



# Let Advanced Composite be the Solution to your Material Challenges

We will take up the SDGs challenges by extending products' life and optimizing life cycle's cost

**Advanced Composite Co., Ltd.**

〒417-0801 2259-9 Fuji City Obuchi

<Established> July 2015 Capital: 255 Million Yen  
Employees: 36

<Patents> Japan 5, USA 1, Asia 5

Development, Manufacture and Sale of Next-Generation Composites materials by Liquid Forging Method

## Liquid Forging

Liquid Forging is a unique casting method where mechanical pressure is used to force liquid solidified into desired shape

## Advantages

- Great Fatigue Resistance
- Dense Casted Specimen
- Minimized Internal Defects
- Heterogenous materials can be produced (Joining, Composites)
- Compatible with various Aluminum Alloys
  - ☞ Different Array of Alloying Elements(1000~7000番)
  - ☞ Die-Cast Alloys(ADC)
  - ☞ Cast Alloys(AC)

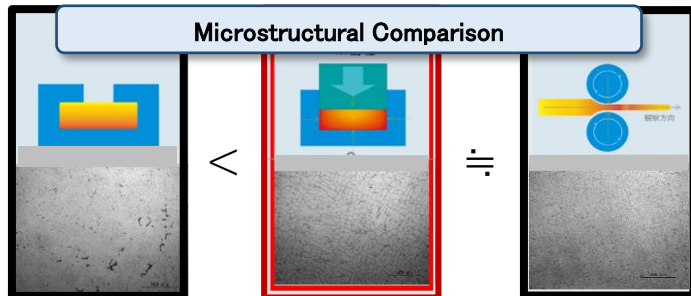
## Liquid Forging Category

- Forging
- Rolling
- Extrusion
- Casting
  - ☞ Gravity Casting
  - ☞ Die-Cast
  - ☞ **High pressure casting (Liquid Forging)**



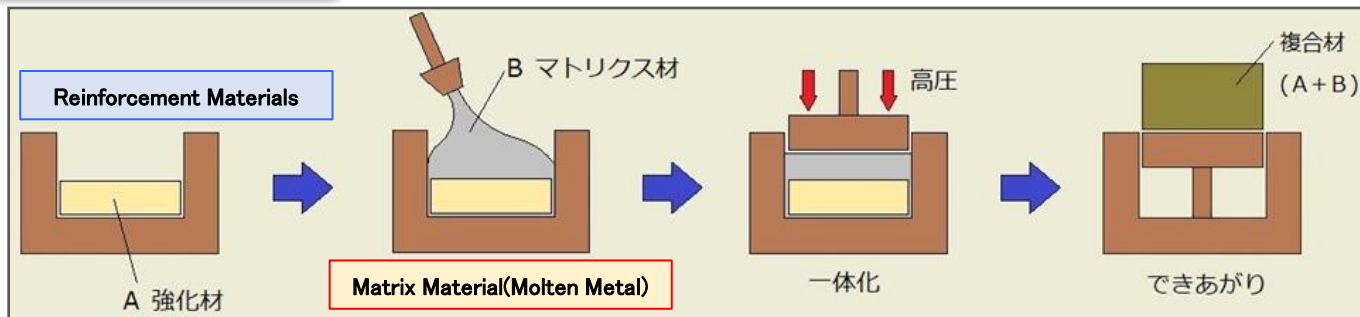
1500t 高圧プレス機

## Microstructural Comparison



## Composite Processing

Combining the attributes of two materials to produce one composite material with improved properties.



### Application(For Light Weight)

<Materials> Albolon, AISiC, AISi

- ① Automobiles・Aircrafts ☞ Improved Fuel Efficiency/Maximum Distance/Parts Durability
- ② Semiconductor Fabrication Machine Parts ☞ Improved Accuracy & Control/Reduced Maintenance
- ③ Robots ☞ Improved Control/Reduced Power Consumption/Improved Durability

### Application(For Thermal Management)

<Materials> ACM, AISiC

- ① Automobiles・Motorcycle ☞ Improved Performance/Better Reliability/Long Life Cycle
- ② Home Appliance・IT equipment ☞ Compact and High Performance/ Quick Heat Dissipation/Better Reliability
- ③ LED Components ☞ Improved Performance/Quick Heat Dissipation/Longer Life Cycle/Reduced Maintenance



# AC-Albolon

## Ceramic-Reinforced Aluminum Matrix Composite

### Novel Material with Lightness of Aluminum and Strength of Cast Iron

### Development Background

**Materials** are the basis of our daily life. In the automobile industry in the recent years, weight reduction has become important for improving fuel efficiency from the global environment perspective. As a result, aluminum, being a versatile lightweight metal, has been used extensively for this purpose. **To meet requirements in mechanical properties**, such as strength or hardness, addition of other elements or ‘alloying’ to alter and achieve those properties has been frequently conducted. However, there are still some characteristics that cannot be achieved with alloying. For example, to change a single material to have the strength or stiffness of cast iron while still retaining the light weight of aluminum would be very challenging using any metal alloys. However, it is **possible with composites**, and we have developed a new material of such characteristics by ‘compositing’ a ceramic material with an aluminum alloy.

#### Features

- **Low Density like Aluminum**
- **Cast Irons level of Tensile Strength and Young’s Modulus**
- **Low Coefficient of Thermal Expansion**
- **Can be machined by Carbide Tools with ease**

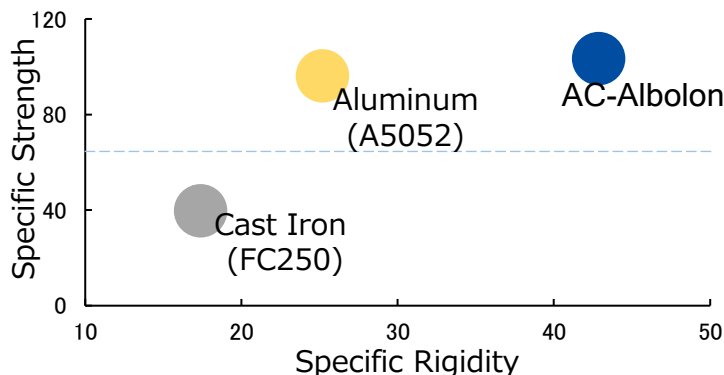
#### Properties

物理的特性	AC-Albolon	鋳鉄 (FC250)	アルミ (A5052)
Density[g/cm³]	2.8	7.3	2.7
Tensile Strength[MPa]	290.0	290.0	260.0
Young's Modulus[GPa]	120.0	127.0	68.0
CTE[ppm/K]	12.0	12.0	23.8
Thermal Conductivity[W/m・K]	77.0	50.0	137.0

#### Advantages

AC-Albolon system allows cost reduction by downsizing with weight reduction of parts while maintaining the strength. AC-Albolon is the optimal material for rotating bodies and high-speed drive parts

#### Comparison for Specific Strength and Rigidity



### Application



Reflow Positioning Jigs

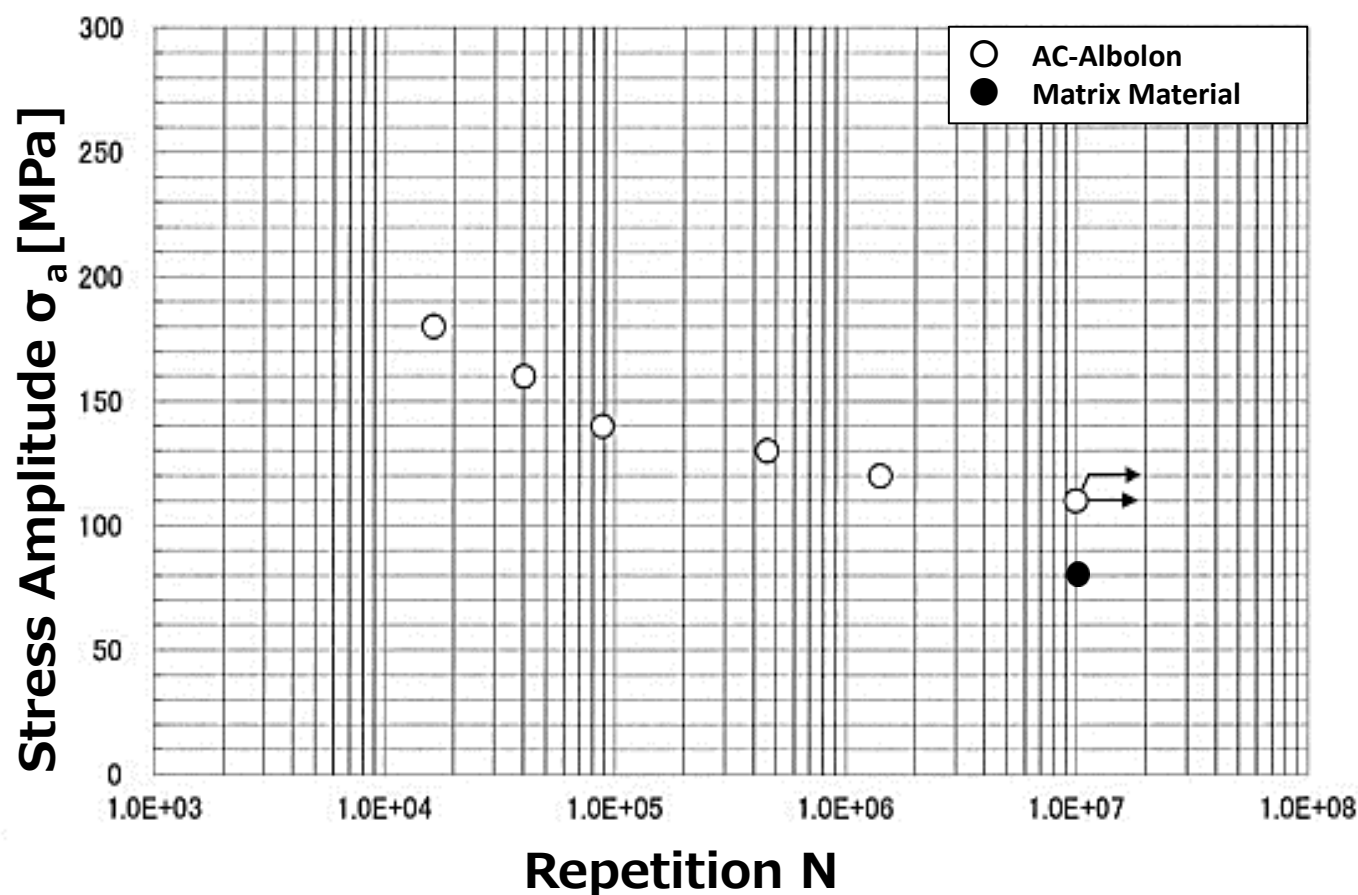


Electronics Manufacturing Machine Parts



Scroll Compressor

# AC-Albolon Fatigue Strength Comparison

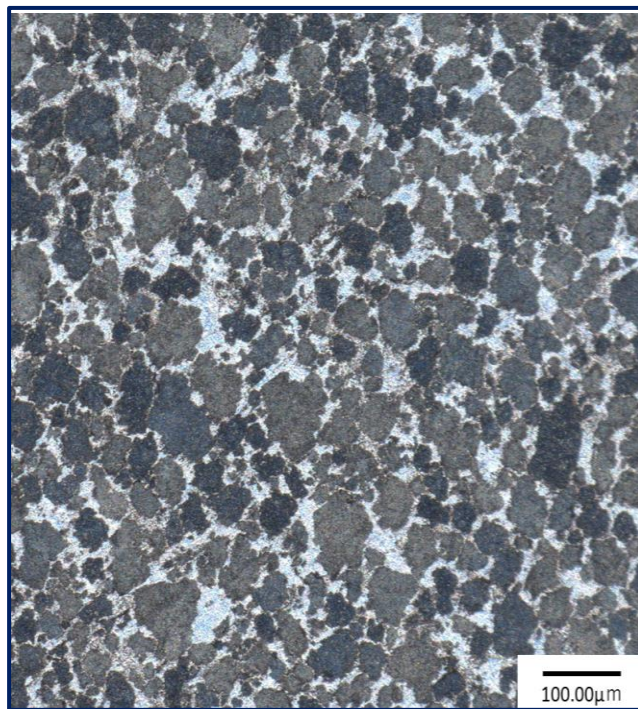


Fatigue Strength of AC-Albolon (At  $10^7$  Repetition ;  $n=2$ ) is 110MPa  
20MPa higher than Matrix material (90MPa)

## Properties

	AC-Albolon
Matrix Material	Aluminum Alloy
Reinforcement Materials	Aluminum Borate
Volume Fraction[%]	40
Density[g/cm <sup>3</sup> ]	2.8
Tensile Strength[MPa]	290
Bending Strength[MPa]	370
Elastic Modulus[GPa]	120
Specific Heat[J/(kg·K)]	1.0
Thermal Conductivity[W/m·K]	77.0
Thermal Expansion[ppm/K]	12

## Microstructure



## Patents

Patent Number 6837685  
6821207、6681079

Advanced Composite Corporation  
<https://advance-composite.co.jp/>





# ACM-io

## Graphite-Reinforced Aluminum Matrix Composite

Conductive Material with Minimized High-Temperature Deformation

### Features

- **High Conductivity**
- **Low Coefficient of Linear Expansion**
- **Thermal Deformation Resistant**
- **Heat Cycle Resistant**
- **Graphite Level Light Weight**
- **Stronger than Graphite**

### Properties

物理的特性	ACM-io	Alumium (A5052)	Copper (C1020P)
Tensile Strength [MPa]	70	260	265
Young's Modulus [GPa]	16.0	68.0	-
CTE [ppm/K]	7.5	23.8	17.7
Conductivity[W/m・K]	164.0	137.0	391.0
Density [g/cm³]	2.1	2.7	8.9

### Advantages

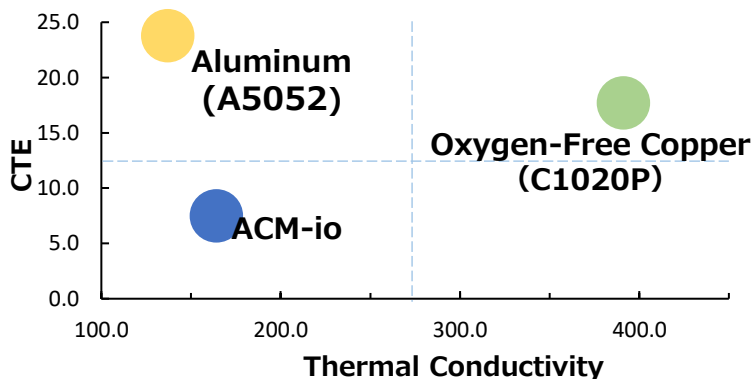
We have succeeded in compositing Graphite and Aluminum, ACM-io, which had been considered a challenging process.

ACM-io is the most suitable materials for parts that require dimensional accuracy due to its good conductivity and thermomechanical properties.

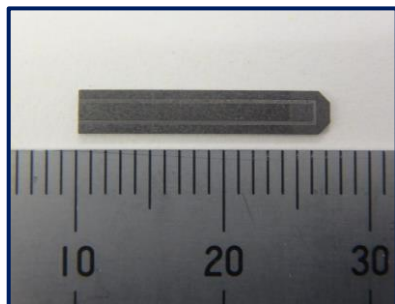
Moreover, heat cycle resistance coupled with deterioration resistance allow its lifetime to last longer than graphitic materials.

In addition, ACM-io is capable of surface treatment, which allows minimized dust generation during the operation comparing to conventional graphite materials.

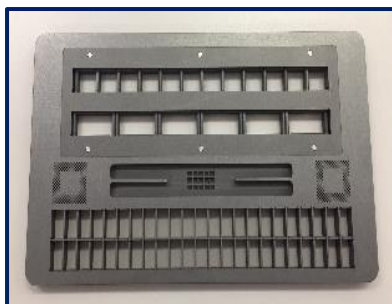
### Comparison (CTE&TC)



### Application



Medical Equipment Parts



Reflow Jigs



X-ray Machine Parts

# ACM-io Surface Treatment (XDP Coating)

Comparing to conventional Trivalent Chrome Plating, wrapability of the plating has been improved allowing the plating to be applied on more complex shaped jigs

## ◎ Main Features

- Environmentally friendly plating process without using Hexavalent Chromium Compound that are harmful to the environment.
- Variety of Color Tones from Light Silver Gray to Dark Tones.
- Plating circumference is 20% larger which allows more complicated parts to be plated.
- Being a thin film of 0.1μm~0.3μm、It can be used together with Electroless Ni-P. It can also be used for parts under severe dimensional management.

## ◎ Main Application

- Parts that require external decoration
  - Parts that require adhesion prevention such as solder and coating film
  - Parts that require corrosion resistance
- ※Plateable Material : Steel(including SUS)、Copper and its composites、Aluminum and its composites. It Ni-P can be coated on top of this materials.

## ◎ Specifications

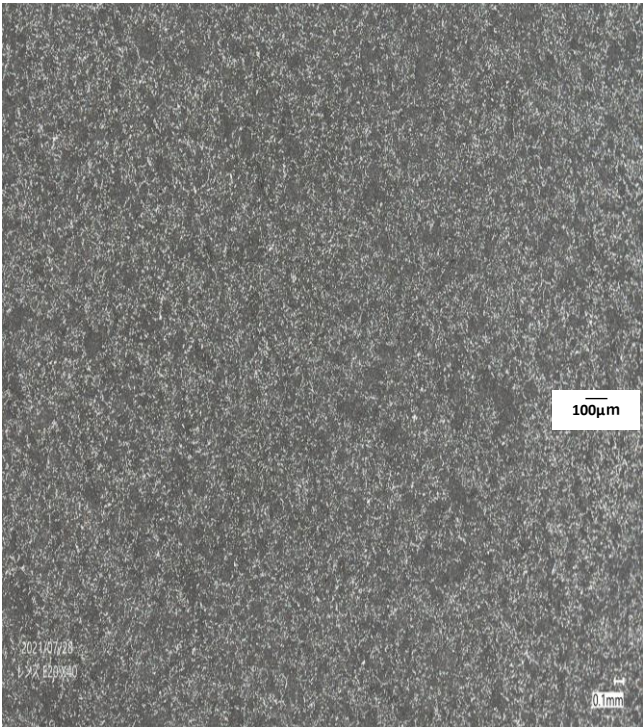
Composition	Cr : ~60% Other : ~40%
Hardness (Hv : )	~800
Crystal Structure	Amorphous

The microstructure below reflects the above surface treatments

## Properties

	ACM-io
Matrix Material	Aluminum Alloy
Reinforcement Material	Graphite
Volume Fraction[%]	85
Density[g/cm³]	2.1
Tensile Strength[Mpa]	70
Bending Strength[Mpa]	93
Young's Modulus[GPa]	16
Specific Heat[J/(kg・K)]	0.8
Thermal Conductivity[W/m・K]	164.0
Thermal Expansion[ppm/K]	7.5

## Microstructure



## Patent Number

Under Preparation



# Reflow Positioning Jig

Graphite-Reinforced Aluminum Matrix Composite  
Ceramic Reinforced Aluminum Matrix Composite

## Novel Materials for Application in Reflow Process

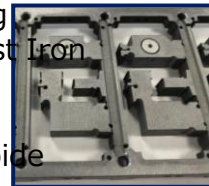
### ACM-io Features

- Low Coefficient of Thermal Expansion
- Resistant to Heat Cycle
- Good Specific Strength
- Long Product Life



### AC-Albolon Features

- Light Weight equivalent to Aluminum
- Tensile Strength and Young Modulus comparable to Cast Iron
- Low Coefficient of Thermal Expansion
- Can be machined with carbide tools



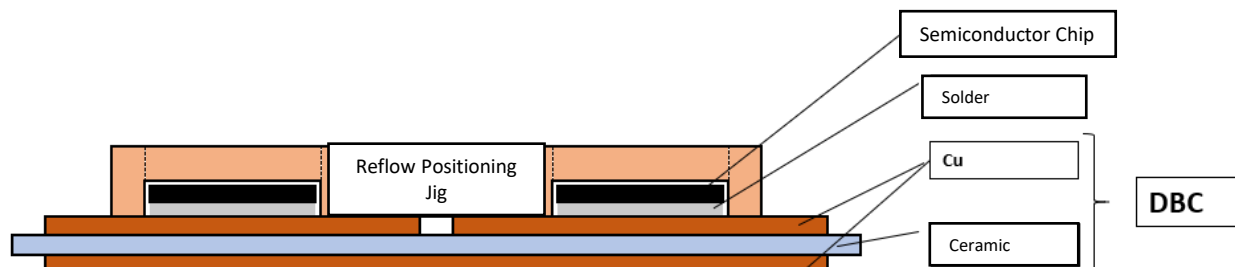
## Advantages

We have developed ACM-io jigs and AC-Albolon jigs as substitutes for Carbon and SUS jigs, respectively.

Replacement of carbon jigs by **ACM-io jigs**, allows an improved heat cycle performance, and suppressed material deterioration due to its low coefficient of thermal expansion. When the thermal deformation during reflow is reduced, dimensional accuracy improvement is achieved. ACM-io, when plated, also have a significantly decreased dust generation unlike the conventional carbon jigs.

**AC-Albolon jigs**, replacing the SUS jigs, allows cost reduction as a whole by downsizing of the system due to reduced weight while maintaining the strength. Moreover, surface of the materials is repellent towards the solder.

## Cross-Section of Power Module



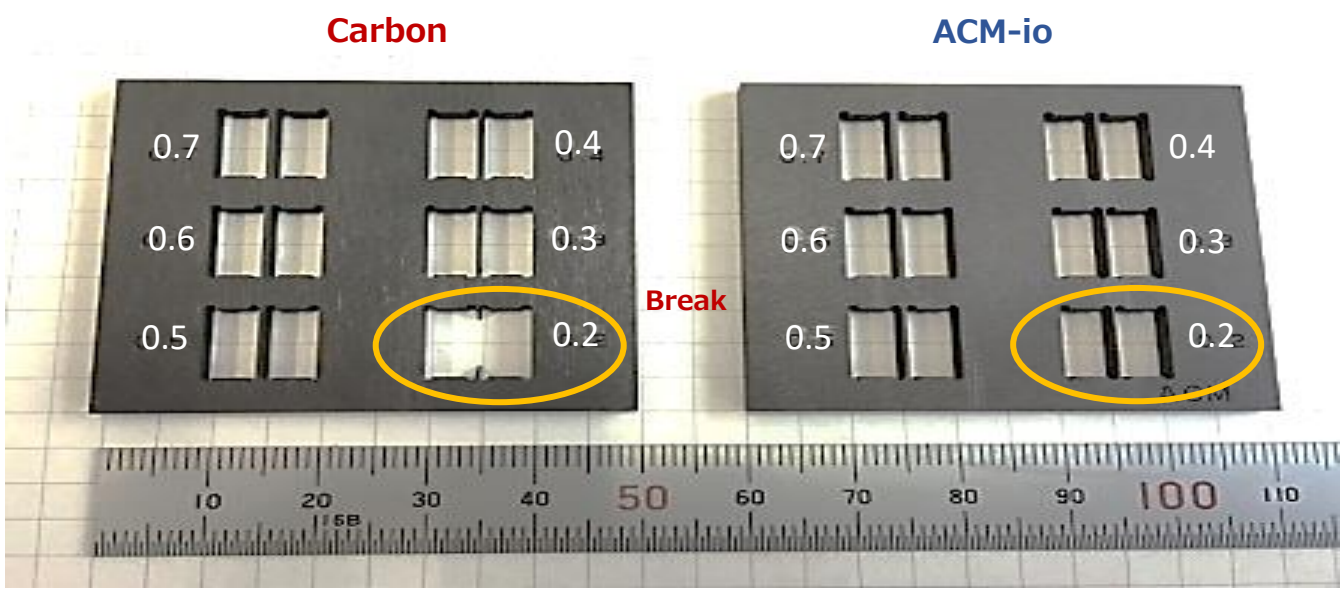
## Properties

Properties	ACM-io	AC-Albolon	Aluminum(A5052)	Carbon(CIP)
Tensile Strength [MPa]	70.0	290.0	260.0	27.0
Young's Modulus [GPa]	16.0	120.0	68.0	10.8
CTE [ppm/K]	7.5	12.0	23.8	4.5
Thermal Conductivity[W/m·K]	164.0	77.0	137.0	128.0
Density [g/cm³]	2.1	2.8	2.7	1.8



# Fine Machining of ACM-io Jigs

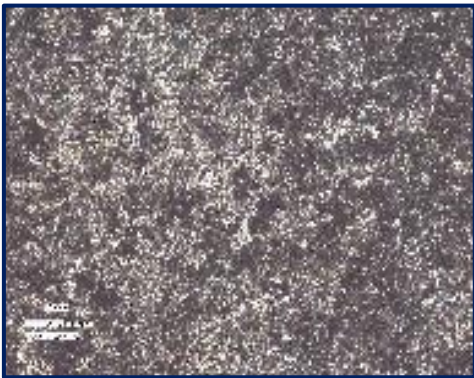
Improved Mechanical Strength of Materials allows Thin Sample Processing



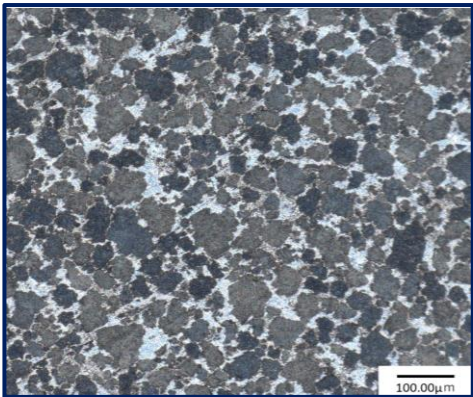
## Properties

	ACM-io	AC-Albolon
Matrix Material	Aluminum Alloy	Aluminum Alloy
Reinforcement Material	Graphite	Aluminum Borate
Volume Fraction[%]	85	40
Density[g/cm <sup>3</sup> ]	2.1	2.8
Tensile Strength[MPa]	70	290
Bending Strength[MPa]	93	370
Young's Modulus[GPa]	16	120
Specific Heat[J/(kg·K)]	0.8	1
Thermal Conductivity[W/m·K]	164.0	77
CTE[ppm/K]	7.5	12

## Microstructure



ACM-io



AC-Albolon

## Patent

ACM-io

Under Preparation for Application

AC-Albolon

Patent Number 6837685  
6821207、6681079