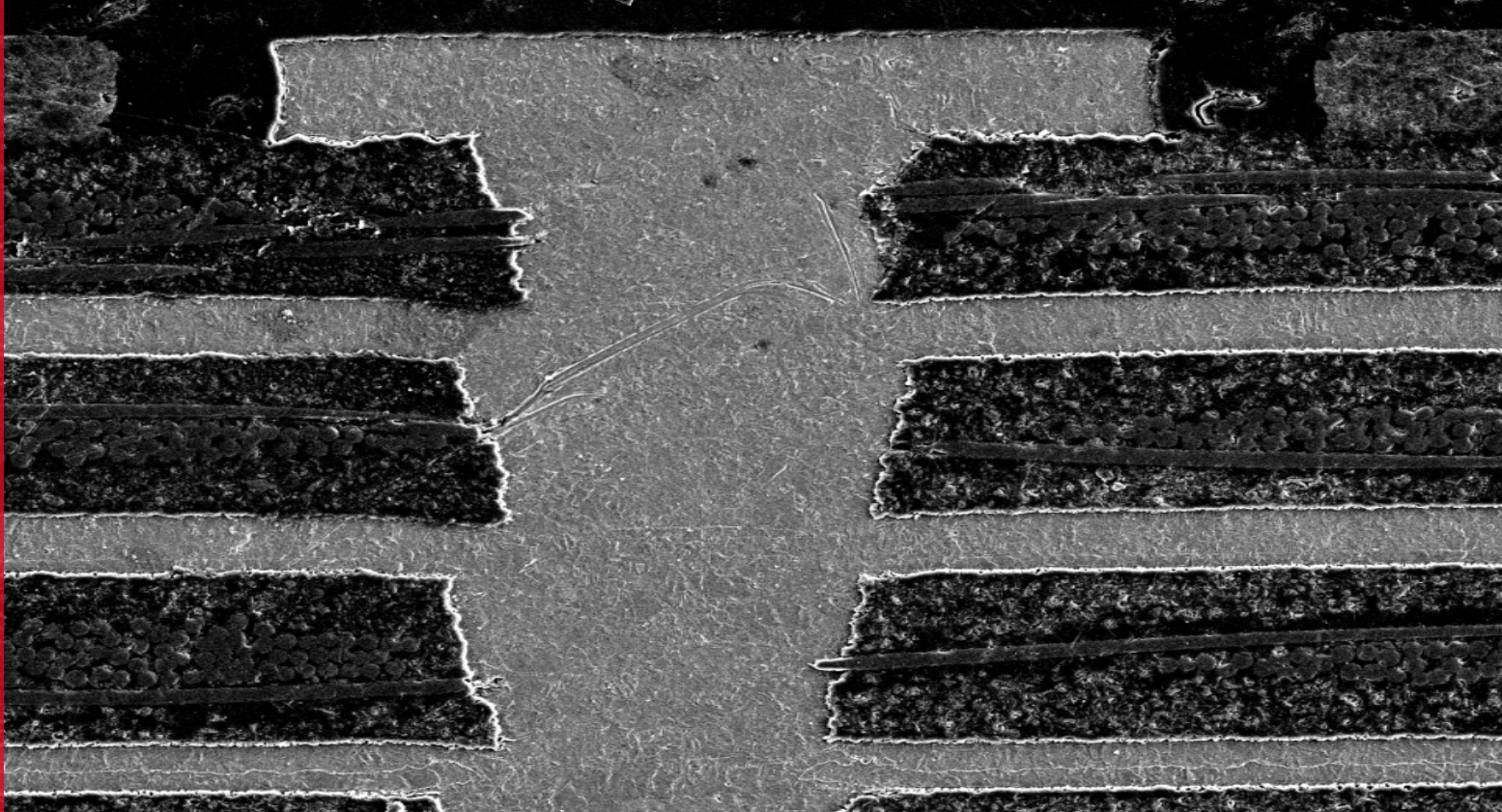




MacDermid Enthone



Microvia Reliability

Key Issues and Preferred Processes



MacDermid Alpha
ELECTRONICS SOLUTIONS



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CIRCUITRY SOLUTIONS

Microvia Reliability

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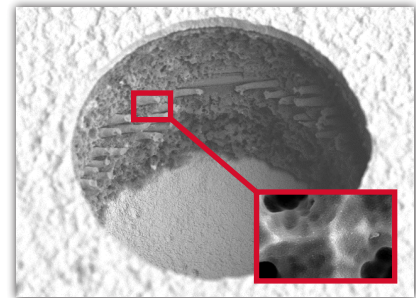
INTRODUCTION

The microvia structure has enabled circuit miniaturization for decades and continues to be the single most important interface in the electronic design. As reliability becomes increasingly important, the ability of these structures to hold up during the stresses of assembly and during end use is under extreme scrutiny. MacDermid Alpha Electronics Solutions has been the partner to the industry for years and has developed electronics manufacturing processes that can produce consistent electrical structures. We have been working to understand the microvia structure and all of its interfaces, failure modes, and ways to improve. Presented here are the key issues and our preferred process selection for the microvia reliability solution.

DIRECT PLATING PROCESSES: BLACKHOLE, ECLIPSE, SHADOW, AND ENVISION

Reduce Copper Interfaces, Improve Yields, and Enable Higher Quality

Direct plating technologies are used widely in electronics manufacturing as an alternative to electroless copper for activating drilled through holes and vias for electroplating. These processes are environmentally friendly and allow a range of benefits compared to electroless copper in terms of cost and quality enhancements to the board design. **Blackhole**, **Eclipse**, and **Shadow** are industry leading processes that coat the surface of the microvia wall with conductive carbon, while **ENVISION HDI** uses a conductive polymer.



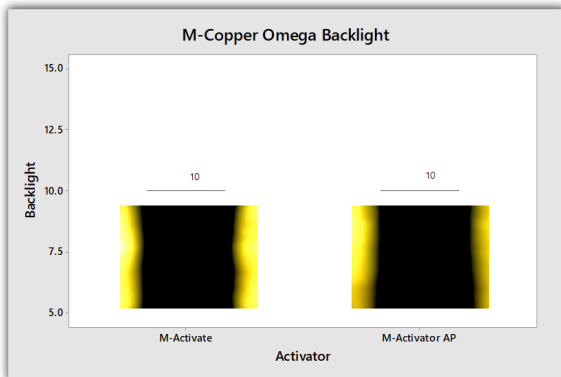
Direct plating allows for a single interface of electrolytic copper to the microvia target pad, eliminating the need for flash plate and electroless copper and reducing the number of potential separation points. The low-etch direct metallization processes **Blackhole LE** and **Eclipse LE** are especially well suited to the challenges of mSAP for SL-PCB and IC substrate designs.

Step	Process	Low Build & Flash	High Build Cu	Blackhole LE / Shadow LE
	Laminate Prepreg & Cu Foil	3 μm	3 μm	3μm
	LDD Oxide Laser Drill De-Oxide	3 μm - 0.5 - 0.5 = 2 μm	3 μm - 0.5 - 0.5 = 2 μm	3 μm
	Desmear Metallization	2 μm - 0.5 + 0.5 + 3 = 5 μm	2 μm - 0.5 + 1.0 = 2.5 μm	3.0μm - 1.0 = 2.0 μm
	Pattern Image Develop	5 μm	2.5 μm	2.0 μm
	Pre-Clean Cu Via Fill	5 μm / +20 = 25 μm	2.5 μm / +19.5 = 22 μm	2.0 μm / +19 = 21 μm
	Strip Resist Flash Etch	0 μm / -7 = 18 μm	0 μm / -4 = 18 μm	0 μm / -3 = 18 μm
Layers of Cu to Flash Etch		3	2	1

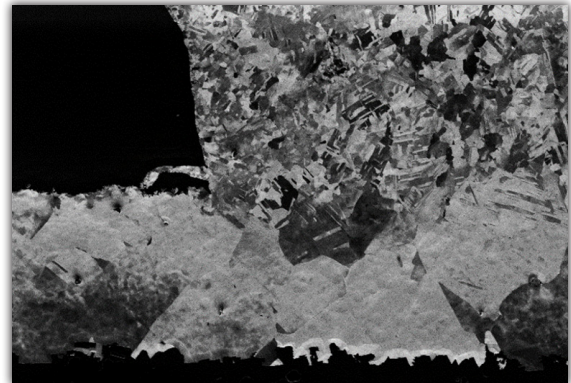
Carbon and graphite technology have co-evolved with HDI to solve manufacturing challenges like mSAP copper etch budget allowing for a reduced copper thickness at the final flash etching step.

ELECTROLESS COPPER TECHNOLOGIES: M-COPPER OMEGA, VIA DEP 4550, SYSTEK SAP Horizontal and Vertical Processes, Multiple Palladium Activator Technologies, and Low Deposit Stress

Electroless copper has been the primary metallization of choice for making through holes and vias conductive for decades. Our extensive suite of chemistries includes the low-stress horizontal or vertical **Via Dep 4550**, and premium **M-Copper Omega** processes for HDI manufacturing. The **Systek SAP** is a high-performance primary metallization process for IC substrate scale designs.



We offer a choice of ionic or colloidal palladium activators both with exceptional activation as measured with backlight coverage.



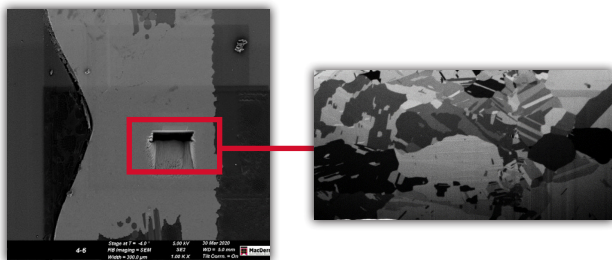
Via Dep 4550 provides the optimal grain structure at the target pad interface for reliable microvias.

ELECTROLYTIC COPPER PLATING SOLUTIONS: VF, AVF, VF-TH, UVF SERIES

Copper Microvia Filling Technology Tailor Matched for Preferred Grain Structure Across Interfaces

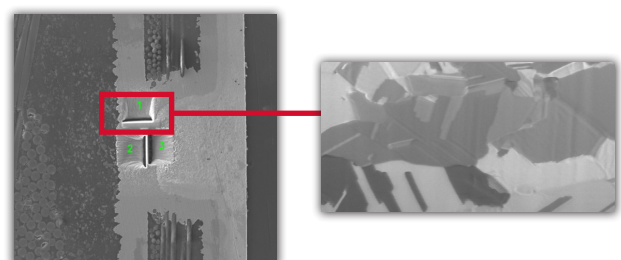
Through our extensive experience in the via filling technologies arena, we have developed highly reliable copper microvia filling processes that pair specifically with our electroless and direct plating primary metallization processes. When combined in unison, an exceptional grain boundary can form through self-annealing, resulting in lasting microvia structures that hold up to extensive cycling and end use stressors. For standard PCB and HDI, the **MacuSpec VF** and **AVF Series** are industry leading processes for copper microvia filling. For advanced HDI, and Substrate-Like PCB, the **MacuSpec VF-TH Series** baths can simultaneously plate through holes and fill copper microvias. For IC Substrate manufacturing, the Systek UVF Series can plate 2 in 1 RDL layers with exceptional co-planarity.

Via Dep 4550 Electroless Copper + MacuSpec VF-TH 200 Via Fill



The low-stress Via Dep 4550 enables thermomechanical benefits compared to regular electroless copper processes and can provide optimal grain structure at the via interface.

Blackhole Direct Metallization + MacuSpec VF-TH 200 Via Fill



Compared to standard electroless copper plating, the via interface with Blackhole direct metallization is simpler and has fewer areas for reliability concern, while also allowing for environmental benefits.

MICROVIA RELIABILITY

Key Issues and Preferred Processes

A PORTFOLIO OF ROBUST PROCESSES FOR IMPROVED VIA INTERFACES

PROCESS SEGMENT		BOARD TYPE		
Main Category	Subcategory	General PCB/HDI	SL-PCB	IC Substrates
Primary Metallization	Direct Metallization	Blackhole, Eclipse, Shadow, ENVISION	Blackhole LE, Shadow LE	
	Electroless Copper	M-Copper Omega, Via Dep 4550		System SAP
Electrolytic Metallization	Via Filling Copper	MacuSpec VF, VF-TH, AVF Series		System UVF Series

MicroviaReliability.com

MACDERMID ALPHA IS YOUR PARTNER FOR WORLDWIDE EXCELLENCE IN IC SUBSTRATE MANUFACTURING

Through the innovation of specialty chemicals and materials under our Alpha, Kester, Compugraphics, and MacDermid Enthone brands, MacDermid Alpha Electronics Solutions provides solutions that power electronics interconnection. We serve all global regions and every step of device manufacturing within each segment of the electronics supply chain. The experts in our Semiconductor Solutions, Circuitry Solutions, and Assembly Solutions divisions collaborate in design, implementation, and technical service to ensure success for our partner clients. Our solutions enable our customers' manufacture of extraordinary electronic devices with high productivity and reduced cycle time. Find out more at MacDermidAlpha.com.

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