Improving the mechanical properties with Titanium anodizing

- Anodizing Type II DOTIZE®
- Anodizing Type III Coloring
Ideal surfaces for osteosynthesis and joint replacement implant components

The anodizing of Titanium alloys is a standard surface treatment with both osteosynthesis and joint replacement implant components. Type II anodizing modifies the biological and biomechanical characteristics of the implants.

Type II anodization (DOTIZE®)

In searching for procedures to improve the internal fixation characteristics of osteosynthesis and Titanium joint replacement implant components, it was determined that the Type II anodizing procedure, which had been originally developed in the USA for aerospace applications, provided excellent properties in that environment. Adapting this technology to the requirements of the orthopedic industry, this electro-chemical surface treatment exhibits a decrease in the cold welding of osteosynthesis products (e.g., between bone nail and -screws), and an improvement in the fatigue strength. Additionally, there is an increase in the abrasion and corrosion resistance, as well as a decreased protein adsorption during the immediate, post-operative interaction process between the blood and the implant surface, thereby reducing the adherence of osteoblasts. This suppresses 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.

Background

Advantages at a glance

- Easier removal of the implants after fracture healing
- Improved fatigue strength of the implants
- Higher pre-loading of threaded connections is possible
- Reduction of the inflammation and allergy risk by reducing the release of Aluminum and Vanadium ions
- Improves identification when compared to untreated stainless steel
- Reduction of the risk of cold welding
Characteristics

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

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Coating thickness</td>
<td>Max. 5 µm</td>
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<tr>
<td>On-growth behavior</td>
<td>Up to 19% reduced colonization of the implants with bone cells caused by reduced protein absorption</td>
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<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>

Technology

The DOTIZE® anodizing procedure developed by DOT, replaces the thin natural oxide film present at the implant surface, with a thick oxide coating. This is achieved through an electric spark discharge produced on the surface of the implant while 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. Most 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 this process.

Type III anodization (coloring)

Background

The principal purpose of the color anodizing is the positive identification of parts during a surgical procedure (colored size marking). Applications cover dental and orthopedic implants as well as osteosynthesis products like screws, plates and instruments. As an additional effect the colored oxide layer reduces the release of Aluminum and Vanadium ions from the Titanium alloy.

Advantages at a glance

- Improves identification of implants
- Cosmetically appealing
- Inhibition of the release of Aluminum and Vanadium ions
Technology

If necessary, pickling in an acid bath takes place, in order to guarantee a uniform quality of the implant surface to be anodized. Subsequently, the anodizing 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 colors of the rainbow can be produced. The standard colors produced are red, blue, yellow and green. Customers may also specify a larger range of colors. Depending upon the selected color the layer thickness is 20–200 nm.

Results

Since 1998 DOT GmbH has anodized several million osteosynthesis products and joint replacement implant components with the DOTIZE® procedure and coloring process. The Type II and III Titanium anodizing in medical technology applications have been approved both in the European Union and in the USA.

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DOT is one of Europe’s leading providers of medical coating solutions for orthopedic and dental implants and instruments.

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.