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TCR® Thin Film Embedded Resistor Foil
Etching Process Recommendations Using Potassium Permanganate for Chromium Silicon Monoxide (CrSiO) Resistive Material

TECHNICAL BULLETIN

Chromium Silicon Monoxide resistive material can be selectively removed with various chemistries to give a clean, well defined resistor. Most circuit fabricators use acid etchants, most commonly cupric chloride, for primary image and resistive layer width definition. A second etch step to define the resistor length requires a different chemistry to ensure copper removal without resistive layer etch or degradation. The Chromium Silicon Monoxide resistive material layer will exhibit a matte grey finish after defining the resistor image. The processing can be properly controlled provided attention is paid to several considerations.

What to Consider

The first consideration is ensuring proper chemistries for the resistor defining processing. Commercially available cupric chloride and hydrochloric acid or ammoniacal etchants are recommended for copper during resistor width definition. The chemistry removes the copper and minimizes the amount of undercut of the copper.

The second consideration is ensuring proper chemistries for the resistor defining processing of the CrSiO. A solution made up of concentrated sodium hydroxide and potassium permanganate is one of the preferred chemistries for this process. The chemistry removes the CrSiO and minimizes the amount of undercut of the copper and CrSiO.

The third consideration is the proper chemistries for selective copper removal to define resistor length. A solution made up of commercially available ammoniacal etchant is the preferred chemistry for this process. The ammoniacal chemistry selectively etches the copper leaving the resistive layer intact.

The last consideration is the method of application of the etching chemistry. The removal of the copper and CrSiO can be performed in either a spray chamber or dip tank. The spray chamber method is preferred to better control etch rates and circuit definition. The temperature and dwell time in the chemistry is solution dependent.

Conclusions

The copper and CrSiO components can be completely removed with excellent circuit definition when care is taken to follow the considerations.

Other chemistries are known etchants of copper and CrSiO alloys. When using other chemistries to remove copper and Chromium Silicon Monoxide other than recommended above, consult the Ticer Technologies Technical Marketing or Research and Development.

Copper and CrSiO Resistive Material Removal Chemistry and Processing Parameters

Etch 1 Solution Copper removal Resistor Width definition	267g/l NH_4Cl 1 g/l ortho-phosphoric acid 392 ml NH_4OH 10 g/l $CuCl_2$
Temperature:	130 - 140º F (54 - 60º C)
Method:	Spray chamber or dip tank
Time:	Adjust for proper etching of copper weight
Etch 1 Solution Alternate Copper removal Resistor Width definition	200 g/l $CuCl_2$ 60g/l HCl
Temperature:	120º F (49º C)
Method:	Spray chamber or dip tank
Time:	Adjust for proper etching of copper weight
Etch 2 Solution Selective CrSiO removal Resistor Width definition	60 g/l $KMnO_4$ 10 g/l Sodium Hydroxide
Temperature:	120º F (49º C)
Method:	Spray chamber or dip tank
Time:	Adjust for proper etching of CrSiO ohms/square
Neutralizer Solution Neutralizer for Etch 2 Solution	25 g/l Oxalic Acid
Temperature:	Room Temperature
Etch 3 Solution Selective Copper removal Resistor length definition	267g/l NH_4Cl 1 g/l ortho-phosphoric acid 392 ml NH_4OH 10 g/l $CuCl_2$
Temperature:	130 - 140º F (54 - 60º C)
Method:	Spray chamber or dip tank
Time:	Adjust for proper etching of copper weight

Potassium Permanganate Resistor Etch Solution Makeup:

For makeup of 10 gallon basic resistor etch solution put 5 gallon of DI water into a 10 gallon container at room temperature (25°C) maintain gentle agitation with stir bar or equivalent. Cautiously add 1,514 grams of Potassium Permanganate. Top off with DI water to 10 gallons. With consistent agitation, adjust pH with sodium hydroxide to pH 9.5. Heat to 120°F. Maintain pH of solution after ample solution use. Note: use a volumetric pipet to add directly to bottom of the solution to eliminate chemical reaction when solution is warm.

Neutralizer Solution Makeup:

For makeup of 10 gallon neutralize solution put 5 gallon of DI water into a 10 gallon container at room temperature (25°C) maintain gentle agitation with stir bar or equivalent. Cautiously add 946 grams of oxalic acid. Top off with DI water to 10 gallons.

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Processing Notes

- Etching time is dependent on sheet resistance and feature size.
- For low ohms/sq CrSiO material, repeated immersing panel into etch solution 2, neutralizer solution, and rinse between may be required to speed up etching.
- Increasing solution temperature increases etching rate. However, $KMnO_4$ salts out quicker for 60g/l $KMnO_4$ solution due to water evaporation.
- Decreasing the concentration of $KMnO_4$ does not decrease etching rate significantly. However, low $KMnO_4$ concentration solution will slightly etch or oxidize copper surface when it is not covered by photoresist.
- High $KMnO_4$concentration solution does not etch or oxidize shiny side of copper, but it will etch off the treatment on RTC foil when it is not covered by photoresist.
- Leaving photoresist on panel is not necessary for etching standard copper resistive foil, but it protects treatment on RTC resistive foil.

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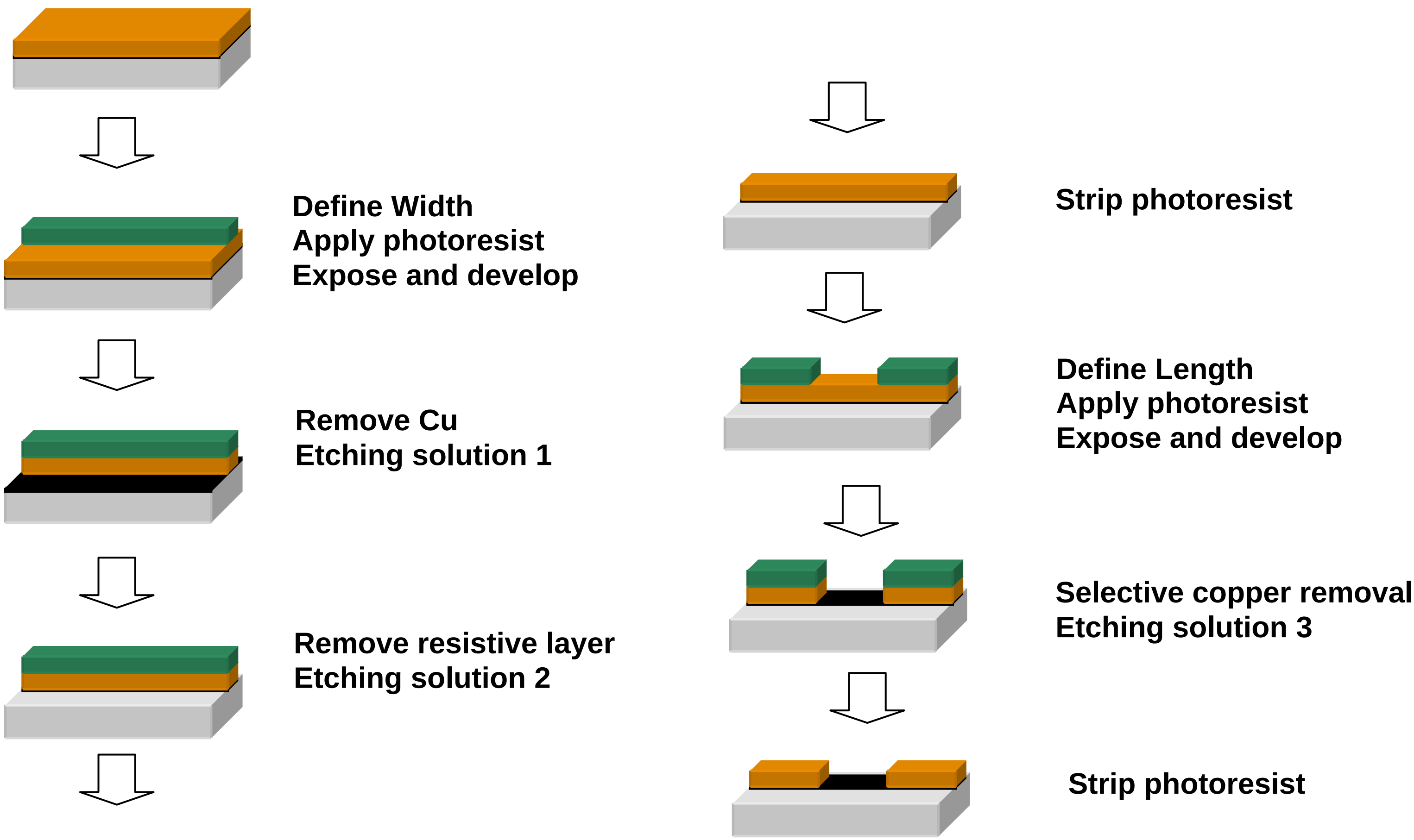
Etching Sequence of Chromium Silicon Monoxide (CrSiO) Resistive Materials



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