

Product Data Sheet

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PRODUCT #: N9130

CuBrite CF-110

Matte Acid Copper Plating Agent

DESCRIPTION:

A matte acid copper plating additive formulated for plating baths with high throwing power resulting in excellent surface to hole thickness ratios in through-hole plating of printed circuit boards. Based on economical copper sulfate and sulfuric acid, it is easy to make up, operate and control. *CuBrite CF-110* is a single grain refining agent that is added on an ampere hour basis and is not removed by circulation of the plating solution through a filter packed with carbon. The addition agent reaction products and organic contamination can thus be removed on a continuous basis to assure excellent deposit ductility. *CuBrite CF-110* produces fine-grained, soft, matte deposits that insure good solderability, resist adhesion and etch characteristics.

BENEFITS:

- **High throwing power**
- **Enhanced resist and secondary plating adhesion**
- **Easy make-up and maintenance**
- **High ductility deposit can be consistently maintained**
- **Recommended for flex and microelectronics applications**

BATH COMPOSITION:

	<u>Optimum</u>	<u>Range</u>
Copper Sulfate	10 oz/gal	8 - 16 oz/gal
Sulfuric Acid	25 oz/gal	25 - 30 oz/gal (10% by vol)
Chloride	50 ppm	15 - 50 ppm
<i>CuBrite CF-110</i>	1.5% by volume	1.25% - 2.0% by volume

OPERATING CONDITIONS:

Temperature	75°F optimum	70°F - 90°F
Agitation	Solution, air and cathode rod (avoid compressed air)	
Cathode Current Density	1 - 80 ASF	
Filtration	Continuous (1 - 5 micron filter is recommended)	
Anodes	Phosphorized copper (0.03% - 0.08% phosphorous). Slab or slug anodes bagged in Dynel or polypropylene (cotton and cellulose are not acceptable).	
Anode Hooks & Baskets	Titanium	
Anode to Cathode Ratio	1 - 2:1 (a 2:1 ratio is optimum)	

MAKE-UP OF PLATING SOLUTION:

		<u>For 100 Gallons</u>
Copper Sulfate	10 oz/gal	63 lbs. CuSO ₄ anhydrous (98 lbs. CuSO ₄ ·5H ₂ O)
Sulfuric Acid	25 oz/gal	10 gals.
Hydrochloric Acid	50 ppm	50 cc's
<i>CuBrite CF-110</i>	1.5% by volume	1½ gals.

MAINTENANCE AND CONTROL:

General:

Prior to make-up, the plating tank should be thoroughly leached with a 5% sulfuric acid solution at 49-60°C (120-140°F) overnight, and then thoroughly rinsed with water to remove any contaminants which may be present in the tank linings. Anodes should be removed from the tank and cleaned. Anode bags, if used, should be new and leached in 5% H₂SO₄. All equipment which will be in contact with the plating solution, e.g., agitation air lines, heaters, cooling coils and filters, should be cleaned prior to solution make-up. Filter cartridges should be thoroughly flushed with hot water prior to use to avoid organic contamination of the bath.

1. Fill the plating tank two-thirds full with deionized water.
2. Using suitable mixing, slowly and carefully add the required amount of 66° Baumé water white sulfuric acid. Do not use technical or commercial sulfuric acid. CAUTION! Heat will be liberated by the mixing of the acid with the water solution.
3. Add the required amount of copper sulfate and completely dissolve by mixing. The heat generated in Step 2 will aid in the dissolution.
4. Pack the filter with 0.5-0.6 g/L (4-5 lbs/100 gallons) of granular carbon and circulate while the solution is cooling. The granular carbon used should be low in iron and chloride.
5. Add the required amount of hydrochloric acid or sodium chloride to bring the chloride level to 30-45 mg/L (30-45 ppm).
6. After allowing the solution to cool to room temperature, add the required amount of ***CuBrite CF-110***.
7. Circulate the plating solution through a filter packed with carbon (granular carbon embedded tubes or a separate granular carbon chamber) until the absorbance @ 420nm is equal to, or less than, 0.05. With a filter unit having a tank turnover rate of two times per hour, the solution will be ready for plating in about 12 hours. There should be no visible signs of brown foam on the tank prior to beginning production plating. If such exists, additional bath filtration is required.
8. While the solution is being filtered, it should be electrolyzed at an anode current density of 1.6-2.2 amps/dm² (15-20 amps/ft²) to develop a black anode film.
9. After the solution has been adequately filtered and a black anode film has been built, the bath is ready for plating.

This product should be used only for its intended purpose. The information stated above is based on our laboratory tests and experience, and is accurate to the best of our knowledge. Since actual use is beyond our control, the recommendations or suggestions are made without warranty, expressed or implied

CuBrite CF-110

CuBrite CF-110 acts to refine grain structure, improve throwing power, and increase deposit ductility. The replenishment rate of is dependent on the operating temperature of the bath, and additions should be made at the rate of one liter every 2700-4200 ampere hours (one quart every 2500-4000 ampere hours) until a more accurate rate based on production can be established.

In order to maintain a uniform concentration of *CuBrite CF-110* in the plating bath after make-up, small frequent additions of *CuBrite CF-110* (0.1% by volume) on a consistent basis should be made. Ampere-hour feeders can be used and are recommended for such additions. For a 500 gallon tank operated at one amp per gallon, a typical addition based on 15,000 amp/hrs per gallon would be 946 mls (1 quart) every 7-1/2 hours (3750 ampere hours). *CuBrite CF-110* level may be checked using the Hull Cell test described in a later section.

Large additions of *CuBrite CF-110* (0.5% by volume or greater) will cause the formation of a brown residue on the surface of the bath. The solution should be thoroughly filtered to remove this material prior to plating.

Bath treatment with activated, powdered carbon (5 g/L or 4 lbs/100 gallons) will remove *CuBrite CF-110*.

Filtration:

Thorough solution filtration is mandatory. The filter must be capable of turning over the solution at the rate of at least two times per hour (actual). Filter tubes of no higher than 5 micron retention should be used. For baths that are worked heavily, 1-5 micron filters may be necessary in order to provide a crystal clear operating solution.

Continuous or periodic circulation of the plating solution through a carbon packed filter should be used to remove addition agent reaction products and organic contaminants, thus assuring optimum deposit ductility. Grain refinement is not affected by such circulation when granular carbon is used.

Filter tubes containing powdered carbon must be avoided since they may be constructed of cellulosic material. Filter tubes containing granular carbon or carbon treatment chambers which are attached to the filter unit are acceptable. Carbon tubes containing filter elements should be flushed in accordance with recommendations for filter tubes. **The quantity of carbon necessary will depend on the turnover rate of the filter, the frequency at which the carbon is changed, the type of carbon used, the degree of contact of the carbon with the solution, and the workload through the tank.** For more information on the use and control of carbon filtration, refer to the Analysis and Control Section of this brochure.

Chloride:

Chloride concentrations above 50 mg/L (50 ppm) should be avoided as they will cause anode polarization at higher current densities. To increase the chloride level of the plating bath, either hydrochloric acid or sodium chloride may be used. 10 mls of concentrated hydrochloric acid or 6.23 grams of sodium chloride, when added to a 100 gallon tank, will increase the chloride level by 10 ppm.

Sulfuric Acid:

Do not adjust the free sulfuric acid content with concentrated acid. Use dilute H₂SO₄ (25% v/v) for all additions. When making additions of *CuBrite CF-110* and sulfuric acid, add the diluted acid first, and after thoroughly mixing with the solution, add the *CuBrite CF-110*.

Anodes:

Excessive anode area, which results in low anode current density, must be avoided to prevent buildup of copper metal in solution. If titanium baskets and copper slugs are used, the 3" diameter round baskets are recommended. When employing both bars and baskets, the latter being to use up copper anode scrap, 2-1/2" x 6" rectangular baskets are recommended. Use of anodes having lower phosphorus content may result in problems such as anode polarization, deposit roughness, or an increase in solution copper sulfate level.

The length of the anode should not extend below the bottom of the work being plated. It is preferred that the length of the anode be several inches shorter than that of the work.

SOLUTION OPERATION:

The *CuBrite CF-110* matte acid copper plating process has proven itself to be easy to operate and free of problems. Problem may be easily corrected by comparing production board results, Hull Cell lab panels, and bath analysis. The procedures for the latter two appear in the solution analysis and control section of this brochure. The following points are pertinent to bath operation.

1. Bath composition, current density, temperature and agitation must be balanced in order to obtain optimum results with respect to both copper thickness distribution and grain refinement.
2. The free acid, copper sulfate and addition agent concentrations should be maintained within the specified limits. Methods of control and analysis are provided under the "Analytical Control" section.
3. For through-hole plating, a current density of 2.2 - 5.5 amps/dm² (20-50 amps/ft²) has been found to produce the most consistent results. Increased agitation permits operation at higher current densities. If air agitation is used, it must be clean and free of oil. The air source should be a low-pressure blower.

SOLUTION OPERATION cont'd.

4. The temperature of the process is not critical but optimum results are obtained within the range 18-32°C (65-90°F). The lower temperature ranges produce the best surface/hole ratios, but lower limiting current densities. Operation at higher temperatures increases the limiting current density but reduces surface/hole ratio.
5. Phosphorized copper anodes (0.025% phosphorus minimum) are required for optimum bath performance. For optimum effective anode surface area, the 1" x 4" bar is suggested. The length of the anode should not extend below the bottom of the work being plated, preferably several inches shorter than the work.
6. It is imperative that excessive anode area, which results in low anode current density, be avoided to prevent buildup of copper metal in solution. If titanium baskets are used, the 3" diameter round baskets are recommended. These allow the anode area to be adjusted to the current load by adjusting the number of baskets while maintaining flexibility in anode placement, so that proper current distribution can be obtained.
7. Bar anodes need not be bagged. Titanium baskets, if used, should be bagged. Dynel or polypropylene are satisfactory, and should be leached in 5% sulfuric acid overnight before using. Maximum anode current density is 3.2-4.9 amps/dm² (30-45 amps).
8. Filter cartridges should be thoroughly flushed with hot running water for at least 15 minutes prior to use to avoid organic contamination of the bath. Check for foaming of flush water. If after the initial flush period there is foaming, flush again.

MATERIALS OF CONSTRUCTION:

Recommended materials of construction are:

Tank Linings:	PVC, PVDC or polypropylene, Koroseal
Heaters:	Quartz, titanium, carbonate
Filters:	Hard rubber, lined Duriron, Hypalon plastic
Filter Aids:	Diatomaceous earth, asbestos (<u>cellulose based materials must be avoided.</u>)
Anode Bags:	Dynel, polypropylene
Anode Hooks:	Titanium

Materials other than these should not be used without first consulting Chemelex Technical Service. Incompatible materials will be attacked and could cause surface roughness, reduced ductility, and contamination of the plating solution. DO NOT use nylon anywhere in contact with the plating solution.

Avoid iron contamination from sources such as exhaust equipment, tank supports, filters and piping.

ANALYSIS:

Copper Content:

Reagents:

0.1M EDTA disodium salt standard solution
PAN Indicator - Dissolve 0.1 g of 1-(2-Pyridylazo)-2-Napthol in 100 ml of Methanol
Ammonium chloride buffer: dissolve 70 g ammonium chloride in 900 ml distilled water. Add ammonium hydroxide to pH 9.5, Dilute to 1 liter with distilled water.

Procedure:

1. Pipette 2 ml sample of plating solution into a 200 mls distilled water in a 500 ml Erlenmeyer flask.
2. Add 5 ml of buffer solution and dilute to 400 ml with distilled water.
3. Add 4 – 6 drops PAN indicator.
4. Titrate with 0.1M EDTA to a green end point.

Calculation: mls of EDTA X M of EDTA X 10.67 = oz/gal copper sulfate

mls of EDTA X M of EDTA X 4.25 = oz/gal copper metal

Sulfuric Acid:

Reagents:

1.0N Sodium Hydroxide Solution - Dissolve 40.0 g of sodium hydroxide C.P. into 500 mls of distilled water and dilute to 1 liter.

Methyl Orange Indicator - Dissolve 100 mg of methyl orange in distilled water and dilute to 100 ml.

Procedure:

1. Pipette 10 mls of plating solution into a 250 ml flask.
2. Add 25 mls of deionized water and 5 drops of methyl orange indicator.
3. Titrate with 1.0N sodium hydroxide solution until color changes from pink to yellow. Record mls used.

Calculation: mls of 1.0N Sodium Hydroxide solution X 0.66 = oz/gal sulfuric acid

OR

mls of 1.0 N Sodium Hydroxide solution X 0.28 = % by volume sulfuric acid

Chloride:

Materials:	Concentrated HNO ₃	Ethylene Glycol
	0.1N Silver Nitrate	Distilled water
	Two 25 ml graduated cylinders, stoppered	5 ml pipet
	10 ml graduated cylinder	1 ml pipet
	Bausch & Lomb Spectronic 20 spectrometer	1 cuvet for Spectronic 20

Procedure:

1. To each of two stoppered 25 ml graduated cylinders, add 5 ml of concentrated HNO₃ and 5 ml sample of the plating bath. Stopper and mix well.
2. Add 10 ml of ethylene glycol to each cylinder.
3. Dilute one cylinder to 25 ml (A) and the other to 24 ml (B) with distilled water. Stopper and mix well.
4. Add 1 ml of 0.1N silver nitrate to sample B and mix well. Allow to stand in a dark place for at least 30 minutes.
5. Transfer each sample to a Spectronic 20 cuvet and read the absorbance at 440 nm.

Calculation:

$$\text{Absorbance B} - \text{Absorbance A} \times 1359 \times 0.112 = \text{ppm chloride}$$

Calculation for adding HCl:

$$\frac{(\text{ppm chloride needed})(3.785)(\text{gal. in tank})}{413.75} = \text{ml of concentrated HCl needed}$$