TINGLO CULMO™ Bright Acid Tin Electroplating (with Starter/Brightener 2.5X)
For Electronic Finishing Applications

Regional Product Availability
- North America

Description
The TINGLO CULMO™ Process offers extremely bright tin deposits with excellent solderability and ductility, capable of meeting the requirements for electronic, industrial and decorative applications. The process is distinguished by its stability, economy, ease of operation and exceptional throwing power.

Advantages
- Bright, levelled deposit
- Good solderability after long periods of storage
- Relatively non-porous deposit
- Meets Mil T-10727A for corrosion protection (salt spray)
- Economy and ease of use

Deposit Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solderability</td>
<td>Excellent</td>
</tr>
<tr>
<td>Shelf Life</td>
<td>Excellent</td>
</tr>
<tr>
<td>Hardness: 8–9 HV25</td>
<td></td>
</tr>
<tr>
<td>Density: 7.31 g/cm³</td>
<td></td>
</tr>
<tr>
<td>Electrical Conductivity (AG=100)</td>
<td>13.0</td>
</tr>
<tr>
<td>Heat Conductivity (AG=100)</td>
<td>15.0</td>
</tr>
<tr>
<td>Melting Point: 233°C (451°F)</td>
<td></td>
</tr>
<tr>
<td>Electrical Resistivity: 11.5 microhm-cm³</td>
<td></td>
</tr>
</tbody>
</table>

Bath Make-Up

<table>
<thead>
<tr>
<th>Chemicals Required</th>
<th>Metric</th>
<th>(U.S.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deionized (D.I.) Water</td>
<td>750 mL/L</td>
<td>(75% v/v)</td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>100 mL/L</td>
<td>(10% v/v)</td>
</tr>
<tr>
<td>Stannous Sulfate</td>
<td>30 g/L</td>
<td>(4.0 oz./gal.)</td>
</tr>
<tr>
<td>TINGLO CULMO™ Starter (2.5X)</td>
<td>40 mL/L</td>
<td>(4% v/v)</td>
</tr>
</tbody>
</table>

Make-Up Procedure
1. Add D.I. water to a clean tank.
2. Slowly add sulfuric acid with good agitation.
   **Caution:** Use extreme care when handling sulfuric acid. Always add acid to water with constant mixing during addition. The reaction is exothermic (generates heat) and temperatures may exceed 70°C (158°F). If this
occurs, stop addition and allow temperatures to drop below 50°C (120°F) before recommencing.

3. In a separate container, mix small portions of the required amount of stannous sulfate with D.I. water into a slurry. Add slurry to the tank and mix until completely dissolved.

4. Allow solution to cool to below 24°C (75°F).

5. Add TINGLO CULMO™ Starter (2.5X) and mix thoroughly.

6. Dilute to final volume with D.I. water and mix thoroughly.

<table>
<thead>
<tr>
<th>Operating Parameters—Metric</th>
<th>Component</th>
<th>Range</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tin Metal</td>
<td>10.0–25.0 g/L</td>
<td>15.0 g/L</td>
<td></td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>85.0–110.0 mL/L</td>
<td>100.0 mL/L</td>
<td></td>
</tr>
<tr>
<td>TINGLO CULMO™ Starter (2.5X)</td>
<td>20–40 mL/L</td>
<td>40 mL/L</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>15–30°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode Current Density</td>
<td>0.1–4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Current Density</td>
<td>0.2–2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agitation</td>
<td>Continuous cathode rod parallel to the anodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode Efficiency</td>
<td>95–100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deposition Rate</td>
<td>1 micron per minute at 2 A/dm² based on 100% cathode efficiency</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Parameters—U.S.</th>
<th>Component</th>
<th>Range</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tin Metal</td>
<td>1.3–3.3 oz./gal.</td>
<td>2.0 oz./gal.</td>
<td></td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>8.5–11.0% v/v</td>
<td>10.0% v/v</td>
<td></td>
</tr>
<tr>
<td>TINGLO CULMO™ Starter (2.5X)</td>
<td>2.0–4.0% v/v</td>
<td>4.0% v/v</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>60–85°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode Current Density</td>
<td>1–40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Current Density</td>
<td>2–25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agitation</td>
<td>Continuous cathode rod parallel to the anodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode Efficiency</td>
<td>95–100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deposition Rate</td>
<td>40 micro inches per minute at 20 A/ft² based on 100% cathode efficiency</td>
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<td></td>
</tr>
</tbody>
</table>
**Pre-Treatment**

A barrier plate of copper or nickel should be used to prevent zinc migration when plating tin over zinc or brass.

A final activation step of 10–20% sulfuric acid is recommended prior to entering the electroplating cell.

**Bath Maintenance**

The TINGLO CULMO™ Process is a two-component system that imparts brightness to the deposit over a wide range of current densities. The solution in most cases is maintained by adding 20 mL of TINGLO CULMO Starter (2.5X) and 10 mL of TINGLO CULMO Brightener (2.5X) per 100 ampere hours. If TINGLO CULMO is being used as an etch resist for a Circuit Board Technologies application, then, it may be possible to replenish the bath only with TINGLO CULMO Starter (2.5X) at a rate of 30 mL per 100 ampere hour.

**TINGLO CULMO Starter (2.5X)**

For makeup and replenishment. For maintaining deposit grain refinement and operating current density range.

**TINGLO CULMO Brightener (2.5X)**

TINGLO CULMO Brightener (2.5X) is used for replenishment to maintain deposit uniformity and brightness. Additions are made based upon Hull cell determination.

**NEUTRA RINSE™ 80 Post-Rinse**

NEUTRA RINSE 80 is a specially designed post-plate rinse for parts plated in the TINGLO CULMO Bright Tin Process. NEUTRA RINSE 80 will Neutralize the acid film left on parts, thus improving solderability and minimizing staining of parts after plating. (For more information, see NEUTRA RINSE 80 datasheet.)

**CLAROSTAN™ S.O. Clarifier**

CLAROSTAN S.O. is a liquid clarifier and flocculating agent used to minimize turbidity commonly found in aged sulfate tin plating solutions. The turbidity is caused by oxidized tin solids suspended in the solution and the treatment with CLAROSTAN S.O. precipitates these solids. Regular treatment of the plating solution is recommended to optimize the plating efficiency.

**Spectrophotometric Analysis of TINGLO CULMO™ Starter (2.5X)**

I. **Equipment**
   a) Five 100 mL volumetric flasks
   b) 0.5 mL pipette
   c) 2 mL and 4 mL volumetric pipettes
   d) UV Spectrophotometer
   e) Quartz cell cuvettes
II. Reagents
   a) Tin stock; 30 g/L SnSO₄, 105 mL/L H₂SO₄
   b) 2% TINGLO CULMO™ Starter (2.5X) solution; pipette 2 mL TINGLO CULMO Starter (2.5X) into a 100 mL volumetric flask and dilute to mark with tin stock
   c) 4% TINGLO CULMO Starter (2.5X) solution; pipette 4 mL TINGLO CULMO Starter (2.5X) into a 100 mL volumetric flask and dilute to mark with tin stock
   d) Sulfuric acid

III. Procedure
   a) Prepare 2% and 4% TINGLO CULMO Starter (2.5X) standard solutions.
   b) Pipette 0.5 mL of each standard, tin stock (used for a blank) and production electrolytes into separate 100 mL volumetric flasks and dilute to the mark with a 5% solution of sulfuric acid.
   c) Set the UV spectrophotometer up to do a single wavelength reading at 280 nm.
   d) Measure the absorbance of the two standards and the production electrolytes at 280 nm and record them.
   e) Plot the absorbance vs. the % TINGLO CULMO Starter (2.5X) on a graph for the two standards.
   f) Using the above curve, determine the % TINGLO CULMO Starter (2.5X) of the production electrolytes from their absorbance.

*Note: Filtering may be necessary before pipetting for second dilution.

Tin Metal

Stannous sulfate contains 55.3% tin metal and is used to maintain the tin metal content. To raise tin metal content by 1.0 g/L (0.13 oz./gal.) add 1.8 g/L (0.24 oz./gal.) stannous sulfate.

Determination of Tin Metal

I. Equipment
   a) 5 mL Class A volumetric pipette
   b) 250 mL Erlenmeyer flask
   c) 50 mL burette
   d) 100 mL graduated cylinder
   e) Eye dropper

II. Reagents
   a) Hydrochloric acid, 20% v/v
   b) Starch indicator solution

III. Titrants
   a) Iodine solution, 0.10N standardized
Dissolve 12.7g iodine in approximately 750 mL of 10% potassium iodide solution. Dilute to 1 liter with D.I. water. Then standardize against a known sodium thiosulfate solution.

IV. Procedure
a) Pipette 5 mL of the tin plating solution to be analyzed into 250 mL Erlenmeyer flask.

b) Add 100 mL of distilled water.

c) Add 20 mL of 20% hydrochloric acid (20%).

d) Add 1 mL starch indicator solution.

e) Titrate with 0.1N iodine solution to a blue color, which persists for 30 seconds.

V. Calculation
stannous sulfate in oz./gal. = mL of 0.1N Iodine used × 0.286

Sulfuric Acid
Sulfuric acid concentration must be maintained for optimum throwing power.

Determination of Sulfuric Acid

I. Equipment
a) 5 mL Class A volumetric pipette
b) 250 mL Erlenmeyer flask
c) 50 mL burette
d) Eye dropper

II. Reagents
a) Tin plating solution
b) Ammonium oxalate (4%)
c) Bromocresol purple indicator

III. Titrants
a) Sodium hydroxide solution, 1.0N

IV. Procedure
a) Pipette 5 mL of the tin plating solution to be analyzed into 250 mL Erlenmeyer flask.

b) Add 50 mL of ammonium oxalate solution (4%).

c) Add 5 drops of bromocresol purple indicator.

d) Titrate with 1.0N sodium hydroxide solution until the color changes from yellow to purple.
V. Calculation

\[
\text{sulfuric acid in } \% \text{ v/v} = \frac{\text{mL of 1.0N sodium hydroxide}}{0.53}
\]

Anode Maintenance

Anode area should be maintained for optimum results. Inspect anodes on a regular basis and replace worn or severely necked slab anodes.

<table>
<thead>
<tr>
<th>Recommended Control Schedule</th>
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</thead>
<tbody>
<tr>
<td><strong>Analysis of</strong></td>
</tr>
<tr>
<td>Stannous Tin</td>
</tr>
<tr>
<td>Sulfuric Acid</td>
</tr>
<tr>
<td>Metallic Contamination</td>
</tr>
<tr>
<td>Chloride Contamination</td>
</tr>
<tr>
<td>Deposit Appearance</td>
</tr>
<tr>
<td>Deposit Thickness</td>
</tr>
<tr>
<td>Throwing Power</td>
</tr>
</tbody>
</table>

Contaminants

The maximum tolerable level of typical contaminants are listed below:

- Copper: 5 ppm
- Iron: 1,000 ppm
- Nickel: 100 ppm

Product Data

For the specific Product Data values, please refer to the Certificate of Analysis provided with the shipment of the product(s).

Associated Products

- TINGLO CULMO™ Starter (2.5X)
- TINGLO CULMO Brightener (2.5X)
- NEUTRA RINSE™ 80 Post-Rinse
- CLAROSTAN™ S.O. Clarifier

Equipment

- **Tanks:** Polypropylene, Polyethylene, CPVC
- **Agitation:** Cathode movement and solution agitation. Work rod speed = 3–4 m/min. (2.0–2.6 in./sec.) Stroke length = 50–70 mm (2.0–2.8 in.) Continuous solution agitation at 3 to 4 turnovers per hour
- **Filtration:** Periodic through 1 micron polypropylene or Dynel cartridges
Solution Cooling: May be required for certain operations; Teflon fluoropolymer coils are recommended

Anodes: Pure tin slabs, minimum purity of 99.95%; the use of titanium anode baskets is not recommended

Rectifier: Continuous voltage control with 5% maximum ripple

**Equipment Preparation**

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.

I. **Cleaning Solution**
   a) Trisodium Phosphate: 15 g/L (2 oz./gal.)
   b) Sodium Hydroxide: 15 g/L (2 oz./gal.)

II. **Leaching Solution**
    Sulfuric Acid: 100 mL/L (10% v/v)

III. **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) Leave leaching solution in tank for minimum of 8 hours.
   j) Recirculate leaching solution through the complete system.
   k) Discard leaching solution.
   l) Recirculate water through the complete system.
   m) Discard water.
Handling Precautions

Before using this product, associated generic chemicals or the analytical reagents required for its control, consult the supplier's 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 Dow Electronic Materials Technical Representative for more information.

Product Stewardship

Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products - from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

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