



## **TCR® Thin Film Embedded Resistor Foil Etching Process Recommendations Using HCl/Glycerin for Nickel Chromium (NiCr) Resistive Material**

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### **TECHNICAL BULLETIN**

Nickel chromium 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 Nickel chromium 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 NiCr. A solution made up of concentrated hydrochloric acid, glycerin, and water is the preferred chemistry for this process. The chemistry removes the NiCr and minimizes the amount of undercut of the copper and NiCr.

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 NiCr 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 NiCr 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 NiCr. When using other chemistries to remove copper and NiCr other than recommended above, consult the Ticer Technologies Technical Marketing or Research and Development.

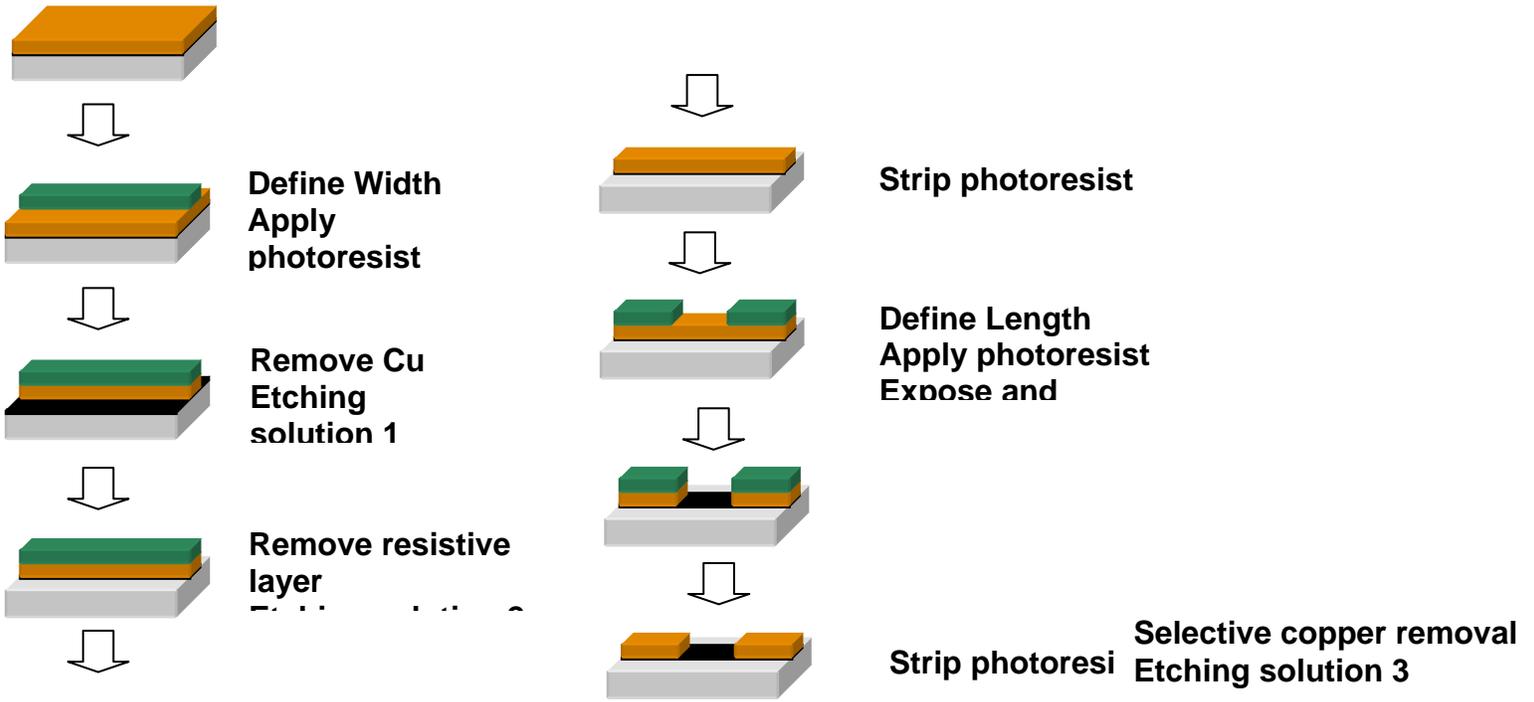
## Copper and NiCr Resistive Material Removal Chemistry and Processing Parameters

|                                                                                  |                                                                                                                           |
|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Etch 1 Solution</b><br>Copper removal<br>Resistor Width definition            | 267g/l NH <sub>4</sub> Cl<br>1 g/l ortho-phosphoric acid<br>392 ml NH <sub>4</sub> OH<br>10 g/l CuCl <sub>2</sub>         |
| Temperature:                                                                     | 130 - 140° F (54 - 60° C)                                                                                                 |
| Method:                                                                          | Spray chamber or dip tank                                                                                                 |
| Time:                                                                            | Adjust for proper etching of copper weight                                                                                |
| <b>Etch 2 Solution</b><br>Selective NiCr removal<br>Resistor Width definition    | 43 volume% HCl (Hydrochloric Acid, 36.5-38%)<br>46 volume % glycerin<br>11 volume% water<br>10 parts per million Thiourea |
| Temperature:                                                                     | 150° F (66° C)                                                                                                            |
| Method:                                                                          | Spray chamber or dip tank                                                                                                 |
| Time:                                                                            | Adjust for proper etching of NiCr ohms/square                                                                             |
| <b>Etch 3 Solution</b><br>Selective Copper removal<br>Resistor Length definition | 267g/l NH <sub>4</sub> Cl<br>1 g/l ortho-phosphoric acid<br>392 ml NH <sub>4</sub> OH<br>10 g/l CuCl <sub>2</sub>         |
| Temperature:                                                                     | 130 - 140° F (54 - 60° C)                                                                                                 |
| Method:                                                                          | Spray chamber or dip tank                                                                                                 |
| Time:                                                                            | Adjust for proper etching of copper weight                                                                                |

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# Etching Sequence of Nickel Chromium (NiCr) Resistive Materials



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