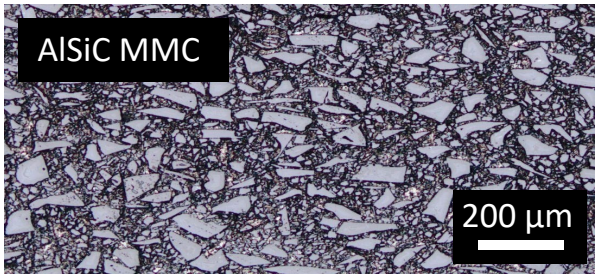
CPS Technologies

AlSiC Composites

CPS Technologies is a premier provider of Aluminum Silicon Carbide (AlSiC) composites. CPS AlSiC combines aluminum (Al) and silicon carbide (SiC) to obtain material properties ideally suited for thermal management. CPS' AlSiC provides high heat dissipation and a low, controlled, and uniform coefficient of thermal expansion.

Benefits

- CPS can fabricate MMCs with a range of volume fractions from 30% to 63%
- Inherently low density, strong, and stiff.
- Low thermal expansion and high thermal conductivity.
- Performance can tuned based on selected reinforcement composition, morphology, and volume fraction.

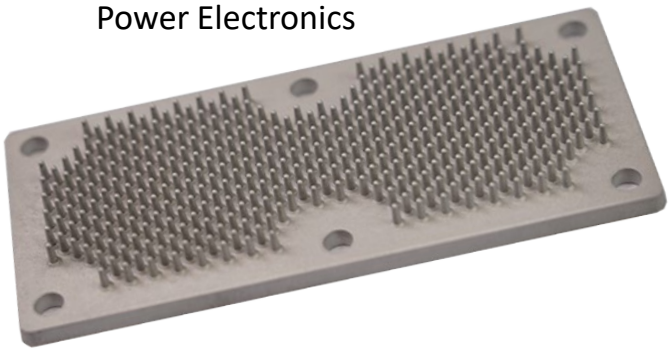


Optical Bench

Applications include:

- IGBTs for Traction
- Flip Chip Lids
- Microprocessors
- HVDC Transmission
- Traction Invertors
- Optical Benches

Pin Fin Cooler for Power Electronics



Select Material Properties	AlSiC-9	AlSiC-12
Aluminum Alloy 356	37% vol	63% vol
Silicon Carbide	63% vol	37% vol
Density (g/cm^3)	3.01	2.89
Thermal Conductivity @25°C (W/mK)	190 typical 180 min	180 typical 170 min
Specific Heat @25°C (J/gK)	0.741	0.808
Thermal Expansion (CTE) (ppm/°C)		
30-100°C	8.00	10.90
30-150°C	8.37	11.20
30-200°C	8.75	11.70
Young's Modulus (GPa)	188	167
Shear Modulus (GPa)	76	69
A-Bar 4-pt Bend Strength (MPa)	488	471
Percent Elongation at Rupture	0.295	-
Fracture Toughness (MPa/m^2)	11.3	-
Electrical Resistance (µOhm-cm)	20.7	20.7
Hermeticity (atm-cm^3/s He)	<10^{-9}	<10^{-9}

CPS Technologies
111 S. Worcester Street
Norton, MA 02766

Joe Englin
Director of Business Development
jenglin@cpstechnologysolutions.com

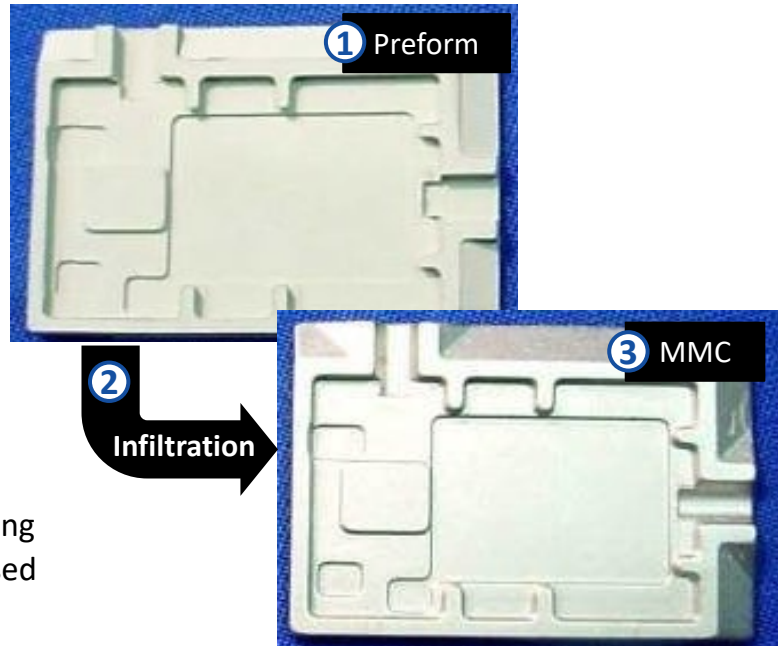
www.cpstechnologysolutions.com

AlSiC Product Development

CPS is actively expanding our AlSiC 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:
  1. Quickset Injection Molding™ yields a porous alloy or ceramic preform that matches the exact geometry of the final part
  2. Pressurized melt infiltration fills the preform's porosity with aluminum
  3. 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



Single Piece Cooler

- Unique infiltration process allows for a single piece AlSiC structure with integrated cooling features
- Compatible with both channels and traditional pin fins
- Zero post-process welding, brazing, or other joining methodologies needed
- One-piece construction eliminates leak paths such as O-rings/gaskets
- Pars AlSiC's 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/cm^3) package while eliminating interfaces that reduce the effectiveness of heat dissipation
- Process optimization ongoing

Closed Cooler cutaways showing internal geometry