Improvement of the mechanical properties with Titanium anodising
Ideal surfaces for osteosynthesis and joint replacement implant components

The anodising of Titanium alloys is a standard surface treatment with both osteosynthesis and joint replacement implant components. Whilst, in principle, Type II anodising modifies the biological and biomechanical characteristics of the implants, Type III anodising (colour anodising) only changes the cosmetic characteristics of the implant. Both anodising procedures are offered by DOT GmbH.

Type II anodisation (DOTIZE®)

Background

In the search for procedures to improve the mechanical characteristics of osteosynthesis and joint replacement implant components manufactured from Titanium, anodising procedures, which had been originally developed in the USA for aerospace applications proved to be very suitable. Adapted to the requirements of the orthopaedic industry, these electro-chemical surface treatments cause among other things a decrease in the cold welding of osteosynthesis products (e.g. between bone nail and screws), an improvement in the fatigue strength and an increase in the abrasion and corrosion resistance. Furthermore anodising can decrease protein adsorption during the immediate post operative interaction process between the blood and the implant surface, thereby reducing the adherence of osteoblasts and suppressing the subsequent bone growth onto the implant. This effect reduces the complications related to the removal of bone nails, screws and plates after successful fracture healing.

Technologies

The DOTIZE® anodising procedure, developed by DOT replaces the thin natural oxide film present at the implant surface by a thick oxide coating. This is achieved through a spark discharge produced on the surface of the implant whilst it is immersed in an electrolytic bath containing a strong alkaline solution. The discharge melts the implant surface and the oxide layer becomes an integral part of the base material. Practically all Titanium alloys used for medical applications are suitable for the DOTIZE® procedure. The implant dimensions are not changed by the surface treatment. Micro-pores and -cracks in the base material are reduced by the procedure.
**Coatings Characteristics**

The DOTIZE® procedure conforms to the standard AMS 2488 (Aerospace Material Specification).

<table>
<thead>
<tr>
<th>Coating thickness</th>
<th>1.5 ± 0.5 μm</th>
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<tbody>
<tr>
<td>Ongrowth behaviour</td>
<td>Up to 19% reduced colonisation of the implants with bone cells caused by reduced protein absorption</td>
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<tr>
<td>Wear resistance</td>
<td>Increased resistance to wear compared with untreated Titanium alloys</td>
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<td>Biocompatibility</td>
<td>Good biocompatibility</td>
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<tr>
<td>Corrosion resistance</td>
<td>The corrosion resistance is up to 44% higher than with untreated Titanium</td>
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<tr>
<td>Fatigue strength</td>
<td>Increase of up to 15% in the fatigue strength compared with untreated base material</td>
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</table>

**Advantages at a glance**

- Easier removal of the implants after fracture healing
- Improved fatigue strength of the implants
- Reduction of the risk of cold welding
- Higher pre-loading of threaded connections is possible
- Improves identifiability when compared to stainless steel

**Background**

The principal purpose of the colour anodising is the identification of parts during a surgical procedure (coloured size marking). Applications cover dental and orthopaedic implants as well as osteosynthesis products such as screws, plates or instruments.
If necessary, pickling in an acid bath takes place, in order to guarantee a uniform quality of the implant surface to be anodised. Subsequently, the anodising is performed in dilute acid. The Titanium oxide film that is produced works as an optical interference filter. By varying the thickness of the coating all the colours of the rainbow can be produced. The standard colours produced are red, blue, yellow and green. Customers can also specify a larger range of colours. Depending upon the selected colour the layer thickness is 20–200 nm.

**Advantages at a glance**

- Improves identification of implants
- Cosmetically appealing

**Results**

Since 1998 DOT GmbH has anodised several million osteosynthesis products and joint replacement implant components with the DOTIZE® procedure and colouring process.

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**DOT – coating specialist for orthopaedic and dental implants**

DOT is one of Europe’s leading providers of medical coating solutions for orthopaedic and dental implants and instruments and also their cleanroom packaging.

We also develop and manufacture products for regenerative medicine for dental and orthopaedic applications.

Our comprehensive supply chain concept makes us an ideal medical technology partner. Our activities help restore the health of patients worldwide and thus make a major contribution to the improvement of their quality of life.