



Continuous Fiber Reinforced Composites

CPS is a premier provider of Metal Matrix Composites (MMCs).

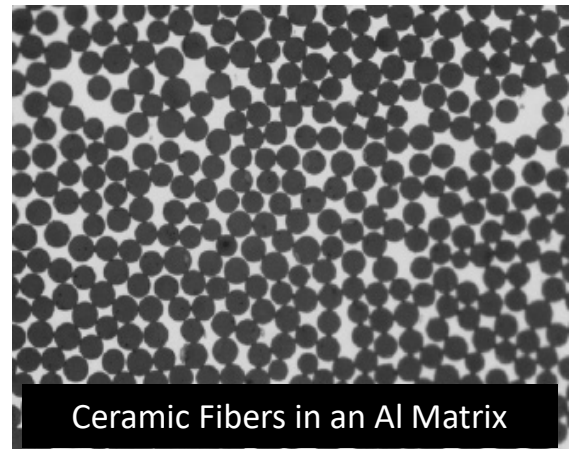
Extremely strong and stiff, **fiber-reinforced MMCs** enable lightweighting of structural components in diverse defense, automotive, energy, and aerospace applications.

Benefits

- CPS works with unidirectional, woven, and wound ceramic fibers to yield continuously reinforced Aluminum MMCs.
- MMCs are inherently low density ($<3.4 \text{ g/cm}^3$), strong ($>200 \text{ ksi}$), and stiff (35 msi).
- Additional benefits include vibration damping, wear resistance, enhanced service temperatures, and low thermal conductivity compared to neat aluminum.
- Ideally suited for any system requiring weight reduction vs. traditional structural alloys and applications where high acceleration loads are applied.
- Products range from thin sheets/laminates to large cylinders.

Applications include:

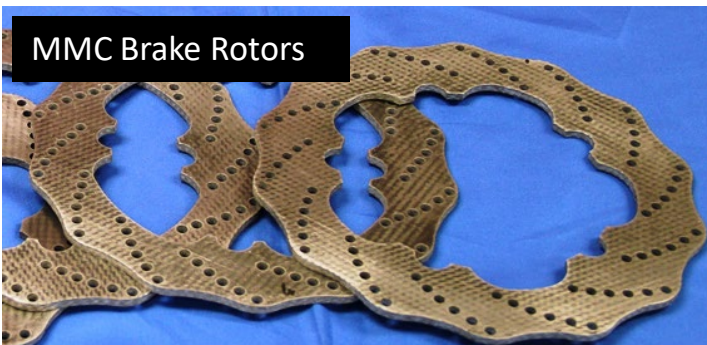
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|----------------------|-----------------|
| ➤ Propulsion systems | ➤ Fire Barriers |
| ➤ Push Rods | ➤ Struts |
| ➤ Landing Gear | ➤ Leading Edges |
| ➤ Brake Rotors | ➤ End Effectors |



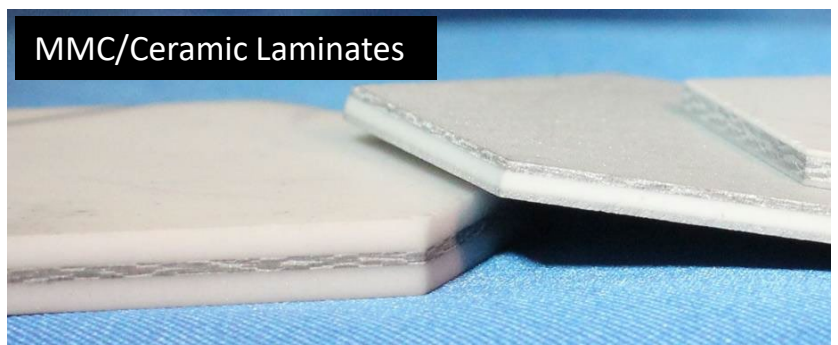
Ceramic Fibers in an Al Matrix



Woven Fiber Cylinders



MMC Brake Rotors



MMC/Ceramic Laminates

CPS Technologies
111 S. Worcester Street
Norton, MA 02766

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

Joe Englin
Director of Business Development
jenglin@cpstechnologysolutions.com



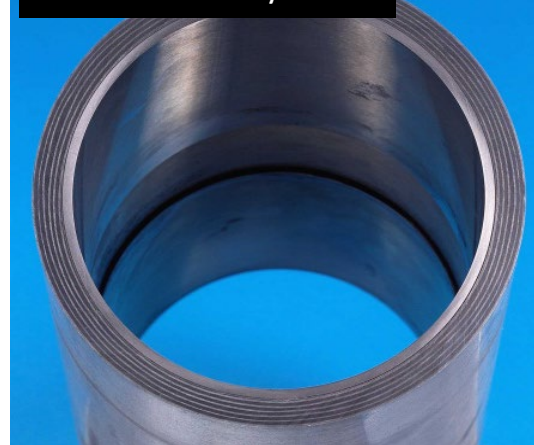
Continuous Fiber Reinforced Composites

MMCs from CPS are particularly suited for thin-walled applications such as cylinders or thermal barriers, where the unique properties of oxide fibers drive performance improvements and weight reductions

Continuously Reinforced MMC Cylinders

- CPS can fabricate continuous fiber parts via traditional composite layup techniques or filament winding.
- Infiltration with aluminum at high pressures yields composites with up to 60 vol% fiber reinforcement.
- Ability to produce large diameter cylinders (example: rocket motor cases) with superior burst strength and decreased mass compared to steel solutions.
- Small diameter tubes (example: gun barrels) pair high strength and stiffness with increased wear resistance.

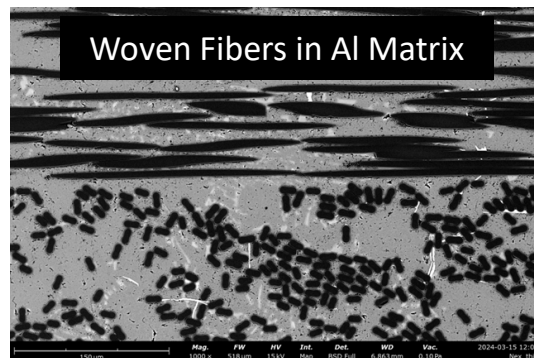
Wound Fiber Cylinder



Fiber Reinforced Sheets

- CPS combines aluminum with highly insulating ceramic fibers to yield robust thermal management solutions.
- MMCs as thin as 0.25 mm act as single-use fire barriers, but other design iterations (with no upper limit to thickness) can yield long-term, reusable, heat shields.
- Various combinations of discontinuous fiber-reinforced Al, continuous fiber-reinforced Al, and monolithic ceramic tiles are possible, with reinforcement content between 5 and 60 vol%.
- Variable ceramic compositions and additives for cost/performance trade-offs and densities as low as 2 g/cm³.
- Demonstrated performance when exposed to torches as hot as 3000 °C for 30 minutes (25 mm thick sample develops pinhole vs. immediate burn through of steel counterparts).
- Mechanical test results post thermal exposure show minimal degradation.

Woven Fibers in Al Matrix



Torch and Grit Testing

