

Titanium: Splendid, light, corrosion-resistant, anti-magnetic and anti-allergenic

The Nuremberg high-tech company GfE Metalle und Materialien uses two models of the Memmert vacuum drying oven in the manufacture of titanium powder.

Not only its complex **production** makes **titanium** so valuable, but also the fascinating combination of all its qualities: As sturdy as steel, but considerably lighter, extremely **corrosion-resistant**, **anti-magnetic** and **anti-allergenic**. It is no surprise that many things that are supposed to be good and allowed to be expensive are made of titanium. Components for the **automobile** and **aerospace industry**, **implants**, bicycles, jewellery and even building facades, such as on the world famous **Guggenheim Museum Bilbao**.



Corrosion-resistant, light and aesthetic: Facades made of **titanium** on the **Guggenheim Museum Bilbao**

Thousands of years of tradition:
Powder metallurgy

The company GfE Metalle und Materialien defines itself as one of the worldwide leading manufacturers and providers of high-performance metals and materials. In the **Coating Materials** division, sputter targets, arc cathodes and sputtering materials are produced using **powder metallurgy** for a wide range of coating techniques. One of the most well-known applications is the **coating** of tools made of hard metal for machine processing, which are made harder and more wear-resistant due to the layers that are often only a few μm thick. In other applications, architectural glass is AR coated and protected from adverse weather effects, electrical appliances are shielded from electrical and magnetic fields, conducting paths are constructed or **implants** made of plastic or metal acquire the necessary biocompatibility.

Titanium – indispensable for medical technology

GfE developed HDH technology, among other things for the manufacture of high purity **titanium powder**, which is used in **medical technology**. HDH stands for hydration – **dehydration**, which means that through the addition of hydrogen, the source material becomes brittle, and can be crushed mechanically. After this process step, the material is returned to its original state in a thermal process under a high vacuum.

Since **titanium**, which in **medical technology** is used for **coating** and **implants**, may not contain any ferromagnetic material whatsoever, tiny particles of iron, which rub off the grinding media during the crushing process, are now removed from the batches in an acid etching bath, and the batches are then dried in the **vacuum drying oven**. The process needs to take place in a vacuum, since **titanium** has a high bonding affinity with oxygen, and the metallic purity of 99.7% could not be achieved in a standard drying oven. The two **Memmert** appliances run for 12 to 14 hours per day and evacuate three to four litres of water in each drying process. “This job is a real chore”, laughs Peter Muntau, an employee in the **titanium powder** production line at GfE. “We cannot afford any production stoppages, which is why the robustness of the **vacuum oven** is absolutely crucial. And the technical service of **Memmert** is always immediately on hand for the necessary replacement of wear parts.” The drying times vary, depending on the amounts and particle sizes, which is why the technicians at GfE like to use the **Memmert** chip card to simply start the stored programme sequences.

Environmental technology:

Waste-to-energy

Reduced drying time in the vacuum drying oven optimises operating procedures in waste management...

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Component production in electronics

Drying time for humidity sensitive electronic components in the vacuum drying oven reduced by more than 13 hours...

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The Jülich Research Centre relieves strain on intervertebral discs

HDH technology enables the **morphology**, that is, the shape of the grain, to be precisely defined. The **Jülich Research Centre** made use of this property when it patented a procedure for the **manufacture** of highly porous titanium shaped bodies for biomedical applications in 2002.

With the Jülich procedure, it was made possible to compress a mixture of the GfE **titanium powder** and a suitable **buffer**, in this case sodium hydrogen carbonate, so hard that the pressed shaped bodies could be processed mechanically before the sintering process. To guarantee the stability of the pressed part, the titanium particles must interlock during the pressing procedure. For this purpose, precisely defined square particles were required, spherical **titanium powder** was not suitable, however.

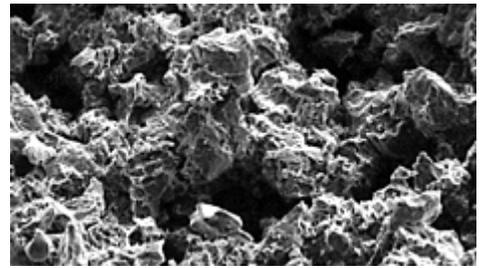
After the forming operation, the **buffer** is decomposed in air at temperatures below 100°C, leaving behind defined pores. The resulting porous titanium shaped body is provided with stability through a final sintering process. In the finished **implants**, the **porosity** allows the bone to be incorporated, thus guaranteeing the attachment of the **implants** in the human body.

An overview of focus topics

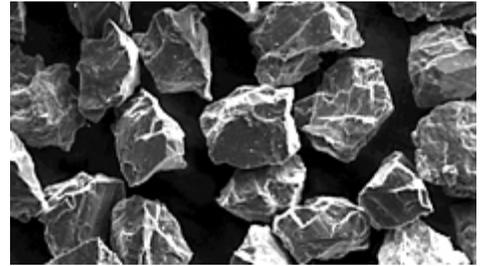
- **Dehydration of titanium powder**
- **Vacuum drying oven**
- **Powder metallurgy**
- **Coating materials**
- **Coating of implants**
- **Porosity**
- Defined **morphology** of titanium particles

Picture credit: Forschungszentrum Jülich, fetcaldu@sxc.hu, GfE Metalle und Materialien

Autor: Memmert GmbH + Co.KG



Powder metallurgy for high-tech applications: the precisely defined **morphology** of titanium powder



Implants for medical technology: Coating of titanium with optimum **porosity**

Drying ovens for industrial applications

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