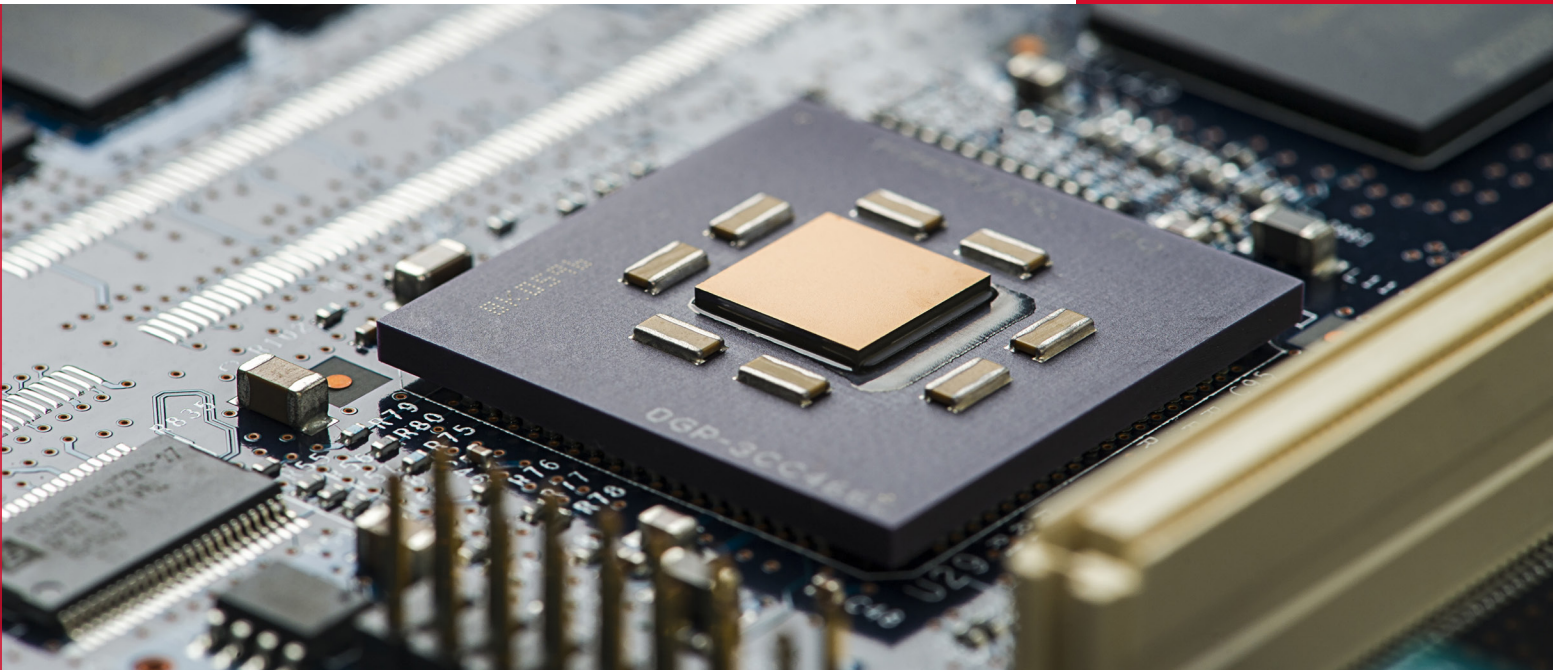




MacDermid Enthone



System™ Advanced Packaging

Chemistries for IC Substrate Manufacturing



www.macdermidalpha.com

CIRCUITRY SOLUTIONS

THE BENCHMARK IN PERFORMANCE AND MANUFACTURABILITY

IC substrates are the critical interface between the semiconductor chip and the conductive component carrier they rest on. Fabricators of these IC substrates require a capability to deliver an interconnect density far beyond that of the typical printed circuit board fabricator. To successfully build these complex designs requires a partner with proven specialty chemicals expertise in high density designs.

MacDermid Alpha's line of IC substrate chemistries represents the pinnacle of performance for the most technically challenging realm of printed circuit board processing. With innovative chemical solutions for metallization, final finishes, and specialized applications, MacDermid Alpha Electronics Solutions has the extensive fabrication experience you can trust. No other company can offer the same breadth of chemistries and ease of achieving higher productivity at lower total costs.

Manufacturing Process Step

Drill, Metallize, Core Through Hole Fill

Lamination

Cored Build-Up



Systemek™ THF

M-Speed HF



MultiBond™ 500

Coreless Build-Up

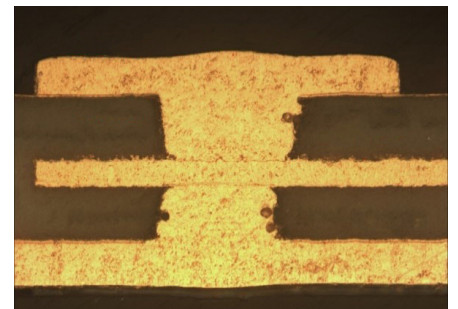


Systemek™ ETS



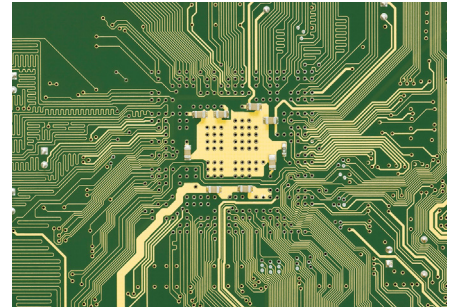
METALLIZATION

Making through holes and blind vias conductive, while physically strengthening the package, is a challenge faced by IC substrate manufacturers. MacDermid Alpha is there to exceed your expectations. Primary metallization, in either a semi-additive or subtractive process sequence, is achieved through your choice of either chemically reduced copper, or an environmentally-friendly direct plate alternative. For electroplating metallization, whether you are building 2 in 1 RDL's, filling copper through holes or vias, or doing other advanced panel-level packaging designs, MacDermid Alpha has an offering to meet every requirement. With a wide array of chemistries designed to work flawlessly together, MacDermid Alpha delivers unmatched flexibility, capability, and reliability.



SURFACE FINISHING

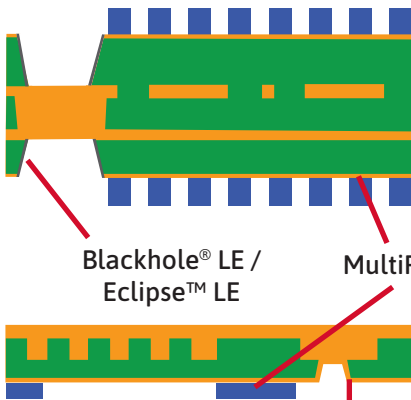
Which finish is best? The one that satisfies your customer while maximizing your profit. Let MacDermid Alpha guide you through the complexities of surface finishing applications. With extensive OEM involvement worldwide, we know the issues governing finish selection, and will exceed your requirements at fabrication. From process ease, to corrosion prevention, to superior solderability, to wire bond reliability, MacDermid Alpha knows finishing – like no other.



Laser Drill Primary Metallization

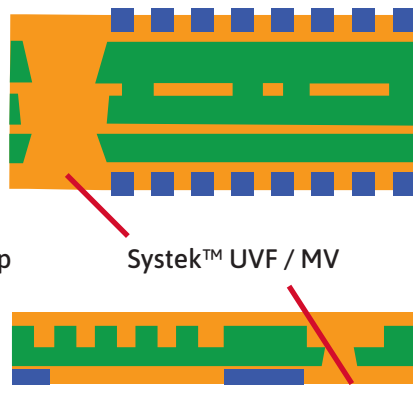
2-in-1 RDL Plating

Quick Etch / Carrier Removal / Final Finish



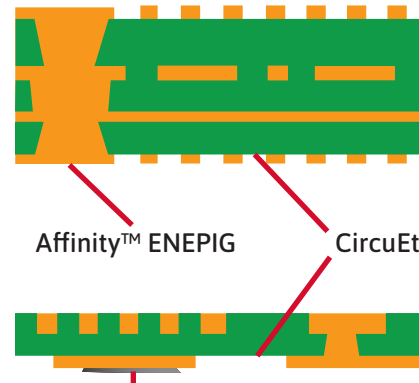
Blackhole® LE /
Eclipse™ LE

MultiPrep



Systek™ UVF / MV

Systek™ SAP



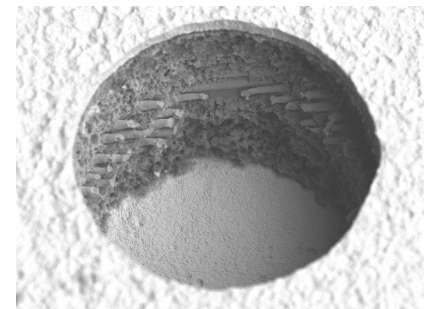
Affinity™ ENEPIG

CircuEtch

ENTEK® Plus HT

SPECIALTY APPLICATIONS

MacDermid Alpha understands the challenges of providing conductor shapes that exceed your customers' controlled impedance requirements, while reliably bonding to next-generation dielectrics for lead-free, low-loss applications. As new materials continue to evolve in this space, MacDermid Alpha will deliver processes for the wide range of specialty applications in IC substrate manufacturing. As the demonstrated market leader in the development of high reliability bonding conversion coatings and precision etches for all substrate applications, let MacDermid Alpha provide you with the solution you need.



PRIMARY METALLIZATION

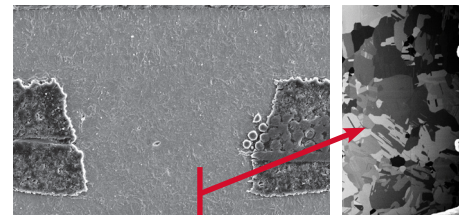
Direct Metallization

Blackhole® LE / Eclipse™ LE

The Blackhole and Eclipse direct metallization processes are a direct plate alternative to electroless copper for improved via interface features without the environmental impact.

Features

- Enables direct copper to copper bonding of plated copper to via target pads for enhanced reliability
- No chelators, formaldehyde or precious metals
- Horizontal conveyerized process
- Compatible with a wide range of substrate materials and material mixes



Low etch carbon-based direct metallization technology enables a single continuous interface at the via fill to target pad boundary for high reliability.

Semi-Additive Process

Systemk™ SAP

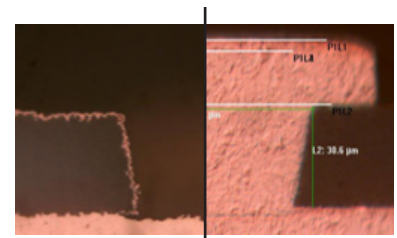
Systemk SAP is a complete line of products for semi-additive build up of high-density designs on rigid and flexible IC substrates. The unique technologies included in the Systemk SAP family of semi-additive processes allow void free filling of blind microvias, uniform copper thickness in hard-to-plate areas, and the high peel strengths needed for fine line reliability. The entire Systemk SAP process can operate in standard equipment with optimum performance.

Systemk™ SAP Copper

The Systemk SAP copper metallization process is a high performance semi-additive primary metallization for IC substrates. The system provides an electroless copper seed layer for unclad build-up substrates and is composed of a complete line of process chemistry including desmear, conditioning, activation, and metallization processes.

Features

- Highly uniform sulfuric acid free glass etch for increased peel strength
- Unique chemical adhesion mechanism offering reduced surface roughness
- Stress-free electroless copper decreasing separation risks
- Capable of fine line processing down to 5/5 µm line/space



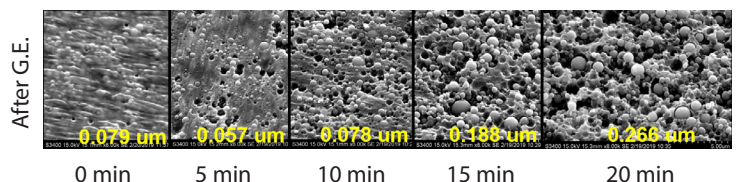
The Systemk SAP Copper 850 deposits a low-stress electroless copper seed layer for with complete coverage allowing for superior via filling performance.

Systemk™ Desmear

Systemk Desmear provides a well-prepared surface for superior adhesion between the base material and electroless Cu seed layer with minimum surface roughness. It includes glass etch or frost to maximize the bonding strength with smooth glass beads.

Features

- Provides clean via target pad of resin & laser residue free
- Permanganate etch maximizes adhesion with minimum surface roughness
- New sulfuric acid free glass etch technology provides uniform glass frost and increased peel strength



ELECTROLYTIC COPPER METALLIZATION

2 in 1 RDL and Via Fill

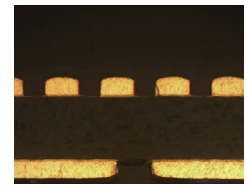
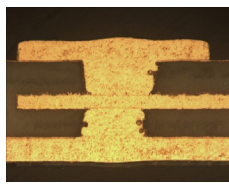
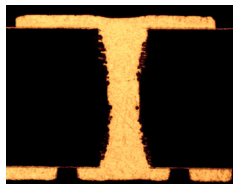
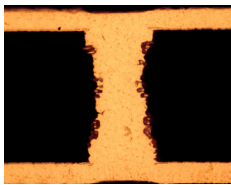
Systek™ UVF and MV Series

The Systek UVF and MV Series of products are specifically designed for the 2 in 1 plating of RDL structures in IC substrates. The systems can fill blind microvias and X-vias while simultaneously plating fine lines, pads, and other surface features with high coplanarity and controlled trace profiles.

Features

- Single step via filling and fine line plating
- R-Values consistently less than 2 μm
- Trace profile consistently under 15%
- Via fill < 5 μm dimple, < 3 μm overfill, surface copper 10 – 15μm

Trace Width	Pad Width	Avg. R	Profile %	Cross-Sectional Example
25 μm	50 μm	0.5 μm	12%	
15 μm	100 μm	1.5 μm	15%	



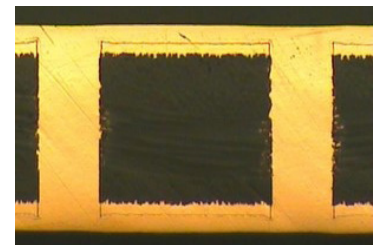
Copper Through Hole Filling

Systek™ THF Series

The Systek THF Series are copper through hole filling metallization processes that can plate solid copper through hole structures in a wide range of substrate thicknesses and hole sizes.

Features

- Void-free through hole filling with minimal surface copper plating
- Improved thermal conductivity for substrate heat management
- Eliminates need for conductive plug and planarization processes



Embedded Trace Substrate Metallization

Systek™ ETS Series

Systek ETS is an advanced DC acid copper pattern plating process specifically formulated to plate fine lines and pads in embedded trace substrates.

Features

- Fine line pattern plating down to 5/5 μm line/space
- High coplanarity of traces and pads with R-Values < 2 μm
- Excellent trace profile for controlled impedance
- Low-stress deposit exceeds IPC Class III standards for tensile strength and elongation eliminating concerns of warpage due to metallization



Coplanarity, WIU Compared to Pad (50 μm)		
Line/Space (μm)	R-Value Max (μm)	R-Value Average (μm)
10/10	0.29	0.11
7/7	1.03	0.68
5/5	1.54	0.86

SPECIALTY APPLICATIONS

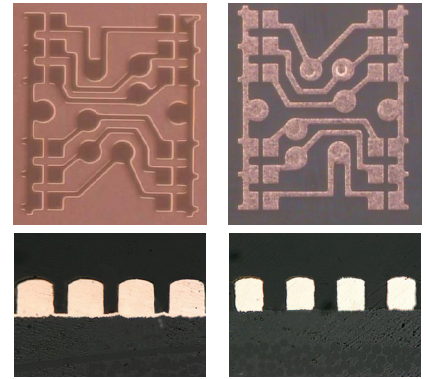
Anisotropic Etching Process for SAP / mSAP

CircuEtch 300

In the final etch that removes the copper foil in mSAP processing or the electrolytic copper seed layer in SAP processing, it is crucial to limit the lateral etching of the trace. The CircuEtch 300 process is a high-performance peroxide-sulfuric etchant system that ensures maximum circuit densities, trace profile, and excellent adhesion.

Features

- Easy to maintain bath
- Anisotropic etching of copper
- Maintains good cross-sectional shape of traces without undercut
- Stable etching rate for predictable performance



Before CircuEtch

After CircuEtch

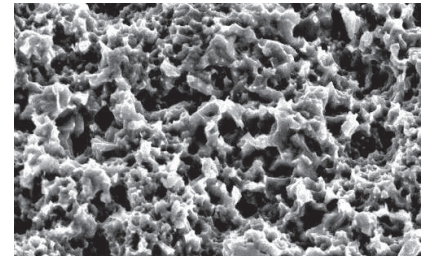
Copper Adhesion Promotion

MultiPrep 200

MultiPrep 200 is a unique pretreatment process that enhances the adhesion of soldermask, dry film, and liquid photoresist to copper substrates. Ideally suited to eliminate the need for pumice or mechanical scrubbing, it delivers an optimized surface topography that maintains high speed signal integrity.

Features

- Dry-film pretreatment for enhanced adhesion for fine line processing
- Uniform etching compared to mechanical scrubbing for greater adhesion consistency
- Improved layer performance



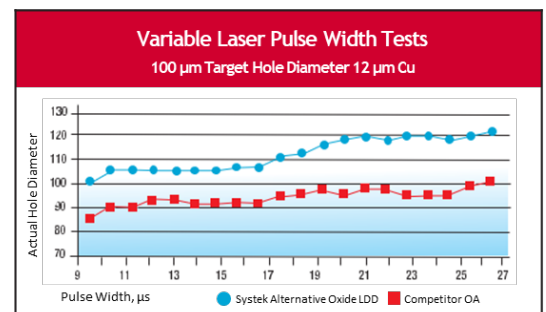
Advanced Alternative Oxide For Laser Direct Drill

MultiBond™ 500

MultiBond 500 is an innovative low-etch alternative oxide for laser direct drilling. Due to its improved topography, color, and lower etch depth, the process enables improvements in laser direct drilling of vias through enhanced absorption of laser energy during the drilling process, while providing optimized topography for the most demanding adhesion requirements.

Features

- Less than 1 micron total copper removal through LDD treatment and de-oxide processing
- Highly uniform dark colored alternative oxide coating



FINAL FINISHES

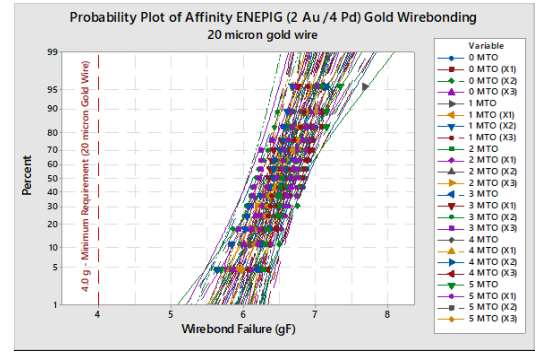
Wire Bondable ENEPIG Final Finish

Affinity™ ENEPIG

A gold surface that is receptive to highly sensitive wire bonding and soldering operations is an important feature in IC substrate designs. The Affinity ENEPIG process plates a nickel-palladium-gold surface that consistently provides the foundation for strong gold wire bond strength and excellent solder joint strength.

Features

- Exceptional palladium thickness uniformity and consistency
- Excellent wire bonding and solderability performance
- Chemical process stability means no extraneous plating between pads
- Predictable palladium tank maintenance over long bath life with zero unexpected plate out



The Affinity ENEPIG process provides a gold finish with stable wire bondability over the process bath life, ensuring consistent assembly performance.

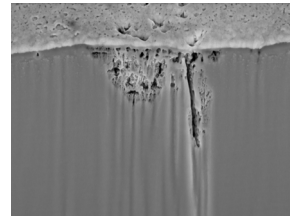
High Performance Nickel-Gold Final Finish

Affinity™ ENIG

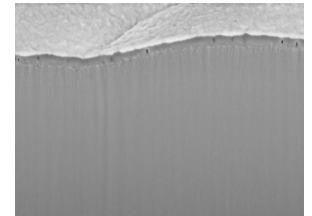
Electroless nickel-immersion gold finishes are widely used to create a reliable surface for solderability with long shelf life. With co-optimized nickel and gold plating technologies, Affinity ENIG deposits a nickel-gold finish with extremely uniform nickel-phosphorous distribution and low variation in pad-to-pad gold thickness.

Features

- Highly uniform nickel-phosphorous alloy content distribution
- Tightest gold thickness distribution for cost savings and better solderability
- Lowest level of EN corrosion for strict adherence to IPC standards for ENIG



Traditional unbalanced ENIG



Uniform coating from Affinity ENIG

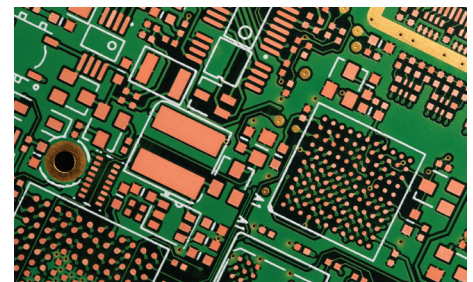
Organic Solderability Preservative

ENTEK® PLUS HT

Organic solderability preservatives are widely used in electronics manufacturing. The ENTEK PLUS HT is a production proven process that applies a metal-free final finish that enables a solder joint directly onto a copper pad.

Features

- Appearance and performance unchanged after multiple lead-free reflow cycles
- Compatible with mixed metal operations
- Selectively deposits on copper
- High degree of coating thickness control unique to ENTEK PLUS HT



SYSTEK ADVANCED PACKAGING

IC Substrate Chemistries

A PORTFOLIO OF TECHNOLOGY ENABLING SOLUTIONS

PRIMARY METALLIZATION

System SAP – semi-additive process for ultra fine pitch

Blackhole LE / Eclipse LE – direct plate simplicity

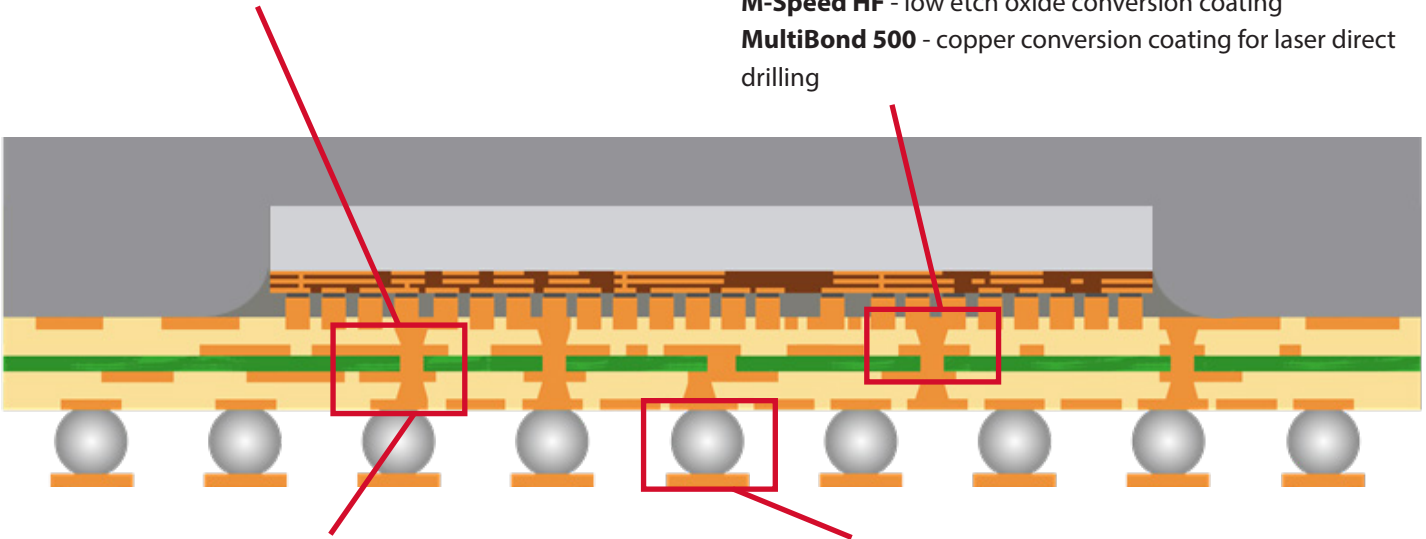
SPECIALTY APPLICATIONS

MultiPrep 200 - adhesion promoter

CircuEtch 300 – differential etch

M-Speed HF - low etch oxide conversion coating

MultiBond 500 - copper conversion coating for laser direct drilling



ELECTROLYTIC COPPER PLATING

System THF Series – copper through hole fill for thermomechanical benefits

System UVF Series – 2 in 1 RDL plating for single-step build-up layers

System ETS Series – Embedded trace substrate plating

System MV Series – high throw / high current density via filling

FINAL FINISH

Affinity ENIG - low temperature, corrosion resistant nickel plating

Affinity ENEPIG - highest reliability wire bonding

Entek Plus HT – organic solderability preservative

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

Through the innovation of specialty chemicals and materials under our Alpha, Kester, Electrolube, 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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CIRCUITRY SOLUTIONS