

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.

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 electrochemical 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 im-

mediate 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.

Characteristics

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

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

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

Type III anodisation (colouring)

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.



Technologies

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 thick-

ness 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.

The Type II and III Titanium anodising in medical technology applications have been approved both in the European Union and in the USA.

Bibliography

1. J Prosthet Dent. 2001 Jul; 86(1): 24-32
"Implant abutment screw rotations and preloads for four different screw materials and surfaces"
W.C. Martin, R.D. Woody, A.W. Miller
2. International Association for Dental Research, Congress 2002, San Diego, 0308
"Torque to Loosen Surface Treated Abutment Screws After Cyclic Loading"
F. Falcao, P. Yaman, M.E. Razzoog, J.B. Dennison
3. 17th European Society for Biomaterials Conference, Barcelona 2002
"Protein adsorption on spark anodized Titanium"
P. Becker, A. Baumann, U. Beck, A. Kirbs, J. Rychly, F. Lüthen, H-G. Neumann

4. Ti 2003, Science and Technology, Vol. V, Proceedings of the 10th World Conference on Titanium, Hamburg 2003; (ed. G. Lütjering, J. Albrecht), 3339-3344
"Spark Anodization on Titanium and Titanium Alloys"
P. Becker, A. Baumann, F. Lüthen, J. Rychly, A. Kirbs, U. Beck, H.-G. Neumann
5. Technical Paper (Unpublished) 2005
"Ti6Al4V with Anodization Type II: Biological Behavior and Biomechanical Effects"
A. Baumann, N. Zander

DOT GmbH

A Member of the Eifeler-Holding
Charles-Darwin-Ring 1a
18059 Rostock, Germany

Phone: +49 381-4 03 35-0
Fax: +49 381-4 03 35-99
info@dot-coating.de
www.dot-coating.de



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

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