

# MacDermid Alpha Electronics Solutions

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Overview

November 2021



# Our Family of Specialty Chemicals & Materials



BUSINESSES



BRANDS



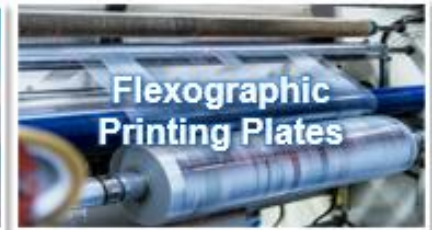
INITIATIVES



# Element Solutions Inc Overview

<b>\$ 1,854M</b>	2020 Net Sales	<b>~ 4,400</b>	Employees		2020 Segment Net Sales		2020 Regional Net Sales
<b>\$ 423M</b>	2020 Adj. EBITDA*	<b>&gt; 50</b>	Countries				

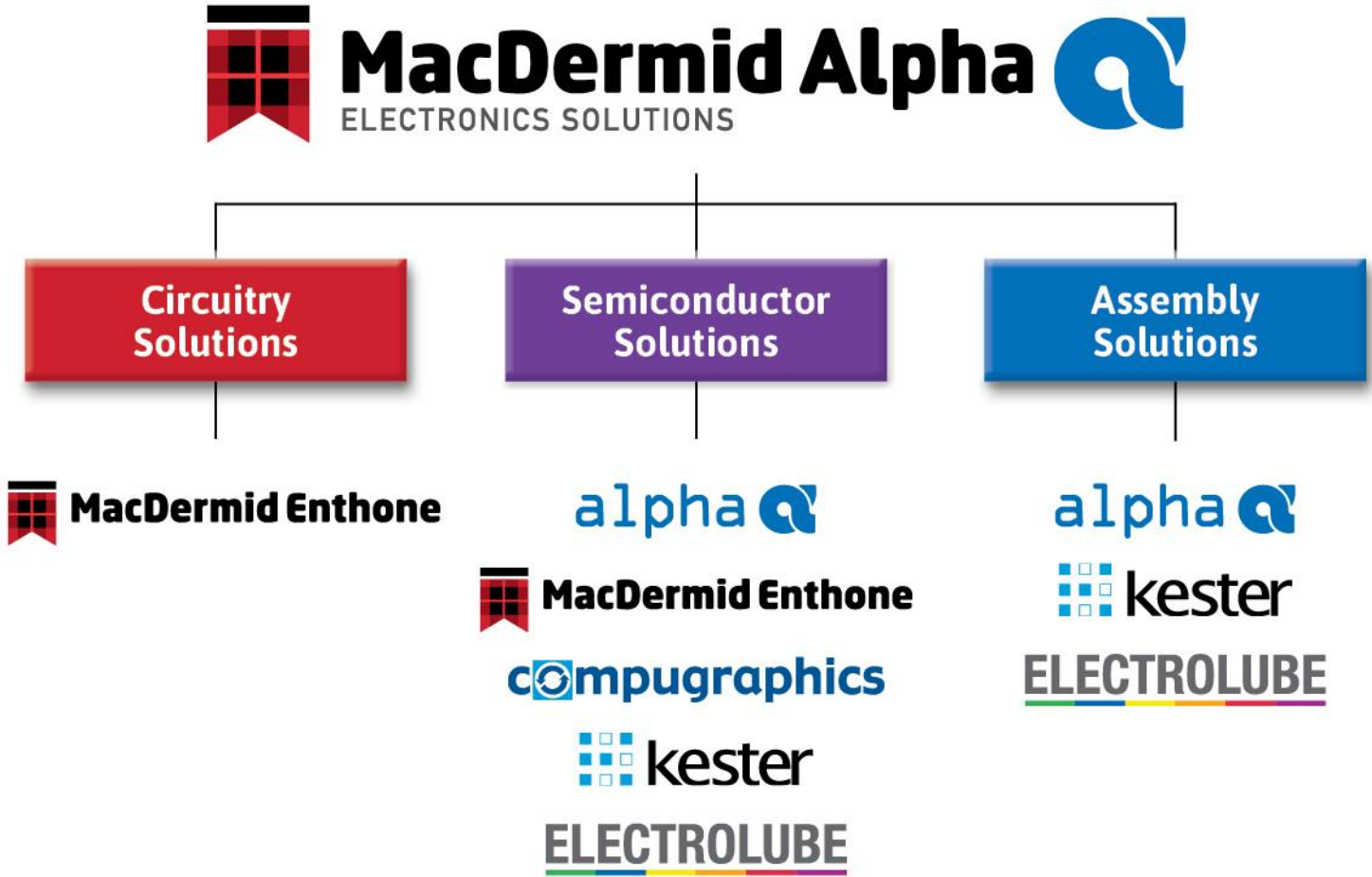
Indicates financial measures which are not prepared in accordance with GAAP. For definitions, discussions of adjustments and reconciliations, please refer to the appendix of this presentation



Electronics

Industrial & Specialty

# The Brands in our Business Divisions



**1 BUSINESS**  
Supporting divisions focused on the key nodes of the supply chain

**3 DIVISIONS**  
Leveraging strengths in innovation, applications, and customer support

**5 PRODUCT FAMILY BRANDS**  
Products that transform ideas into next generation electronic devices

# Key Statistics - MacDermid Alpha



As a \$1.2 billion business, we have the resources to support long-term partnership



Operating in over 30 countries, we stay with you as you expand globally



Our staff provides local service to over 10,000 customers

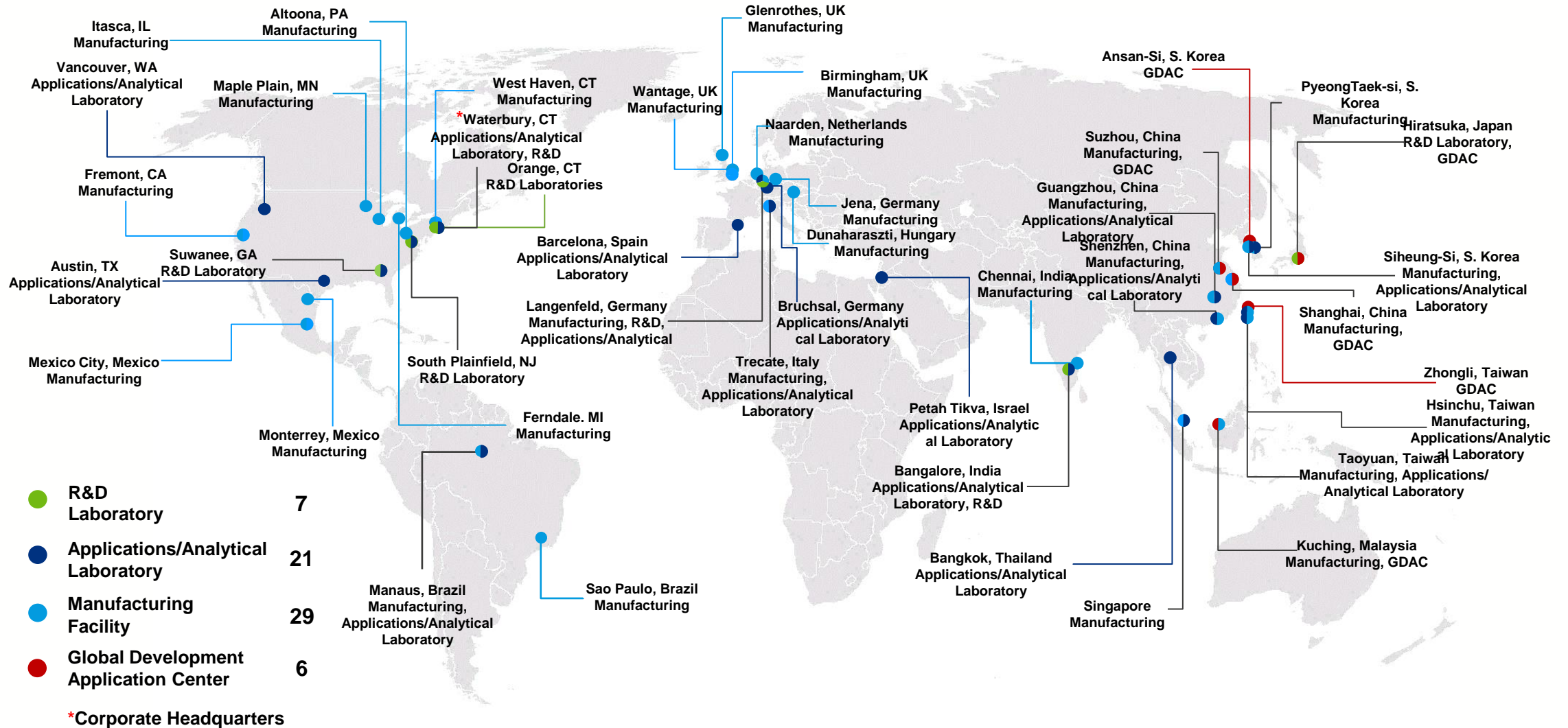


Connections among our 2,200 employees to assure subject matter expertise



More than 50% of our employees serve in innovation, technical, and service roles

# Electronics Solutions – Key Locations

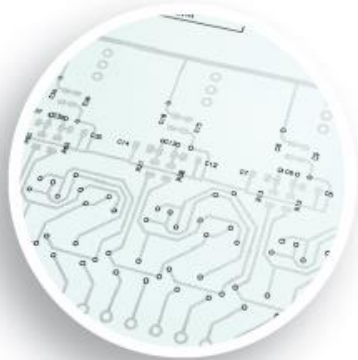


# We Touch Every Aspect of Electronics Manufacturing

- Deep expertise throughout the electronics supply chain
- In every component of an electronic device
- Unique position in the industry

**ONE**  
SOLUTIONS SUPPLIER  
*for*  
**ONE**  
ELECTRONICS INDUSTRY

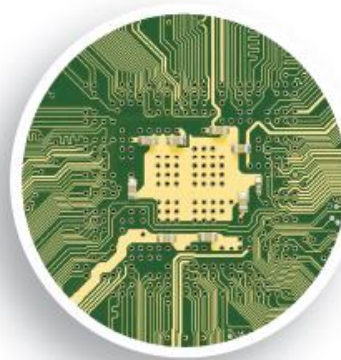
Device Design



Material Supply



Circuit Fabrication



Component Assembly



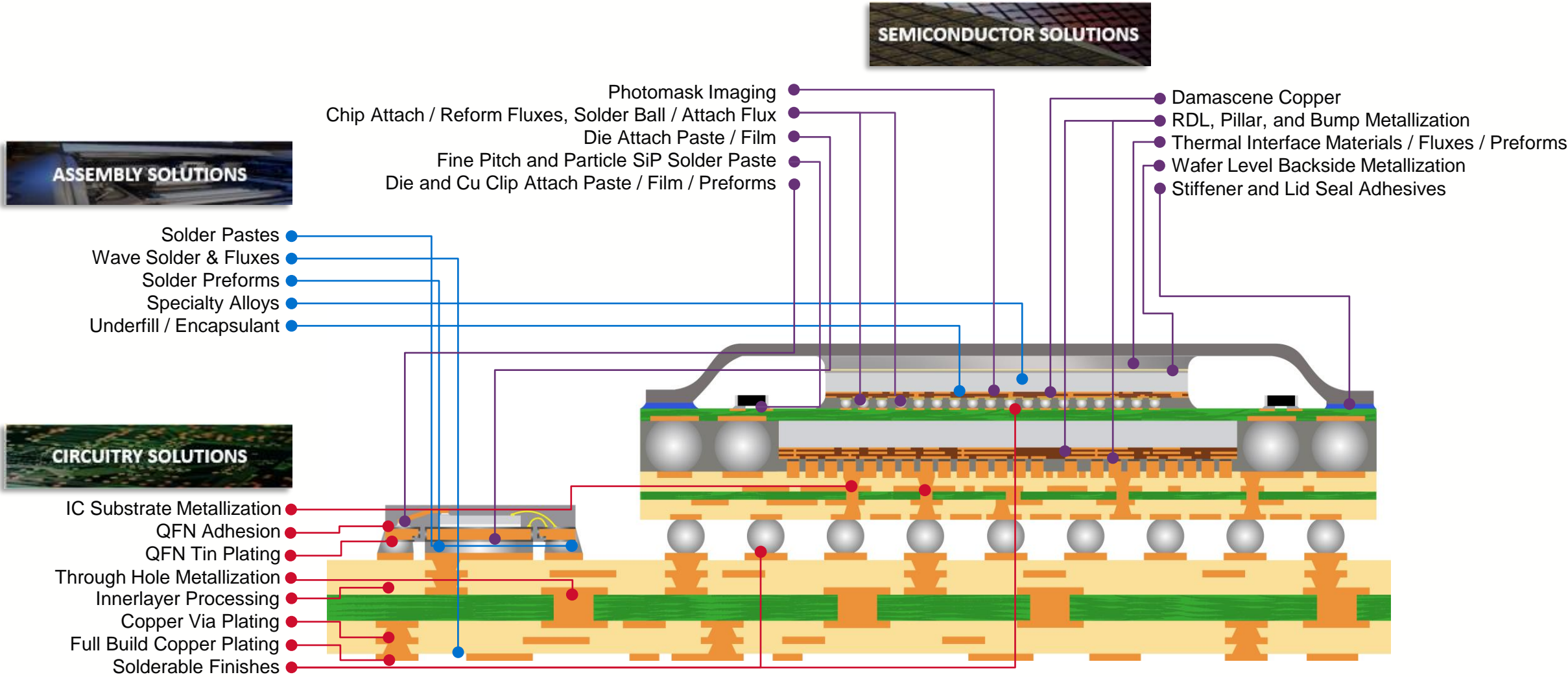
Original Equipment



Device End Use



# We are INTEGRAL to Electronics Manufacturing



# Major Electronics Trends

Increasing device complexity, more demanding reliability and sustainability requirements are long-term secular tailwinds

## High-End Electronics Exposure



**Mobile Devices & Tablets**  
~30%



**Data & Telecom Infrastructure**  
~25%



**Automotive**  
~15%



**Engineering Applications**  
~15%



**Other Electronics**  
~15%

## Attractive Long-Term Growth Drivers

### Auto Electronic Content

Increasing electronic content in automotive systems compounded by growth in electric vehicle markets



Source: Management Estimates

### 5G Technologies

Higher density and reliability requirements for 5G technologies in both infrastructure and mobile devices



Source: Prismark

### Internet of Things (IoT)

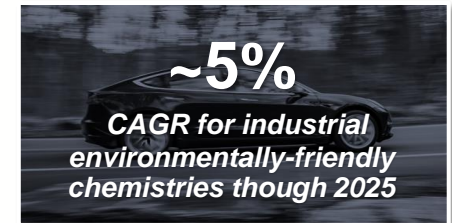
Growing focus on connectivity and the electrification of consumer goods



Source: IDC

### Environmental Focus

Increasing environmental standards driven by OEM supply chains

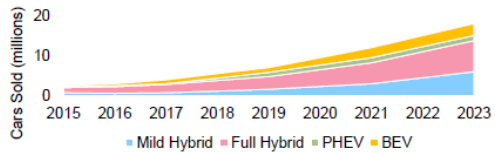


Source: Million Insights

Our commercial initiative connecting innovation and technical service resources from within all our operating businesses to more effectively serve the automotive industry

### Electric Vehicles

EV / HEV Market Evolution (Yole - 2018)



- New materials and engineering with a focus on increased performance & range

### Vehicle Automation

More ADAS Sensors = More Interconnects



- Cameras
- Short & long range RaDAR
- 3D Flash LiDAR
- Ultrasonic Sensors

- Reliability is a critical concern with >50,000 interconnections – many critical to safety in ADAS systems hardware

### Interiors & Displays



Design Flexibility for Personal Consumer Experience

- Replacement of mechanical switches with touch sensitive displays and fully integrated displays



A TEAM OF CROSS-FUNCTIONAL AND TECHNOLOGY EXPERTS DEDICATED TO SUPPORT OEMS, TIER 1'S AND SPECIFIERS



We are supplying innovative specialty processes and materials across the entire 5G electronics supply chain:

**Circuitry Solutions:** Circuit manufacturing solutions that address 5G challenges and opportunities from high speed innerlayers on exotic board materials to circuit density improvements in power hungry electronic devices.

**Semiconductor Solutions:** The highest technology electronics metallization and packaging assembly processes that are powering the processors of next-generation mobile, mm-Wave devices, fiber optic networks and more.

**Assembly Solutions:** High reliability joining / soldering material solutions for electronic assemblies used in a broad range of 5G related equipment; from wearable and handheld mobile devices to antennas and high speed infrastructure hardware.

## Communication Devices

Mobile Phones & Wearables

## Fronthaul

Remote Radio Heads  
(integrated antennas)  
and Base Stations

## Backhaul

Switches, Routers  
Data Center Servers

# Divisional Focus

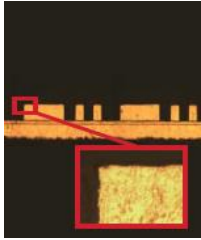
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Product Portfolios and Responsiveness to Industry Needs



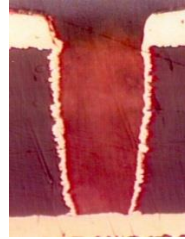
# Circuitry Solutions - Product Portfolio

## IC SUBSTRATE SOLUTIONS



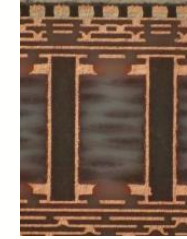
- High Speed Signal Integrity
- SAP / mSAP
- Primary Metallization
- Through hole filling
- Laser direct drilling coating
- Embedded Trace Substrates
- 2-in-1 Via Fill RDL Plating

## PRIMARY METALLIZATION



- Electroless Copper
- Direct Metallization
  - Conductive Polymer
  - Carbon
  - Graphite

## ELECTROLYTIC METALLIZATION



- Electrolytic Coppers
  - High Throw DC
  - Periodic Pulse Reverse
  - Via Fill / Through Hole Fill

## FINAL FINISHES



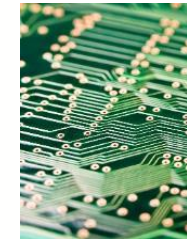
- Organic Solderability Preservative
- Immersion Tin
- Immersion Silver
- Electroless Nickel Immersion Gold
- Electroless Nickel Electroless Palladium Immersion Gold

## MEMORY DISK



- Pre-clean and Zincate Solutions for Al substrate
- High Quality Electroless Nickel

## ELECTRONICS SPECIALTIES

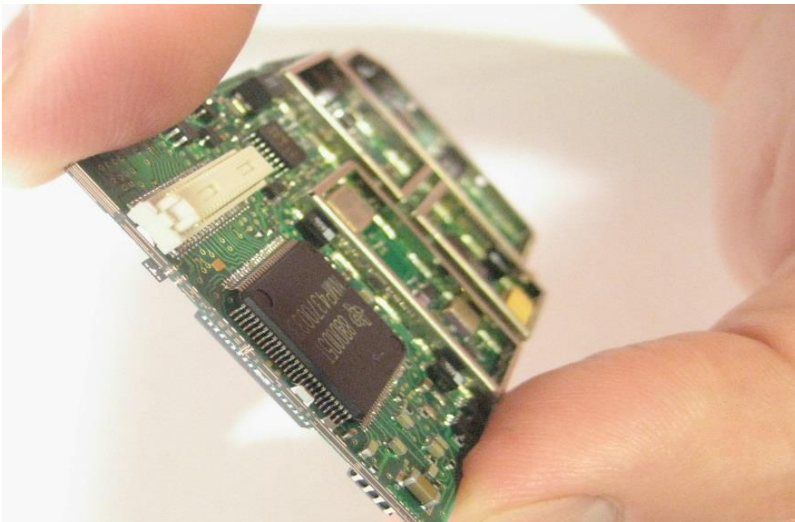


- Leadframe Adhesion Promotion
- Component Termination Solderability
- Molded Interconnect Devices
- Solar Cell Metallization
- Develop, Etch, Strip
- Oxide and Oxide Alternatives

# Achievements in... PCB and IC Substrate Fabrication

## Industry Demands

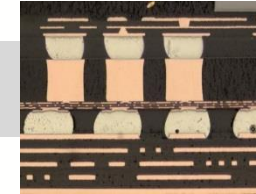
- Heterogenous integration
- GHz signal speeds
- Balance performance and cost
- Microvia reliability



## Innovation Initiatives

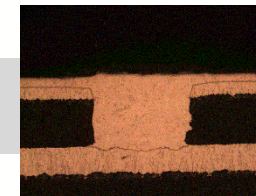
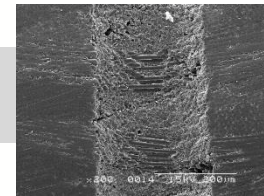
- Broad selection of processes for advanced substrates
- Environmentally friendly and highly reliable direct metallization
- Reliable copper interfaces
- Innovative new gold and palladium final finishes

## Our Solutions



System UVF, ETS

Blackhole, Shadow



M-Copper and AVF

Affinity Family



# Achievements in... Formable & Flexible Circuitry

## Industry Demands

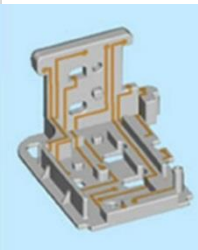
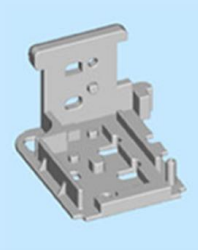
Mechanical Parts

*and*

Electrical Pathways

*become*

Electromechanical Devices



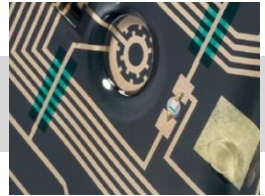
## Innovation Initiatives

- Performance needs
  - Strength in 3-D
  - Flexible conductivity
  - Precise circuit patterns



## Our Solutions

Film Insert Molding



Formable Inks



Flex Processing

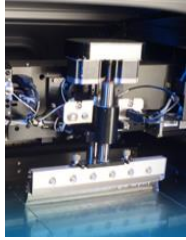


Molded Interconnects



# Assembly Solutions - Product Portfolio

## SURFACE MOUNT TECHNOLOGIES



### Printing & Dispensing

- Solder Paste
  - OM & WS Series Pastes
- Stencils
  - Laser Cut Stencils
  - tensorRED® Tensioning Frame

### Jetting

- Solder Paste
  - JP Series Pastes



### Pick & Place

- Solder Preforms
  - Tape & Reel
  - Flux Products



### Rework & Repair

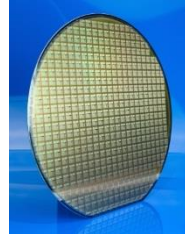
- Cored Wire
  - HF & XL Series Wire
- Stencils
  - Repair Stencils

## WAVE/SELECTIVE SOLDERING



- Bar and Solid Wire
  - SAC Series Alloys
  - SACX Series Alloys
  - SnCX Series Alloys
- Liquid Flux
  - EF Series Flux
  - Halogen Free Family

## DIE ATTACH/SINTERING



- Sinter Paste, Films & Preforms
- High Reliability Solder Preforms
- Conductive Adhesive

## ADHESIVE SOLUTIONS



- SMD Adhesives
- UV Adhesives
- Encapsulants
- Underfill/Cornerfill

## FHE, IMSE & PRINTED ELECTRONICS



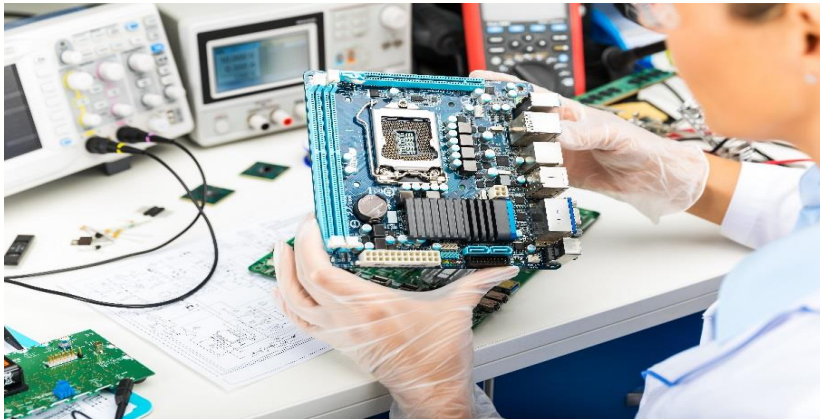
- Solder Paste
  - Ultra Low Temperature Alloys
- Inks
  - Conductive Silver Inks
  - Carbon Inks
  - UV & Thermally Curable Dielectric Inks

# Achievements in... Circuit Board Assembly

## Industry Demands

Engineered materials that...

- Provide lowest total cost of ownership
- Anticipate next-gen designs
- Perform in the harshest environments



## Innovation Initiatives

- Novel lead-free alloys
- Sourced 'conflict-free' and active recycling programs
- High-reliability, low temperature alloys
- Best-in-class void prevention

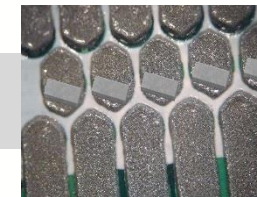
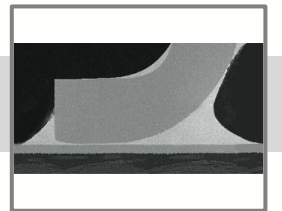
## Our Solutions

Innolot, HRL 1



Alpha Flux

Alpha Paste

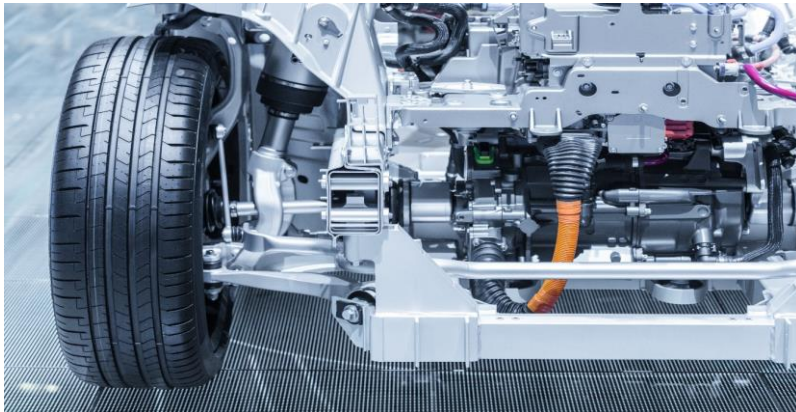


Preforms

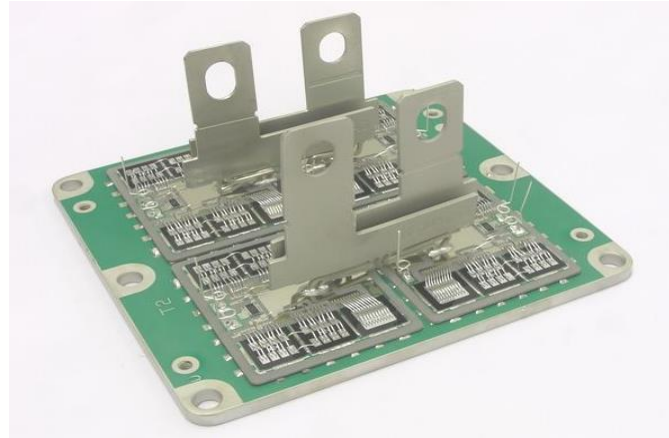
# Achievements in... Specialized Materials

## Industry Demands

- Low resistance for high current EV inverters
- New materials for bending, stretching, and expansion
- Low temperature bonding on sensitive substrates



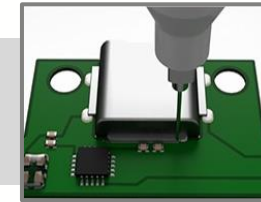
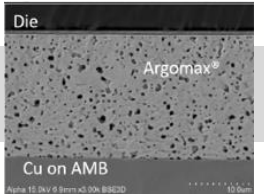
## Innovation Initiatives



- Sintered nano particle silver & hybrid paste
- Thermal interface materials
- Novel metal connector finishes

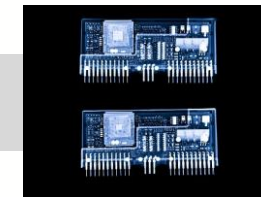
## Our Solutions

Argomax, Atrrox



Non-Conductive Adhesives

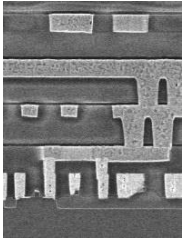
Low Temp Alloys



Connectors

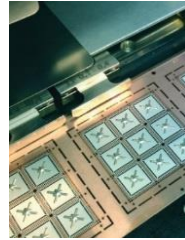
# Semiconductor Solutions - Product Portfolio

## DAMASCENE COPPER – MacDermid Enthone brand



- Advanced copper interconnects
- Void Free Via Metallization
- Products Ranging from 130nm – 10nm+ Node Size

## HYBRID SILVER SINTERING DIE ATTACH – Alpha brand



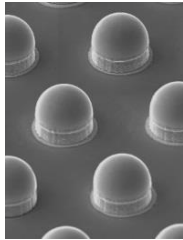
- Pressure-less Ag Sintering
- Rapid heat dissipation from die
- High thermal conductivity > 50 W/m-K up to 250 W/m-K
- Superior Reliability Performance
  - DA for QFN, SO, QFP, PBGA
- MSL1 Reliability performance

## SOLDER SPHERES– Alpha brand



- High Reliability Alloy's
  - SACX, Innotot
- Low Temp Alloy's
  - SBX02, HRL1
- Low Cost Alloy
  - SNCX

## WAFER LEVEL PACKAGING – MacDermid Enthone brand



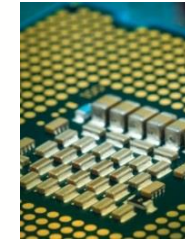
- Tin / Tin-Silver Wafer Bumping
- Copper Pillars
- Redistribution Layers
- Under-Bump Metallization

## MOISTURE & HYDROGEN GETTERS – Alpha brand



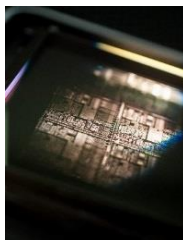
- Paste and film formats, 2-in-1 PSA film attach materials (3--30MIL)
- Custom designed preforms for shaped applications.
- High capacity moisture & hydrogen absorption (~5-15% by weight)
- OPTO, MIL and Medical applications

## SOLDERING FLUXES/Pastes – Alpha/Kester brand



- Water soluble
- No-clean, low and ultra low residue
- Polymer based
- Large variety alloys
- High yield on Cu & CuOSP finish
- Fine pitch

## PHOTOMASKS – Compugraphics brand



- Stepper & Scanner Reticles (1X, 2X, 4X, 5X)
- 1X Masters
- Large Area Photomasks
- 1X Submasters & Copyplates
- Mask Protection Technology
- Wet-Etch & Dry-Etch Processing
- Reticle Enhancement Techniques (OPC, Grayscale & other RET)
- Quick-Turn Pellicle/Repell & Mask Cleaning
- Direct Write Wafers
- Mask Layout/CAD Services

## THERMOPLASTIC REWORKABLE ADHESIVES- Alpha brand



- Paste and film formats, PSA film attach materials (0.5-20MIL)
- Custom designed preforms for shaped applications
- Various fillers; Ag, AlN, Al<sub>2</sub>O<sub>3</sub>, BN, custom & non-filled systems.
- OPTO, MIL and Medical applications
- Meets MIL-STD-883

## THERMAL INTERFACE MATERIALS – Kester brand

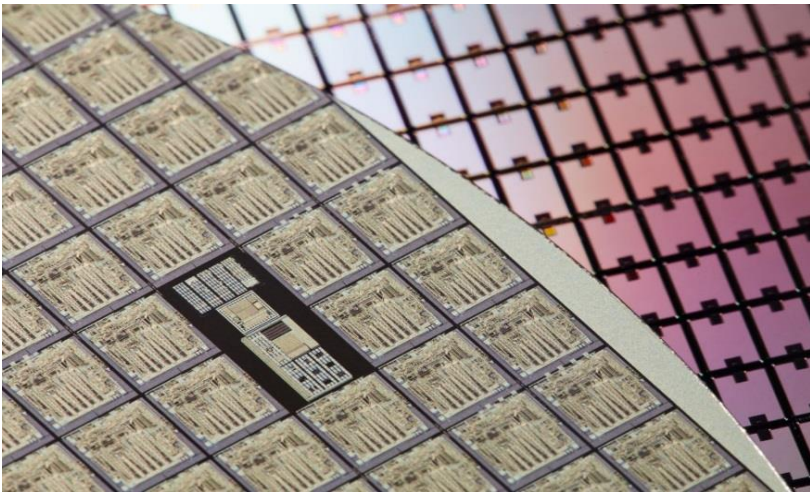


- High degree of flexibility
- No-clean, very low flux residue
- Excellent mechanical strength and wetting to various metallizations
- Extremely wide processing window in multiple reflow profiles

# Achievements in... Semiconductor Fabrication

## Industry Demands

- Cost effective scaling of transistor nodes
- Ship-to-control quality
- Multi-dimensional interconnectivity



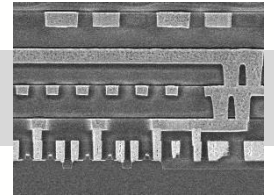
## Innovation Initiatives



- Lower resistivity interconnection
- Production scale capability at  $\leq 7\text{nm}$
- 3D silicon packaging

## Our Solutions

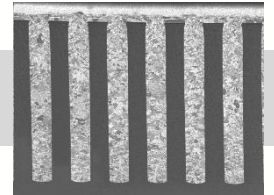
ViaForm Copper



ViaForm Cobalt



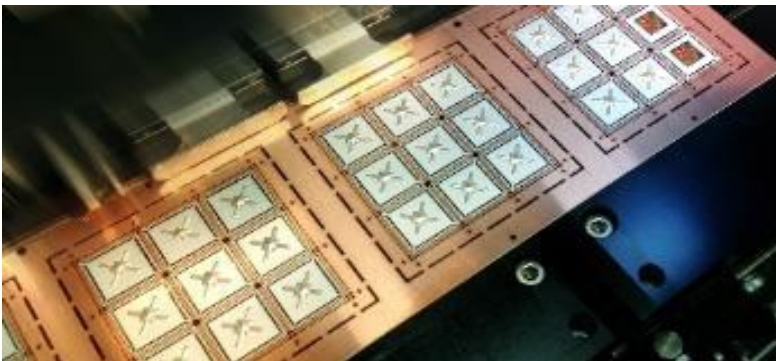
ViaForm TSV



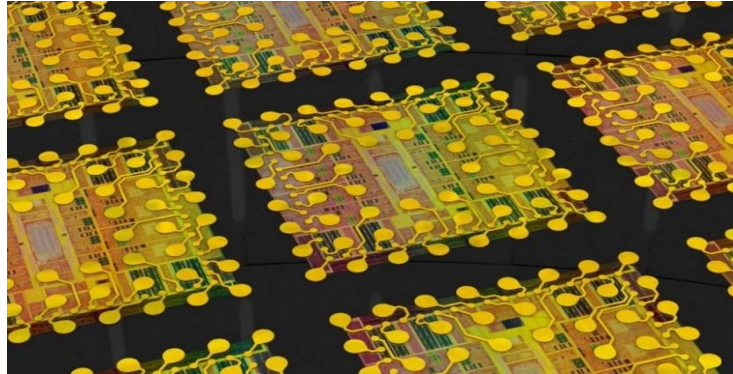
# Achievements in... Semiconductor Packaging & Assembly

## Industry Demands

- Interconnect sub-micron transistors to the outside world
- Enable “More-than-Moore” packaging solutions
- Increased power density in power semiconductor



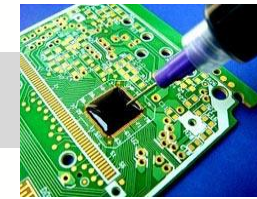
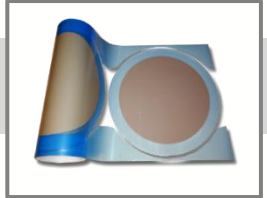
## Innovation Initiatives



- Increased power density
- Adhesive solutions
- 3 dimensional interconnects
- CTE compatibility

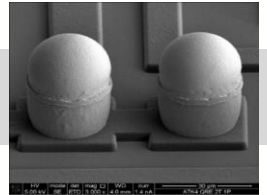
## Our Solutions

Atrox, Argomax

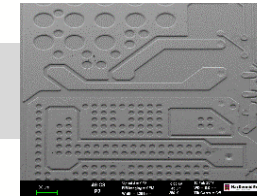


Adhesives

MicroFab



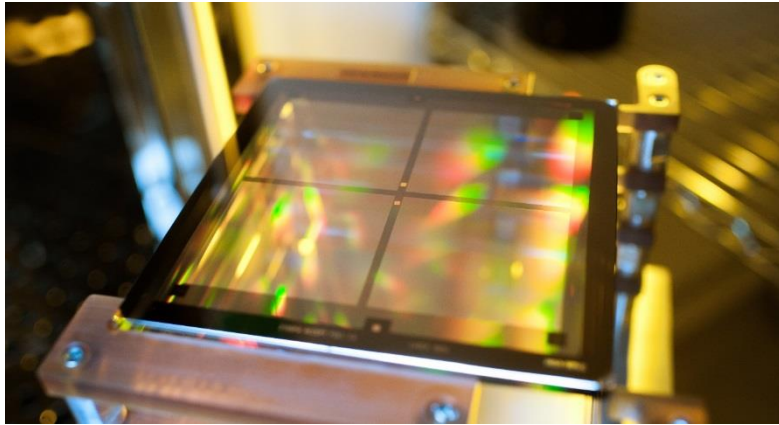
RDL



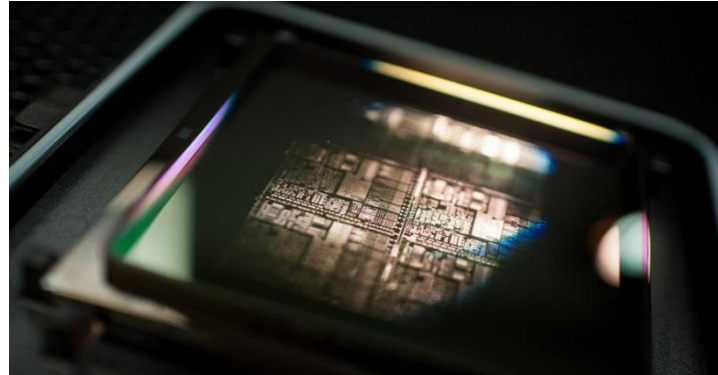
# Achievements in... Semiconductor Photomasks

## Industry Demands

- Projection lithography for 300 mm wafer fabs
- IOT & Sensor Explosion
- Increased network speeds and bandwidth
- Reduced cycle times, time to market



## Innovation Initiatives



- Niche material solutions
- Efficient printing of non-traditional semiconductor geometries
- Tailored customer AI solutions for CAD support, order processing and shop floor workflow automation

## Our Solutions

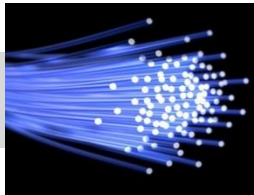
Large Area Masks



MEMS Masks



Opto/Photonic Masks



Pellicle Repair/  
Re-Certification



# Global Innovation and Service Support

- Key technical facilities for high level development and support
  - Global Development Application Centers (GDAC) – Circuitry Solutions & Semiconductor Solutions
  - Global Applications Technology Engineering Group (GATE) – Assembly Solutions

Technical Expertise for Troubleshooting

Fast Customer Response

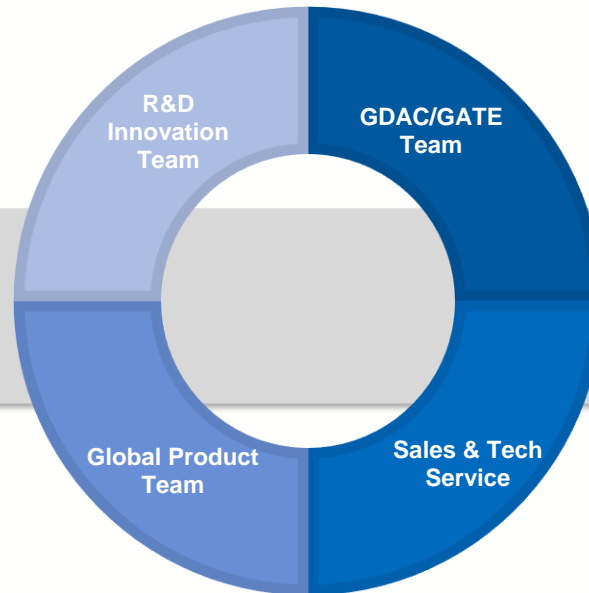
Joint Customer Development Projects

Support for Alpha and Beta Site Testing

Connecting Global R&D to Regional Sales + Service



Voice of the Customer



Customer Success

# Stay Connected...

Please contact us for further information on how MacDermid Alpha Electronics Solutions can help you today.



A screenshot of the MacDermid Alpha Electronics Solutions website. The header includes the company logo, navigation links for 'News &amp; Events', 'About Us', and 'Contact Us', and a search bar. Below the header is a video player with a 'DISCOVER OUR COMPANY' button and a 'PAUSE VIDEO' control. The main content area features a section titled 'OUR DIVISIONS' with a sub-header 'OUR DIVISIONS' and a paragraph: 'Our deep connections to all areas of the electronics supply chain are a crucial element in our customers' success.' Below this are three columns: 'Circuitry Solutions' (Specialty chemical solutions for the most complex printed circuit board and IC substrate designs), 'Semiconductor Solutions' (Advanced interconnect metallization and assembly materials used in leading-edge chip fabrication and wafer-level packaging), and 'Assembly Solutions' (High performance component attachment materials for the assembly of printed circuit boards and power electronics applications). Each column includes an image and a 'LEARN MORE' link.