Elga Europe

ACID COPPER Cu 230

PRODUCT DATA SHEET
Edition 01 – 18 September 2013

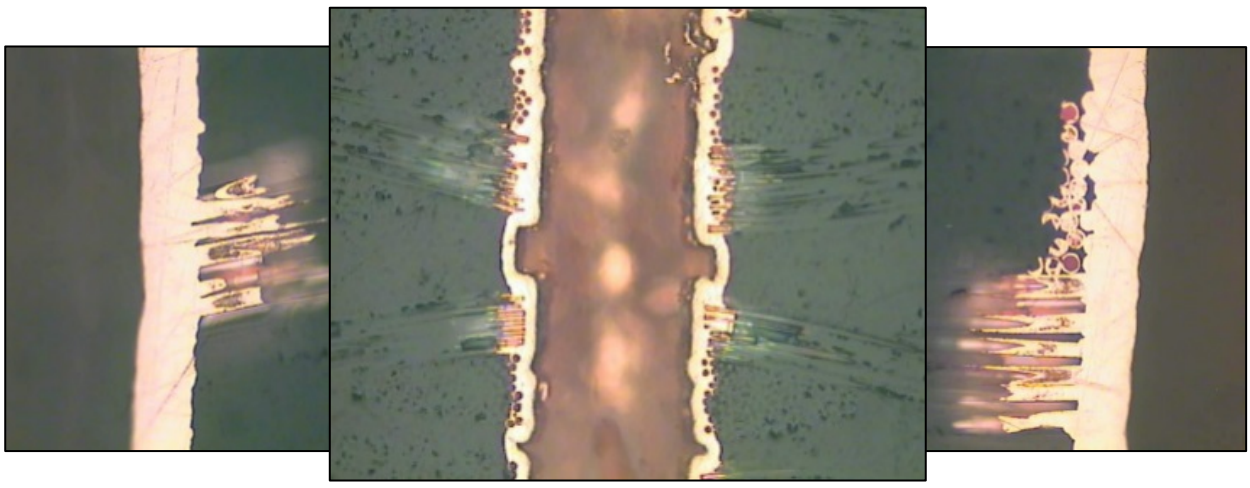
PRODUCT DESCRIPTION

Acid Copper Cu 230 is designed for through-hole printed circuit board applications as a high throw, micro-levelling acid copper electroplating process.
The electrodeposits produced by the Acid Copper Cu 230 process are fine grained equiaxed, high purity, ductile copper deposits from a single additive system, providing advanced technology from an economical solution that will meet or exceed all the requirements of MIL-P-55110-D and BS9760.

All of the components in the process are fully analyzable and the Acid Copper Cu 230 process is specifically optimized for on-line analysis and control by EBA automated bath analysis equipment or by HPLC.

MAIN FEATURES

- Specifically engineered for Direct Current applications to produce even, bright deposits from a stable electrolyte.
- Economical to use.
- High purity fine grained, equiaxed deposits.
- Excellent over-plating and soldering properties.
- Flexible enough to work with airless (E-ductors) and standard conventional DC plating tank configurations.
- Easily controlled by EBA-Analysis, and/or auto-dosing methodologies.



DEPOSITION CHARACTERISTICS

Parameters	Data	
Structure	Fine-grained	
Density	8.9 g/cm^3	
Conductivity	0.59 MS/cm	
Elongation	18 – 26%	
Tensile Strength	280 – 350 N/mm^2	
Hardness	Just deposited	180 – 220 Knoop
	After 2-4 days	80 – 120 Knoop
	After 1-2 hours at 100°C	80 – 120 Knoop

EQUIPMENT

Equipment	Material
Tanks	PP, PE, PVC
Anodes	Phosphorous-dioxide copper (0.04-0.08%p/p), bar anodes or copper chucks/mini-slugs in suitably sized titanium baskets
Anodic Bags	PP, Synel®, Un-napped Terylene®
Heater	Teflon, Porcelain
Filtration	Cartridge 1-5 µm

EQUIPMENT PREPARATION

Tanks:

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

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

- *Cleaning Solution*

  Trisodium Phosphate (TSP) 22.5 – 45 g/l
- *Leaching Solution*

  Sulphuric Acid (H_2SO_4) 100 ml/l

Leaching procedures:

1. Thoroughly wash down the tank and ancillary equipment with clean water.
2. Recirculate the water through the complete system to remove water soluble materials.
3. Discard the water.
4. Add the solution of trisodium persulphate to the tank, heat to 30 – 50°C and recirculate.
5. Discard the solution of trisodium persulphate.
6. Recirculate the water through the complete system and discard the water.
7. Add the solution of sulphuric acid and recirculate through the complete system. Leave the solution of sulphuric acid in the tank for a minimum of 8 hours.
8. Recirculate the solution of sulphuric acid through the complete system.
9. Discard the solution.
10. Recirculate the water through the complete system.
11. Discard the water.

Anodes:

1. Immerse the anodes in a standard micro etch solution.
2. Rinse thoroughly.
3. Immerse the anodes in 10% of sulphuric acid (H_2SO_4) solution.
4. Rinse thoroughly with deionized water.

When Titanium anode baskets are used, care must be taken to ensure that they are completely filled with copper anode slugs.

Anode Bags & Polypropylene filter cartridges:

1. Wash thoroughly in hot deionized water (60°C).
2. Leach with 10% of sulphuric acid (H_2SO_4) solution for 8 hours.
3. Rinse thoroughly with deionized water

SOLUTION MAKEUP

Standard Operation (1.5 – 5 A*dm^2)

The following electrolyte is recommended to obtain maximum throwing power and through- hole thickness uniformity for a majority of products.

Chemicals Required	Amount
Deionized Water	To final volume
Electronic Grade Copper Sulphate ($CuSO_4 \cdot 5H_20$) **or** **Purified Liquid Copper Sulphate [300 g/l $CuSO_4 \cdot 5H_20$]**	75 g 250 ml/l
C.P. Grade Concentrated Sulphuric Acid (H_2SO_4)	100 ml/l
C.P. Grade Concentrated Hydrochloric Acid (HCL)	0.16 ml/l
CU 230 Brightener make up	5 ml/l
CU 230 Carrier make up	7.5 ml/l

Hi Throw Operation (0.5 – 1.5 A*dm^2)

The following electrolyte, with reduced copper and increased sulphuric acid concentration, is recommended to obtain maximum throwing power and through-hole thickness uniformity for the plating of narrow bore or a High Aspect Ratio (HAR) boards.

Chemicals Required	Amount
Deionized Water	To final volume
Electronic Grade Copper Sulphate ($CuSO_4 \cdot 5H_20$) **or** **Purified Liquid Copper Sulphate [300 g/l $CuSO_4 \cdot 5H_20$]**	40 g 135 ml/l
C.P. Grade Concentrated Sulphuric Acid (H_2SO_4)	140 ml/l
C.P. Grade Concentrated Hydrochloric Acid (HCL)	0.16 ml/l
CU 230 Brightener make up	5 ml/l
CU 230 Carrier make up	7.5 ml/l

MAKE UP PROCEDURE/ORDER OF ADDITION

Using Copper Sulphate Crystals or Powder:

1. Fill an appropriately cleaned storage tank with 2/3 of warm (32 – 38°C) deionized water.
2. Add electronic grade copper sulphate (powder or crystal) to the storage tank and thoroughly mix until completely dissolved.
3. Recirculate the solution through a 1 micron polypropylene filter cartridge for at least 2 tank volume turnovers.
4. Slowly, with thorough mixing, add C.P. grade concentrated Sulphuric Acid (d= 1.84).
   CAUTION!! This reaction is EXOTHERMIC.
5. Add deionized water to bring the solution to the final tank volume and allow the solution to cool to 55 – 60°C.
6. Add to the solution activated sulphur-free carbon powder (3 g/l).
7. Thoroughly mix the solution for 1 – 2 hours and allow the carbon to settle for 4 – 6 hours.
8. Determine the chloride ion concentration and add C.P. grade concentrated Hydrochloric Acid (d= 1.18) to raise the chloride level to 60 ppm (60 mg/l).
9. Once added, confirm the chloride concentration and make adjustments, if necessary.

Note:

If you use a bath R.T.U, after to fill up the tank, the process will start with the following point:

1. Insert bagged anodes into the plating tank.
2. Pre-electrolyze using clean copper-clad laminate cathodes:
   Electrolyze at 0.5 A/dm2 for 1 hour.
3. Make additions as necessary during electrolysis.
4. Check the chloride concentration and adjust to 60 ppm, if necessary.
5. Pre-electrolyze using clean copper-clad laminate cathodes:
   Electrolyze solution at 2 A/dm2 for 2 hours.

OPERATING PARAMETERS

	Range	Optimum
Copper Sulphate Pentahydrate ($CuSO_4 * 5H_20$)	60 – 90 g/l	75 g/l
Copper Metal	15 – 22.5 g/l	18.75 g/l
Sulphuric Acid (96% Pure Grade)	185 – 195 g/l	190 g/l
Chloride Ion	40 – 80 ppm	60 ppm
CU 230 Brightener Make Up	0,5 – 7,5 ml/l	3 ml/l
CU 230 Carrier Make Up	3 – 15 ml/l	7,5 ml/l
Temperature	20 – 30°C	25°C
Cathode Current Density	0.5 – 5 A/dm^2	
Anode Current Density	0,75 – 2.0 A/dm^2	
Anode to Cathode Distance	15 – 30 cm (20 cm optimum)	
Agitation: Reciprocal Cathode Rod and Oil Free Air Sparger/E-ductors	Vigorous air movement: • 0.035 kg/cm^2 for each meter of solution depth • 0.09 – 0.18 m^3/min for each meter of sparger length from pumps or e-ductors and cathode rod 5-10 cm excursion, 4-5 cycles/min.	
Filtration Rate	3 tank volume turnovers per hour	
Deposition Rate	42 µm/hour at 3A/dm^2 and under at optimum operating parameters	

RECOMMENDED REPLENISHMENT AND CONTROL SCHEDULE

Component	Analytical Method	Frequency of Analysis	Estimated Replenishment Rate
Copper	• Volumetric Analysis • AAS	Weekly	Based upon analysis
Sulphuric Acid	• Volumetric Analysis	Weekly	Based upon analysis
Chloride	• Volumetric Analysis • Specific ion Electrode • Spectrophotometric Analysis	Weekly	Based upon analysis
Cu 230 Additive	• EBA • HPLC	Daily	400ml/1000Ah
Metallic Contamination (Fe, Ni, Sn)	• AAS	Weekly	N/A
Process Performance	• Hull Cell • Thermal Shock	Daily or once per shift	N/A

Note:

As the temperature increases, the consumption of Cu 230 Additive increases as well.

Also, as the anode area increases, particularly in combination with titanium anode baskets, the consumption of Cu 230 Additive also increases.

METALLIC IMPURITIES

The maximum tolerable level of metallic contaminations is listed below:

- Fe: 1000ppm
- Ni: 1000ppm
- Sn: 100ppm

GENERAL MAINTEINANCE

1. Filters should be changed at 2 – 4 weeks intervals.
2. Anode area should be checked and maintained on a regular basis when using a titanium basket/anode slug combination: the anode slug should be completely removed and cleaned to avoid any sludge build-up, then replenishment and reconditioning should be performed.
3. Anodes should be bagged with un-napped Terylene®, Synel® or PP bags.
   The bags should be checked frequently for any holes, rips or tears.
   Defective anodes bags must be replaces immediately.
4. Periodic carbon treatment of the acid copper electrolyte is required.
5. Routine carbon treatments are recommended at 3 – 6 moths intervals.
6. Carbon treatment is also recommended if:
   a. The physical properties of the copper electro-deposit fall below specifications.
   b. The Hull cell panel indicates a presence of either organic contamination or an excess of brightner.

Note:

Any change in colour of the electrolyte from blue (normal colour) to a greenish-blue, solid green colour indicates the presence of organic build-up.

In estbilishing a carbon treatment schedule and procedure, the use of hydrogen peroxide and/or potassium permanganate to assist the oxidation of the organics in your electrolyte may be included.

PROCESS SEQUENCE

The performance of Acid Copper Cu 230 process relies upon two significant factors:

- Maintaining the process at optimum parameters.
- Limiting the introduction of non-compatible chemistries into the process.

The PCB fabrication process sequence is as follow:

Parameters	Temperature	Contact Time
Acid Cleaner 230E	25 – 35°C	3 – 5 minutes
Water Rinse	25 – 35°C	1 – 2 minutes
MicroEtch 3100	25 – 35°C	1 – 3 minutes
Water Rinse	25 – 35°C	1 – 2 minutes
10% Sulphuric Acid	25 – 35°C	1 – 2 minutes
Acid Copper Cu 230	24 – 27°C	***
Water Rinse	25 – 35°C	1 – 2 minutes
Water Rinse	25 – 35°C	1 – 2 minutes
10% Sulphuric Acid	25 – 35°C	1 – 3 minutes
Elga Tin TL	22 – 27°C	***
Water Rinse	25 – 35°C	2 – 3 minutes

***: The time depends on current density of operation and the thickness requirements.

Note:

Rinse times should be increased if rinse water temperatures are below 20°C. If not, it will result in a significant amount of plating defects.

TROUBLESHOOTING TIPS

Defect	Cause	Correction
Anode polarization	Too high Copper concentration	Analyse the copper concentration and adjust to optimum
	Too high Sulphuric acid concentration	Analyse the sulphuric acid concentration and adjust to optimum
	Too high Chloride concentration	Analyse the chloride concentration and adjust to optimum
White anode film/Polarized anodes	Too high Chloride concentration	Analyse the chloride concentration and adjust to optimum
Poor metal distribution	Too low sulphuric acid concentration	Analyse the sulphuric acid concentration and adjust to optimum
Dendrites or rough deposit	Too low chloride concentration	Analyse the chloride concentration and adjust to optimum
Burning in the high current density range	Too low Acid Copper Cu230 Brightener concentration	Add 0.5-1ml/l of Cu230 Brightener until the phenomenon disappear.
	Temperature is to low	Increase the temperature
Poor throw in the low current density range	Too low Acid Copper Cu230 Carrier concentration	Add 0.5-1ml/l of Cu230 Brightener until the phenomenon disappear.
	Temperature is to low	Increase the temperature

ANALYTICAL CONTROL METHODS

Determination of copper metal

Equipment

- Pipette
- 50ml burette
- 250ml Erlenmeyer flask
- 25ml Graduated Cylinder

Reagents

- Potassium Iodide crystal
- Sodium Thiosulfate solution 0.1N
- Starch Paste Indicator solution

Procedure

1. Pipette 5.0 ml of working solution into a 250ml Erlenmeyer flask.
2. Add 100 ml of DI water.
3. Add 2 g of potassium iodide crystal.
4. Add 5 drops of starch paste.
5. Titrate with sodium thiosulfate 0.1N until the colour change from brown to dirty-white.

Calculation

Concentration of copper sulphate (g/l) = mls of $Na_2S_2O_3$ 0.1N * 4.982.

Determination of Sulphuric Acid

Equipment

- Pipette
- 50 ml Burette
- 250 ml Erlenmeyer flask
- 25ml Graduated Cylinder

Reagents

- Sodium Hydroxide 1N
- Methyl orange indicator solution

Procedure

1. Pipette 5 ml of working solution into a 250 ml Erlenmeyer flask and add 100 ml of DI water.
2. Add 5 drops of methyl orange indicator.
3. Titrate with 1 N sodium hydroxide until yellow/orange colour develops.

Calculation

Sulphuric Acid Concentration (g/l) = ml of NaOH * 9.8.

Determination of Chloride ion concentration

Equipment

- Pipette
- 50 ml Burette
- 250 ml Erlenmeyer flask
- Electrode

Reagents

- Acid nitric solution 50% (1:1)
- Silver Nitrate solution 0.02N

Procedure

1. Put 50 ml of bath sample into a 250 ml Erlenmeyer flask.
2. Add 5 ml of nitric acid 50%.
3. Titrate with silver nitrate solution, adding 0.5 ml each time. Record the mV displayed by the electrode and make a curve. Record the mV value corresponding to the maximum change in mV.

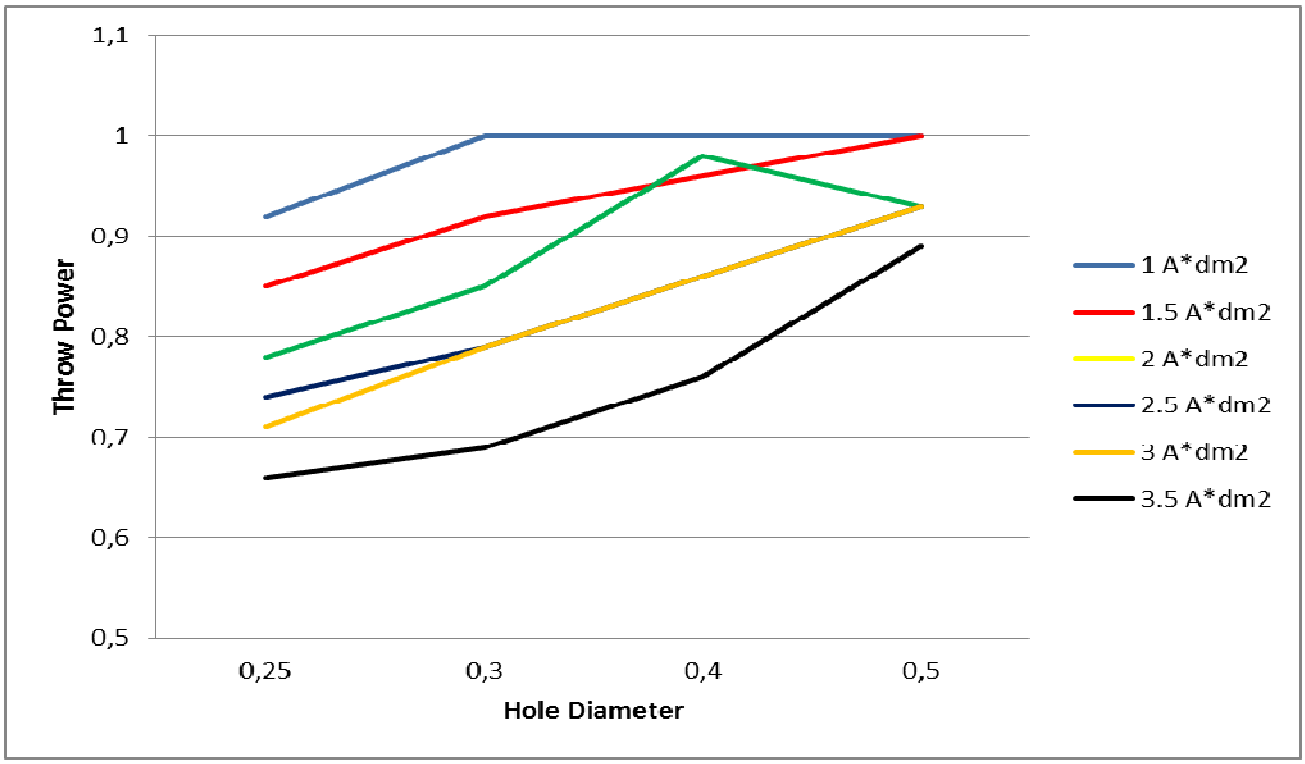
Calculation

Chloride ion concentration (ppm) = ml silver nitrate *14.3.

INFLUENCE OF STANDARD PLATING PARAMETERS

Parameter	Effect on				
	Throw Power	Levelling	Crack Resistance	Maximum Current Density	Surface Appearance
Increasing Brightener Content	Minimal	Improve	Worsens	Improve	Improve
Increasing Copper Content	Worsens	Minimal	Minimal	Improve	Minimal
Increasing Sulphuric Acid Content	Improve	Worsens	Minimal	Worsens	Minimal
Increasing Chloride Content	Minimal	Minimal	Minimal	Minimal	Worsens
Increasing Temperature	Worsens	Worsens	Worsens	Improve	Brightener dependant
Increasing Current Density	Worsens	Improve	Improve	None	Brightener dependant

PERFORMANCE OF ACID COPPER Cu 230 IN STANDARD CONDITIONS



STORAGE

Only store Cu 230 Brightener, Cu 230 Carrier and Cu 230 Additive in original containers, upright, away from direct sunlight and in a dry area at 10 – 32°C.
Keep container closed when not in use.
Keep away from organics, reducing agents, strong alkalis and oxidizers.

HANDLING PRECAUTIONS

Cu 230 Brightener, Cu 230 Carrier and Cu 230 Additive working solution are highly acid and require the normal precautions for handling strong acids.
Avoid the contact with skin and eyes.
Handle with care.
Wear chemical goggles, chemical gloves and suitable protective clothing when handling Cu 230 Brightener, Cu 230 Carrier and Cu 230 Additive working solutions.
In case of contact flush affected area with copious amounts of cold, clean water for at least 10 minutes.
In case of serious exposure, particularly for eyes, obtain medical attention for acid burns.

READ MATERIAL SAFETY DATA SHEET PRIOR TO HANDLING THIS PRODUCT

WASTE TREATMENT

It is the user's responsibility to verify that treatment procedures comply with local regulations. Working solutions should be diluted, neutralized and disposed of in accordance with local regulation.

In case of order please indicate this code:

Cu 230 Brightener Make Up	**GC 7205**
Cu 230 Carrier Make Up	**GC 7215**
Cu 230 Additive	**GC 7219**

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Reg. Imp. di Milano n. 154339
C.F. /P.IVA 01857060154
Cap. Soc. € 3.014.026,00 I.V.

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