Technical Data Sheet

Copper Gleam™PC
Low Speed & High Speed

Copper Gleam PC is an acid copper plating process designed to produce stable, bright, ductile copper deposits. It can be used for low speed applications such as electroforming, barrel plating or through hole plating of printed circuit boards. Copper Gleam PC can also be used in high speed mode, specifically for reel-to-reel and jet plating applications. The process uses a single additive with easy process control and is economical in use. Frequent carbon purification is not normally required. Deposits withstand thermal shock tests to BS9760.

Copper Gleam PC is also excellent for barrel bright copper strike plating of beryllium copper and phosphor bronze components.

OPERATIONAL DATA

Low Speed – Rack or Normal Barrel Operation

Parameter	Range	Optimum
Copper sulphate ($CuSO_4 \bullet 5 H_2O$)	60 - 90 g/l	75 g/l
Sulphuric acid	160 – 220 g/l	180 g/l
Chloride ion (Cl^-)	40 - 80 ppm	70 ppm
Copper Gleam PC Additive	1.5 – 4.0 ml/l	2.5 ml/l
Temperature	23 - 32°C	27°C
Cathode current density Rack Barrel	1.5 – 4.0 A/dm^2 0.1 - 0.5 A/dm^2	2.5 A/dm^2 0.25 A/dm^2
Anode current density	1 - 3 A/dm^2	As high as possible.
Agitation	Moderate air agitation and mechanical movement. For printed circuits 1 metre / minute cathode rod movement plus vibration is recommended.	
Deposition rate	0.5 micron per minute at 2.5 A/dm^2	

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Barrel Strike Operation

Parameter	Range	Optimum
Copper sulphate ($CuSO_4 \bullet 5 H_2O$)	25 - 35 g/l	30 g/l
Sulphuric acid (S.G. 1.84)	200 – 250 g/l	220 g/l
Chloride ion (Cl^-)	50 - 70 ppm	60 ppm
Copper Gleam PC Additive	1.5 – 4.0 ml/l	2.5 ml/l
Temperature	23 - 32^oC	27^oC
Cathode current density	0.1 - 0.5 A/dm^2	0.25 A/dm^2
Anode current density	1 - 3 A/dm^2	As high as possible.
Agitation	Moderate air agitation and barrel rotation.	
Deposition rate	0.05 micron per minute at 0.25 A/dm^2	

Electroforming Applications

Parameter	Range	Optimum
Copper sulphate ($CuSO_4 \bullet 5 H_2O$)	140 - 160 g/l	150 g/l
Sulphuric acid (S.G. 1.84)	160 – 220 g/l	180 g/l
Chloride ion (Cl^-)	40 - 80 ppm	70 ppm
Copper Gleam PC Additive	5 – 10 ml/l	7.5 ml/l
Temperature	23 - 32^oC	27^oC
Cathode current density	1.5 – 5.0 A/dm^2	3.0 A/dm^2
Anode current density	1 - 3 A/dm^2	As high as possible.
Agitation	Moderate air agitation and mechanical movement.	
Deposition rate	0.6 micron per minute at 3 A/dm^2	

Medium to High Speed Operation

Parameter	Range	Optimum
Copper sulphate ($CuSO_4 \bullet 5 H_2O$)	260 - 320 g/l	290 g/l
Sulphuric acid (S.G. 1.84)	18 - 55 g/l	36 g/l
Chloride ion (Cl^-)	40 - 80 ppm	70 ppm
Copper Gleam PC Additive	5 – 50 ml/l	(see Notes 2 & 3)
Temperature	21 - 50^oC	27^oC
Cathode current density	5 – 30 A/dm^2	(see Notes 2 & 3)
Anode current density	1 - 3 A/dm^2	As high as possible.
Agitation	Vigorous solution plus work piece movement.	
Deposition rate	2 microns per minute at 10 A/dm^2 under all normal operating conditions	

DEPOSIT DATA

Copper	Semi-lamellar copper of high purity with excellent over-plating and soldering properties
Density	8.9 g/cm^3: 0.89 mg/cm^2 = 1 micron
Conductivity	0.59 megamho/cm
Hardness	180 - 220 VPN falling to ca. 100 - 120 VPN after 1 hour at 100°C or ca. 3 days at room temperature.
Internal Stress	ca. 100 kg/cm^2 tensile

SOLUTION MAKE UP FOR 1 LITRE – RACK OR BARREL OPERATION

Chemicals Required	Volume
Purified Liquid Copper Sulfate	250 ml
Deionised water	500 ml
Sodium chloride	0.1 g *
Sulphuric acid 65 % BP Grade (S.G. 1.55)	180 ml
Copper Gleam PC Additive	2.5 ml
Deionised water	To make one litre

SOLUTION MAKE UP FOR 1 LITRE – BARREL STRIKE OPERATION

Chemicals Required	Volume
Purified Liquid Copper Sulfate	100 ml
Deionised water	600 ml
Sodium chloride	0.1 g *
Sulphuric acid 65 % BP Grade (S.G. 1.55)	220 ml
Copper Gleam PC Additive	2.5 ml
Deionised water	To make one litre

SOLUTION MAKE UP FOR 1 LITRE – ELECTROFORMING APPLICATIONS

Chemicals Required	Volume
Purified Liquid Copper Sulfate	500 ml
Deionised water	250 ml
Sodium chloride	0.1 g *
Sulphuric acid 65 % BP Grade (S.G. 1.55)	180 ml
Copper Gleam PC Additive	2.5 ml
Deionised water	To make one litre

Copper sulphate can vary according to speed and component geometry (higher copper sulphate permits higher current densities but with lower throwing power) and care must be exercised to avoid excess total sulphate otherwise copper sulphate will precipitate randomly due to common ion effect. The higher initial addition of Copper Gleam PC Additive is in order to reduce internal stress of thick deposits to near zero. Replenishment should be close to normal bulletin recommendations for both barrel and electroforming.

SOLUTION MAKE UP FOR 1 LITRE – MEDIUM TO HIGH SPEED OPERATION

Chemicals Required		Volume
Purified Liquid Copper Sulfate		970 ml
Sodium chloride		0.1 g *
Sulphuric acid (S.G. 1.84)		20 ml
Copper Gleam PC Additive	medium speed (5 - 20 A/dm^2) high speed (21 - 300 A/dm^2)	5 - 10 ml 10 - 50 ml (see notes 2 & 3)

Make up procedure

1. Use only Purified Liquid Copper Sulfate supplied by Rohm and Haas EM which contains 300 g/l copper sulphate. Add the required volume of Purified Liquid Copper Sulfate to a clean tank.

2. Add the required volume of deionised water depending on the formulation required.

3. Carefully add the required volume of sulphuric acid whilst stirring the solution to avoid localised overheating and spattering. Allow the solution to cool to below 30°C. Note that the use of Sulphuric acid 65% BP Grade (S.G. 1.55) is recommended whenever possible. However due to volume restrictions sulphuric acid (S.G. 1.84) must be used for medium speed and high speed solutions. **Caution:** Suitable protective clothing, gloves and safety glasses must be worn at all times when working with acid copper plating solutions.

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4. Add the required volume of Copper Gleam PC Additive and dilute to final volume with deionised water as required.

5. Allow the solution to mix thoroughly then determine the chloride ion concentration.

6. * Add the precise quantity of sodium chloride to raise the chloride ion concentration to 80 ppm (see note 4).

7. When copper anodes are used, electrolyse the solution at 5 A/dm^2 until a minimum of 2 ampere-hours / litre has elapsed. The solution is now ready for use.

EQUIPMENT

Tanks	Temperature-stabilised translucent white polypropylene lined.
Anodes	Phosphorus deoxidised copper (0.03 – 0.08% P), anode bars or slugs in titanium baskets, bagged with woven polypropylene. In high speed reel-to-reel equipment platinised titanium mesh may be used (see note 1).
Heaters	PTFE with thermostat control.
Filtration	Preferably continuous using 5 micron woven polypropylene cartridges with a flow rate of ca. three times tank volume / hour.
Electrical	4 - 16 volt stabilised DC supply (maximum ripple 5%) with preference for stepless control and ampere-hour meter.
Fume extraction	Recommended

SOLUTION MAINTENANCE

Replenishment	For low speed operation ca. 200 – 300 ml Copper Gleam PC Additive per 1000 Ampere-hours. In high speed mode ca 250 - 1000 ml Copper Gleam PC Additive per 1000 Ampere-hours, dependent on operation (see notes 1 and 2).

ANALYSIS

Prior to sampling, the bath volume must be adjusted to operating level with deionised water and thoroughly mixed.

Using copper, sulphuric acid, chloride and Copper Gleam PC Additive determinations, make appropriate adjustments according to the Replenishment Schedule.

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NOTES

1. When platinised titanium anodes are used in high speed reel-to-reel equipment, the additive consumption will be significantly higher than when copper anodes are used. Furthermore the solution will have a finite life because of the build up of sulphate ion from continued replenishment of copper sulphate.
2. Maximum deposition speed at current densities of greater than 30 A/dm^2 is only normally feasible in jet plating equipment. For maximum speed the temperature can be raised up to 50°C but at temperatures above 35°C additive consumption will be increased significantly. For maximum economy operate the solution at the lowest possible temperature above 21°C to achieve the desired current density range. For given solution conditions an increase in Copper Gleam PC Additive content will increase the current density range.
3. The amount of Copper Gleam PC Additive required for the make up of a new solution depends on the proposed current density. For medium speed operation 5 - 20 A/dm^2, 5 - 10 ml/l is normally sufficient and for high speed operation (with very vigorous agitation) 21 - 300 A/dm^2, 10 - 50 ml/l should be added in 10 ml/l increments until the desired level of brightness is achieved.
4. 0.016 g/l sodium chloride will increase the chloride ion concentration by 10 ppm.
5. High chloride levels can cause anode polarisation. Consult Rohm and Haas customer service laboratories for recommendations to remove chloride.
6. Very low anode surface area, operating anodes in titanium baskets and any other effects that produce anode polarisation will always increase additive consumption. In extreme cases this can even cause rough deposits.

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When ordering please use the following product descriptions:

LIST OF PRODUCTS

Product Name
Purified Liquid Copper Sulfate
Copper Gleam PC Additive

Electroplating chemicals and specialities can be corrosive, harmful and poisonous. Care should be taken with respect to appropriate storage, handling and utilisation. When disposing such chemicals, the regulations regarding the treatment of waste water are to be strictly observed.

Date: February 2007
Issue: 1
Supersedes: Previous Copper Gleam PC and High Speed Copper Gleam data sheets.

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