KTW Technology
DRIVEN BY INNOVATION

Titan Matrix Composites (TMC)

The Featherweight Champion

Business Division of KTW Technology

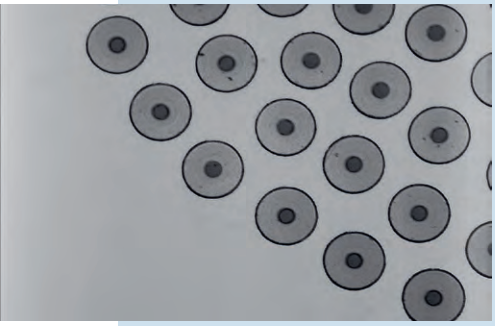
Solution

Less weight and more stiffness and strength

TMC is a problem solver, not only for aerospace and medical tech and replaces a high number of standard components.

Story of TMC

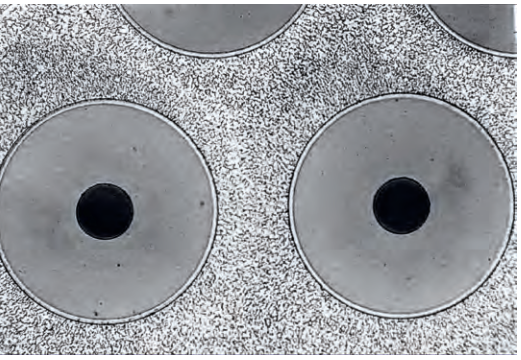
Aerospace engine and airframe designers are constantly seeking lighter weight high strength materials to reduce weight and improve performance of powerplants and aircraft. Titanium metal matrix composites



(Ti MMCs) have offered the promise of significant weight savings since their initial development in the early 1960s, but in the past their inadequate quality and reproducibility combined with high high processing and materials costs have prevented their introduction into production applications.

This brochure describes the state-of-the-art for TMC aerospace fabrication and the recent advances in processing which are now leading to high quality, affordable TMC components.

TMC by KTW Technology is the result of more than 20 years of research



What is TMC?

It is a composite made of Ti-Alloy (Titan) and Si-C Fibre
Advantages:

- Less weight
- Higher stiffness
- Higher strength

as conventional methods!

TMC in general

TMC is very suitable in environments where high forces occur and lightweight components with high strength and stiffness are required. Our process for the production of reinforced components with SiC fibers offers the best possible properties and a wide variety in production. The high strength of the fiber leads to the fact that the mechanical properties of TMC, such as the bending stiffness, are by far surpassing the properties of components made of conventional materials.

Advantages of the Magnetron Sputter Process

No. 1 Optimal fiber distance distribution
No. 2 Perfect material properties
No. 3 Reproducibility (serial production)
No. 4 Different metal matrix composites possible
No. 5 Homogenity
No. 6 No X-Rays

TMC in comparison

Characteristics	TMC	high strength steel	Ti-alloy
Density in g/cm^3	4	7,8	4,6
Strength in Mpa	2200	1700	1100
Strength at 600°C in Mpa	1400	800	650
Stiffness in Gpa	210	190	115
Elongation in %	1,3	6	15
Thermal expansation in K°-1	5 x 10-6	12 x 10-6	8,5 x 10-6

Performance data in a pulling test of TMC compared to

a) high strength steel:
- up to 50% less weight
- up to 75% more strength
- up to 10% more stiffness

b) Titanium:
- up to 15% less weight
- up to 115% more strength
- up to 80% more stiffness

Applications for TMC

TMC is suitable for a variety of applications in the following industries:

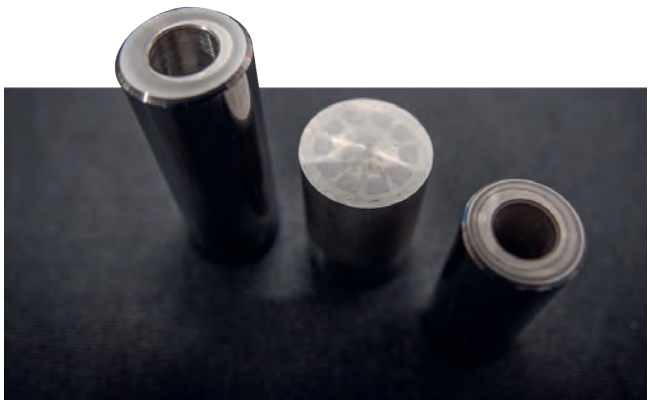
- Aviation
- Space Travel
- Med Tech
- Racing
- Defense
- Maritim

Today TMC is already implemented in the Aircraft Industry. Typical applications of TMC:

Turbine / Fan Blades (weight less 30%)
Impeller Blade Wheel (weight less 30%)
Inlet / Outlet Valves (weight less 15%)
Connecting Rod (weight less 10%)

Stud Bolt (weight less 40%)
Piston Pin (weight less 40%)
Drive Shaft (weight less 50%)

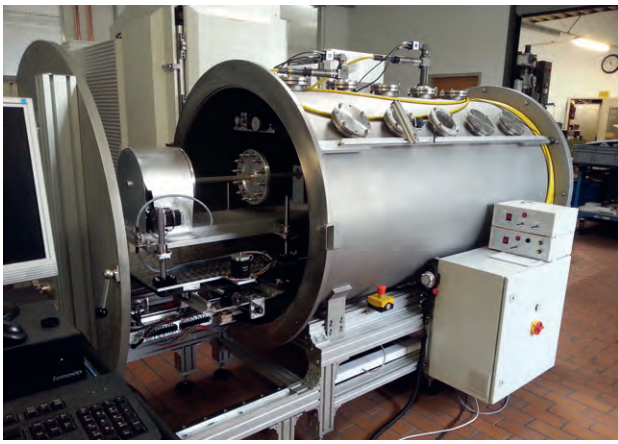
TMC was successfully implemented in TOYOTA engines in Formula 1 (2002–2006), before FIA changes the regulations. They convinced with one of the staunchest engines in Formula 1 history.
Technical Director: Norbert Kreyer



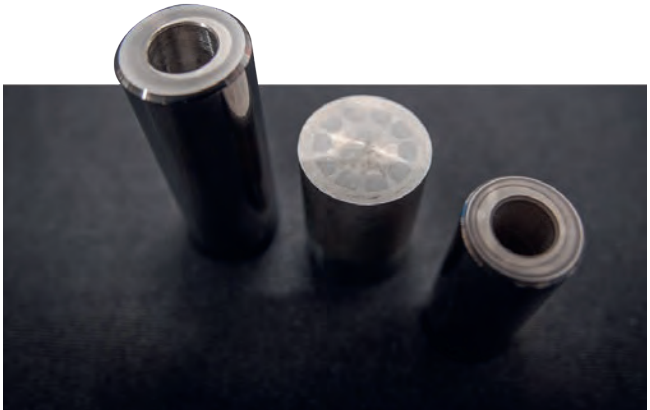
General Information

The Magneton Sputter Process by KTW is the only known state-of-the-art production process of TMC. In combination with additive manufacturing the breaktrough of TMC should be now! KTW Technology presents itself as a partner for a cooperation with companies from the aerospace, racing, medical tech sectors or other industries.
A collaboration could take place in form of a Joint Venture or as a common project with the aim of transferring the Know-how of TMC to the project partner.

Fiber Coating Machine



High-Vacuum Laser Welder



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