MacDermid MID Technologies

Innovative Plating Solutions for LDS MIDs

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MacDermid Performance Solutions

- Over 2000 Worldwide Employees in 23 Countries
- Over 3500 Customers Served Worldwide by Direct Sales/Service Organizations
- Regional Centers of Expertise

Industrial Solutions

Electronics Solutions

Printing Solutions
In 2014, MacDermid Electronics Solutions spent an industry-leading 7.8% of our revenue on R&D.
Electronics Solutions Enabling Technology

- **MacuSpec VF Series**: Viafilling Electrolytic Copper Metallization
- **AFFINITY**: Electroless Nickel/Immersion Gold Technology
- **M-Speed**: Chemical System for High Speed Innerlayers
- **STANTEK PC SERIES**: Electrolytic Tin Plating for Passives
- **MID**: Selective Electroless Metallization for Molded Interconnect Devices
- **BLACKHOLE**: Through Hole and Blind Via Metalization Technology
Worldwide Coverage

MacDermid’s regions of MID expertise
Modern, clean, and well-equipped facility serving as “proof source” for MacDermid global research and as key demonstration site for key customers and OEMs.

Small scale (40 liter) barrel piloting dedicated to electroless copper MID plating enables fast confirmation of developments combined with close to real-world loading and plating conditions.
MacDermid MID Metallization Solutions

A “Merger” of Surface Finishing Innovations

Plating on Plastics Used for Decorative and Functional coatings

Electroless Copper for Electronics

A combined expertise in POP and electronics plating applications remain crucial in the development and optimization of MID plating processes.
Molded Interconnect Device (MID)

- Defined as an injection molded thermoplastic substrate which incorporates a conductive circuit pattern
  - integrating mechanical and electrical functions

Today’s Market

- Growth in MID is a result of advances in plastic materials and the development of Laser Direct Structuring (LDS)
  - Majority of production volume still remains in antennas for mobile communication devices including mobile phones, laptops, tablets, etc.

- Growth opportunities in additional markets
  - Automotive, medical, lighting, consumer goods
  - Opens up capabilities in design and function
  - New options for miniaturization for form and fit
MID Industry Drivers and Trends

- **Fine Pitch Technology**
  - Opens design capabilities
  - Miniaturization

- **SMT Capability**
  - Reflow resistant plastics
  - Solderable surface finishes

- **Wire bond capability**
  - Proper choice of plastics, plating thickness, surface roughness and final finish

- **Lighter design**
  - Integrating circuitry with existing part to reduce number of components

- **Power and Style**
  - Integrating circuitry to provide opportunities for future designs
• Improved surface roughness
  – MID Copper X1 process
  – Better surface appearance, smoother deposit
  – Improved SMT and wire bond performance
• Fast plating speed
  – MID Copper 100 XD process
  – 50% reduction in plating time
• Improved Adhesion to emerging plastics
  – MID Copper 100 XD process
  – Enhanced adhesion to PC substrates
• Improved manufacturing plating process
  – MID Copper 100 XB process
  – Optimized plating capability on LDS substrates
  – Initiation, stability = high yields, lower cost
Improved manufacturing performance

• **MID Copper 100 XB** process provided industry with
  – A novel *Strike* copper process
    • Complete uniform initiation on LDS substrates
    • Consistent predictable plating rates
    • Stable process chemistry, long bath life
    • Eliminated skip plating issues
  – A novel *Build* copper process
    • Consistent predictable plating rates
    • Stable process chemistry, long bath life
    • Eliminated overplating (extraneous) issues
    • Fully analyzable stabilizer package
## MID Copper 100 XB - Key MID Plating Priorities

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<td>![Development Image]</td>
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- **Yields**
- **Productivity**
- **Ease of Use**
- **Operating Cost**
• MID manufacturers began to migrate from PC/ABS to PC substrates.
• PC (polycarbonate) substrates offer improved impact resistance.
• Challenges with adhesion of the plated deposit began to be reported.

• **MID Copper 100 XD** process developed to provide improved adhesion to PC MID substrates
• Note delamination within PC substrate due to plating chemical attack.
• Associated with failed tape testing.
Cu grain structure after peroxide etch.

- No visible signs of delamination within LDS PC substrate.
- Improved adhesion verified by industry standard tape testing.
Improved Adhesion

• Adhesion of electroless Cu is quantitatively tested using a highly sensitive digital pull apparatus.
• MID XD and X1 copper have improved adhesion on PC plastics with all commonly utilized laser structuring powers.
• Responding to demands for increase throughput.
• MID Copper XD process doubled the plating speed without negative impact on stability or bath life.
• Further increase production output without negative impact on quality.
• Lower overall running cost by maintaining stability and high speed.
Improving surface roughness

• Surface roughness can be a challenge as MIDs are used in new applications.
• Roughness of the plated deposit may affect SMT and wire bonding requirements.
• Plated deposit roughness is linked to the roughness of the activated plastic.
  – LDS surfaces are rougher than DS surfaces

• **MID Copper X1** process provides a smoother, fine grain, and “shiny” copper deposit.
• MID X1 Copper has a lower surface roughness than previous MID Cu formulations.
• MID X1 Copper has the same improved adhesion as XD combined with the surface smoothness needed for attractive cosmetics.
Benefit of Improved Surface Roughness

- Optical microscope shows the surface gets visibly smoother as Cu thickness increases.
- Conventional wire bonding improves with thickness.
- Conventional wire bonding will improve with smoother structure.
- *Stand-off stitch bonding can be successfully applied for all thicknesses.*
Improved Surface Reflectivity

MID X-Copper has improved glossy surface appearance vs. older formulations.
Improved Running Cost

- Continuous product development leading to reduced running cost.
- Lower running cost achieved through improved speed and optimized running conditions and extended bath life.
- Maintain high yield!
Innovations in Final Finishes

- **MID Gold 100 CF**
  - A true CN free gold finish
  - Low operating temp, 40°C
  - Neutral pH

- **MID Palladium 100**
  - Wire bondable finish for emerging MID applications

- **MID Silver 100**
  - Low cost alternative to ENIG
  - Excellent solderability
  - Non cyanide process
There Are No Limits to MID

AUTOMOTIVE

CONSUMER GOODS

TELECOM & COMPUTING

MEDICAL

LIGHTING

Chemicals Make The Connections

MacDermid Electronics Solutions