

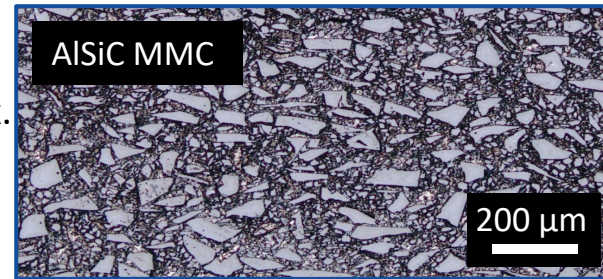
CPS Technologies

Particle Reinforced Composites

CPS Technologies is a premier provider of particle-reinforced **Metal Matrix Composites (MMCs)** with enhanced performance vs. unreinforced alloys. Ideal for applications such as thermal management, energy storage, and radiation shielding.

Benefits

- CPS fabricates MMCs with high volume fractions (>60%) of ceramic or alloy reinforcement in an aluminum matrix.
- MMCs are inherently low density, strong, and stiff.
- Low thermal expansion and high thermal conductivity.
- Performance can be tuned based on selected reinforcement composition, morphology, and volume fraction.



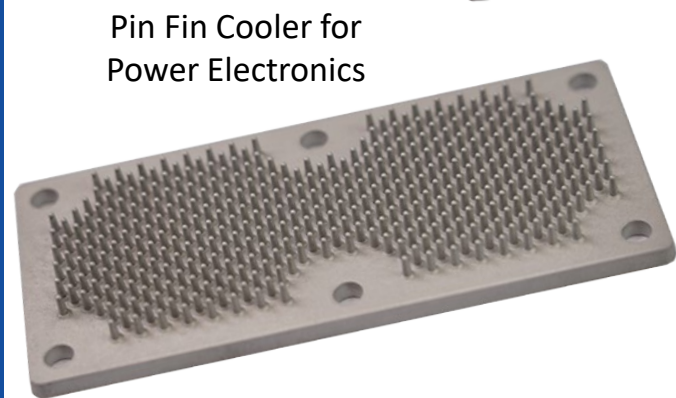
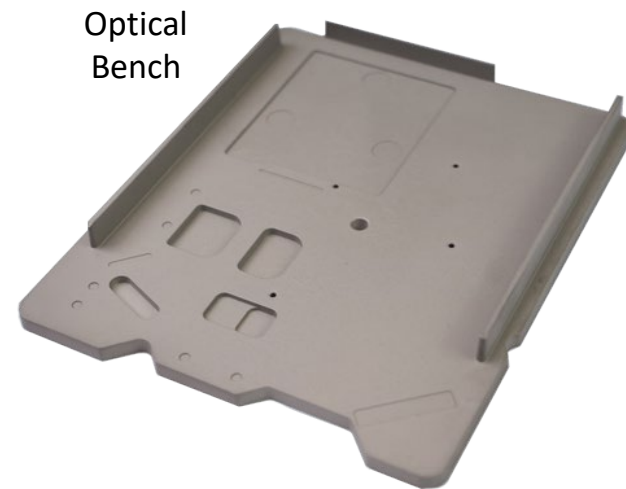
Applications include:

- | | |
|----------------------|-----------------------|
| ➤ Power Electronics | ➤ Radiation Shielding |
| ➤ Thermal Management | ➤ Energy Storage |
| ➤ CTE Matching | ➤ Wear Resistance |
| | ➤ Optics |

Example MMC: AlSiC

Aluminum reinforced with Silicon Carbide

- CPS has provided thousands of AlSiC components to customers per week, for decades.
- SiC reinforcement is tuned between 35-63 vol% depending on the performance requirements.
- Favored for thermal management of high-power electronics, AlSiC blends a high thermal conductivity (>180 W/mK) and a low coefficient of thermal expansion (8.0 ppm/°C at room temperature) in a low density (3.01 g/cm³) package.



CPS Technologies
111 S. Worcester Street
Norton, MA 02766

Steve Kachur, PhD
Vice President of Technology
skachur@cpstechnologiesolutions.com

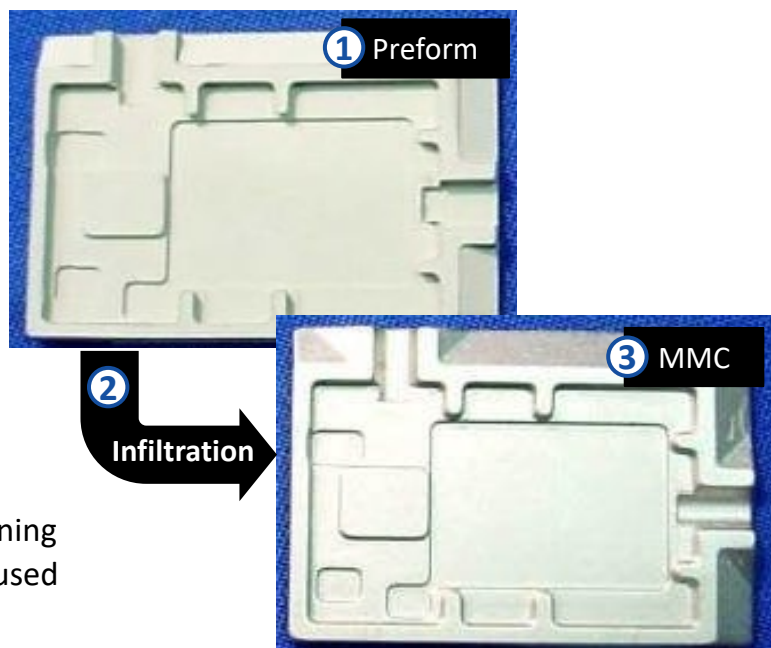
Joe Englin
Director of Business Development
jenglin@cpstechnologiesolutions.com

Particle Reinforced Composites

CPS is actively expanding our MMC portfolio. The following case studies demonstrate novel composite manufacturing processes, material systems, and applications:

MMC Processing

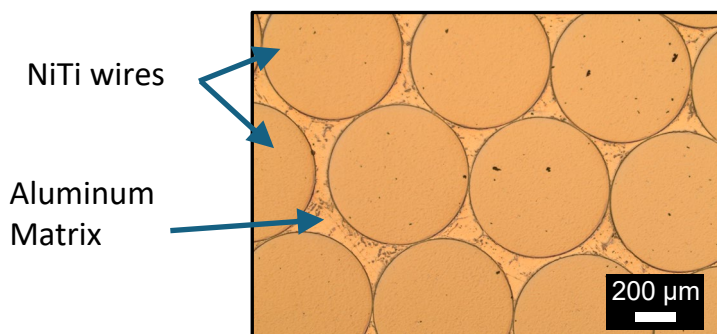
- CPS defines a composite's properties by controlling reinforcement composition & volume fraction with a proprietary 2-step process:
 - Quickset Injection Molding™ yields a porous alloy or ceramic preform that matches the exact geometry of the final part.
 - Pressurized melt infiltration fills the preform's porosity with aluminum.
 - The process yields a fully dense MMC that retains the original geometry of the preform.
- Net-shape manufacturing eliminates costly machining
- Mature, high-throughput manufacturing process used to fabricate thousands of components per week.



Leveraging MMCs for Thermal Energy Storage



- Nitinol (NiTi) stores thermal energy due to a solid to solid phase transformation.
- Energy storage performance is optimized by forming a composite with Al for light weighting and increased thermal conductivity.
- Reversible, reusable, and does not require robust encapsulation like wax-based storage materials.



Lightweight MMC Radiation Shielding



- CPS can combine multiple reinforcements in a single MMC to address both gamma and neutron radiation.
- Overall system mass is reduced by 50% compared to legacy shielding
- Composition of shielding material is designed, combining tungsten and boron carbide in an aluminum matrix in the appropriate ratio.

