enthone

Technical Data Sheet

MICROFAB® AU 660

A mild alkaline non-cyanide gold electroplating process

MICROFAB AU 660 is a mild alkaline non-cyanide gold electroplating process that produces deposits of 99.99% purity. MICROFAB AU 660 is frequently used in bump plating on metalized silicon wafers. The deposits obtained from this process meet the requirements of Military Plating Specification MIL-G-45204B, Amendment 2, Type I, Grade A and Type III, Grade A. READ ENTIRE TECHNICAL DATA SHEET BEFORE USING THIS PRODUCT.

EQUIPMENT REQUIRED

Tank	Polypropylene or heat resisting PVC
Anode	Pt/Ti anode
Filtration	Continuous filtration is recommended using properly leached polypropylene filter cartridges. Use 1 to 5µm mesh filters. (Avoid using cotton filters.)
Heater	Teflon coated heater (Avoid using quartz or stainless steel heater.)
Leaching	Tanks, filter-cartridges and related equipment must be leached prior to installation. See section titled “New Equipment and Filter Leaching”.
Rectifier	It should be able to rectify to DC with less than 5% ripple at the designated amperage.
Ventilation	Adequate fume control is essential to safe operation.

OPERATING CONDITIONS

	Nominal	Range
Gold	16 g/L	14 to 18 g/L
Temperature	60 °C (140 °F)	55 to 65 °C (131 to 149 °F)
pH	8.0	7.8 to 8.2
Specific gravity (°Be’)	---	15 to 25
Current density (A/dm 2)	0.8	0.5 to 1.2

*The above data of pH and specific gravity are based on the experimental data at 25 °C (77 °F).

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MATERIALS REQUIRED

MICROFAB AU SERIES

Product Name	Usage	Packaging
MICROFAB AU 660"B"	To be used for bath make up. Adjust temperature to the recommended operating level and the solution is ready.	4 Liters in a polyethylene container
MICROFAB AU 660"R"	To be used to maintain the AU concentration in the plating solution. MICROFAB AU 660 "R" consists of two parts, A and B. **A:** contains one troy ounce of metal gold. **B:** contains the other necessary constituents except metal gold.	**A:** 778 mL in a polyethylene Container **B:** 78 mL in a polyethylene container.
MICROFAB AU 660 Agent	To be used for replenishing free electric conductive salt.	1 kg or 10 kg in a cardboard box
MICROFAB AU 660 Grain Refiner	To be used for adjustment of grain refiner concentration. 1 L in a polyethylene container	1 L in a polyethylene container

Solution Control

Gold ion concentration

Analyze gold ion concentration for better control of deposit properties and operating costs.

Range: 14 to 18 g/L

Performance: If the gold concentration falls below 14 g/L, deposits tend to become hard and bright. The uniformity may decline. When over 18 g/L, the gold drag-out tends to increase.

Adjustment: Add MICROFAB AU 660 "RA" and MICROFAB AU 660 "RB" while agitating to keep gold content in balance.

Analysis: Analyze with ICP or AA.

pH

Analyze pH for the better control of deposit properties and solution stability.

Range: 7.8 to 8.2

Performance: When the pH of the solution is low, gold precipitation tends to occur. (Do not allow the pH of the solution to drop below 7.0.) When the pH of the solution is high, it tends to have bright and hard deposits.

Adjustment: To lower the pH of the solution, add 1 to 3% reagent grade sulfuric acid solution. To raise the pH of the solution, add 5 to 10% reagent grade sodium hydroxide solution.

Analysis: Analyze with pH meter. The pH level should be measured at a solution temperature of 25 °C (77 °F).

Specific gravity

Analyze the specific gravity to make sure that the total concentration of the all constituents in the bath is within the range.

Range: 15 to 25 °Be'

Performance: When the specific gravity is over 25 °Be', the limiting current density declines, the uniform macrothrowing power is reduced and the burnt deposits resulting in poor adhesion may appear. The crystallization of conducting salt may occur.

Analysis: Analyze with BAUme's hydrometer at a solution temperature of 25 °C (77 °F).

Sulfite ion concentration

Sulfite ion works as a chelating agent to stabilize gold sulfite metal complex as well as works as a conducting salt to facilitate conductivity of the solution.

Initial Concentration: 30 to 40 g/L

Operating Range: 20 to 80 g/L

Performance: If sulfite ion concentration falls below 20 g/L, it may induce non-uniform deposition, a rough surface, and gold precipitation. When over 80 g/L, burnt deposits may appear in the high current density areas.

Adjustment: Add MICROFAB AU 660 Agent to bring up sulfite concentration to the normal range if analysis indicates insufficient concentration. To adjust sulfite ion by 10 grams, use 17 grams of MICROFAB AU 660 Agent

Analysis: Analyze with ion chromatography.

Sulfate ion concentration

Sulfate ion works as a conducting salt to facilitate the conductivity of the solution.

Initial Concentration: 30 to 40 g/L

Operating Range: 20 to 80 g/L

Performance: When the concentration is over 80 g/L, the high specific density may have undesirable effects. Sulfate ion concentration increases as the plating time passes due to decomposition of the sulfite ion and other effects. There is no adjustment required.

Adjustment: No adjustment required.

Analysis: Analyze with ion chromatography.

Thallium concentration

Thallium facilitates crystallization, uniformity and increases the limiting current density.

Range:	7 to 15 mg/L
Performance:	If the concentration falls below 7 mg/L, the deposit crystals become smaller. Further concentration diminishment induces non-uniform reddish deposit with needle like crystals. When over 15 mg/L, the larger crystal formation induces rough deposition surface and dilated bumps. The amount of eutectoid Tl increases and softens the deposit after annealing.
Adjustment:	Add 1 mL of MICROFAB AU 660 Grain Refiner to increase 1 mg of thallium content.
Analysis:	Analyze with ICP or AAS.

Temperature

Range:	55 to 65 °C (131 to 149 °F)
Performance:	When below 60 °C (140 °F), bright and hard deposits tend to occur. When over 65 °C (149 °F), the crystal grains become bigger and bump width increases.

Current density

Range:	0.5 to 1.2 A/dm 2

Efficiency

Range:	New MICROFAB AU 660 plating solutions will deposit gold at an efficiency of 120 mg/A•min. As the solution ages, efficiencies greater than 117 mg/ A•min are typical.

Contamination of the solution with the metallic impurities

Performance:	Contamination of the operating solution with metallic impurities may reduce the quality of deposits.
Adjustment:	When poor deposits are observed, remove the contaminated plating bath and replace it with the new one. There is no other way to remove the metallic impurities.
Remarks:	Prevent contamination of the operating solution from iodine and lead ion.

Organic impurities

Organic impurities such as the ones leached from photoresist can get into the solution and may harden the deposits. The solution should be given carbon treatment regularly as preventive maintenance. Avoid using pipes and seals made in rubber such as EPDM (ethylene propylene rubber) or the solution will be contaminated beyond carbon treatment cleansing effectiveness.

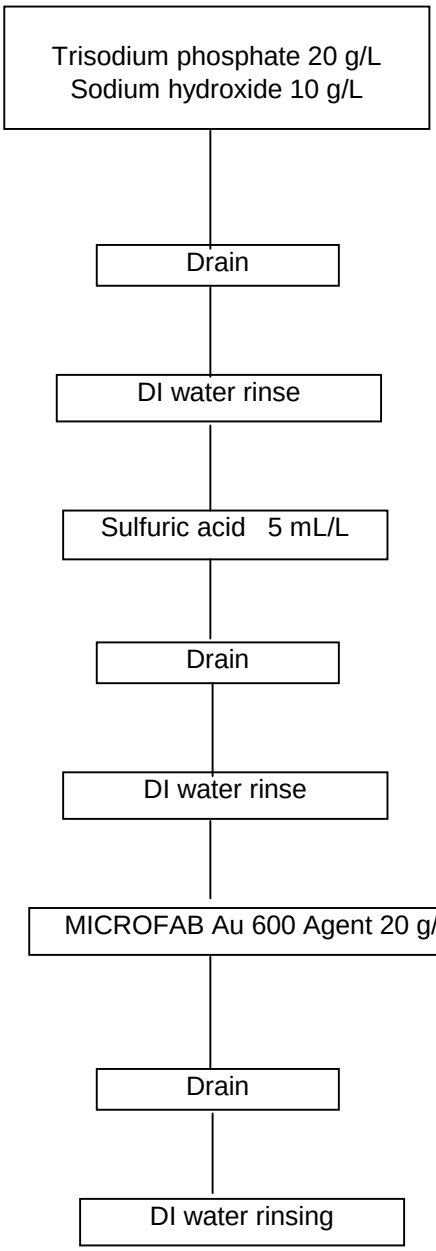
STRIPPING OF PRECIOUS METAL DEPOSITS

Precious metals may get reduced onto the anode, tank, pipes, and pumps after prolonged use of the electrolyte. The reduced metal can induce further instability, thereby shortening the electrolyte life, even that of new solution make-ups. Regular maintenance is recommended; and the use of a stripping solution may be necessary.

Stripping solutions are highly corrosive materials that can cAUse serious burns, and damage to equipment if either handled or used improperly. Care must be taken when mixing these materials, and during tank treatment. It is critical that personnel are familiar with the risks and health hazards involved. Proper precautions must be taken to protect employees and equipment prior to use.

NEW EQUIPMENT and FILTER LEACHING

The following sequence may be used for either immersion or recirculation leaching.


Trisodium phosphate 20 g/L
Sodium hydroxide 10 g/L
Temperature: 60 °C (140 °F)
Time: 1 hour
Drain
DI water rinse
Repeat until rinse water pH is 6 to 7
Sulfuric acid 5 mL/L
Temperature: 60 °C (140 °F)
Time: 1 hour
Drain
DI water rinse
Repeat until rinse water pH is 6 to 7
MICROFAB Au 600 Agent 20 g/L
Temperature: 60 °C (140 °F)
Time: 1 hour
Drain
DI water rinsing

MICROFAB AU 660 Troubleshooting

TROUBLE	POSSIBLE CAUSE	COUNTERMEASURE
Hard deposit Small grain size of deposit Bright appearance	1. Low gold content 2. High pH level 3. Low operating temperature 4. High current density 5. Insufficient Agent 6. Organic impurities	1. Adjust gold content to 16 g/L with Replenisher. 2. Adjust pH to 8.0 with 1 to 3% H2SO4 Solution. 3. Raise to 60 °C (140 °F) or higher 4. Lower the current density 5. Add 10 to 30 g/L of Agent 6. Carbon treatment
Burnt deposit Dog bone bumps	1. Low gold content 2. Low operating temperature 3. High current density 4. Poor agitation 5. Insufficient Agent	1. Adjust gold content to 16 g/L with Replenisher 2. Raise to 60 °C (140 °F) or higher 3. Lower the current density 4. Agitate vigorously 5. Add 10 to 30 g/L of Agent
Non-uniform appearance	1. Copper ion contamination 2. Organic impurities	1. Replace the solution 2. Carbon treatment
Nodules on bumps	1. Gold particles in the solution 2. Insufficient Agent	1. Filtration (0.1 to 0.5µm) 2. Add 10 to 30 g/L of Agent.
Bump failure due to attached bubbles	1. Poor pre-treatment of base material 2. Poor agitation	1.Pre-treat with bump cleaner. 2. Agitate vigorously

SAFETY AND HANDLING INSTRUCTIONS

CAUTION! MICROFAB AU 660 B, MICROFAB AU 660 RA, MICROFAB AU 660 RB, MICROFAB AU 660 AGENT, MICROFAB AU 660 GRAIN REFINER OR THE OPERATING SOLUTION MAY CAUSE SEVERE SKIN IRRITATION, EYE DAMAGE.

HAZARDS: MICROFAB AU 660 B, MICROFAB AU 660 RA, MICROFAB AU 660 RB, MICROFAB AU 660 AGENT, MICROFAB AU 660 GRAIN REFINER or the operating solution may cause severe skin irritation, eye damage. Inhalation of vapors or dusts from MICROFAB AU 660 B, MICROFAB AU 660 RA, MICROFAB AU 660 RB, MICROFAB AU 660 AGENT, MICROFAB AU 660 GRAIN REFINER or the operating solution may cause irritation to the respiratory tract. MICROFAB AU 660 B, MICROFAB AU 660 GRAIN REFINER and the operating solution contain thallium, which is a toxic material. MICROFAB AU 660 AGENT and the operating solution contain sodium sulfite. May cause allergic reaction in persons sensitive to sulfites. Do not get in eyes, on skin, or on clothing. Do not inhale or take internally.

CONSULT SUPPLIERS' MSDS FOR INFORMATION ON pH ADJUSTERS

FIRST AID: In case of contact of MICROFAB AU 660 B, MICROFAB AU 660 RA, MICROFAB AU 660 RB, MICROFAB AU 660 AGENT, MICROFAB AU 660 GRAIN REFINER, pH adjusters or the operating solution, flush skin or eyes with plenty of cool, clean water for at least 15 minutes. For eyes, obtain immediate medical attention. Remove and wash contaminated clothing and shoes.

HANDLING INFORMATION: When handling MICROFAB AU 660 B, MICROFAB AU 660 RA, MICROFAB AU 660 RB, MICROFAB AU 660 AGENT, MICROFAB AU 660 GRAIN REFINER, pH adjusters or the operating solution, wear protective clothing, chemical safety goggles, respirator, face-shield and rubber gloves. Exhaust ventilation is recommended to remove vapors that may be generated during make-up and operation. When preparing or maintaining solutions, always add MICROFAB AU 660 B, MICROFAB AU 660 RA, MICROFAB AU 660 RB, MICROFAB AU 660 AGENT, MICROFAB AU 660 GRAIN REFINER and pH adjusters slowly and cautiously. Avoid breathing vapors. Avoid contamination with acids, alkalis, oxidizers or any other foreign materials. Wash thoroughly after handling.

CONTAINER INFORMATION: Keep containers tightly closed. Store indoors in a cool dry area. Loosen closure cautiously when opening. Do not reuse containers. Wash before disposal. Improper disposal or reuse of containers may be dangerous and illegal.

REFER TO MSDS FOR FURTHER SAFETY AND HANDLING INFORMATION

MATERIAL SAFETY DATA SHEETS

For more detailed information on the toxicological properties of the products described herein, reference can be made to the Material Safety Data Sheet (MSDS) for each product. If you do not have the proper MSDS, it can be requested from: Enthone Inc., attention: Regulatory Affairs Department, 350 Frontage Road, West Haven, CT 06516. For emergency assistance call CHEMTREC (800) 424-9300.

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