KTW SYSTEMS

DRIVEN BY INNOVATION

Business Division: Titan Matrix Composites

Our Team

"Engineers from Aerospace, Defense and Formula 1 and international experienced Managers"

WOLF TEICHMANN
CEO

International experienced Manager

NORBERT KREYER
PROJECT MANAGER

Extrem successful career as engineer in racing and aerospace engine tech

STANISLAV KOPECEK
COO

Chemical Eng. with a wide field of experience in Defense and Automotive Industry

KAUS WEBER
MANAGER R&D

Innovator of KTW SYSTEMS Engineer Aerospace, former German Aerospace Research

HA
GM ASIA & PACIFIC

Sales Prof with a huge network

Our Business Divisions

Titan Matrix Composites

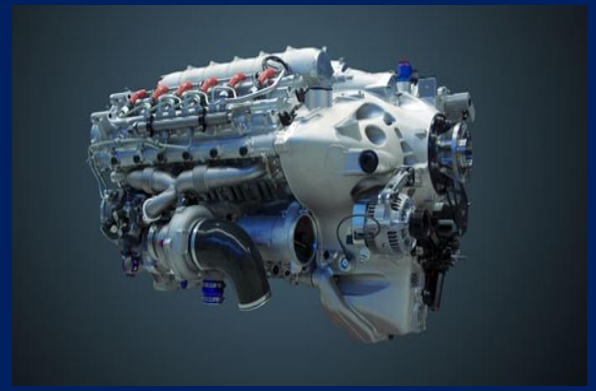
World novelty with up to 50% weight reduction by higher density and stiffness

Fast Switching Valves

The fastest valve on earth with a magnetized ball as closure element

Vacuum Laser Welder

The ultimate option to electronic beam welding with a lot of advantages



Engine Technology

Modern Engines - Solutions to reduce costs and fuel consumption

We develop solutions where (process) safety, weight, efficiency, savings in resources and reliabilty are important. Our typical customers coming from aerospace, medical technology, automotive, chemical, pharmaceutical and other High-tech industries

Titan Matrix Composites (TMC)

The Featherweight Champion

Problem1:

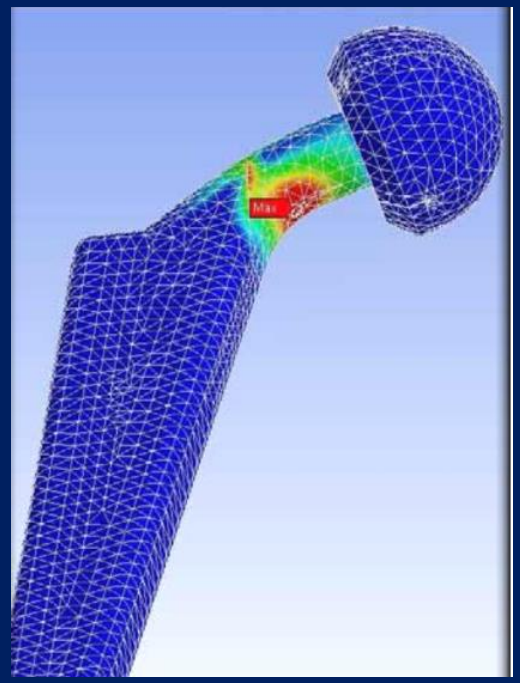
Cost per kg to space and to aviation is too high

The aerospace industry is ALLWAYS LOOKING for solutions to reduce the costs per kg they send into space or air! Metal Matrix Composites subject to a high level of research efforts.

Problem2:

Hip Implants are limited in dwell time and weight of the patient

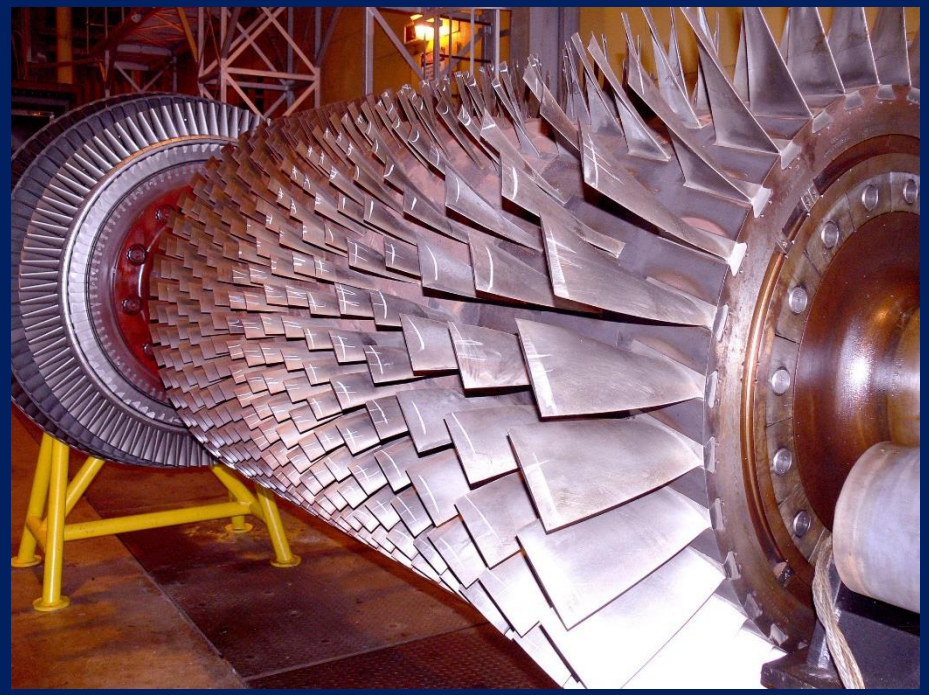
Titanium is the ideal material for hip implants, since the metal is considered to be non-allergenic. Due to its strength and stiffness titanium has disadvantages in residence time and reasonable load. Patients over 110 kg in weight can not be supplied with a titanium hip implant usually. The joint also becomes fatigued after 15 years and the implant has to be replaced by surgery..



Solution:

Titan Matrix Composites: Less weight and more stiffness and strenght

TMC is a problem solver , especially 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 processing and materials costs have prevented their introduction into production applications. This project book 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.

Titan Matrix Composites

TMC by KTW SYSTEMS is the result of over 20 years of research

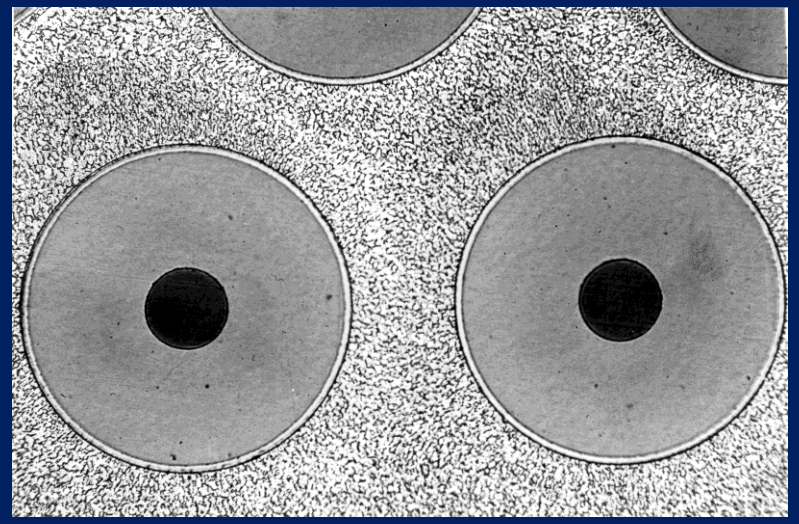
What is TMC?

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

Advantages:

- Less weight
- Higher stiffness
- Higher strenght

as conventional methods!



Titan Matrix Composites

More than 50 million € in research funds were invested in the development of TMC

TMC was developed in the German Aerospace Center (DLR) by our founder Klaus Weber. This technology is based on our patents DE 43 35 557.9-09 and DE 198 03 743 with EP 1 087 856 (FR, GB, IT)

Titan Matrix Composites

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

TMC in comparison

Characteristics	TMC	high strength Steel	Ti- alloy
Density in g/cm³	4	7,8	4,6
Strength in Mpa	2200	1700	1100
Strenght at 600°C in Mpa	1400	800	650
Stifness in Gpa	210	190	115
Elongation in %	1,3	6	15
Thermal expansation in K°-1	5x10-6	12x10-6	8,5x10-6

Performance data in a pulling test of TMC compared to

a) high strength steel:

- up to 50% less weight
- up to 75% more strenght
- up to 10% more stiffness
- less than 7 times in thermal expansation

b) Titanium:

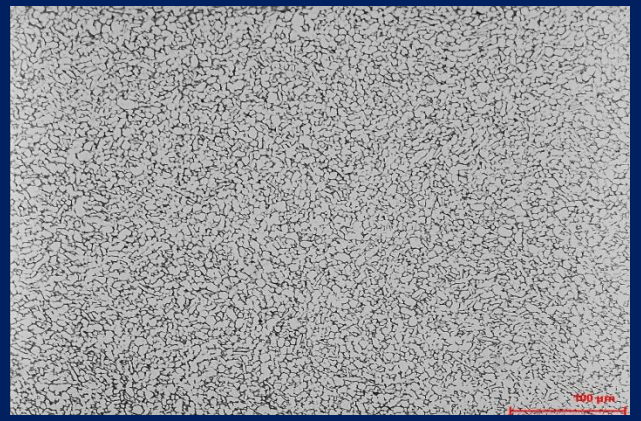
- up to 15% less weight
- up to 115% more strenght
- up to 80% more stiffness
- less than 3,5 times in thermal expansation

Manufacturing Process

Magneton Sputter Process – used by KTW SYSTEMS

2 Components

Si-C Fibre



Ti-Alloy

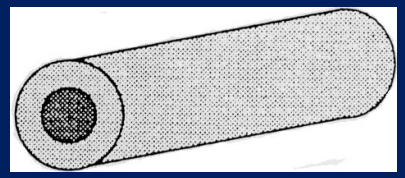
Different alloys for different temperature ranges:
Up to 200 degrees: SP700
Up to 400 degrees: Ti-64
Above 400 degrees: Ti-6242

Manufacturing Process

Magneton Sputter Process – used by KTW SYSTEMS

1. <u>Step:</u>

Endless Si-C Fiber spooled on fixture



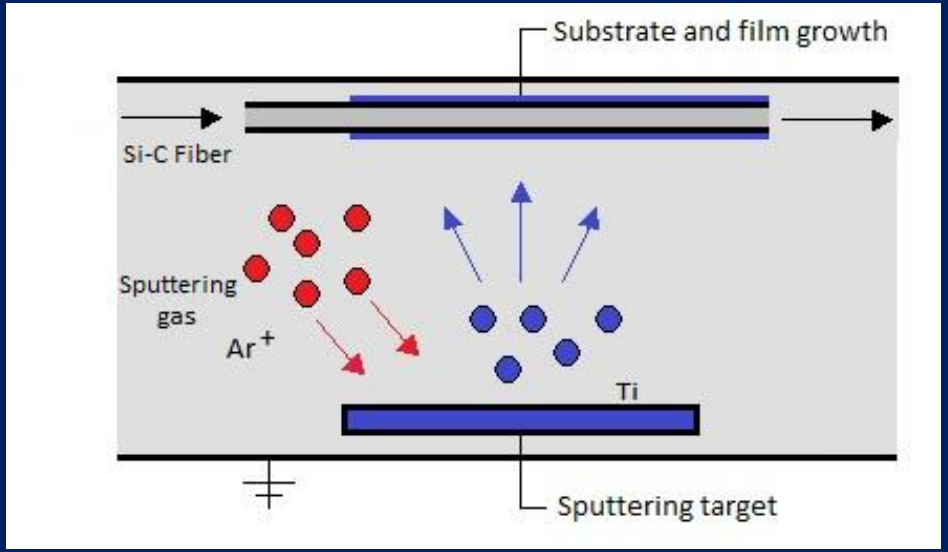
Endless fiber

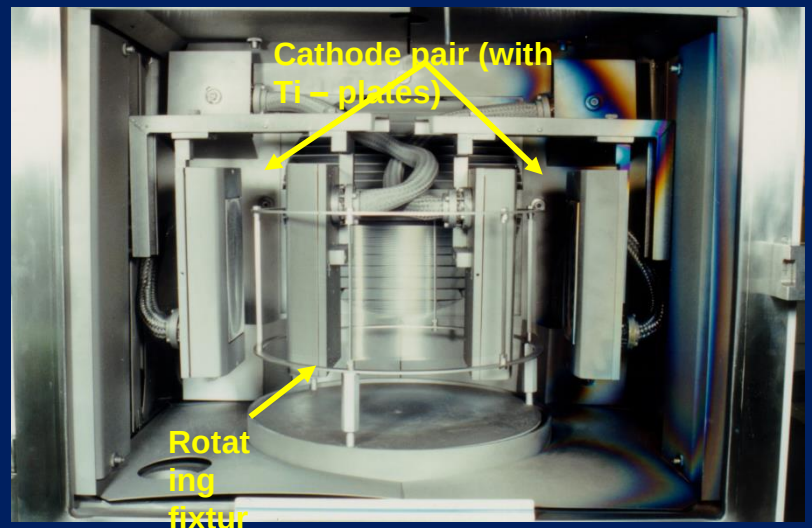
Manufacturing Process

Magneton Sputter Process – used by KTW SYSTEMS

2. Step:

Sputter Process





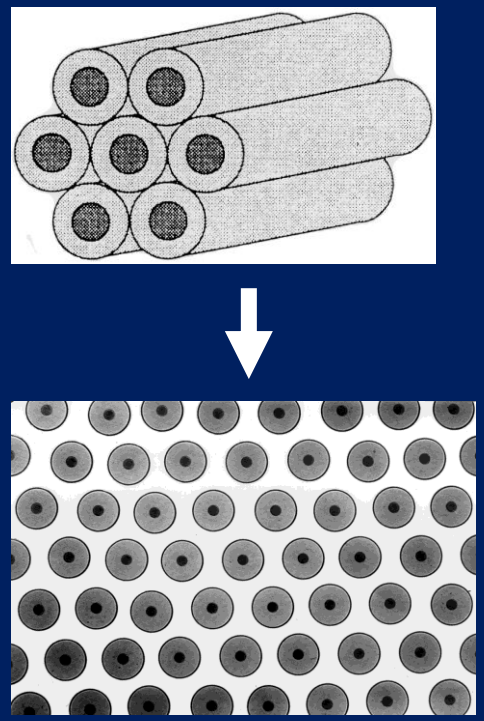
Coating Chamber

Manufacturing Process

Magneton Sputter Process – used by KTW SYSTEMS

3. Step:

Filling of specimen with coated fibers

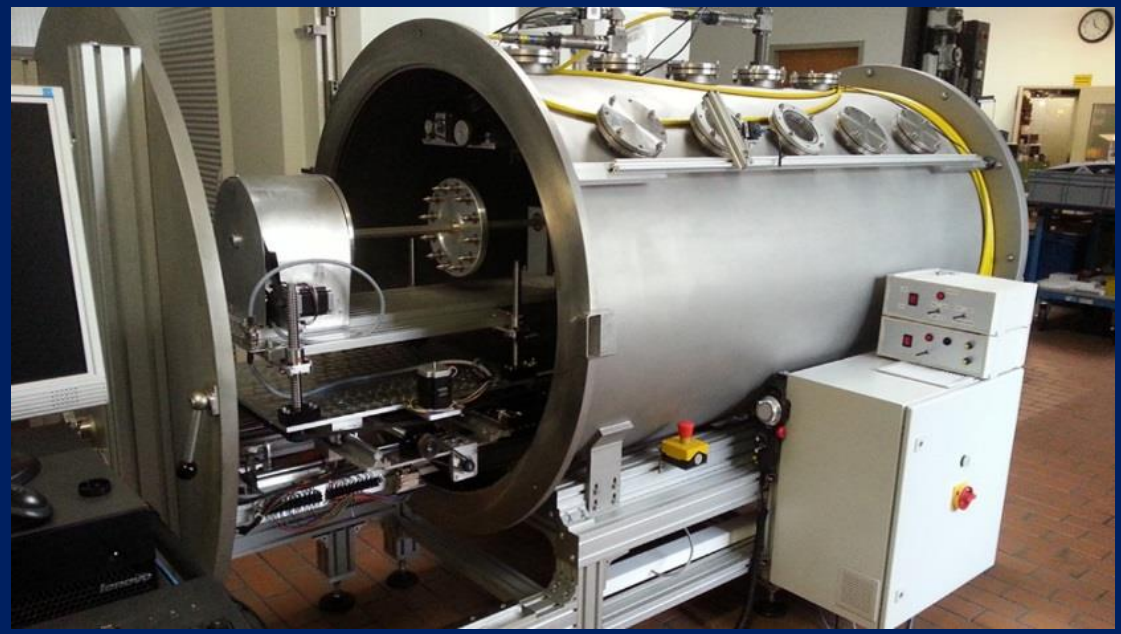


Manufacturing Process

Magneton Sputter Process – used by KTW SYSTEMS

Next Steps:

4. Vacuum welding
5. Hot isostatic pressing
6. Working out the final shape



Manufacturing Process

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

Markets for TMC

TMC is suitable for different markets

AVIATION

SPACE TRAVEL

RACING

MED TECH

Aviation

TMC is successful implemented in the Russian Aircraft Industry

https://viam.ru/en

Typical Applications of TMC:

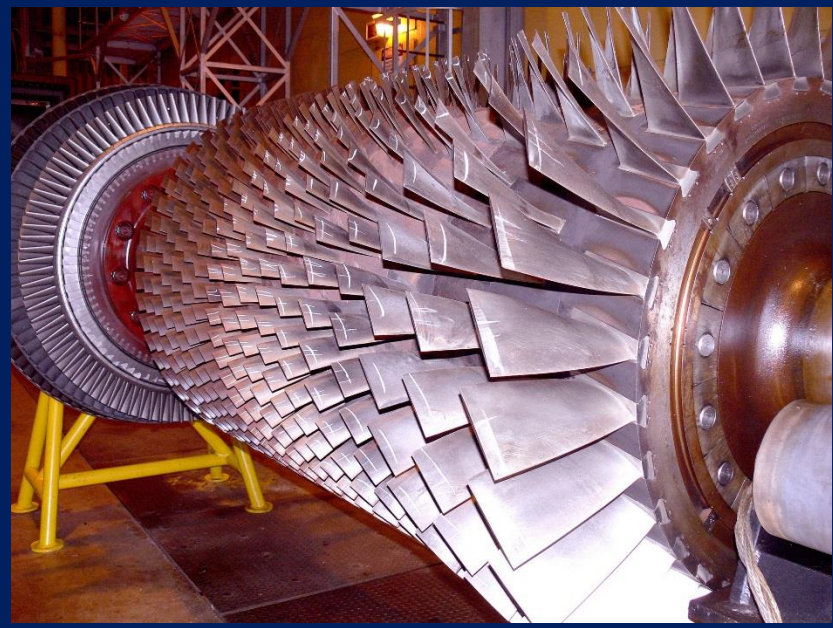
Turbine / Fan Blades (weight less 30%)
Impeller Blade Wheel (weight less 30%)
Inlet/Outlet Valves (weight less 15%)
Connecting Rod (weight less 10%)
Stud Bolt (weight less 40%)
Piston Pin (weight less 40%)
Drive Shaft (weight less 50%)

Aviation

KTW SYSTEMS solved all existing problems of TMC, described in literature

The use of TMC in the compressor of the turbine will get a huge effect.

For example you can reduce the number of fans, or make them even smaller and you get less weight and more safety!



Space Travel

TMC is ready for space trips

The cost per kg to space is a main objective in the space travel industry.

With a weight reduction up to 50% and the convincing features as stiffness and strength, TMC is more than an alternative

Racing

TMC was successful implemented in TOYOTA engines in Formula 1

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 was Norbert Kreyer

Report in ATZ about use in motorsport :
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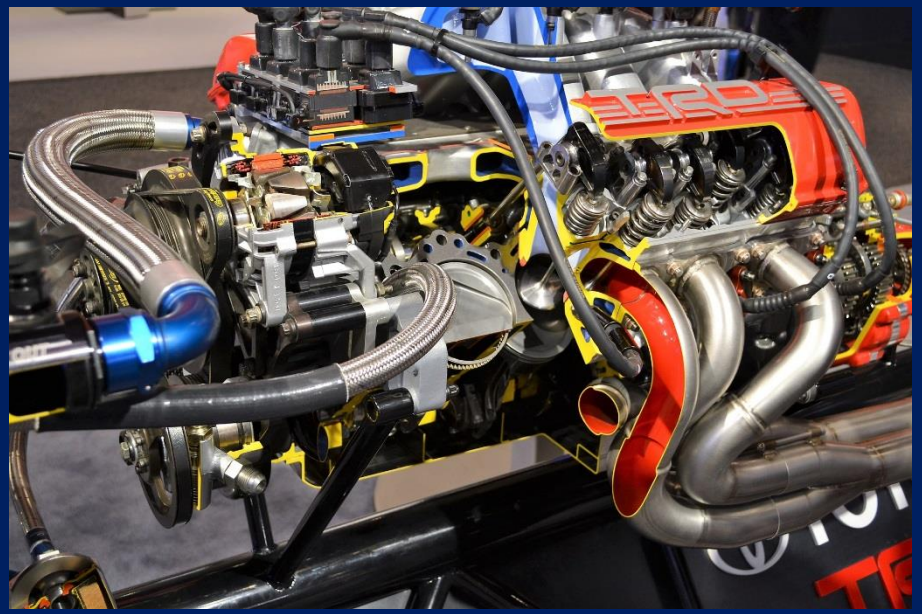

Medical Tech

The TMC advantages promises to be the perfect material for hip implants

Per anno 400.000 hip implant operations in Germany,

Worlwide Turnover of hip implants is approx. $20bn

Problem: the dwell time is limited to ~15 years inside the body

Solution: hip implants of TMC shall have a significant longer lifetime (we are in the research phase)

Idea: prostheses made of TMC in additive manufacturing process (3D) under use of Ti-Alloy with medical approval

Advantage: further operative procedures are extremly reduced and relief of the health system

Hip Implants

Information in Summary

The prosthetic socket of a hip prosthesis usually consists of:

- Titanium alloys (TiAl6V4, TiAl6Nb7 - forging alloy) (cementless)
- CoCrMo forging alloys (cemented)
- (not anymore) CoNiCrMo
- (occasionally) fiber-reinforced plastics

Average cost per operation in the amount of EUR 7,626 in Germany (Source: SpringerMedicine)

Average cost in the US per operation: $ 11,080 (source: Statista)

Project Description
General Infos

KTW SYSTEMS presents itself as a partner for a cooperation with companies from the aerospace, racing and medical tech sectors.

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.

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Project: Hip Implants made of TMC

tbd

Due to TMC's outstanding features and our experience with Ti-64 (medical approval), this project is very promising as it protects patients and the healthcare system.

With global sales per year of $ 20 billion, the market is also attractive enough for an investment.

Here we see in particular the possibility of a Joint Venture with a partner from the medical technology, which already has the market access today.

In addition to the TMC procedure, our strategy is to produce the hip implants in the additive manufacturing process (3D printing).

Project: TMC for Aerospace/ Racing

Discover Ideas

This project is highly dependent, which products or solutions should be implemented with TMC. With our wealth of experience from more than 20 years of research work and implementation at TOYOTA Formula 1 and the Russian aviation, we advise the project partner on the appropiate use of TMC.

For the transfer of know-how, a period of 2 years is realistic!

Equipment required for the production of TMC´s

Main Equipment

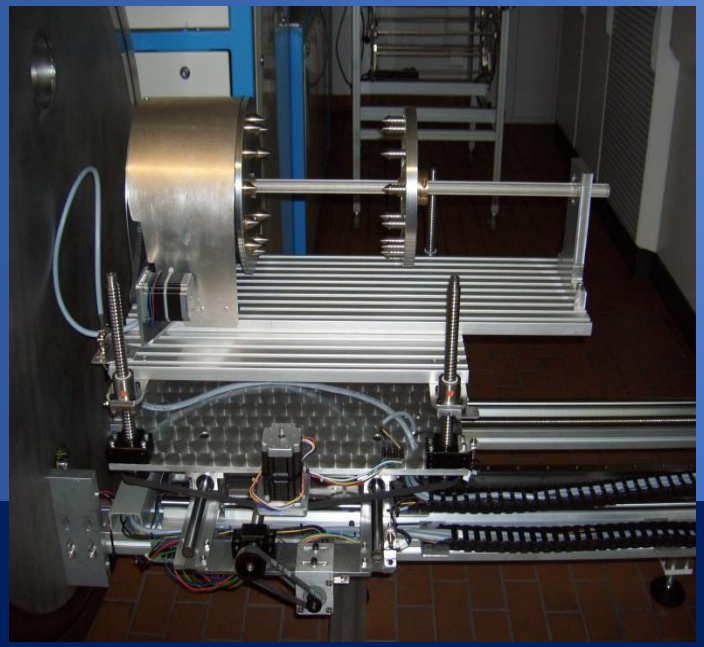
Fiber Coating Machine

Vacuum Laser Welder

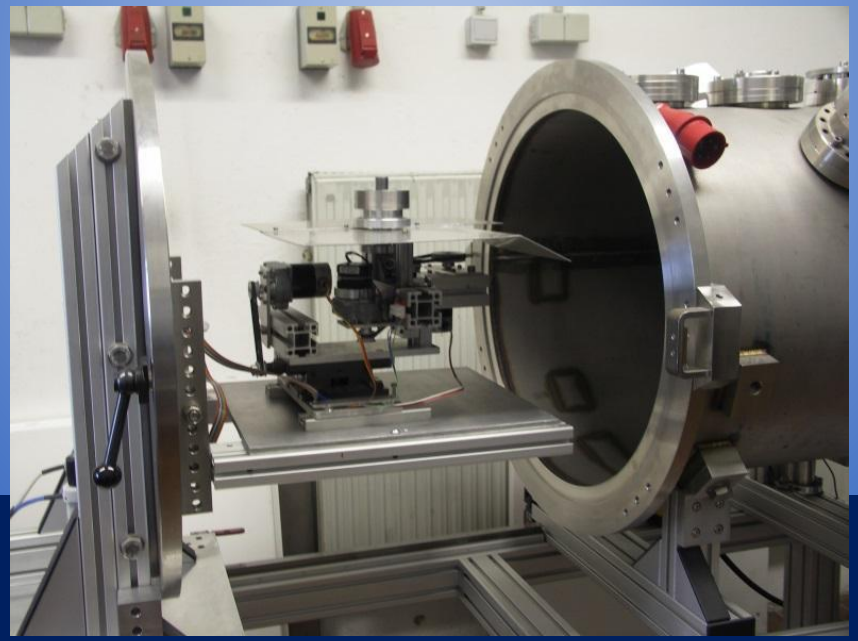
Hot Isostatic Pressing

Equipment required for the production of TMC´s

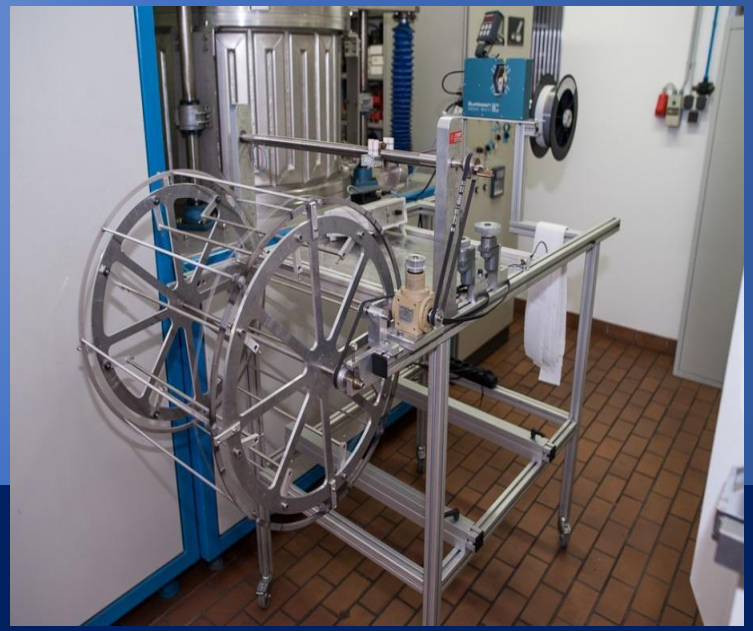
Additional Equipment



Revolver Rotating Devices



Ring and Disk Welding Device



Winding Machine

Get in Touch

The best way to predict the future is to invent it

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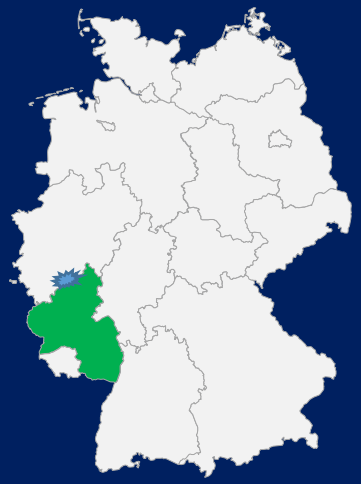

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Thank You.

The best way to predict the future is to invent it

KTW SYSTEMS GmbH