

METAL MATRIX COMPOSITES (INTRODUCTION)

According to the classification of composite materials:

Metal Matrix Composite (MMC) is a material consisting of a metallic matrix combined with a ceramic (oxides, carbides) or metallic (lead, tungsten, molybdenum) dispersed phase.

- **Aluminum Matrix Composites (AMC)**
- **Magnesium Matrix Composite**
- **Titanium Matrix Composite**
- **Copper Matrix Composites**
- **Properties of some Metal Matrix Composites**

Aluminum Matrix Composites (AMC)

This is the widest group of Metal Matrix Composites.

Matrices of Aluminum Matrix Composites are usually based on aluminum-silicon (Al-Si) alloys and on the alloys of 2xxx and 6xxx series.

Aluminum Matrix Composites (AMC) are reinforced by:

- Alumina (Al_2O_3) or silicon carbide (**SiC**) particles (particulate Composites) in amounts 15-70 vol%;
- Continuous fibers of alumina, silicon carbide, Graphite (long-fiber reinforced composites);
- Discontinuous fibers of alumina (short-fiber reinforced composites);

Aluminum Matrix Composites are manufactured by the following fabrication methods:

- Powder metallurgy(sintering);
- Stir casting;
- Infiltration.

The following properties are typical for Aluminum Matrix Composites:

- High strength even at elevated temperatures;
- High stiffness (modulus of elasticity);
- Low density;
- High thermal conductivity;
- Excellent abrasion resistance.

Aluminum Matrix Composites (AMC) are used for manufacturing automotive parts (pistons, pushrods, brake components), brake rotors for high speed trains, bicycles, golf clubs, electronic substrates, cores for high voltage electrical cables.

Magnesium Matrix Composite

Magnesium Matrix Composites are reinforced mainly by silicon carbide (**SiC**) particles (particulate composites)

The following properties are typical for Magnesium Matrix Composites:

- Low density;
- High stiffness (modulus of elasticity);
- High wear resistance;
- Good strength even at elevated temperatures;
- Good creep resistance.

Magnesium Matrix Composites are used for manufacturing components for racing cars, lightweight automotive brake system, aircraft parts for: gearboxes, transmissions, compressors and engine.

Titanium Matrix Composite

Titanium Matrix Composites are reinforced mainly by:

- Continuous monofilament silicon carbide fiber (long-fiber reinforced composites);
- Titanium boride (**TiB₂**) and titanium carbide (**TiC**) particles (particulate composites).

Powder metallurgy (sintering) is used for fabrication of Titanium Matrix Composites.

The following properties are typical for Titanium Matrix Composites:

- High strength;
- High stiffness (modulus of elasticity);
- High creep resistance;
- High thermal stability;
- High wear resistance.

Titanium Matrix Composites are used for manufacturing structural components of the F-16 jet's landing gear, turbine engine components (fan blades, actuator pistons, synchronization rings, connecting links, shafts, discs), automotive engine components, drive train parts, general machine components.

Copper Matrix Composites

Copper Matrix Composites are reinforced by:

- Continuous fibers of carbon (**C**), silicon carbide (**SiC**), tungsten (**W**), stainless steel 304 (long-fiber reinforced composites);
- Silicon carbide particles (particulate composites).

Powder metallurgy (sintering) and infiltration technique are used for fabrication Copper Matrix Composites.

The following properties are typical for Copper Matrix Composites:

- Low coefficient of thermal expansion;
- High stiffness (modulus of elasticity);
- Good electrical conductivity;
- High thermal conductivity;
- Good wear resistance.

Copper Matrix Composites are used for manufacturing hybrid modules, electronic relays, electrically conducting springs and other electrical and electronic components

Properties of some Metal Matrix Composites

(Materials Data)

- Metal Matrix Composite MC-21
- Metal Matrix Composite Duralcan F3S.20S
- Metal Matrix Composite 2124-25%SiC
- Metal Matrix Composite Al-60% Al₂O₃ fiber
- Metal Matrix Composite Al-2%Cu-60% Al₂O₃ fiber

Source : http://www.substech.com/dokuwiki/doku.php?id=metal_matrix_composites_introduction