolon.com](http://www.ikolon.com)**

**[www.dryfilmresist.com](http://www.dryfilmresist.com)**

## Applications:

### Plating:

KOLON KP-2100 series will plate in most common baths without lifting.

KOLON KP-2100 series has little or no leaching in most common plating baths.

### Tenting:

The 1.5mil will reliably tent 0.25 inch holes not using the 2mil version. But the dry film of the 2mil thickness can be used for the panel with the rough surface after panel plating.

### Etching:

KOLON KP-2100 series will withstand most acid etchants.

KOLON KP-2100 series will withstand most alkaline etchants with a pH between 8.0 and 8.5.

## Benefits of KOLON KP-2100 Series

|   |  |
|---|--|
| A Universal Film for Plating, Tenting and Etching | Reduce Inventory and Waste             |
| Extremely Wide Processing Latitude                | Increase Yields                        |
| High Tenting Performance                          | Increase Yields                        |
| High Resolution                                   | Ability to Image Fine Lines/Spaces     |
| Excellent Adhesion to Nearly All Surfaces         | Increase Yields                        |
| Vivid Print Out Image                             | Increase Yields                        |
| Very Clean Panel and Chamber after Development    | Reduce Copper/Copper Peeling           |
| Fine Pieces of Resist in Stripping                | Reduce Stripping Costs with Filtration |

## KOLON KP-2100 Series Film Specifications:

Thickness: 1.5 mil (38  $\mu$  m), 2.0mil(48  $\mu$  m)

Unexposed color: light green/Blue

Exposed color : dark Blue

Widths: 6 to 24 inch, with .25 increments

Length: 500 feet is standard, other lengths are available

Core: 6 inch is standard, 3 inch is available

## QUICK REFERENCE GUIDE(KP-2100 series)

| PROCESS   | CONDITON  |
|---|---|
| <b>HOT ROLL LAMINATION</b><br>Temperature<br>Speed<br>Pressure<br>Exit Temperature                        | 100 ~ 120 (210~250 )<br>1 ~3m/min (3~10 fpm)<br>1.5 ~ 4 bar (20 ~60 psi)<br>45 ~ 65 (110~150 )                              |
| <b>CUT SHEET LAMINATION</b><br>Temperature<br>Speed<br>Pressure<br>Exit Temperature                       | 100 ~ 120 (210 ~ 250 )<br>1 ~ 3m/min (3 ~10 fpm)<br>3 ~ 5 bar (45 ~75 psi)<br>45 ~65 (110 ~ 150 )                           |
| <b>EXPOSURE</b><br>21 Step Guide<br>mJ/cm <sup>2</sup>  | Clear Copper 8 ~ 10<br>30 ~ 80  |
| <b>DEVELOPMENT</b><br>Chemicals<br>Concentration (wt%)<br>Temperature<br>Speed<br>Spray Pressure<br>Rinse | Na <sub>2</sub> CO <sub>3</sub><br>1 ± 0.2%<br>30 ± 2 (86 ± 4 )<br>65 ± 10% BP<br>1.5 ~ 3kg/cm <sup>2</sup><br>Over 30 sec. |
| <b>STRIPPING</b><br>Chemicals<br>Concentration<br>Temperature<br>Speed<br>Spray Pressure<br>Rinse         | NaOH<br>3.5 ± 1.0%<br>50 ± 5 (120 ± 10 )<br>50 ± 10% BP<br>1~3kg/cm <sup>2</sup> (15 ~ 45 psi)<br>Over 20 sec.              |

# KOLON KP-2100 Series

## - Processing Guide -

### Section 1. Surface preparation

The optimum performance of KOLON KP-2100 Series Photopolymer depends on the condition and cleanliness of the copper surface prior to lamination.

The surface must be free of contaminants such as chromate conversion coatings(innerlayers), residual water, acid stains and antitarnish residues. Other contaminants can be generated by the environment in take wet chemistry areas.

Copper substrate glass weave and imperfections must also be taken into consideration. These include pits, dents, deep scratches, and epoxy bleed through. The presence of these imperfections will result in poor photoresist adhesion in these areas, resulting in low yields, reduced productivity and quality.

### Electroless Copper Plating

The amount of electroless copper deposition will depend on the manufacturer's recommendation for the type of panels being processed, i. e. double sided, multilayer, flex-rigid, etc. Normally, the deposition ranges from 1.3-2.5 $\mu$ m(50-1000 microinches). KOLON KP-2100 Series preplate etch requires approximately 0.125 $\mu$ m(5microinches) removal for good copper-to-copper adhesion.

### Cleaning Copper Surfaces

There are several method that can be employed to prepare the panels for lamination after electroless deposition:

#### 1. SCRUBBED COPPER SURFACE

Scrubbing of the copper prepares the surface for the application of KOLON KP-2100 series photoresist. It is less dependent on rinsing, neutralizing, drying, and hold time than the no-scrub electroless copper process. This method will give the widest latitude for photoresist adhesion.

When scrubbing is chosen, the results of lamination depend on the type of cleaning method

selected. Listed below are accepted methods for good surface preparation:

- a. Pumice scrubbing(3F or 4F grade)
- b. Compressed brush type
- c. Wet bristle brush(320grit)
- d. Chemical clean(including a micro etch)
- e. Chemical clean(plus mechanical scrub)

Note: The proper type and grade of pumice should be selected depending on the equipment being used, i. e. jet pumice spray requires a non-fused type for good topography and residue removal. With equipment requiring brushes, a fused pumice is recommended for a good surface and residue removal.

## 2. Unscrubbed copper surface

The application of KOLON KP-2100 Series photoresist over an unscrubbed surface requires complete control of rinsing neutralizing and drying, as well as controlled hold times prior to lamination, even with the use of an antitarnish.

The unscrubbed method requires a well controlled neutralization step after the electroless copper process. Residual solutions from the electroless copper bath in holes and on the porous surface will adversely affect resist adhesion. Highly effective rinsing is needed to accomplish a suitable surface for the photoresist. A typical procedure is listed below:

| <b>POST ELECTROLESS RINSING PROCEDURE</b> |   |
|---|---|
| FUNCTION                                  | COMMENTS  |
| Drag Out Rinse                            | 1 minute. Remove excess copper solution to minimize drag into next rinse tank.  |
| Counterflow Rinse                         | 2 tanks 1 ~2 minutes each. Good water flow is needed to accomplish thorough rinsing.  |
| Neutralization                            | 1 ~ 2 minutes, 3 ~ 5% H <sub>2</sub> SO <sub>4</sub>  |
| Counterflow Rinse                         | 2 minutes ( maybe air sparged to enhance rinsing action)  |
| Antitarnish                               | 1 ~ 2 minutes 0.5 to 0.75%  |
| Hot Water Rinse                           | 1 ~ 2 minutes static tank   |
| Dry                                       | 10 ~ 15 minutes if an in-tank dryer is used at 140 ~ 150 (60 ~ 66 ). For best results a conveyORIZED, hot air turbine dryer is recommended. |

\*Water flow must be strong enough to keep tanks clean and the pH should be maintained at 6.6-7.1.

For panels processed using the above method, hold times prior to lamination must not exceed four hours if stored in a clean room environment. For panels held longer than the recommended four hours and/or when poor surface performance has been observed, regeneration of the electroless copper surface is necessary. This can be done by the following procedure:

1. Rinse panels thoroughly.
2. Etch approximately 0.13µm(5microinches) of copper
3. Rinse Thoroughly
4. Dip in 3-5 % H<sub>2</sub>SO<sub>4</sub>
5. Rinse thoroughly
6. Hot air dry

For work on innerlayer copper foil, one of the methods in the Scrubbed Electroless Copper section should be used. The chemical clean or the pumice clean method is recommended.

## SECTION 2. LAMINATION

Lamination of KOLON KP-2100 Series must be performed in an environment that is free from dust and dirt. The condition and maintenance of the lamination equipment is also important to high production quality and yields.

The lamination parameters listed in the following table are general guidelines.

| LAMINATION                  |                          |
|-----------------------------|--------------------------|
| <b>HOT ROLL LAMINATORS</b>  |                          |
| Roll Temperature            | 100 ~120 (210 ~ 250 )    |
| Roll Pressure               | 1.5 ~ 4 bar (20 ~ 60psi) |
| Laminating Speed            | 1 ~ 3 m/min (3 ~10fpm)   |
| Exit Temperature            | 45 ~ 65 (110 ~150 _      |
| <b>CUT SHEET LAMINATORS</b> |                          |
| Roll Temperature            | 100 ~120 (210 ~250 )     |
| Roll Speed                  | 1 ~3 m/min (3 ~10 fpm)   |
| Roll Pressure               | 3 ~5 bar (45 ~75 psi)    |
| Tack Bar Temperature        | 50 ~ 60 (120 ~140 )      |
| Tack Time                   | 1 ~ 2.5 sec.             |
| Panel Entrance Temperature  | 40 ~ 60 (105 ~140 )      |
| Panel Exit Temperature      | 45 ~ 65 (110 ~150 )      |

## A HANDLING OF PANELS AFTER LAMINATION

Panels may be processed immediately after lamination, it is recommended to rack the panels allowing them to stabilize to room temperature prior to exposure. Unexposed KOLON KP-2100 Series is soft and stacking of panels horizontally is not recommended. Any type of particle that is trapped between panels will leave impressions that can lead to defects.

Racks should be provided to stack the panels vertically(on edge) at an angle of approximately 20 from perpendicular.

## SECTION 3. EXPOSURE

The exposure time of KOLON KP-2100 series film is a function of type and intensity of the light source. There are a number of light sources available, ranging from 1KW to 10KW that will give excellent results. KOLON KP-2100 series film responds to light energy emitted in the near ultraviolet portion of the spectrum below 400 nanometer(4000 angstrom).

For KOLON KP-2100 series film we can see the change of the step with exposure energy in Figure 1. As you can see in Figure 2 and Figure 3 KOLON KP-2100 series film has the excellent adhesion and resolution on the copper surface with wide range of exposure energy. Resist thickness of the KP-2140 and KP-2150 is 38  $\mu$  m and 48  $\mu$  m, respectively.

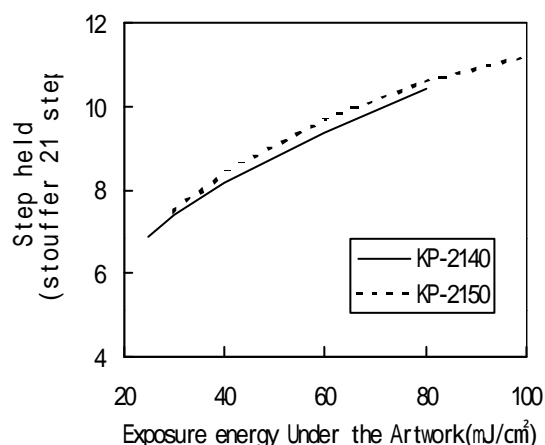


Figure 1. The change of SST with exposure energy,  
Exposure: 5kW, Development condition: Na<sub>2</sub>CO<sub>3</sub>,  
1wt%, 30 , spray pressure=1.5kgf/cm<sup>2</sup>, breakpoint=50%

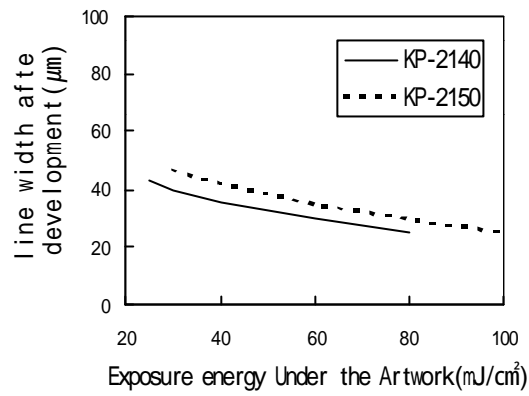


Figure 2. The change of adhesion with exposure energy,  
 Exposure: 5kW, Development condition: Na<sub>2</sub>CO<sub>3</sub>, 1wt%,  
 30 , spray pressure=1.5kgf/cm<sup>2</sup>, breakpoint=50%

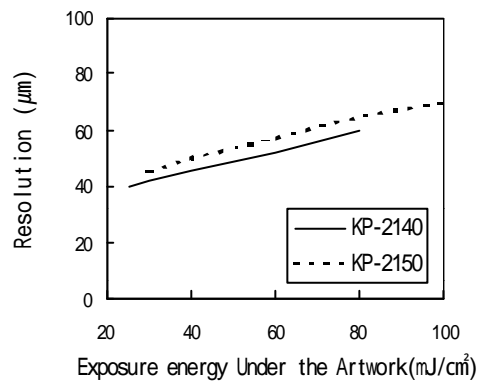


Figure 3. The change of resolution with exposure energy,  
 Exposure: 5kW, Development condition: Na<sub>2</sub>CO<sub>3</sub>,  
 1wt%, 30 , spray pressure=1.5kgf/cm<sup>2</sup>, breakpoint=50%

Optimum exposure will be a combination of image resolution and polymerization required to yield the proper chemical etchant and plating resistance. To assure the exposure process is optimum, the following conditions should be met:

1. The exposure unit must be clean and free from dust and dirt.
2. The artwork, diazo, or silver halide must be of high quality.
3. Use bleeder strips to assure the intimate contact required for optimum resolution.
4. Use a radiometer in conjunction with the Stouffer Density Tablet to confirm correct exposure levels.

Optimum exposure, following the guidelines outlined in the following table, should be accomplished. It is recommended that further testing be performed to achieve the best possible exposure for the present.

| <b>EXPOSURE</b>    |                         |                         |
|--------------------|-------------------------|-------------------------|
| mJ/cm <sup>2</sup> | 30 ~ 80                 |                         |
|                    | Stouffer 21 Step Tablet | Stouffer 41 Step Tablet |
| Resist             | 7 ~ 9                   | 20 ~ 28                 |
| Copper             | 8 ~ 10                  | 22 ~ 30                 |

All measurements were made through the artwork for both the radiometer and the density tablet.

## **SECTION 4. DEVELOPMENT**

KOLON KP-2100 series films develop in totally aqueous solutions of sodium carbonate or potassium carbonate. Miscible solvents (i. e. butyl cellosolve) will be detrimental to the photoresist and should never be used in the developing process.

### **A. Temperature**

Operating temperature of the working solution is extremely important to the development of the resist and 28 to 32 for KOLON KP-2100 series film. In Figure 4 the higher temperatures result in faster development time. But exceeding the recommended temperature range can cause attack on the resist sidewall or foot, resulting in resist lifting or ragged circuit lines. Operating at a lower temperature can also result in attack on the resist due to

excessive dwell time in the developing chamber or under-development. Minimum development time means time to clean in Figure 4.

It is important to verify the temperature with a thermometer. DO NOT rely on gauges supplied with the equipment.

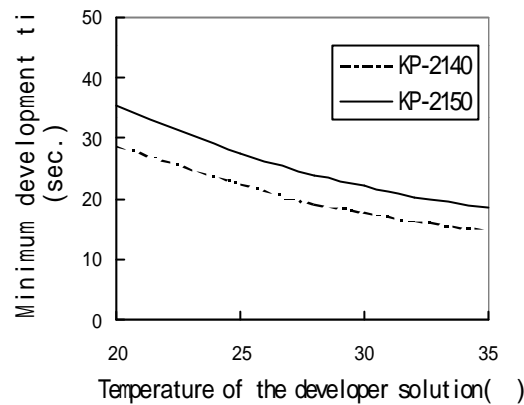


Figure 4. The change of the minimum development time with solution temperature.  
Condition:  $\text{Na}_2\text{CO}_3$ , 1wt%, spray=1.5kgf/cm<sup>2</sup>

## B. Spray pressure

Spray pressures become more critical when fine line resolution is the goal.

The spray pressure :

- affects the developing rate in Figure 5.
- determines the need for filter change
- is affected by plugged nozzles
- is affected by machine design

Recommended spray pressures are 18 to 30 psi(1.2 to 2.0 BAR) with the higher pressure preferred for fine line work.

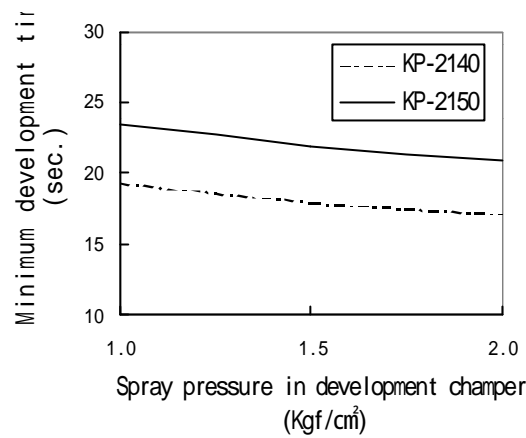


Figure 5. The change of the development time with spray pressure. Condition: Na<sub>2</sub>CO<sub>3</sub>, 1wt%, 30 , 1.5kgf/cm<sup>2</sup>

### C. Spray nozzles

Spray nozzle configurations may be modified from the original set up. For fixed manifold and spray pattern equipment, the best configuration is a combination of full fan and full cone nozzles. Specific configurations will depend on equipment, pump size, chamber size, and number of manifolds. These modifications will achieve better and more aggressive developing action and improved rinsing for fine line work.

### D. Breakpoint

The breakpoint must be maintained within the recommended range of 55-75% of the developing chamber. A slower breakpoint will attack the sidewalls and affect the swelling of the resists. A faster breakpoint will result in undeveloped resist in the circuit traces or residues at the foot.

### E. Loading

As the developed resist for developer solution increases the development time increases and pH of the developer solution decreases. The change of the pH and development time with resist loading is shown in Figure 6 and Figure 7, respectively. The development time of KP-2140 dry film with loading is uniform from 0.05 to 0.25 square meter per liter. This result in the excellent application for both batch and replenishment system.

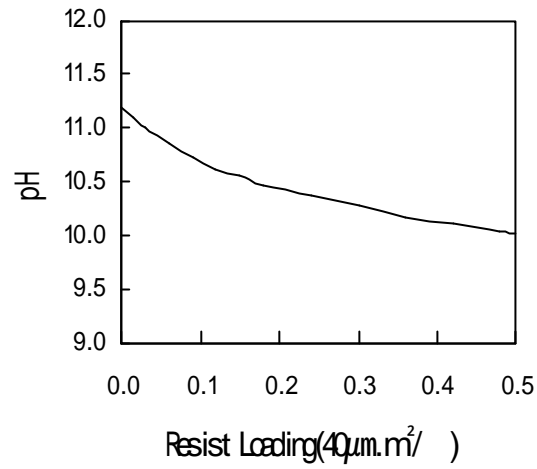


Figure 6. The pH change of the developer solution with resist loading. Condition: Na<sub>2</sub>CO<sub>3</sub>, 1wt%, 30 , 1.5kgf/cm<sup>2</sup>

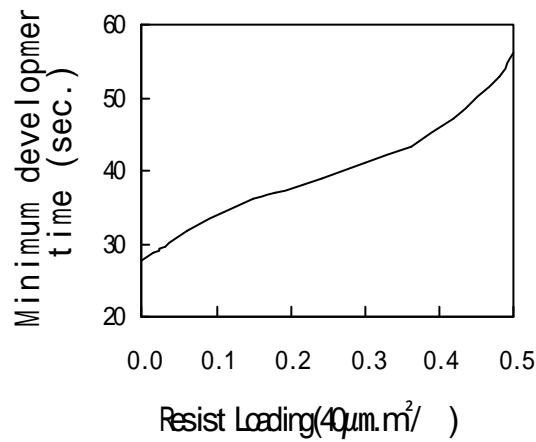


Figure 7. The change of minimum development speed with resist loading. Condition: Na<sub>2</sub>CO<sub>3</sub>, 1wt%, 30 , 1.5kgf/cm<sup>2</sup>

Test panels should be processed prior to production to set the proper parameters for the process. Refer to the following table for Operational parameters for developing.

| <b>DEVELOPMENT CONDITION</b> |                               |                   |
|------------------------------|-------------------------------|-------------------|
| <b>Condition</b>             | <b>Optimum</b>                | <b>Acceptable</b> |
| Pressure                     | 1.5 ~ 2.0 bar                 | 1.2 ~3.0 bar      |
| Temperature                  | 85                            | 80 ~90            |
| Concentration                | 1.0%                          | 0.9 ~1.3%         |
| Breakpoint                   | 65%                           | 55 ~75%           |
| Rinse Pressure               | > 1.4 bar                     | 1.0 ~3.0 bar      |
| Rinse Temperature            | 70 ~80                        | 60 ~ 85           |
| Rinse Length                 | Over 50% of Developer Chamber | Same              |

Sodium carbonate make up

NOTE: All solids forms of carbonate are hygroscopic and will produce low strength solutions. Fresh solutions should be analyzed by acid titration, and adjustments made accordingly for desired strength. See Analytical Section for procedures.

## F. Antifoam

It may be necessary to add a defoamer to the developer solution. This will depend on the quality of water, developer chemistry quality, and the amount of dry film loading. The amount to be used is approximately 0.3-0.5 vol% per developer solution. The antifoaming agent( defoamer) should be added at the time of solution make-up. For automatic feed and bleed systems, add the antifoam directly to the sump at a predetermined rate.

NOTE: DO NOT use antifoam containing water miscible solvents(i. e. butyl cellosolve) because they will attack the photoresist.

## G. Rinsing and drying

To affectively clean between circuit traces to remove all developing residue, the panels must be thoroughly rinsed with hard water at temperatures ranging from 15 to 30 (59-86F) and pressures greater than 1.4 bar(20psi). Poor rinsing may promote ragged edges, rough plating, step plating, resist lifting or pruned tenting. Rinsing is a most important part of the developing process.

Boards should be dried thoroughly after rinsing, Water allowed to dry on the panels can

result in non-uniform plating and ragged lines.

NOTE: The control of developer solution is normally accomplished by monitoring pH. Analytical procedures for concentrations can be found in the analytical section of this guide.

## **SECTION 5. PLATING**

KOLON KP-2100 series is a multipurpose photoresist that has excellent properties for pattern plating in acid plating baths. KOLON KP-2100 series can normally be used with copper sulfate, bright acid tin, tin/lead, nickel and gold.

### **A. Tenting**

KOLON KP-2100 series film can be used in tenting applications because resist is tough and flexible and better adhesion on the copper. Since KOLON KP-2100 series film has the excellent tenting performance the resist thickness of 38 microns(KP-2140) can reliably tent. But the dry film of the 48microns(KP-2150) can be used for the panel with the rough surface after panel plating. However, process controls and conditions, hold times, and plating parameters can affect the tenting results.

In Figure 8 we can see the change of strength and elongation of KP-2140 dry film with exposure energy. As exposure energy increases the crosslink density of the resist increase. Then strength increases and elongation decreases after development. The tenting performance of KP-2150 is better than KP-2140 dry films because of the thicker resist, as shown in Figure 9. As the holding time between lamination and exposure increases the tenting performance of resist is very worse. In case of holding after exposure and development the decreasing rate of tenting performance is lower than holding after lamination, because the unexposed resist can flows around the tent hole, as shown in Figure 10 and 11. The maximum holding time between lamination and exposure is 8 hours. The preferable holding time after lamination is 4 hours. If it is necessary to hold the working panels the ones after exposure must be held and the shorter hold time is better.

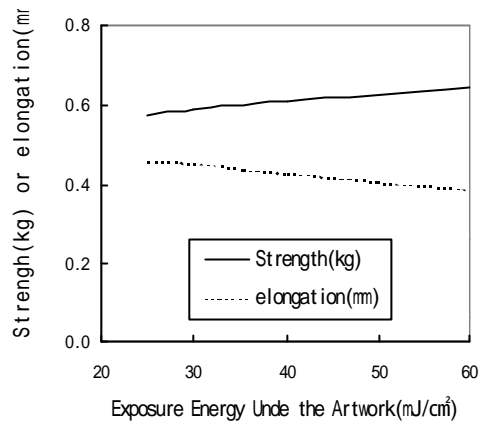


Figure 8 The change of strength and elongation with exposure energy. After development, strength and elongation of resist were measured by compressive mode of INSTRON. Sample: KP-2140  
Development: Na<sub>2</sub>CO<sub>3</sub>, 1wt%, 30s, 1.5kgf/cm<sup>2</sup>, B.P.=50%, Hole size: 6.3mm

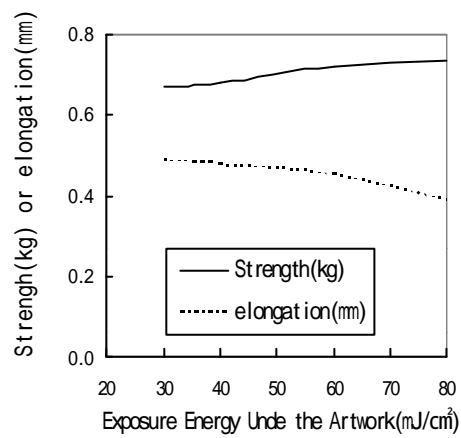


Figure 9 The change of strength and elongation with exposure energy. After development, strength and elongation of resist were measured by compressive mode of INSTRON. Sample: KP-2150  
Development: Na<sub>2</sub>CO<sub>3</sub>, 1wt%, 30s, 1.5kgf/cm<sup>2</sup>, B.P.=50%, Hole size: 6.3mm

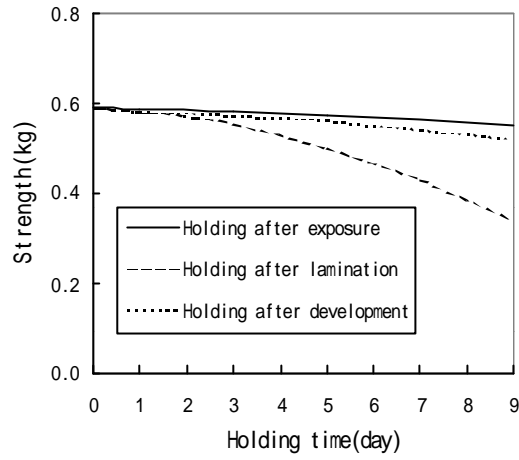


Figure 10. The change of strength with holding time.  
 The evaluated sample is KP-2140.  
 Test condition: exposure energy: 30mJ/cm<sup>2</sup>  
 Development: Na<sub>2</sub>CO<sub>3</sub>, 1wt%, 30 , breakpoint=50%

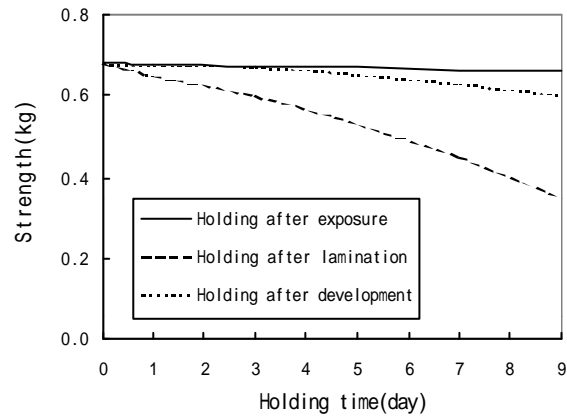


Figure 11. The change of strength with holding time.  
 The evaluated sample is KP-2150  
 Test condition: exposure energy: 30mJ/cm<sup>2</sup>  
 Development: Na<sub>2</sub>CO<sub>3</sub>, 1wt%, 30 , breakpoint=50%

## B. Preplating cleaning

The preplate cleaning cycle is essential to obtain a good copper-to-copper bond between the electroless copper surface and the electrolytic copper plating. Standard cleaning techniques similar to those outlined in the following table produce excellent results.

| <b>PREPLATE CLEANING</b>      |                |
|-------------------------------|----------------|
| <b>Process Sequence</b>       | <b>Minutes</b> |
| Acid Cleaner                  | 2 ~ 3          |
| Rinse Counterflow             | 1 ~ 2          |
| Rinse Counterflow             | 1 ~ 2          |
| Microetch 5 microinches       | As Required    |
| Rinse Counterflow             | 1 ~ 2          |
| Spray Rinse                   | 1 ~ 2          |
| Sulfuric Acid (10% by Volume) | 1 ~ 2          |
| Spray Rinse (optional)        | 1 ~ 2          |

## C. Hot soak cleaner conditions

Acid hot soak cleaners operating at a minimum temperature of 40 (105 ) is recommended. The parameters should be within the recommended concentration range of the manufacturer's data sheets.

## D. Rinse conditions

The rinsing cycles are the most important in the plating cycle. Thoroughly rinse the hot soak cleaner and microetchant which could contaminate the other baths. Counterflow rinses are recommended, with good water flow to eliminate color and foam build up.

## E. Microetch conditions

The microetch chosen must be acidic and must remove at least 0.125pm(5microinches) to ensure a surface thoroughly cleaned of all photoresist residues. A clean surface will result in a good metal-to-metal bond.

Etch rates must be checked regularly, depending on the performance of the etchant being used. Weight gain coupons should be used for this test, as they have been through the same deposition as the production panels. These coupons should be processed through dry film expose and develop prior to the preplate cleaning cycle. This will give a more accurate reading on the amount of copper being removed.

## **SECTION 6. ETCHING**

KOLON KP-2100 series will withstand acid etchants, cupric and ferric chloride with normalities in the range of 0.5-3.0, and alkaline etchants with the pH maintained between 8.0-8.5. With line widths in the 3 mil(75micron) range, first pass yields in the mid 90% can be achieved.

## SECTION 7. STRIPPING

KOLON KP-2100 series film is readily stripped in conventional immersion or conveyORIZED stripping equipment using either a solution of potassium hydroxide(KOH) or sodium hydroxide(NaOH) at 50-55C(130-140F). It is recommended that stripping be followed with an immediate water rinse to reduce oxidation of the substrate. ConveyORIZED stripping, using high pressure nozzles in both the stripping and rinsing modules, is recommended.

Stripping time increases slightly as exposure energy increases in Figure 12 and Figure 13. In KOH solutions the stripping speed is 30-40% slower than NaOH solution. As the temperature of the stripping solution decreases the stripping time is longer. The stripping time of KOLON KP-2140 dry film is the minimum with a range from 3 to 5 wt% NaOH solution in Figure 14. The higher concentration is required in order to get the faster stripping time in KOH solution.(Figure15). In Figure 16 to Figure 19 the stripping characteristics of KP-2150 dry film are shown. These data for stripping were obtained by dipping method.

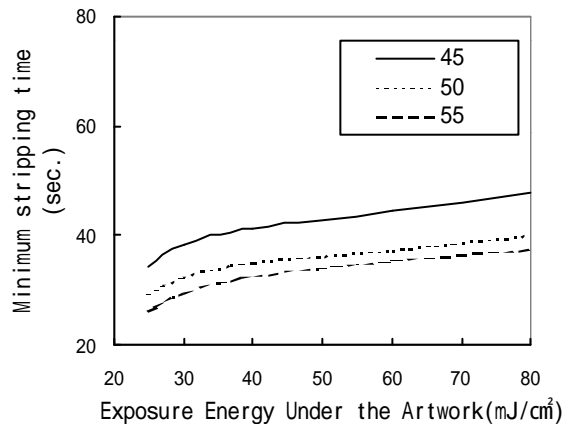


Figure 12. The change of the stripping speed with exposure energy.KP-2140.(NaOH 4wt%,Dipping method)

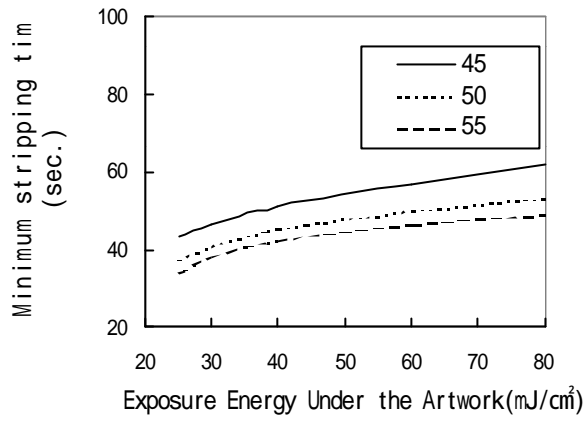


Figure 13. The change of the stripping speed with exposure energy.KP-2140 .(KOH 4wt% ,Dipping method)

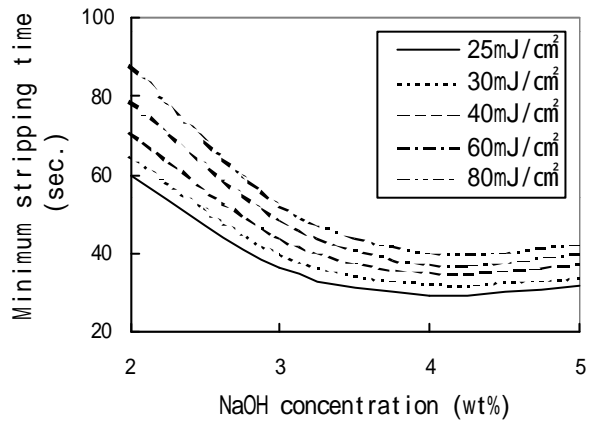


Figure 14. The change of stripping time with NaOH concentrations.KP-2140 (Dipping method,50 )

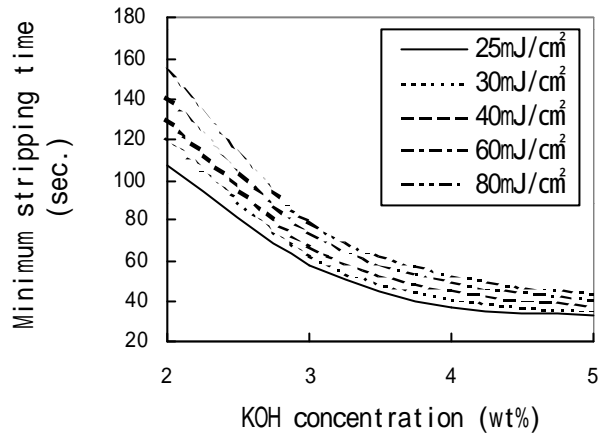


Figure 15. The change of stripping time with KOH concentrations. KP-2140 (Dipping method, 50 )

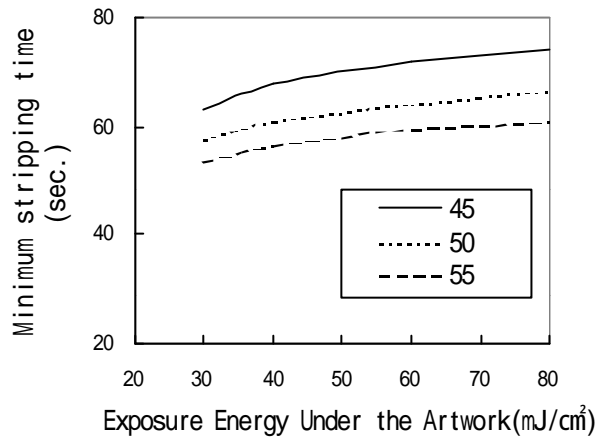


Figure 16. The change of the stripping speed with exposure energy. KP-2150 . (NaOH 4wt% ,Dipping method)

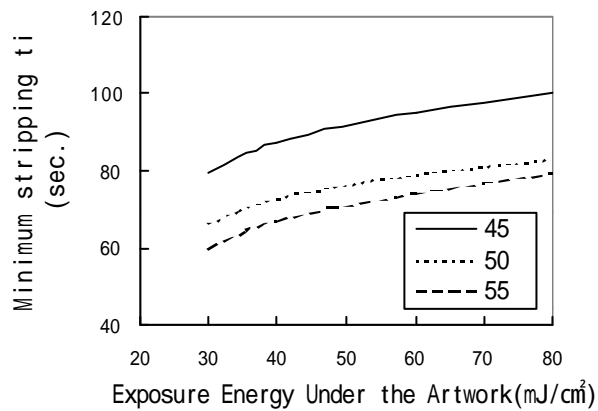


Figure 17. The change of the stripping speed with exposure energy. KP-2150 . (KOH 4wt% ,Dipping method)

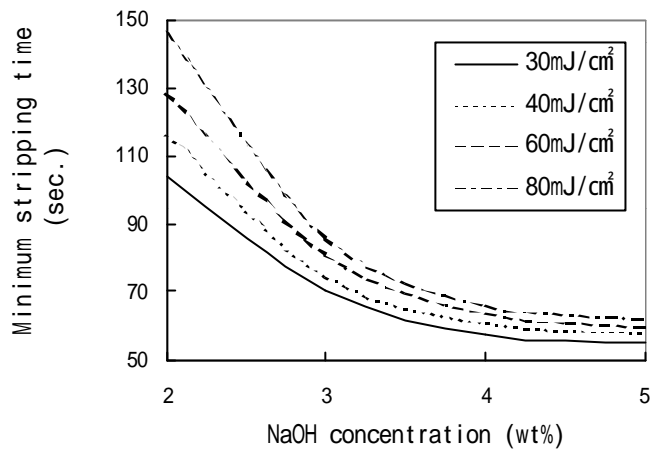


Figure 18. The change of stripping time with NaOH concentrations. KP-2150 (Dipping method, 50 )

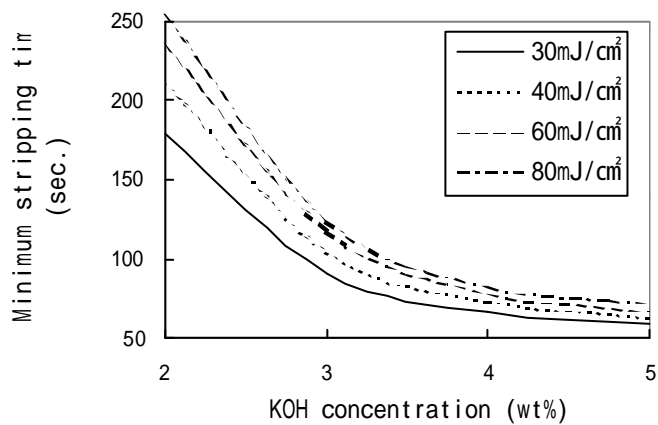


Figure 19. The change of stripping time with KOH concentrations. KP-2150 (Dipping method, 50 )

## **SECTION 8. SAFE LIGHTING**

One significant property of KOLON KP-2100 series photoresist is that they polymerize when exposed to ultraviolet(UV) light. The resist sensitivity to UV peaks near 360 nanometer and extends to 400 nanometer. To prevent premature polymerization, it is recommended that the photoresist be handled under yellow, amber, or gold fluorescent "safe lights" which have no UV or blue wavelengths. The use of these safe lights must be in all of the process areas from lamination through development, and panel storage areas. Filter sleeves that reduce UV light transmission are NOT RECOMMENDED.

Protect panels from unwanted white light sources which include photocopiers, inspection lights, light fixtures and sunlight.

## **SECTION 9. ANALYTICAL PROCEDURES**

### **DEVELOPER SOLUTION ANALYSIS**

The method described here determines the active carbonate concentration of a developer solution by a potentiometric titration. Colorimetric methods measure only the total carbonate content, that is, the percentage carbonate and bicarbonate in the solution.

The effective constituent responsible for development is the carbonate ion,  $\text{CO}_3$ . As the developer solution is loaded with resists, the carbonate ion is depleted because of protonation to form the bicarbonate ion,  $\text{HCO}_3$ . Therefore, in a batch system(as compared to a feed and bleed system), total carbonate and bicarbonate concentration in the solution remains constant.

This method uses the first inflection point of the pH curve where neutralization of the  $\text{CO}_3$  occurs. This inflection point, at pH 8.2, is used as the end point of the titration and directly determines the  $\text{CO}_3$  concentration.

## DEVELOPER ANALYSIS(SODIUM CARBONATE)

### Equipment

pH Meter  
Buret, 50ml  
Beaker, 250ml  
Magnetic stir bars and stir plate  
Pipet, 10 ml

### Reagents

0.1 N Hydrochloric acid(HCl)  
Buffer solutions, pH 7 and 10

### Procedure

Standardize the pH meter using pH 7 buffer. If the meter is the type in which a 2 point calibration can be done, also standardize with pH 10 buffer.

Pipet 10ml of developer solution (sodium carbonate) into a 250ml beaker. Add 100ml of DI water and a stir bar. Rinse the pH probe and immerse in the sample solution.

Titrate with 0.1 HCl to a pH of 8.2 and record. Determine the  $\text{Na}_2\text{CO}_3$  and  $\text{CO}_3$  by:

Calculation :

$$\text{ml HCl} \times \text{N HCl} \times 12.4/\text{ml sample} = \% \text{Na}_2\text{CO}_3 \text{ H}_2\text{O}$$

$$\text{ml HCl} \times \text{N HCl} \times 6/\text{ml sample} = \% \text{CO}_3^{2-}$$