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Title	Procedure for Room-Temperature Metallization of Electroless Copper Plating			

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## 1. Summary

- This procedure outlined below will describe how to perform room-temperature metallization (RTM) of electroless copper plating. The process includes the methods to prepare parts to be plated as well as the plating process itself. In good conditions, the copper will deposit at 1.69 microns (0.067 mils) over 20 minutes of plating time.

## 2. Scope

- This procedure applies to the RTM electroless copper kit purchased from Transene® for the plating of ceramics, and other dielectric materials. Plating this way also extends to certain metals compatible with copper.

## 3. List of Equipment and Resources Required

- 3 beakers or vats large enough to fully submerge parts to be plated
- 1 additional beaker or vat **compatible with the etching solution used**
- Hot plate and magnetic stirrer
- Plastic or glass stirring rod
- Non-metallic tweezers or pliers
- Thermometer to monitor bath solution temperature

## Applications

The RTM process is applicable to metallizing substrates in hybrid and microcircuits, insulated heat sinks, ceramic tubes, windows and terminals. Strong bond structures are produced. Structures with hermetic seals are formed as well.

The RTM process is also useful for metallizing barium titanate and ferrites. In addition, many polymeric materials, notably polyesters, epoxies, cellulosic, mylar and acrylonitrile-butadiene-styrene (ABS terpolymer) may be metallized following suitable modifications of the etch (Solution A).

RTM lends itself productively to the application of photolithographic technology using photoresist materials to register metallization patterns. In this manner, conductive pads may be formed for thin film and hybrid circuits. Base plates for building capacitor structures are also quite feasible.

## Method of Plating

The RTM process involves first etching the surfaces of the part to be treated, to increase surface roughness and improve copper adhesion. This is material dependent, but usually involves an acid to partially dissolve the surface layers.

Post-etch, the part is sensitized and activated catalytically for the copper. This is done with palladium chloride, a tried-and-true activator.

Finally, the palladium acts as auto catalyst for the copper sulfate solution to reduce on. The copper will self-plate. Similarly for other metals. To reduce side reactions, the pH is kept Alkaline as it reduces.

### 4. Optional Etching Pre-treatment if Applicable

Before we begin plating, the parts to be plated must be prepared for the treatment. The first step is to determine whether the surface of these parts should be chemically etched. Etching increases surface roughness and improves adhesion of the copper layers during plating. Transene® recommends a surface roughness of about 20 microinches before plating. Consult the following for recommended etching pre-treatments based on material.

1. Solvent Decrease – Removes oil and grease; followed by vigorous water rinse.
2. Pumice Powder – Wet or dry, removes oxides, heavy soils (and/or vapor-blasting); followed by thorough water rinse.
3. Alkali Soak (5 Min) – Hot 150° to 180°F to further clean copper surface; condition laminate; improve surface wetting. Followed by warm water rinse.
4. Persulfate Etch (2 min) – Produces matte pink copper surface: ammonium persulfate – 200 gm/L; sulfuric acid – 10 ml/L. Followed by water rinse.
5. 10% Sulfuric Immersion (2 min) – Removes insoluble salts (Step #4). Followed by water rinse.
6. 33% HCL Immersion (2 min) – To protect from harmful drag-in.

**Warning: Some etching components use dangerous caustics, such as hydrofluoric acid (HF). Consult the dedicated SOPs for those specific steps. This is only a general guide, with emphasis on the plating process itself.**

## COMPOSITION OF ETCH SOLUTIONS

**Buffered Etch (Solution A)** – a buffered solution **hydrofluoric acid**.

### Chromic Acid

Chromium Trioxide	7.5 grams
Sulfuric Acid	25 mL
Water to	1 liter

### Metal Etch

Nitric Acid	50% by volume
Glacial Acetic Acid	40% by volume
Water	10% by volume

### Chromic-Sulfuric-HF- Solution

Chromium Trioxide	5% by volume
Sulfuric Acid	10% by volume
Hydrofluoric Acid (4896)	19% by volume

### Stannous Chloride Solution

Stannous chloride 2% with hydrochloric acid added to obtain a clear solution.

## 5. PROCEDURE FOR RTM PROCESS

1. Preheat Electroless Copper Part A (blue copper-containing liquid) to desired operating temperature; 35 C produces good quality results.
2. Sensitizer Solution C (2 min. immersion) – Seeds epoxy/glass laminate. Followed by water rinse.
3. Activator Solution D (2 min. immersion) – Activates an autocatalytic layer for copper deposition. Followed by thorough water rinse.
4. 5% Sulfuric Dip (3-5 min. immersion) – Speeds electroless copper deposition, protects from drag-in contamination. Followed by water rinse.
5. Electroless Copper Parts A & B (60 min. typical) – Mix Electroless Copper Part B (clear liquid) into Part A, which has been preheated to operating temperature. Immerse part in plating bath and agitate slowly. Operate @ 30-45 °C. 35 C typically produces the best deposition, and 400 RPM agitation is sufficient. Follow by water rinse.

**Approx. Plating Rate:** 5.08 microns (0.2 mils) per hour immersion time of optimally run plating. In practice, typically see faster plating deposition depending on copper content and temperature, among other factors.

### **OPTIONAL – Follow up with electrolytic plating post-electroless copper immersion**

6. 5% Sulfuric Dip – Neutralizes surface. Follow by water rinse.
7. 20% HCl Acid Dip (10-60 sec.) – Follow by water rinse.
8. Electroplate Copper – To build up desired copper thickness.

## CARE OF RTM SOLUTION

Special Electroless Copper (Solution A) has an alkaline pH. This pH should not be allowed to drop below 7.0; although the solution is well buffered, the addition of sodium hydroxide from time to time may be required. The use of pH test paper is satisfactory for control.

Use at 30-45 °C (not over 50 °C). Bath should be held at optimum operation temperature of 40 °C for uniform plating thickness. Continuous mild agitation of work. Nominal plating rate 0.2 mil/hour. PC Electroless Copper is used for depositing thin layers of copper, up to 0.5 microns. For thicker films, Transene Copper Plating Acid Type should be used after initial electroless copper deposition. The copper content is 16 grams/gallon.

The electroless copper solution should be filtered to extend the usefulness of the solution whenever particles occur. The glass vessel used for RTM may sometimes develop a deposit of copper, due to overheating. The glass vessel should then be cleaned as well.

Sufficient quantities of RTM solutions should be used in the RTM Process. These used solutions, however, should not be returned to the original container to guard against contamination.

## 6. Training Plan and Measures of Competency

- If using any etching solution that contains any amount of hydrofluoric acid (HF), then the user is required to take MIT's specific HF course.

## 7. Work Health and Safety Considerations

- Any use of etching solutions, including HF, poses a safety hazard. Consult with the individual SOPs for those procedures.

## 8. References, Related Resources, and Acknowledgments

1. Transene Company, Inc.

## 9. Attachments or Related Documents

1. <https://transene.com/rtm-process/>
2. <https://transene.com/cu/>