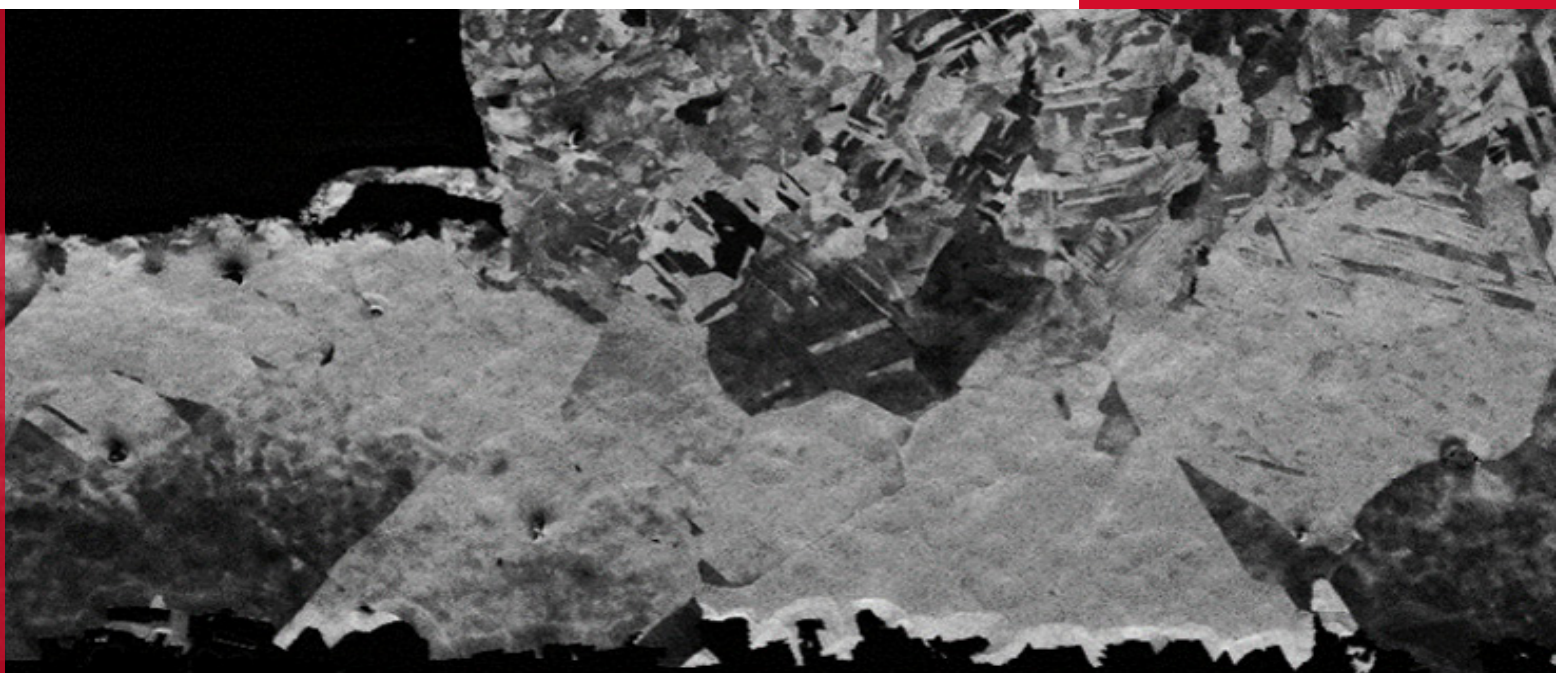




MacDermid Enthone



System[™] SAP

High Performance Build-up Processes for IC Substrates



MacDermid Alpha
ELECTRONICS SOLUTIONS



www.macdermidalpha.com

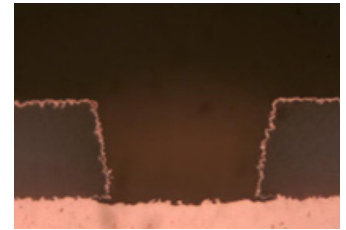
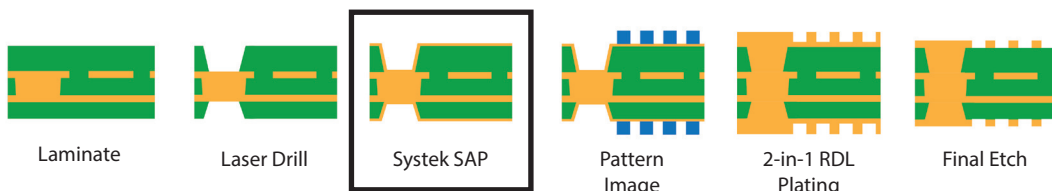
CIRCUITRY SOLUTIONS

System™ SAP

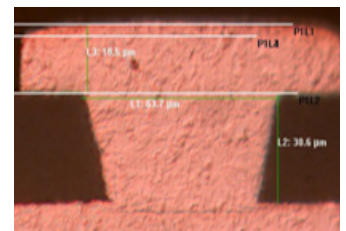
High Performance Build-up Processes for IC Substrates

SEMI-ADDITIVE COPPER METALLIZATION PROCESS

The System™ SAP copper metallization process is a high performance semi-additive primary metallization for IC substrates with multiple process improvements. The system is specifically designed as a metallization seed layer for unclad build up substrates and is composed of a complete line of process chemistry including desmear, conditioning, activation, and metallization processes. For completion of the build-up process, System SAP is compatible with System advanced 2-in-1 plating technology, allowing the filling of copper micro vias and plating of traces simultaneously. The combined process improvements of System SAP enable very high density circuitry with minimal substrate roughening for enhanced layer performance and reliability.



Micro via structure plated with System SAP ready for build-up



System SAP micro via structure filled with System 2-in-1 plating

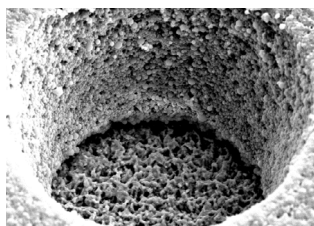
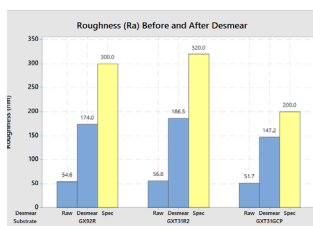
SYSTEM SAP DESMEAR PROCESS

System SAP starts with a four-step desmear process that can be calibrated to optimally prepare multiple substrate materials, imparting minimal roughness while ensuring clean via side walls and copper target pads. The first step is the **System Sweller 120**, a solvent-based sweller that modifies the surface of the build-up material to be more wettable. This is then followed by the **System Oxidizer 200** and **System Neutralizer 200**, a permanganate etch / neutralizer system that removes laser debris and increases topography.

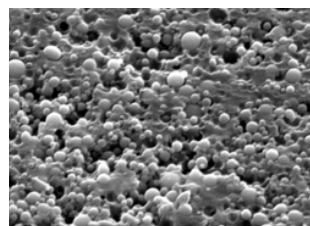
The desmear process is completed with the **System GE 360** glass etch which promotes uniform palladium adsorption on glass surfaces of the build-up material. The System SAP desmear steps provide minimum roughness on the build-up film substrate while consistently ensuring a clean via sidewall and copper target pad for superior copper-to-copper adhesion at all copper interfaces.

SYSTEM GE 360

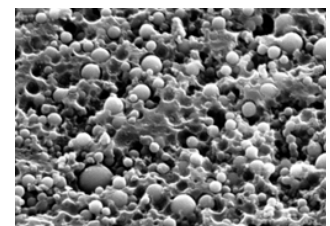
The **System GE 360** is an innovative glass etch process that uniformly frosts glass substrates while removing loose glass spheres with minimal attack. The unique glass etch solution is free of sulfuric acid which allows for improved adhesion and increased peel strength on glass build-up substrate materials.



Process improvements in multiple areas allow the System SAP desmear to provide a below-spec roughness on many widely used build-up materials



Substrate surface: Desmear, Neutralizer only, 8000x



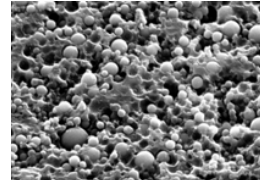
Desmear, Neutralizer, Glass Etch, 8000x

SYSTEK SAP CONDITIONER PROCESS

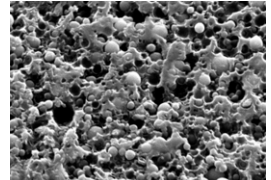
The Systek SAP conditioner process is a three-step system that ensures adsorption of the palladium catalyst into the substrate. The process starts with the **Systek Conditioner 400**, a chemical bond enhancing pre-conditioner bath, followed by the **Systek Condition 460**, a cationic resin and glass conditioner bath. Conditioning is completed with the **Systek Oxidizer 500**, a target pad activating micro etch. Working together, these three processes allow unparalleled activation capability for electroless copper initiation in hard-to-reach and hard-to-clean areas of the build-up layer.

SYSTEK CONDITIONER 400

The **Systek Conditioner 400** is an alkaline solution with functional organics used to increase peel strength capability. The bath removes loose glass spheres and attaches functional groups to the surface to increase surface energy resulting in superior wetting difficult-to-reach areas such as the target pad wedge. Additionally, the process provides the optimal surface for the subsequent **Systek Condition 460**.



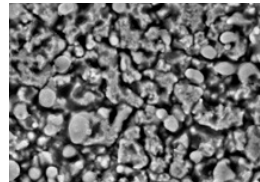
Substrate surface:
Desmear, Neutralizer,
Glass Etch, 8000x



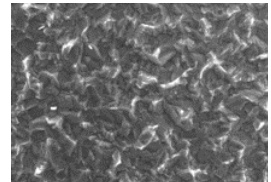
Substrate surface:
Desmear, Neutralizer,
Glass Etch, 8000x

SYSTEK OXIDIZER 500

To ensure proper micro via structure reliability, an optimized micro etchant process that gently lifts any remaining debris and residues from the micro via target pads is required. The **Systek Oxidizer 500** is a highly controlled micro etch bath that works specifically with the wedge geometry to create superior copper to copper bonding during the subsequent activation and electroless copper metallization step. The process is particularly useful for restoring the copper topography of recast copper that appears on the target pads during UV laser drilling.



Target pad after UV laser
drill showing recast
copper, 5000X



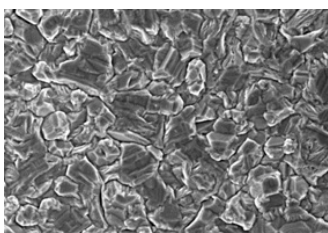
Target pad after Desmear
& Microetch showing
good copper structure,
5000X

SYSTEK SAP COPPER METALLIZATION PROCESS

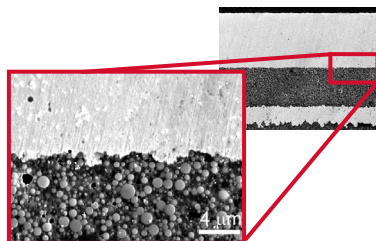
The Systek SAP copper metallization process includes a palladium activation system, an electroless copper metallization process, and an optional anti-tarnish. The **Systek Activate 620 / Systek Reducer 700** is an ionic palladium activator system that works specifically with the conditioner technology to provide a highly active surface for metallization. The **Systek Copper 850** is a zero-stress electroless copper plating bath. Following activation of the substrate, the micro via structures enter the final electroless copper plating stage.

SYSTEK COPPER 850

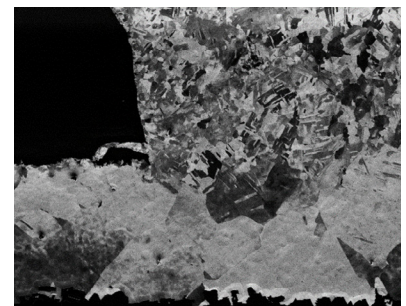
The **Systek SAP Copper 850** is an electroless copper plating process with stellar physical properties. The bath ensures complete and uniform coverage of the surface with just 0.25 to 1 micron thick, stress-free copper. The deposit allows for reduced roughness on the substrate surface, resulting in improved signal properties without sacrificing adhesion. The bath operates at a low temperature of 25 to 38 °C and is suitable for SAP build-up for IC substrate designs on flex, rigid-flex and rigid materials.



Systek Copper SAP 850 produces the angular grain structure that is indicative of improved physical properties



Excellent copper to glass substrate adhesion with lower roughness than competing processes with less than 25 ppm Ni co-deposited



A solid electroless copper deposit at the corner interface of the epoxy and target pad with Systek SAP Copper 850's superior grain structure

Systek™ SAP

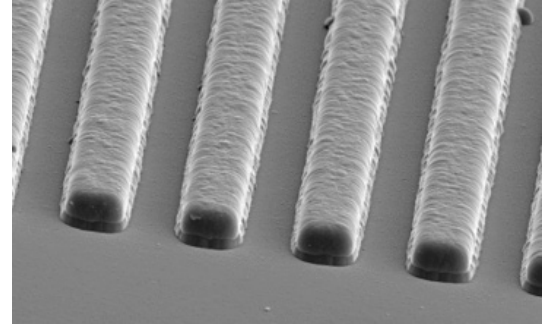
High Performance Build-up Processes for IC Substrates

COMING SOON...

SEMI-ADDITIVE METALLIZATION PROCESS FOR FLEX AND POLYIMIDE SUBSTRATES

The Systek SAP Flex process is an innovative process to metallize bare polyimide materials with a thin nickel-phosphorus deposit for superior adhesion. The **Systek SAP Nickel 910** can be used on applied PI films or on flexible circuit PI films with laser via formation prior to metallization.

The Systek **SAP Nickel 910** features a low stress electroless Ni-P deposit with 3-5% phosphorus that is optimized for adhesion to smooth substrates. Systek SAP process includes pre-treatment, NiP seed layer deposition and flash copper plating for photo resist adhesion. The process is followed by Systek copper via filling pattern plating, resist strip and the **Systek NiEtch 900** nickel-copper sulfuric peroxide flash or differential final etch.



SAP formed traces on bare PI film at 25/25 μm L/S after ENIG

SYSTEK SAP FLEX DESMEAR

The specially formulated desmear process for flex and polyimide applications utilizes a short dwell time in the **Systek Sweller 120** and **Systek Oxidizer 200** baths followed by **Systek Neutralizer 300**. The oxidizer is a permanganate process that improves the hydrophilic properties of the polyimide without significant roughening, optimizing the surface for subsequent conditioning and activation steps.

SYSTEK SAP FLEX CONDITIONING AND ACTIVATION

Following desmear, the polyimide surface is treated with **Systek Conditioner 400** for improved adhesion. The **Systek Oxidizer 500** provides a soft etch on the copper target pads, deoxidizing the surface and making it more active. Catalytic activation of the polyimide surface is achieved with the ionic palladium **Systek Activator 620** and **Systek Reducer 700**.

SYSTEK SAP FLEX NICKEL TIE-COAT

The **Systek Nickel 910** is a low-temp alkaline electroless nickel process that provides a substantive bond to the polyimide substrate. The short dwell time is followed by a 15 min bake to remove moisture from the polyimide material. The nickel coating can be immediately flash copper plated to prepare the panel for photoresist and image patterning before electrolytic copper plating.

SYSTEK FINAL ETCH

The final step for the circuit formation is a flash or differential etch. The **Systek NiEtch 900** is a nitric-peroxide etchant that removes NiP tie-coat between the line spacing without damaging the underlying copper. An alternative sulfuric-peroxide etch option to remove the flash copper and nickel tie-coat is available as well. The etch is then followed by **Systek Pd Remover 975** to remove any residual Pd seed from the activation step.

**MACDERMID ALPHA HAS YOUR SOLUTIONS FOR WORLDWIDE
EXCELLENCE IN IC SUBSTRATE MANUFACTURING**



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