

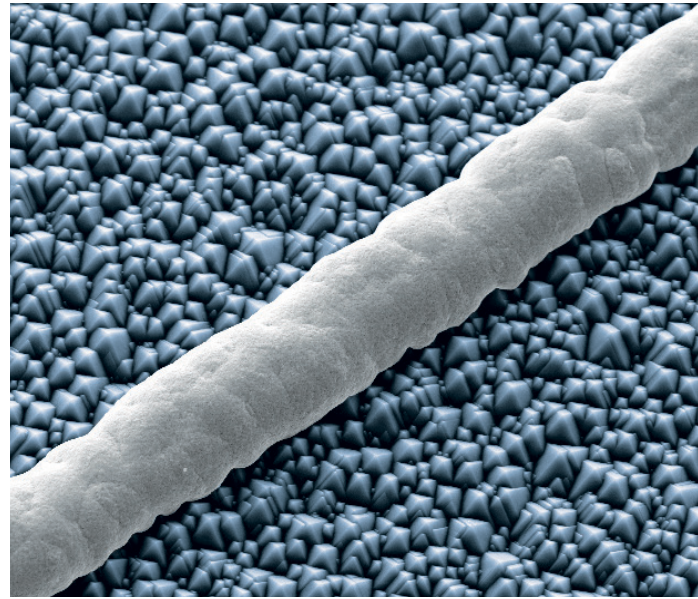
# Helios

## Wet Chemical Copper Metallization for Silicon Solar Cells

### All Cell Designs Benefit from Copper

Imagine the process advantages of eliminating silver paste! The Helios suite of products can deposit nickel, copper and silver directly on silicon using fully automated, conveyORIZED plating tools. Comprehensive independent testing proves Helios Electrolytic Copper plates a strong, ductile deposit with very low internal stress. Innovative chemistry allows fast plating with consistent deposit characteristics at high or low current density. Helios can be used in either light-induced plating or fully electrolytic mode for unsurpassed uniformity and highest productivity.

MacDermid Enthone and our experienced integration partners deliver a complete system including specialty chemistry, laser patterning tools, high speed automated plating equipment and chemical controls. Join the leaders in PV efficiency by making the switch to copper technology today.



### KEY FEATURES

- Modules achieve more power; reduced cell-to-module loss
- Cell-to-cell efficiency is more consistent
- Plated conductors enable new 'shingle' and 'multiple wire' interconnect methods
- Conductors are 50% more narrow than the best screened paste - more photon capture
- Copper conductors bring out the best of PERC, SHJ & IBC designs
- Up to 30% savings in conductor bill-of-materials



**MacDermid Enthone**

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## The Evolution of Conductor Grid Metallization

### Silicon Heterojunction

Replace low temperature silver paste with copper on top of a sputtered seed. Paste is a huge bill of materials expense and limits conductivity. Copper plates at a low temperature, conducts 5x better than paste, and has superior adhesion. In-line, fast plating tools metallize both sides simultaneously.

### P-Type Multi, Mono and PERC

Wet chemical deposition of nickel, copper and silver is the inevitable future for terrawatt scale production of silicon solar cells. Copper is inexpensive, widely available beyond silver's resources, and shows a clear path for continued efficiency improvements. By removing the unpredictable effects of silver paste cost, due to silver metal price volatility, the PoSi copper process offers low BOM and cost stability.

### Interdigitated Back Contact

New high speed copper formulations allow for continued efficiency gains at the same time as dramatic cost reductions. Our newest copper chemistries plate above 20 ASD and reduce stress as compared to today's copper formulations.

### N-type, Bi-facial Designs

Bi-facial cells are among the highest efficiency cells - why compromise with silver paste? Enable the cell's maximum potential with low-shading, superior contact copper conductors.

### Selective and Shallow Emitters

The full metal contact of plated nickel forms an optimum contact resistance pathway for maximum current extraction from silicon. Differing from paste's high resistance and non-uniform contacts, plated nickel conductors contact the entire width and length of the conductor. This enables low-resistance contact to lightly-doped homogeneous emitters as well as selective emitters.

## The Natural Choice for Efficiency, Adhesion and Cost Savings

### Copper:

Proven PV reliability spanning 25 years at Multi GW levels

### Efficiency:

Helios enables the use of various types of emitters, less shadow and lowered series resistance

### Adhesion:

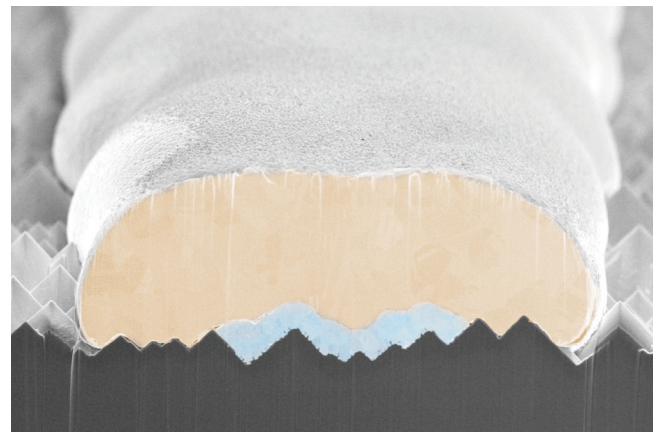
Stronger than the silver paste bond to silicon

### Cost:

Savings of \$0.06 per cell

### Supply:

With continued growth in worldwide PV usage, silver will not be an option. Copper is the inevitable choice



macdermidalpha.com  
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MacDermid Enthone is a product brand of MacDermid Alpha Electronics Solutions.