



## MICROFILL™ EVF Copper Via Fill

For PWB Metallization Applications

### Regional Product Availability

- North America
- Japan/Korea
- Asia
- Europe

### Description

MICROFILL™ EVF Copper Via Fill is specifically formulated for use with insoluble anodes and direct current (DC) operation. MICROFILL EVF Copper Via Fill provides enhanced via filling performance with simultaneous through-hole plating, at low surface thickness, unattainable by previous generation systems. Formulated to operate over a broad range of operating conditions, MICROFILL EVF Copper Via Fill can be tuned for both HDI and IC Substrate applications, offering end users excellent production flexibility.

When using MICROFILL EVF Copper Via Fill for applications that do not require through-hole plating, the plating parameters can be adjusted to provide even higher via filling with lower surface deposition. Microvias up to 60 µm deep can be completely filled with as little as 12 µm plated copper on the surface. If the applications of simultaneous via filling with through-hole plating is required, the plating parameters can be adjusted to provide balanced performance in both pattern and panel plate operation.

### Advantages

- Bright, highly ductile, leveled deposits
- Exceptional microvia filling performance
- Simultaneous microvia filling and through-hole plating
- DC process with insoluble anodes for simple operation and elimination of idle time effects
- Designed for pattern and panel plate applications
- Easily analyzed and controlled by conventional CVS
- Proven system for HDI and IC substrate applications
- Highly tunable process for specific end user requirements

### Bath Make-up for Applications With Through Holes

Chemicals Required	Metric	U.S.
MICROFILL™ EVF Starter Solution	913.4 ml/l	91.3% v/v
MICROFILL EVF Make-up Solution	5.0 ml/l	0.5% v/v
MICROFILL EVF Brightener Solution	0.8 ml/l	0.08% v/v

## Alternative Make-up for Applications With Through Holes

Chemicals Required	Metric	U.S.
Electronic Grade Copper Sulfate Pentahydrate (CuSO <sub>4</sub> • 5H <sub>2</sub> O)	200 g/l	26.7 oz/gal
C.P. Grade Sulfuric Acid (SG = 1.40 H <sub>2</sub> SO <sub>4</sub> )	143.4 ml/l	14.3% v/v
C.P. Grade Hydrochloric Acid (SG = 1.18 HCl)	116 µl/l	0.0116% v/v
MICROFILL™ EVF Carrier Solution	34 ml/l	0.34% v/v
MICROFILL EVF Leveler Solution	8.0 ml/l	0.8% v/v
MICROFILL EVF Brightener Solution	0.8 ml/l	0.08% v/v

**WARNING!** Proper care must be taken to avoid physical contact with sulfuric acid solution as severe burns can result. The use of proper safety equipment is necessary, including chemical goggles, chemical gloves, and suitable protective clothing.

**WARNING!** Proper care must be taken to avoid physical contact with hydrochloric acid solution as severe burns can result. The use of proper safety equipment is necessary, including chemical goggles, chemical gloves, and suitable protective clothing.

## Bath Make-up for Applications Without Through Holes\*

\*Contact local Dow Electronic Materials sales representative for specific recommendations.

### Make-up Procedure

- 1) Add D.I. water to an appropriately cleaned storage tank and heat to 32–38°C (90–100°F).
- 2) Slowly add electronic grade copper sulfate and mix thoroughly until completely dissolved.
- 3) Recirculate the solution through a 1 micron polypropylene filter cartridge for at least two tank volume turnovers.
- 4) **VERY SLOWLY**, with thorough mixing, add C.P.-grade concentrated sulfuric acid (SG 1.40). **CAUTION!** Reaction is exothermic: heat is generated.
- 5) Add D.I. water to bring solution to final volume and allow the solution to cool to 50–55°C (122–131°F).
- 6) Analyze solution for copper sulfate and sulfuric acid levels and adjust if necessary.
- 7) Add Norit RO 0.8 or equivalent activated carbon (2–5 g/l).
- 8) Thoroughly mix solution for 1–2 hours.
- 9) Allow carbon to settle.
- 10) Using a 1 micron polypropylene filter cartridge, filter the solution into the electroplating tank and allow the solution to cool to below 32°C (90°F).
- 11) Add C.P.-grade concentrated hydrochloric acid (SG 1.18)
- 12) Confirm chloride concentration by analysis.
- 13) Add MICROFILL™ EVF Brightener Solution, Makeup, Starter Solution and mix thoroughly.
- 14) Analyze for copper, acid, chloride and MICROFILL EVF Carrier Solution, MICROFILL EVF Brightener Solution, and MICROFILL EVF Leveler Solution. Adjust as needed.

## Feature Geometries

The following list is an approximate guide to the MICROFILL™ EVF Copper Via Fill capability. It is not a process capability map or guarantee.

Typical feature dimensions for MICROFILL EVF Copper Via Fill:

- Blind microvia diameter: 75–150 µm (3–6 mil)
- Blind microvia depth: 30–100 µm (1.2–4 mil)
- Through-hole diameter: 0.15–0.30 mm
- Panel thickness: 0.8–1.0 mm
- Other feature dimensions are possible

The smaller diameter microvias will fill more quickly and to a better degree of fill than larger diameter microvias. Smaller diameter microvias are also a greater challenge for desmear and electroless copper processes and are more susceptible to voiding.

## Deposit Properties

Conductivity:	59 × 10 <sup>6</sup> S/m
Elongation:	Over 16%
Tensile Strength:	290–340 N/mm <sup>2</sup>
Solderability:	Excellent
Structure:	Fine-grained, equiaxed
Solder Floats:	6 cycles with no cracking [solder float 288°C (550°F) for 10 seconds]

## Operating Parameters

Parameter	Range	Recommended
Copper Sulfate Pentahydrate	190–210 g/l	200 g/l
Sulfuric Acid	90–110 g/l	100 g/l
Chloride Ion	40–60 mg/l	50 mg/l
MICROFILL™ EVF Brightener Solution	0.6–1.0 ml/l	0.8 ml/l
MICROFILL EVF Carrier Solution	24–44 ml/l	34 ml/l
MICROFILL EVF Leveler Solution	4–12 ml/l	8 ml/l
Temperature	20–24°C (68–75°F)	22°C (71°F)
Cathode Current Density	1.0–3.0 A/dm <sup>2</sup> (10–30 A/ft <sup>2</sup> )	2 A/dm <sup>2</sup> (20 A/ft <sup>2</sup> )
Anode Material	Uncoated Insoluble Iridium oxide (IrO <sub>2</sub> coated Ti)	

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## Process Sequence

The performance of MICROFILL™ EVF Copper Via Fill relies upon two main factors:

- 1) Maintaining the process at optimum operating parameters.
- 2) Preventing the introduction of non-compatible chemistries into the process.

The importance of these two factors cannot be overstressed. Dow Electronic Materials has developed a process of proven products that are compatible with the MICROFILL EVF Copper Via Fill. For these reasons, we strongly recommend using the appropriate, compatible Dow Electronic Materials preplate metallization process.

## Bath Control

### Bath Operation and Control

The inorganic solution constituents can be analyzed by chemical titration. The MICROFILL™ EVF Carrier Solution, MICROFILL EVF Brightener Solution, and MICROFILL EVF Leveler Solution can be analyzed by CVS. The analytical procedures are detailed in the MICROFILL EVF Copper Via Fill process manual.

The solution can be operated at a cathode current density from 1.0–3.0 A/dm<sup>2</sup> (10–30 A/ft<sup>2</sup>). For most applications 2 A/dm<sup>2</sup> is recommended depending on feature dimension and board design.

### MICROFILL EVF Copper Via Fill Replenishment Rates

EVF organic and copper oxide replenishment rates described below are subject to change dependent on anode type and plating equipment operation.

MICROFILL EVF Brightener Solution	0.08–0.16 ml/amp hour
MICROFILL EVF Carrier Solution	0.16–0.32 ml/amp hour
MICROFILL EVF Leveler Solution	0.1–0.2 ml/amp hour
ELECTROPOSIT™ Copper Replenisher	1.49 g CuO/amp hour

### Metallic Impurities

The maximum tolerable level of metallic contaminants are listed below:

Fe 1,000 mg/l  
Ni 1,000 mg/l

## Carbon Filtration Purification Procedure

Carbon treatment is required when the physical properties of the deposit change, such as the elongation and tensile strength fall below the minimum requirements.

Dull plating in the low current density areas can also be indicative of the need for carbon treatment. To carbon treat the bath, follow the procedure described below:

- 1) Pump the bath into the treatment tank.
- 2) Stir the solution.
- 3) Add 2–3 ml/l 35% H<sub>2</sub>O<sub>2</sub> solution and mix for ½–1 hour at room temperature.
- 4) Heat solution to 40–50°C (104–122°F). (Usage of air agitation is useful.)
- 5) Add 2–5 g/l Norit RO 0.8 high-quality activated carbon or equivalent into the heated solution.
- 6) Discontinue heating and stir the solution for 1–2 hours. Allow carbon to settle.
- 7) Filter the solution into the plating tank through a 1–5 micron polypropylene filter pre-coated with filter aid.

## Equipment

Tanks and wetted parts:	Reinforced polypropylene, PVC, 316 stainless steel, titanium or PTFE fluoropolymer/PTFE-coated.
Anodes:	Insoluble type (IrO <sub>2</sub> ).
Anode Bags:	Unnapped terylene or polypropylene.
Heaters:	Titanium, PTFE fluoropolymer/PTFE-coated or PTFE-coated immersion heaters.
Filtration:	1–10 micron polypropylene filter cartridges; filter continuously at a rate of 5 tank volume turnovers per hour.
Carbon Filtration:	Details and frequency are detailed in the MICROFILL™ EVF Copper Via Fill process manual.
Power Supply:	6–9 volt rectifier with a maximum of 5% ripple is required; for optimal plating distribution, split rectification is recommended.
Agitation:	Impingement system and knife agitation is recommended. Contact Dow Sales for specification.
Cooling Coils:	Reinforced polyethylene, polypropylene, PVC, 316 stainless steel, or PTFE fluoropolymer/PTFE fluoropolymer-coated.

This list is not intended to be all inclusive.

## Equipment Preparation

### Tanks

Prior to makeup, the process tank and ancillary equipment should be thoroughly cleaned and then bleached with a sulfuric acid solution. This procedure is particularly important for new equipment or equipment previously used for other processes.

#### I. Cleaning Solution

Sodium Hydroxide: 20–50 g/l (2.5–6.5 oz/gal)

#### II. Leaching Solution

Sulfuric Acid: 20–50 ml/l (2–5% v/v)

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#### 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 and insoluble anode.
- c) Discard water and remove insoluble anode.
- d) Add cleaning solution to the tank, heat to 55–60°C (131–140°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) Discard leaching solution.
- j) Recirculate water through the complete system.
- k) Discard water.

**CAUTION! Cleaning solution should not be used on IrO<sub>2</sub> surfaces.**

#### IV. Anodes

- a) Immerse anodes in hot D.I. water or persulfate microetch.
- b) Rinse thoroughly.
- c) Immerse anode in 10% sulfuric acid solution.

You may contact your Dow Electronic Materials Representative for more information about the insoluble anodes.

#### V. Anode Bags

- a) Wash thoroughly in hot D.I. water.
- b) Leach with a 10% sulfuric acid solution for 8 hours.
- c) Rinse thoroughly with D.I. water.

#### VI. Polypropylene Filter Cartridges

- a) Wash thoroughly in hot D.I. water.
- b) Leach with a 10% sulfuric acid solution for 8 hours.
- c) Rinse thoroughly with D.I. water.

## Product Data

### **MICROFILL™ Make-up Solution**

Specific Gravity @ 20°C: Approximately 1.2  
Appearance: Blue  
pH: <1

### **MICROFILL EVF Brightener Solution**

Specific Gravity @ 20°C: Approximately 1.0  
Appearance: Light blue  
pH: >2

### **MICROFILL EVF Leveler Solution**

Specific Gravity @ 20°C: Approximately 1.0  
Appearance: Light blue to light green  
pH: <2

### **MICROFILL EVF Carrier Solution**

Specific Gravity @ 20°C: Approximately 1.0  
Appearance: Light blue  
pH: <2

## Handling Precautions

Before using this product, or the analytical reagents required for its control, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on material 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.

## Customer Notice

Dow strongly encourages its customers to review both their manufacturing processes and their applications of Dow products from the standpoint of human health and environmental quality to ensure that Dow products are not used in ways for which they are not intended or tested. Dow personnel are available to answer your questions and to provide reasonable technical support. Dow product literature, including safety data sheets, should be consulted prior to use of Dow products. Current safety data sheets are available from Dow.

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