COPPER GLEAM™ HS-200 (WITH HS-200 B-1)
HORIZONTAL ACID COPPER
For PWB Metallization Applications

Regional Product Availability

<table>
<thead>
<tr>
<th></th>
<th>N. America</th>
<th>Japan/Korea</th>
<th>Asia</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
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DESCRIPTION
Copper Glem HS-200 is a full bright acid copper plating process specifically formulated for use in horizontal plating equipment. Formulated for high current density plating, the process is capable of producing uniform, bright deposits of high ductility and tensile strength in accelerated plating times. In addition to productivity, this technology exhibits exceptional metal distribution that can be utilized in the manufacture of high density product, which requires thin innerlayer metallization. Simple analytical procedures are available for all components allowing for the use of CVS techniques.

ADVANTAGES
- High throwing power, in horizontal plating applications, at accelerated plating rates (>6 ASD, 56 ASF)
- Capable of producing bright, uniform deposits
- Excellent through-hole microleveling
- Superior plating distribution (less than 10% variation over the usable surface)
- Deposits exhibit unsurpassed physical properties, typically >15% elongation and tensile strength of 44 kpsi, 300 N/mm²
- Thermal Shock resistance exceeds MIL-P-55110E
- Complete analytical control

BATH MAKE-UP

<table>
<thead>
<tr>
<th>Component</th>
<th>Metric</th>
<th>(U.S.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deionized Water</td>
<td>650 ml/l</td>
<td>65% v/v</td>
</tr>
<tr>
<td>Electronic Grade Copper Sulfate</td>
<td>100 g/l</td>
<td>13 oz./gal.</td>
</tr>
<tr>
<td>Copper Sulfate CuSO₄•5H₂O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur Free Carbon Powder</td>
<td>6 g/l</td>
<td>0.8 oz./gal.</td>
</tr>
<tr>
<td>Norit 211 Granular or Norit RO 0.8</td>
<td>9 g/l</td>
<td>1.2 oz./gal.</td>
</tr>
<tr>
<td>Copper Glem HS-200 A</td>
<td>0.25 ml/l</td>
<td>0.025% v/v</td>
</tr>
<tr>
<td>Copper Glem HS-200 B-1</td>
<td>2.00 ml/l</td>
<td>0.200% v/v</td>
</tr>
<tr>
<td>C.P. Grade Concentrated Sulfuric Acid</td>
<td>100 ml/l</td>
<td>10% v/v</td>
</tr>
<tr>
<td>C.P. Grade Concentrated Hydrochloric Acid</td>
<td>0.13 ml/l</td>
<td>0.013% v/v</td>
</tr>
</tbody>
</table>

BATH MAKE-UP PROCEDURE

a) Add deionized water to an appropriately cleaned storage tank and heat to 32–38°C (90–100°F).
b) Add electronic-grade copper sulfate and mix thoroughly until completely dissolved.
c) Recirculate the solution through a 1 micron polypropylene filter cartridge for at least two tank volume turnovers.
d) SLOWLY, with thorough mixing, add C.P.-grade concentrated sulfuric acid (SG 1.84). CAUTION! Reaction is exothermic; heat is generated.
e) Add deionized water to bring solution to final volume and allow the solution to cool to 50–55°C (122–130°F).
f) Analyze solution for copper sulfate and sulfuric acid levels and adjust if necessary.
g) Add activated sulfur-free granular carbon (Norit 211, Norit RO 0.8 or equivalent).
h) Thoroughly mix solution for 1–2 hours.
i) Allow carbon to settle.
j) Using a 1 micron polypropylene filter cartridge, filter the solution into the electroplating tank and allow the solution to cool to below 32°C (90°F).
k) Determine chloride on concentration.
l) Add CP grade concentrated hydrochloric acid (SG 1.18) to raise chloride level to 60 ppm (2.5 ml/100 liters; 10 ml/100 gal = 12 ppm chloride ion).
m) Confirm chloride concentration by analysis.
n) Insert anodes into plating tank.
COPPER GLEAM HS-200 (WITH HS-200 B-1) HORIZONTAL ACID COPPER

**Note:** The Copper Gleam HS-200 bath requires electrolyzing before starting to properly film the anodes and to produce the desired deposit. Electrolyze with blank foil laminate properly cleaned at 14–20 ASF with approximately 3/4 amp per gallon loading. Electrolyze until 18 ampere hours per gallon of plating is achieved. Twentyfour hours of plating time is required to complete the electrolyzing procedure. Replace the foil laminate every 2–4 hours with new panels to prevent any nodules that form on the edges from entering the bath. The Copper Gleam HS-200 will naturally stabilize at a concentration of 1.5–2.5 ml/l during the above electrolyzing procedure. Maintain the concentration within this range by making additions of additive every 2–4 hours or as required by CVS analysis or Hull cell plating tests. After the startup electrolyzing procedure is completed, the bath is ready for production plating.

**BATH CONTROL**

**Solution Operation and Control**

The solution constituents, with the exception of the Carrier and Additive, are controlled by chemical analysis. The Carrier and Additive are controlled by CVS or Hull cell. The solution can be operated at a cathode current density from 5–15 ASD (50–150 ASF; the lower current density is recommended for very high aspect ratio boards). For most boards, 6–10 ASD (60–100 ASF) is recommended.

For Hull cell control, use a standard 267 ml cell equipped with air agitation, a phosphorized copper anode and a standard 7x10 cm polished brass cathode panel. The cathode panel should be properly cleaned to a water break free surface before plating. Plate panel at 1 amp for 30 minutes and view panel for brightness and uniformity. The panel should appear semi-bright to bright without any burn or dull area across the entire panel surface.

To view the extreme low current density, plate panel at 0.25 amp for 30 minutes. The appearance should also be semi-bright to bright across the entire panel surface.

**COPPER GLEAM HS-200**

The Copper Gleam HS-200 A contains no active grain refiners.

Copper Gleam HS-200 A should be replenished at a rate of 0.1–0.5 ml/amp hour, dependent on method of operation.

**Note:** Copper Gleam HS-200 A consumption increases with increased temperatures of operation and increased anode area, particularly in combination with titanium anode baskets.

**BATH OPERATION**

**Metric**

<table>
<thead>
<tr>
<th>Component</th>
<th>Range</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper Sulfate</td>
<td>80–120 g/l</td>
<td>100 g/l</td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>95–105 ml/l</td>
<td>100 ml/l</td>
</tr>
<tr>
<td>Chloride</td>
<td>50–80 ppm</td>
<td>60 ppm</td>
</tr>
<tr>
<td>Copper Gleam HS-200 A</td>
<td>0.10–0.30 ml/l</td>
<td>0.25 ml/l</td>
</tr>
<tr>
<td>Copper Gleam HS-200 B-1</td>
<td>1.5–20.0 ml/l</td>
<td>2.00 ml/l</td>
</tr>
<tr>
<td>Temperature</td>
<td>25–35°C</td>
<td>30°C</td>
</tr>
<tr>
<td>Cathode Current Rate</td>
<td>5–15 A/dm²</td>
<td>10 A/dm²</td>
</tr>
</tbody>
</table>

Deposition Rate: 25 microns in 20 min. at 6 A/dm²

**U.S**

<table>
<thead>
<tr>
<th>Component</th>
<th>Range</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper Sulfate</td>
<td>10–16 oz./gal.</td>
<td>13 oz./gal.</td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>24–26 oz./gal.</td>
<td>25 oz./gal.</td>
</tr>
<tr>
<td>Chloride</td>
<td>50–80 ppm</td>
<td>60 ppm</td>
</tr>
<tr>
<td>Copper Gleam HS-200 A</td>
<td>0.01–0.03% v/v</td>
<td>0.025% v/v</td>
</tr>
<tr>
<td>Copper Gleam HS-200 B-1</td>
<td>0.15–2.00% v/v</td>
<td>0.20% v/v</td>
</tr>
<tr>
<td>Temperature</td>
<td>77–95°F</td>
<td>86°F</td>
</tr>
<tr>
<td>Cathode Current Rate</td>
<td>50–150 A/ft²</td>
<td>100 A/ft²</td>
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</tbody>
</table>

Deposition Rate: 1 mil. in 20 min. at 60 A/ft²
COPPER GLEAM HS-200 (WITH HS-200 B-1) HORIZONTAL ACID COPPER

RECOMMENDED CONTROL SCHEDULE

<table>
<thead>
<tr>
<th>Analysis of</th>
<th>Procedure</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>Volumetric Analysis, Atomic Absorption</td>
<td>Weekly</td>
</tr>
<tr>
<td></td>
<td>Spectroscopy</td>
<td></td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>Volumetric Analysis</td>
<td>Weekly</td>
</tr>
<tr>
<td>Chloride</td>
<td>Specific Ion Electrode</td>
<td>Weekly</td>
</tr>
<tr>
<td>Metalic Contamination</td>
<td>Volumetric Analysis</td>
<td>Weekly</td>
</tr>
<tr>
<td>(Fe, Ni, Sn)</td>
<td>Atomic Absorption Spectroscopy</td>
<td></td>
</tr>
<tr>
<td>Process Performance</td>
<td>Hull Cell</td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td>CVS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thermal Shock</td>
<td>Once per shift</td>
</tr>
</tbody>
</table>

METALLIC IMPURITIES

The maximum tolerable level of metallic contaminants are listed below:

- Fe plus Ni: 1,000 ppm
- Sn: 100 ppm

PURIFICATION PROCEDURE

Carbon treatment is required when the physical properties of the deposit change, such as the elongation and tensile strength fall below the minimum requirements. Dull plating in the low current density areas can also be indicative of the need for carbon treatment.

To carbon treat the bath, follow the procedure described below:

a) Pump the bath into the treatment tank.
b) Add 2–3 ml/l 35% hydrogen peroxide and mix for 1 hour at room temperature.
c) Heat solution to 55°C (130°F) for 1 hour.
d) Add 15.0 g/l NORIT 211 or Norit RO 0.8 carbon into the heated solution.
e) Discontinue heating and allow the carbon to settle for approximately 1/2 hour. Slowly stir the solution for one hour.
f) Filter the solution with a precoat of filter aid into the plating tank.

eqipment

- Tank: Semi-hard PVC, polypropylene or Koroseal lined
- Anodes: Insoluble anode (Pt-Ti); Phosphorus deoxidized copper (0.04%–0.08% P)
- Anode Bags: Unnapped terylene, polypropylene or Dynel
- Heaters: PTFE-coated panel heaters, silica or aluminous porcelain immersion heaters
- Filtration: 1–5 micron polypropylene filter cartridges; filter continuously at a rate of 5 tank volume turnovers per hour
- Power Supply: 4–6 volt rectifier with a maximum of 5% ripple is required; for optimal plating distribution, split rectification is recommended
- Agitation: Oil free air plus mechanical cathode reciprocation, normal to the anodes, to produce flowing action of the solution through the holes

EQUIPMENT PREPARATION

I. Tanks

Prior to makeup, the process tank and ancillary equipment should be thoroughly cleaned and then leached with a sulfuric acid solution.

This procedure is particularly important for new equipment or equipment previously used for other processes.

II. Cleaning Solution

<table>
<thead>
<tr>
<th>Sodium Hydroxide</th>
<th>20–50 g/l (2.5–6.5 oz./gal.)</th>
</tr>
</thead>
</table>

III. Leaching Solution

<table>
<thead>
<tr>
<th>Sulfuric Acid</th>
<th>20–50 ml/l (2–5% v/v)</th>
</tr>
</thead>
</table>
**COPPER GLEAM HS-200 (WITH HS-200 B-1) HORIZONTAL ACID COPPER**

**IV. Procedure**

a) Thoroughly wash down tank and ancillary equipment with clean water.

b) Recirculate water through the complete system to remove water soluble materials.

c) Discard water.

d) Add cleaning solution to the tank, heat to 55–60°C (130–140°F) and recirculate through the complete system.

e) Discard cleaning solution.

f) Recirculate water through the complete system.

g) Discard water.

h) Add leaching solution and recirculate through the complete system.

i) Discard leaching solution.

j) Recirculate water through the complete system.

k) Discard water.

**INSOLUBLE ANODES**

Iridium oxide coated titanium is recommended.

*Note:* If insoluble anodes are not supplied by the equipment manufacturer, then they must demonstrate the production proven capability of tolerating the corrosive environment of acid copper plating solutions.

**POLYPROPYLENE FILTER CARTRIDGES**

a) Wash thoroughly in hot deionized water.

b) Leach with a 10% sulfuric acid solution for 8 hours.

c) Rinse thoroughly with deionized water.

**GENERAL MAINTENANCE**

a) Filters should be changed every 2–4 weeks.

b) If soluble anodes are in use, the anode area should be checked and maintained on a regular basis. For titanium basket/anode sludge, this should include a periodic complete removal of the anodes, thorough cleaning of any sludge build-up, replenishment and reconditioning.

c) If soluble anodes are in use, the anodes should be bagged with unnapped Terylene or polypropylene bags. Bags should be checked frequently for holes or tears. Replace defective anode bags immediately.

d) Periodic carbon treatment of acid copper electrolytes is required. Routine carbon treatments are recommended at 3-6 month intervals.

Carbon treatment is also recommended if

1. The physical properties of the copper electrodeposit fall below specification.

2. Analytical procedures indicate either organic contamination or excess additive conditions.

*Note:* Any change in color of the electrolyte from the normal blue toward a green color is indicative of organic build-up.

e) The Rohm and Haas Electronic Materials technical service organization will assist in establishing a carbon treatment schedule and procedure, which may include the use of oxidizing agents such as hydrogen peroxide and/or potassium permanganate appropriate for your operation.

**DEPOSIT PROPERTIES**

- Conductivity: 0.59 micro-ohm/cm
- Elongation: 14–20%
- Tensile Strength: 43–50 kpsi
- Solderability: Excellent
- Structure: Fine grained equiaxed
- Thermal Shock: No cracks after 5 cycles
  (solder float 288°C for 10 seconds)

**PRODUCT DATA**

**Copper Gleam HS-200 A:**

- Specific Gravity: ~1.01
- Appearance: Clear, light blue liquid
- pH: <2.0

**Copper Gleam HS-200 B-1:**

- Specific Gravity: ~1.03
- Appearance: Clear, light blue liquid
- pH: <2.0
HANDLING PRECAUTIONS
Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

CAUTION! Keep combustible and/or flammable products and their vapors away from heat, sparks, flames and other sources of ignition including static discharge. Processing or operating at temperatures near or above product flashpoint may pose a fire hazard. Use appropriate grounding and bonding techniques to manage static discharge hazards.

CAUTION! Failure to maintain proper volume level when using immersion heaters can expose tank and solution to excessive heat resulting in a possible combustion hazard, particularly when plastic tanks are used.

STORAGE
Store products in tightly closed original containers at temperatures recommended on the product label.

DISPOSAL CONSIDERATIONS
Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user’s responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Rohm and Haas Electronic Materials Technical Representative for more information.
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For locations and information please visit http://electronicmaterials.rohmhaas.com

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