



MacDermid Enthone



ELECTROLYTIC COPPER METALLIZATION

Product Selection Guide



macdermidalpha.com

CIRCUITRY SOLUTIONS

ELECTROLYTIC COPPER METALLIZATION

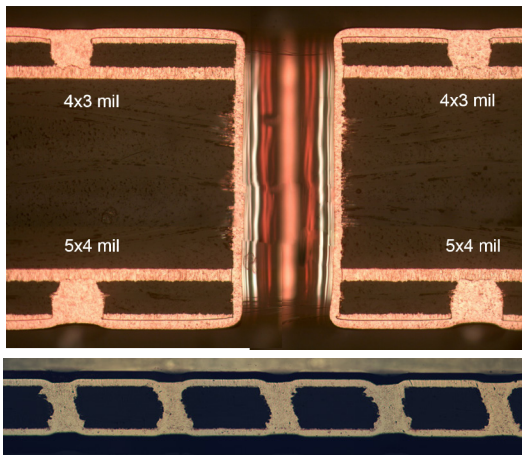
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Our electrolytic copper metallization technologies provide a wide array of solutions from general use plating processes for standard technology applications to the most advanced fine line and feature plating solutions for MSAP and IC substrates. Each copper metallization process is specially designed to be a perfect fit for its specific application. With industry leading performance in a wide range of applications, our processes provide customers with the ability to manufacture any circuitry design required. Each installation and all technical service are performed by highly experienced technical staff, ensuring that every production line is capable of meeting all technical requirements.

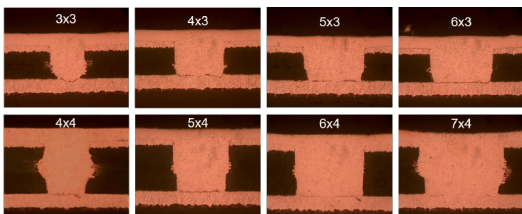
We offer electrolytic copper plating solutions for a wide range of applications:

- **Micro Via Filling:** Full and partial copper filling of blind microvias for a wide range of sizes for high density interconnect technologies and advanced applications such as mSAP.
 - **Periodic Pulse Reverse:** For high aspect ratio and thick boards, our PPR chemistries are able to provide high throwing power and high reliability copper deposits at high speeds.
 - **High Throw DC:** For medium technology boards or general plating, these processes extend the capabilities of DC plating, delaying the need to invest in PPR processing.
 - **IC Substrate Metallization:** Specifically formulated baths for extremely fine lines and spaces, providing the utmost consistency in trace height and profile as well as via filling and copper pillar plating.
 - **Through Hole Filling:** Processes for the complete filling of through vias for thermal management of circuit boards.
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TECHNOLOGY HIGHLIGHT: VIA FILLING



MacuSpec™ VF-TH 200 for simultaneous via filling and through hole plating, and X-via filling.



MacuSpec™ AVF 700 performs on a wide range of difficult-to-plate micro via sizes.

One of the most expansive and complete portfolios of via filling chemistries in the industry, our MacuSpec™ Via Fill processes provide pure, high reliability copper filling of microvias ranging from hundreds of microns across, to those found in the smallest of high density designs being utilized today. The VF-TH series of baths allows for single-step simultaneous plating of through holes with the filling of microvias. Our AVF advanced via filling chemistries provide super filling capabilities of a wide range of microvia sizes, while minimizing the amount of surface copper plated for high density interconnect applications.

MacuSpec™ Via Filling Highlights:

- Pre-dip free options available
- Specialized chemistries for various board designs
- Physical properties that exceed IPC 6012D 3.2.6.2 tensile strength/elongation
- Extensive deployment in production environments around the globe

METALLIZATION PROCESSES

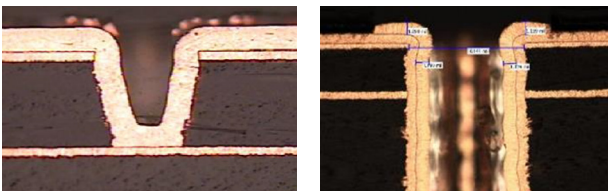
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TECHNOLOGY HIGHLIGHT: PERIODIC PULSE REVERSE

Global Data (n ~ 100)	Tensile (psi)	Elongation (%)
Average	41,806	27.5
Std. Dev.	4,671	4.5

PC-600: Widely installed around the globe with consistent performance.

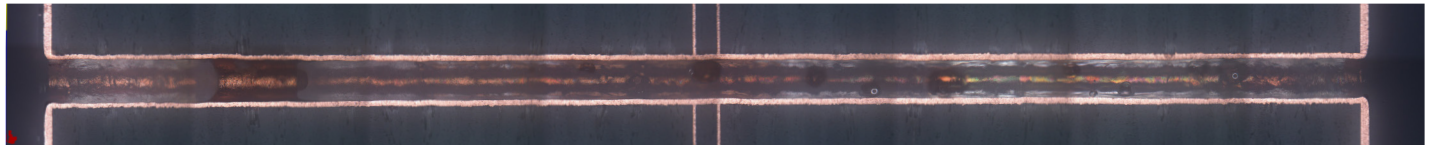
For circuit board manufacturing with very high layer counts and high aspect ratio through holes, our portfolio of Periodic Pulse Reverse acid copper plating processes provides exceptional reliability for thick, high technology boards, while also providing the excellent process throughput expected of pulse plating.



Wide ranging capabilities such as high aspect ratio conformal and button plating.

MacuSpec™ Periodic Pulse Reverse Highlights:

- High throwing power in through holes up to and beyond 30:1 aspect ratio
- High volume production with lowest cost of ownership
- Choice of operation in vertical or horizontal equipment
- Stable, dependable performance over long bath life
- Excellent deposit properties



MacuSpec™ PPR 200 high aspect ratio plating with industry leading performance.

PERIODIC PULSE REVERSE ACID COPPER

Product Name	Application							Anode Type
		Hoist	VCP	Panel	Pattern	Button	Aspect Ratio	
MacuSpec PPR 100	High aspect ratio plating of through holes	✓	✓	✓	✓	✓	25-30:1	Soluble
MacuSpec PPR 200		✓	✓	✓	✓	✓	25-30:1	Soluble
PC-600		✓	✓	✓	✓	✓	25-30:1	Soluble
MacuSpec MPR 100	Mid-aspect ratio plating of through holes	✓	✓	✓	✓	✓	12-15:1	Soluble

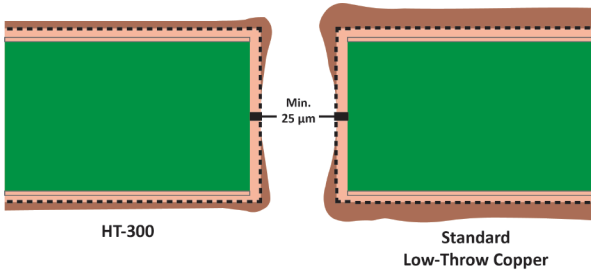
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TECHNOLOGY HIGHLIGHT: HIGH THROW DC



MacuSpec™ HT 360 Conformal Plate



HT-300

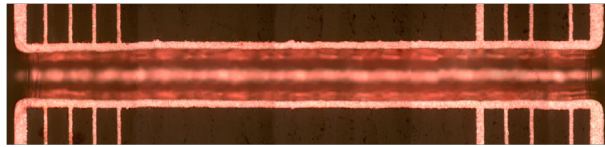
Standard
Low-Throw Copper

MacuSpec™ High Throw DC baths increase throughput while also decreasing the amount of wasted surface plating.

Our portfolio of High Throw DC Acid Copper plating solutions meet the needs of any application requiring DC plating. The high throwing power extends the need to upgrade to pulse plating for many designs. All baths are compatible with our industry leading portfolio of primary metallization processes for enhanced performance.

MacuSpec™ High Throw DC Copper Highlights:

- Greatly increase plating speed compared to incumbent plating solution
- Achieve significant savings on wasted copper that would normally be plated on surface
- Provide excellent physical properties to withstand harsh assembly temperatures



MacuSpec™ HT 300 on 12:1 AR

HIGH THROW DC ACID COPPER

Product Name	Application							Anode Type
		Hoist	VCP	Panel	Pattern	Button	Aspect Ratio	
MacuSpec HT 200	Low to mid aspect ratio plating of through holes	✓	✓	✓	✓	✓	12:1	Soluble
MacuSpec HT 300	Low to mid aspect ratio through holes, control depth drilled blind vias. <2.5 ASD	✓	✓	✓	✓	✓	12:1	Soluble
MacuSpec HT 360	Low to mid aspect ratio through holes, conformal plating of blind microvias Up to 3.5 ASD	✓	✓	✓	✓	✓	12:1	Soluble/ Insoluble
Cuprostar ST-2000	Low to mid aspect ratio through holes, conformal plating of blind microvias Up to 3.5 ASD	✓	✓	✓	✓	✓	12:1	Soluble

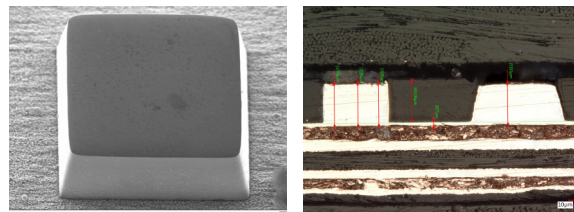
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TECHNOLOGY HIGHLIGHT: IC SUBSTRATES

IC substrates represent the critically important interface between semiconductor chips and the carrier that they rest upon. The interconnect density of these highly advanced printed circuit boards created today is far beyond that found in regular boards. In today's constantly shifting electronics technology landscape, manufacturers need more options available to them than ever to meet the demands of OEMs who are seeking to pack an increasing amount of functionality into products.

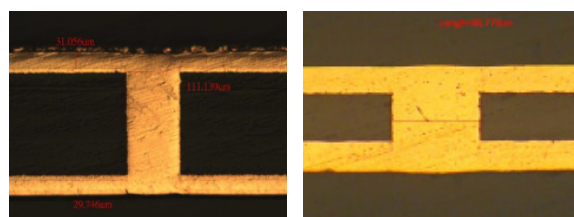
The Systek™ IC substrate copper metallization processes™ provide IC substrate fabricators with specialized tools for solving complex design problems with highly reliable plated copper interconnections. Offerings include the industry standard processes for highly advanced via filling, 2-in-1 plating, and embedded trace plating to design enabling technologies such as substrate-side copper pillars and single-step copper through hole filling. With the Systek brand IC substrate chemistries, our customers are making huge strides in what they can achieve in their devices.



Systek™ BMP copper pillar plating for substrate side bumping.



Systek™ ETS embedded trace filling with excellent thickness distribution, plating to replace filling.



MacuSpec™ THF 100 void free filling on a variety of through hole thicknesses and diameters.

IC SUBSTRATE PLATING

Product Name	Application	Description	Anode Type
Systek ETS 1200	Embedded trace substrate plating	DC acid copper plating system for the fine line plating of embedded trace features with excellent trace profiles and copper thickness distribution	Soluble/ Insoluble
Systek UVF 100	Simultaneous via filling and fine line plating in RDL applications	DC acid copper plating system for the simultaneous filling of microvias and fine line pattern plating with excellent trace profiles in RDL applications for FOWL P	Insoluble
Systek MV 300	Via filling with minimal surface copper	DC acid copper plating system for the filling of microvias with minimal surface copper build up	Insoluble
Systek MV 400	Via filling with minimal surface copper	DC acid copper plating system for the filling of microvias with minimal surface copper build up	Insoluble
Systek BMP-LP8	Build up of copper pillars	DC acid copper plating system for the formation of domed copper pillars with excellent within panel and within unit thickness uniformity at current densities up to 12 ASD	Insoluble
MacuSpec THF 100	Copper through hole filling	Acid copper plating process for the copper filling of X-via, laser drilled and mechanically drilled through holes in core layers. Filling of through holes for thermal management Panel plate capability	Insoluble

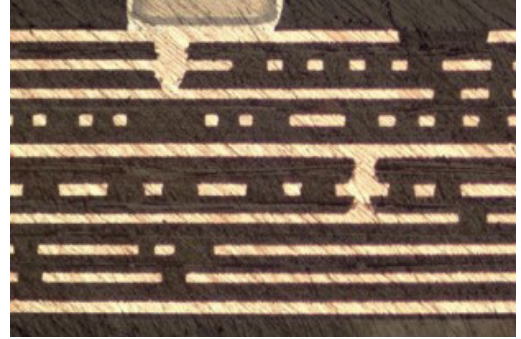
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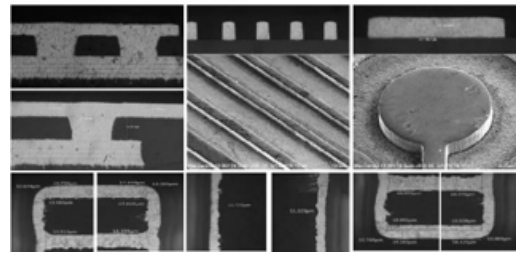
TECHNOLOGY HIGHLIGHT: MSAP

Mobile electronics applications today require ever smaller line and space dimensions combined with ever increasing functionality. To meet the demands to create smartphone boards that allow growing battery sizes and incorporation of 5G communications processing, the complex modified Semi Additive Process (mSAP) has become more widely adopted among high volume manufacturers.

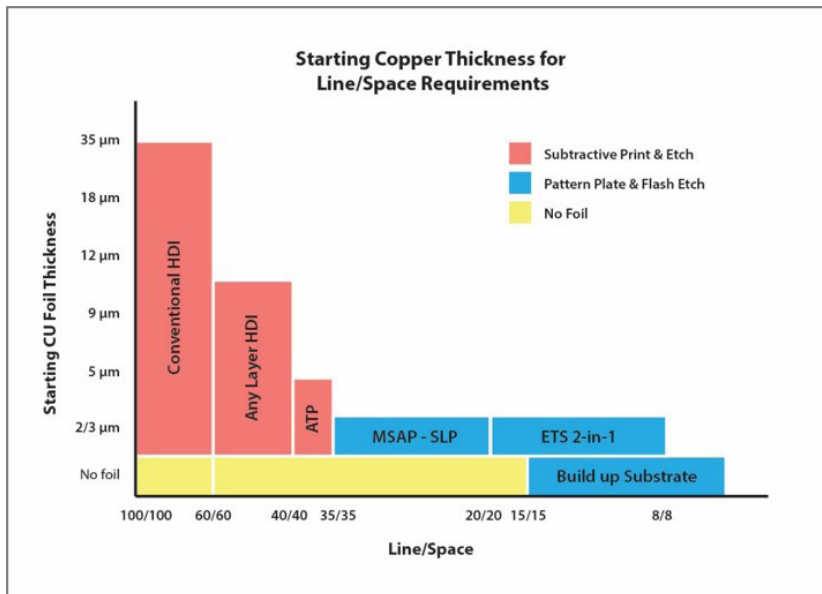
Access to technology from the most advanced manufacturing done in circuit engineering means that not only can we offer customers leading edge line/space performance, but also a variety of unique process flows to suit highly specialized applications in board design.



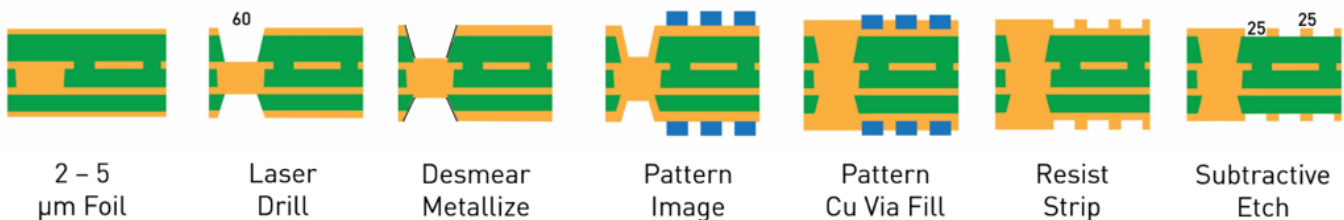
Smartphone board designs created with mSAP are becoming the standard in the industry.



With copper metallization technology spanning the entire breadth of electronics manufacturing, our customers have a wide selection of tools to choose from.



As line and space requirements narrow, advanced technologies such as SAP and mSAP are required to build boards to specification.



From start to finish, we offer entirely customizable mSAP processing options designed to suit each individual customer's requirements.

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MACDERMID ALPHA IS YOUR PARTNER FOR WORLDWIDE EXCELLENCE IN COPPER METALLIZATION

Through the innovation of specialty chemicals and materials under our Alpha, Compugraphics, Kester, Electrolube, 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 at high productivity and reduced cycle time.

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