

Carbon / Carbon Composites

Introduction

- **C/C Composite (Carbon Fiber reinforced Carbon Matrix Composites)** is composed of carbon only, and it has excellent features like toughness, high strength and modulus. Also, it can be used in such high temperature as more than 1000°C conditions.
- Compared with CFRP, it has advantage in heat resistance, chemical resistance, and thermal stability.

Possible Applications

- Friction material : Airplane, Formula 1, MotoGP brake, clutch
- High Temperature material : Aerospace, Heat shield
- Industrial material : Hot press mold, Divertor Armor, Bolt, Nut, Crucible for semi conductor

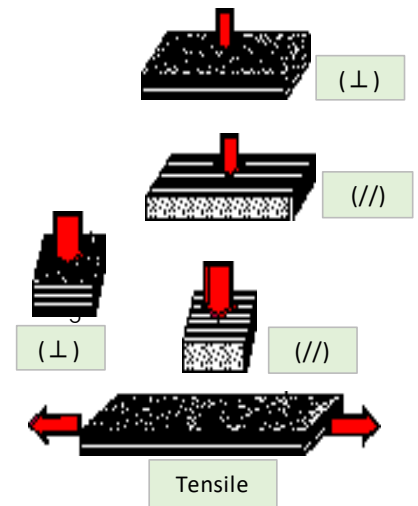


Typical Characteristics

Flexural Strength	(//)	MPa	180
Flexural Modulus	(//)	GPa	70
Flexural Strength	(⊥)	MPa	180
Flexural Modulus	(⊥)	GPa	70
Compression Strength	(//)	MPa	200
Compression Strength	(⊥)	MPa	160
Tensile Strength		MPa	110
ILSS		MPa	22
Rockwell Hardness		HRP	95
Bulk Density		g/cm3	2
Porosity		Vol%	9
Thermal conductivity	(//)	W/mK	90
Thermal conductivity	(⊥)	W/mK	12
Coefficient of thermal expansion	(//)	$\times E(-6)/^{\circ}\text{C}$	-1~0
(RT~700°C)	(⊥)	$\times E(-6)/^{\circ}\text{C}$	6~8



Courtesy of Moriwaki Engineering Co., Ltd.



- **Mitsubishi Chemical provides tailored products based on the customer's design and requirement.**

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CMC (Ceramic Matrix Composite)

Introduction

- CMC is composed of C/C Composite and Ceramic, and it has an integrated characteristics of C/C and Ceramic (SiC).

Features

- **Lightweight** : Specific gravity about 1/3 that of iron
- **High Strength, High Modulus**
- **High impact resistance, Tough** compared with ceramics
- **Hardness**
- **Low Coefficient of thermal expansion**
- **Thermal conductivity**
- **High heat Resistance** (Under inert atmosphere~1300°C)
- **Low wear and High μ (coefficient of friction)** : can be used as brake disc of automotive.
- **As brake disc, it has excellent performance in rainy conditions.**

Carbon Fiber type		Pitch	PAN
		CMC	CMC
Bulk density	[g/cm ³]	2.3	2.4
Flexural Strength	[MPa]	140	55
Flexural Modulus	[GPa]	60	30
Tensile Strength	[MPa]	75	25
Thermal Conductivity	[W/mK]	80	40

* This information can be used for material selection only.

Ceramic Matrix Composite Brake

Φ330mm Disk

- Cast Iron: 9kg
- CMC : 3kg

Weight Reduction

$$\Delta 6\text{kg} \times 4\text{discs} = \Delta 24\text{kg/car}$$



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