FerroTec Offers Advanced Metal Matrix Composites (AMCs)

**AMCs have superior material properties that exceed those of both conventional metals and ceramics.
They are used as structural component in precision machinery and electronic component manufacturing equipment where lightweight and high rigidity are both required.**

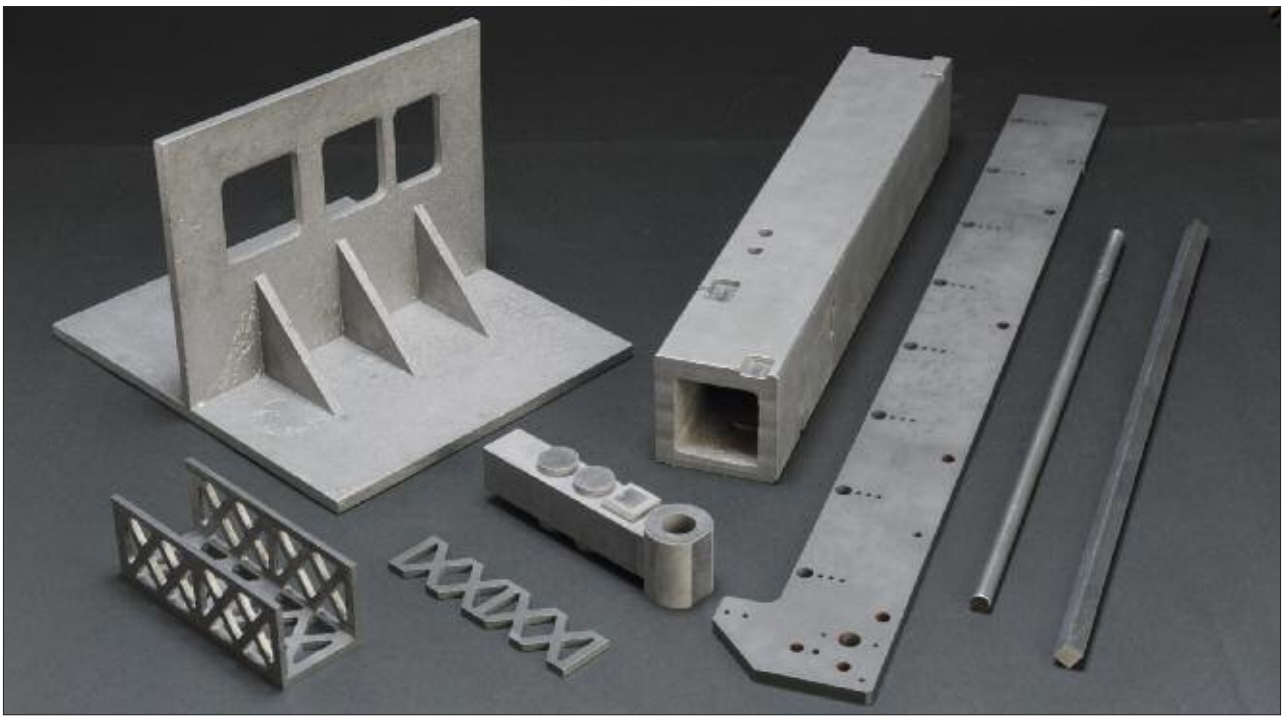

Fig. 1
Structural components made of AMC (source: FerroTec)

Introduction
AMC is a composite material made from a mix of metal and ceramics and is manufactured by *Japan Fine Ceramics Co.*, Ltd. *FerroTec GmbH* is distributing AMC materials worldwide except in Japan. AMC has superior material properties that exceed those of both conventional metals and ceramics. AMC has high performance and is used as structural component in precision machinery and electronic component manufacturing equipment where lightweight and high rigidity are both required. AMC has superior specific rigidity and vibration dampening characteristics and can be particularly helpful in situations when you wish to further improve device performance or when you encounter problems meeting dimensional specifications.

Keywords
composites, lightweight, rigidity

Main applications
- Semiconductor manufacturing and inspection equipment
- Liquid crystal manufacturing and inspection equipment

FerroTec GmbH
Seerosenstraße 1
72669 Unterensingen
Germany

www.ferrotec-europe.de
ceramics@de.ferrotec.com

Tab. 1
Physical properties of AMCs and comparison to other materials

Item	AMC						Aluminum Alloy	Cast Iron	Carbon Steel	Stainless Steel	Ceramics	
	NPX-40	NPX-50	NPX-60	NPA-45	NPSiC-MS2	NPSiC-SH1						
Composition	Al 60 % SiC 40 %	Al 50 % SiC 50 %	Al 40 % SiC 60 %	Al 55 % Al_2O_3 45 %	Si 30 % SiC 70 %	Si 25 % SiC 75 %	AC4A (F)	FC250	S55C	SUS304	Al_2O_3	AlN
Density [g/cm³]	2,85	2,90	2,97	3,24	2,92	3,00	2,70	7,30	7,30	7,90	3,90	3,30
Youngs modulus [GPa]	154	179	230	161	320	340	75	115	205	210	390	320
Youngs modulus/ density	54	62	77	50	110	113	28	16	28	27	100	97
Bending strength (3 points) [MPa]	–	270	290	205	450	230	–	–	–	–	440	350
Coefficient of thermal expansion [10^{-6}/K] (RT ~ 100 °C)	11,5	9,5	8,4	12,3	2,8	2,9	21,0	10,0	12,0	17,0	7,7	4,6
Thermal conductivity [W/m · K]	–	169	180	87	145	205	138	50	60	15	33	170

- Chip mounters/assemblers and bonders
- Various types of precision machinery
- Heatsink.

Features

- Lightweight (almost the same weight as aluminum alloys)
- High rigidity (equal to or greater than stainless steel*1
- Low thermal expansion (equal to or less than alumina*2
- High thermal conductivity (equal to or greater than aluminum alloys*3
- Excellent vibration dampening (equal to or greater than cast iron)
- Difficult to crack (compared to other ceramics)
- Near net shape production is possible*4.

Advantages

Structural components such as beams and columns made of AMC will provide various advantages:

- Lightweight, high rigidity and excellent dampening will bring you a high speed operation in your equipment new design.
- Low thermal expansion will gives superior accuracy in measurement equipment.
- Casting technology and the near-net-shaped semi-finished blanks will reduce the cost of final machining and generally AMC components provide cost competitiveness over ceramics.

Tab. 2
AMC potentials to replace other materials

Original Material	Advantage of Changing to AMC
Iron base materials	Cycle time improved. Lightweight and damping improved.
Aluminum alloy	Lightweight with higher rigidity. Better heatsink with high thermal conductivity.
Ceramics	Capable to manufacture complicated figures. Increase in shock resistance and high thermal conductivity.

Matrix type materials

Al-matrix type materials: NPX and NPA can be made into large-sized products. Reductions in weight and increases in speed of the equipment contribute to improved production efficiency.

Si-matrix type materials: NPSiC is free of surface defects and is perfect for use in semiconductor/liquid crystal manufacturing and inspection equipment.

Benchmarking of AMC properties to competitive materials is shown in Tab. 1. Tab. 2 gives examples in which AMC application can be superior to stand materials.

*1*2*3: does not include NPA-45
*4: processing requirements 0,5–1,5 mm (depends on physical shape of the product)